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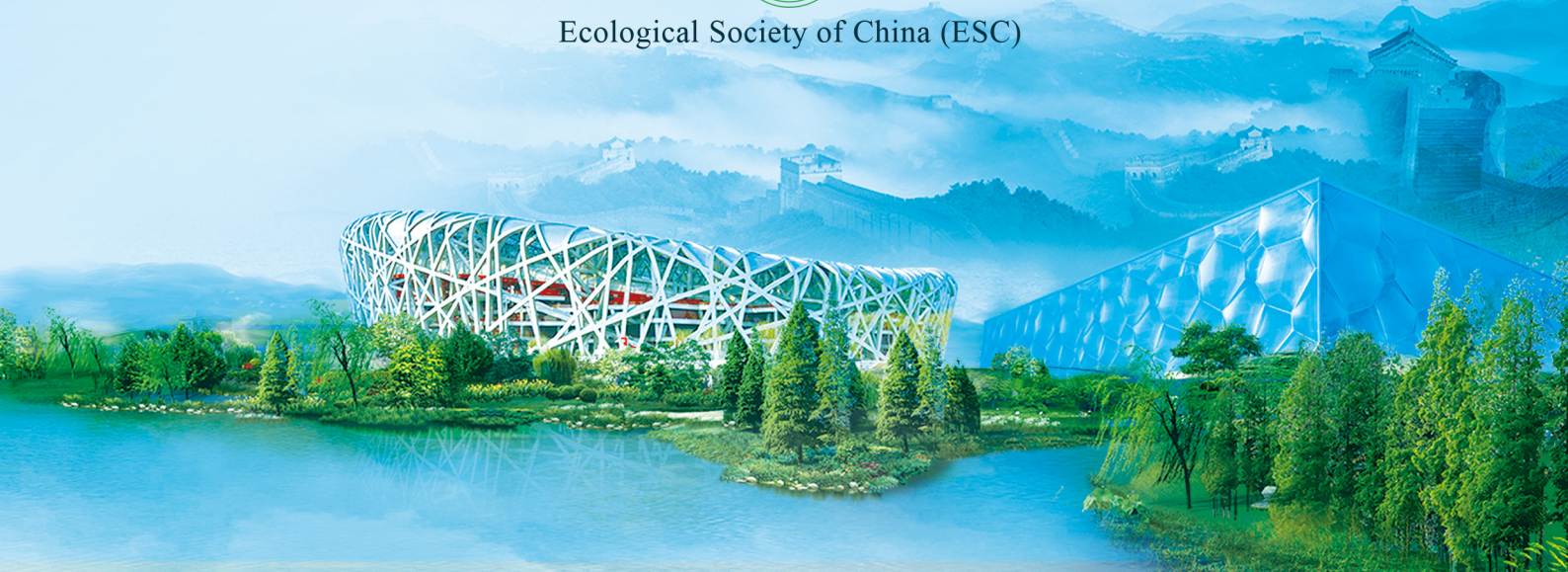

Preface

The 12th International Congress of Ecological (INTECOL) is held in Beijing in August 21-25, 2017. Near 2000 participants, coming from 134 countries and regions, submitted an abstract for their oral or poster presentations.

The theme of INTECOL 2017 is "Ecology and Civilization in a Changing World", which will focus on harmonious and sustainable development among people, nature, and society in the context of global development. The presentations for this conference cover an enormously wide spectrum of ecology, including ecosystem service valuation and sustainable development, culture conservation and human well-being, global change, environmental change in urbanization, ecosystem restoration and management, biodiversity conservation and ecosystem health, ecological civilization, molecular ecology and ecological genomics. After some editing is made, a total of 1430 abstracts are published as this volume. A few abstracts are not included due to different reasons.

We thank all the contributors. We appreciate the efforts made by the participating ecologists for elucidating how our world has been shaped by the long-lasting and extensive interaction between human and nature, and can our understanding of the human-nature relationship contribute to the sustainability of the Earth – our only shared homeland.

CONTENTS

1. Bee or Not to Be? – Importance of Wild Bees for Well-Being and the Threats of Land Use Change ..... Anikó Kovács-Hostyánszki 1
2. Fm Vials to Lakes: On the Role of Environmental Complexity for Eco-Evolutionary Feedbacks in Microbial Communities .....Bastiaan Ibelings 1
3. The Science and Practice of Valuing Nature in Decisions .....Gretchen C. Daily 2
4. Changing Winter Climate Alter Nitrogen Biogeochemistry in Northern Forest Ecosystems ..... Hideaki Shibata3
5. Ecological Civilisation: A Map for the Future? .....Isabel Hilton 3
6. Generative Models for Ecological Forecasting: How Entire Communities Will Respond to Climate Change ..... James S. Clark 4
7. Leveraging Values for Societal Transformations towards Sustainability: Some Bold Propositions ..... Kai Ming Adam Chan 4
8. Understanding Tropical Forests and Climate Change: A Journey along an Elevation Transect in the Amazon and Andes ..... Norma Salinas 5
9. China's Research in Ecology - Interface between Science and Policy-Making ..... Shirong Liu 5
10. Ecology on the Light Side: Explorations of Non-Forested Ecosystems .....William J. Bond 6
11. Collating the Global Evidence and Using It to Make Local Conservation Decisions .....William Sutherland 6
12. Ecosystem Pattern, Services, Challenges and Governance in China .....Zhiyun Ouyang7
13. Dealing with the Problems of Difficult Settlement in our Time: An Ecosystemic Approach ..... André Francisco Pilon 9
14. Efficiencies of Energy Consumption and Carbon Emissions on Tourism Industry in Destination: A case of the WSA in China Chengcai Tang[1], Linsheng Zhong[2] 10
15. Ecotourism as a Way to Build up Partnerships between Kengting National Park and Local Communities- a Case of Shir-Ding ..... Dau Jye Lu[1], Yuchen Chang[2], Chih Liang Chao[2] 11
16. Higher Q10 of Carbon Decomposition in Finer Soil Particles Does Not Bring a Long-Lasting Dependence of Q10 on Soil Texture .....Fan Ding[1], Wenjuan Sun[2], Yao Huang[2], Xunyu Hu[2] 12
17. Impacts of Community Forestry on Biodiversity Conservation in Nepal ..... Ishwari Prasad Poudel 13
18. Designing Wildlife-Based Tourism Programmes for Managing Species of High Conservation Value ..... Jeff Muntifering[1], Susan Clark[2], Wayne Linklater[3], Andrew Knight[4], Simson Uri-Khob[5] 14
19. Assessing the Importance of Ecosystem Services for Local Well-Being in Wolong Natural Reserve .....Jianying Xu, Qing Wang 15
20. The Effects of Three Fire Regimes on the Abundance of Hemiptera in a Tropical

Humid Savanna (Lamto, Central CôTe D'Ivoire)
..... Kodjale Varel Armel N'DAH, Dosso Kanvaly 16
21. Environmental Education in Conditions of Qianjiangyuan National Park, China
.....Lianlian Xiao, Linsheng Zhong 16
22. Alien Plant Species Association with Recreational Roads in a National Park in the Eastern Himalaya, China
..... Mingyu Yang[1], Xiaokun Ou[1], Robert De Wulf[2], Luc Hens[3] 17
23. Factors Affecting Inn Operator's Willingness to Pay Resource Protection Fees: A Case of Erhai Lake in China
..... Peng Li, Ying Zou, Min Zhao, Tianying Li, Linsi He 18
24. Economic Value of National-Park Ecotourism Via Human Mental Health
.....Ralf C. Buckley 18
25. Designing Ecotourism in a Chinese Cultural Context for Sanjiangyuan National Park ..... Ralf C Buckley[1], Travis Winn[2], Weiyi Li[2], Peter Winn[2] 19
26. First Evaluation of the Impact of Catch Activities and Illegal Commercialization on Populations Ofgold Finches (Carduelis Carduelis) In the North-East Algerian Guelma Region
..... Sadek Atoussi[1], Imane Razkallah[2], Zihade Bouslama[2], Moussa Houhamdi[2] 20
27. Can an Advertising Campaign Reduce Chinese Desire for Elephant Ivory in China?
.....Tien Lee[1], Grace Gabriel[2] 20
28. Concentrations, Distribution and Source Apportionment of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediment Cores from the North of Dianchi Lake
.....Xiaohua Ma, Hao Yang, Changchun Huang 21
29. The Synergism of Plant-Derived Compounds and Sex Pheromones of Spodoptera Litura
..... Xinlong Wan, Rui Zeng, Yulei Fang, Xiayan Zhu, Xinlong Wan 22
30. Study on the Protection and Innovation of Traditional Food Culture from the Perspective of Protection of Agricultural Cultural Heritage
.....Yingying Su, Yehong Sun, Lingyi Jin 23
31. A Study on the Measurement of Sustainable Tourism Efficiency and Improving Strategies in China .....Yong Ma[1], Jun Liu[1], Yun Tong[2], Na Li[2] 24
32. Landscape Evaluation of Hiking Trails in Zhangjiajie National Forest Park Based on Uni-polar EEG Technology
.....Yongde Zhong, Hao Chen, Qiong Xiao, Yongde Zhong 24
33. Impact of Tourists' Environmental Awareness on Environmentally Friendly Degree: A Case Study of Qinghai Lake, China
.....Yuxi Zeng, Linsheng Zhong 25
34. Assessment of Local Community Attitudes towards Wildlife Conservation at Mangla Dam, AJK
.....Zulfiqar Ali[1], Bushra Nisar Khan[1], Syed Turab Raza[2] 26
35. The Varying Impact of Agri-Environment Schemes on Avifauna in Two Regions

of Poland Artur Golawski[1], Stansislaw Tworek[2], Marek Jobda[3], Jakub Kosicki[4] 28
36. Research on Global Biodiversity and Ecosystem Services during 1990–2015: A Bibliometric Analysis ..... Dandan yu, Nan Lv, Bojie Fu 28
37. Valuing the Storm Surge Mitigation Effect of Coastal Wetland .....Fanglin Sun 29
38. How to Integrate the Value of Ecosystem Services and the National Economic Accounting System? Take Weichang County as an Example ..... Guangshuo Dai[1], Daiqing Li[1], Linbo Zhang[1], Xiaobin Dong[2], Fen Li[1], Chunfei Hou[1], Xiu Gu[1] 30
39. Identifying the Supply-Demand Mismatches for Ecosystem Services Management: A Case Study in an Eco-Fragile Region of Loess Plateau, China ..... Hejie Wei, Xiaobin Dong, Weiguo Fan, Xuechao Wang, Nachuan Lu, Zihan Xu, Jiahui Ren 31
40. The Building of Ecological Service Assess Index System of Dryland Terrace Agriculture System Based on Coupling Structure .....Heyao Li 32
41. The Importance of Feedback Links from Ecosystem Functions to Species for Ecosystem Management. ..... Hui Xiao[1], Régis Sabbadin[2], Nathalie Peyrard[2], Iadine Chadès[3], Laura E Dee[4], Eve McDonald Madden[1] 33
42. A Comprehensive Eco-Economic Regionalization Method Based on Ecosystem Service Values Assessment: A Case Study from an Urban Area in China 34 .....Jia He[1], Yu Wan[2] 34
43. Construction of Urban Ecological Security Pattern Based on the Least-cost Distance Model .....Jiansheng Wu, Xinxin Yue 34
44. Assessing the Value of Mangrove for Erosion Protection in Urban Sea: A Case Study of Xiamen Bay .....Jie Su, Benrong Peng 35
45. Environmental Loss and Damage Assessment in China: Principle, Procedure and Practice .....Jing Yuan, Fang Yu 36
46. Assessment of the Capital Values of Marine Biological Resources in Sanya ..... Linhua Hao, Shang Chen, Tao Xia 37
47. The Change of Landscape Pattern in Beijing Fringe Area and Its Impact on the Ecosystem Services: A Case Study in Niulanshan-Mapo Town .....Liqun Wang 38
48. The Spatial Dynamics of Reconstruction of Urban Village: A Case Study on Xishan District, Kunming during 2004–2016.....Meirong Su[1], Ying Zheng[2] 39
49. Effects of Land Use and Climate Change on Ecosystem Services in Central Asia's Arid Regions: A Case Study in Altay .....Qi Fu, Bo Li 40
50. Transnationally Coherent Sea Shipping Planning in Baltic Sea Region- Design and Results of a Game-Based Quasi-Experiment .....Qiqi Zhou[1], Igor Mayer[2], Lodewijk Abspoel[3], Xander Keijser[4] 41
51. A Rapid Evaluation Method for the Impact of Integrated River Basin Planning on Ecosystem Services ..... Rong Xi, Naizhong Xu, Kun Yang 42
52. Ecological Capital: Assessment, Management and Investment

..... Shang Chen, Tao Xia, Linhua Hao 42
53. World Window: Green Development in Modern Circulation Green Ecological Agriculture in Baiquan County, Northeastern China ..... Shuqing Wang 43
54. How to Benefiting Local People through a National Park-An Ecosystem Services Approach
.....Siyuan He[1], Louise Gallagher[2], Yang Su[3], Hongguang Cheng[1], Lei Wang[4] 44
55. Economic Valuation of World Cultural and Natural Heritage from Recreational Approach: A Case Study of Mountain Huangshan .....Tan Li 46
56. Management of Ecosystem Services from Coral Reef Degradation and Restoration Opportunities in the Gulf of Thailand .....
57. Thamasak Yeemin, Makamas Sutthacheep, Wichin - Suebpala, Sittiporn - Pengsakun, Wanlaya - Klinthong 46
58. Synergies between Soil Retention and Water Yield in the Pearl River Delta
.....Tian Hu, Jiansheng Wu 47
59. Germany's Ecosystem Services - State of the Indicator Development for a Nationwide Assessment and Monitoring .....
60. Ulrich Walz[1], Karsten Grunewald[2], Ralf-Uwe Syrbe[2], Benjamin Richter[2], Gotthard Meinel[2], Hendrik Herold[2] 48
61. Ecological Regime Shifts and Changes of Lake Ecosystem Service in a Shallow Yangtze Lake (Taibai Lake, China) over the past 150 Years
.....Xuhui Dong, Min Xu, Xiangdong Yang 49
62. Study on Marine Ecological Environment Protection with Quality Improvement as the Core .....Yijun Tao 50
63. Problems with Traditional Ecological Service Assessment and Their Solution-A Case Study with Panjin Coastal Zone, Liaoning Province, China .....Yong Lin 50
64. Measuring the Value of Coastal Wetland for Typhoon Protection: A Case Study of China .....Zhumei Huang, Benrong Peng 51
65. Science Popularization for Marine Environment Protection in China
.....Zhuoping Cai[1], Shunshan Duan[2] 51
66. Dancing with Nature and the Power of Imagination ....Bruno Matheus Doedens 53
67. Use of Ikebana Art in the Teaching and Research of Mire Vegetation and Ecology
.....Harri T. Vasander 53
68. Mobilizing Social Energy and Communicating Landscape Interventions
.....Hester Ebrich Annema, Elisabeth Floris 54
69. Cultural Landscape Development .....Joachim Jan Titus Mulder 55
70. Reconciling Science with Art: Testing Scientific Hypotheses in an Experimental Dune Landscape in the Netherlands .....
Juul Limpens[1], Bruno Doedens[2], Machiel Spaan[3], Hester Anema[4,] Elisabeth Floris[4] 56
71. Value Deconstruction of "Life Aesthetics" Derived "Living Environmentalism"
.....Liping Huang 56

72. The Scientist and the Artist .....Matthijs Schouten 57
73. How to Facilitate Science-Art Interactions in Graduate Programs? .....
Milena Holmgren[1], Francisca Barten[2], Verina Ingram[1], Arjan Karssen[2], Philippine Vergeer[1], Pieter Zuidema[1] 57
74. Assessment of Terrestrial Ecosystems Biodiversity Based on IUCN Protocol and Remotely Sensed Data .....Ainong Li, Jianbo Tan, Guangbin Lei 59
75. Increased Forest Areas in Tropical Hainan Island, China, through Data Fusion and Analysis of PALSAR, PALSAR-2, and Landsat Imagery during 2006-2015
..... Bangqian Chen[1], Zhixiang Wu[1], Xiangming Xiao[2], Xiangping Li[3] 60
76. Land Cover Mapping and Forest above Ground Biomass Estimation in China
..... Bingfang Wu, Yuan Zeng, Dan Zhao 61
77. Remote Sensing Application for Rangeland Monitoring of Mongolia
.....Bulgan Davdai 62
78. The Impact of Management Modes on Ecosystem Service Values
.....Fengqin Yan, Shuwen Zhang, Dan Chen 62
79. Evaluation of Urban Ecological Risk during the Industrial Transformation and Upgrading ..... Hong Xie[1], Meirong Su[2] 63
80. Net Primary Productivity of Alpine Vegetation and Its Responses to Climate Change through Models Comparison in Qinghai, Qinghai-Tibetan Plateau
..... Hui Ye, Bangjun Wang 64
81. Characteristics of Land Use/Cover Change in the Three-River Headwaters Region after Implementation of Ecological Projects .....Lulu Liu[1], Quanqin Shao[2] 65
82. One Method of Rapid Evaluation of Wetland Area Change
.....Minglei Liu, Qingze Han, Ying Liu, Min Jiang, Zhiguo Zhang 66
83. Analysis on Leaf Area Index of Vegetation in Shanghai, Huangpu District
.....Mo Na, Xiaofeng Wang 67
84. Global Retrieval of Land Surface Phenology from MODIS Data
.....Rong Shang[1], Ronggao Liu[1], Yang Liu[1], Lu Zuo[1], Mingzhu Xu[2] 67
85. Assessment of Eco-Environmental Quality in Hainan Island Based on Landsat 8 Operational Land Imager Data .....
Rui Sun, Bangqian Chen, Zhixiang Wu, Guoyu Lan, Dongling Qi, Chuan Yang 68
86. Estimating Soil Sand Content Using Thermal Infrared Spectra in Semi-Arid Grassland of North China.....Shimeng Li, Nisha Bao, Shanjun Liu 69
87. Surface Modelling of Biodiversity and Ecosystem Services .....TianXiang Yue 70
88. Integrative Approaches of Ground Spectral and Remote Sensing for Estimating the Aboveground Plant Biomass of Alpine Grassland in Qinghai-Tibet Plateau .....
89. Xiaoxia Gao[1], Shikui Dong[1], Shiliang Liu[1], Haidi Zhao[2], Yu Li[1], Yong Zhang[2], Xuexia Wang[3], Xukun Su[4], Lin Tang[5], Xiaoyu Wu[1] 71
90. Soil Stored Most of Carbon in Grassland Ecosystems on the Loess Plateau
.....Yinyin Wang, Zhouping Shangguan 71
91. Forest Biodiversity Mapping Using Airborne LiDAR and Hyperspectral Data

.....Yuan Zeng[1], Dan Zhao[1], Bingfang Wu[1], Yujin Zhao[2] 72
92. The Dynamic of Temporal and Spatial Patterns of Vegetation NPP in the Yunnan - Guizhou Plateau ..... Yufeng Xu 73
93. Study on the Change of Island Ecosystem Services Based on Remote Sensing .....Yuzheng Sui[1], Shujuan Li[2] 73
94. Mapping the Distribution and Abundance of Mangrove Species in Futian Mangrove National Nature Reserve, Shen Zhen, Using WorldView-2 Data .....Zhen Li, Yushi Xiao 74
95. Grassland Coverage Estimation Using Chinese GF-1 Satellite Data and Unmanned Aerial Vehicle Photogrammetry from Large Surface Mining Affected Area .....Zonglei Cai, Nisha Bao, Fan Li 75
96. Changes of Waterbird Habitat Suitability in the Sanjiang Plain of China .....Zongming Wang, Dehua Mao, Bai Zhang 76
97. Art, Law, Ecosystem Resilience and the Blued Trees Symphony .....Aviva Alexandra Rahmani 77
98. Reading the River .....Basia Irland 78
99. Sustainable Stormwater Management Using a Floating Treatment Wetland— A System Approach ..... Brendan McAndrew, Changwoo Ahn 79
100. Conversation on Systems Thinking Between an Ecologist and an Eco-Artist: A Reflection on Urban Rain by Jackie Brookner (1945-2015) .....Changwoo Ahn 80
101. Innovating Interdisciplinary Higher Education in Environmental Sustainability for Better Science Communication and Ecological Literacy .....Changwoo Ahn 82
102. WATERWASH: Interweaving Culture and Science in Wetland Habitats .....Lillian Ball 83
103. A Dryland Re-Vegetation in Northern China: Success or Failure? Quick Transitions or Long Lags? ..... Ning Chen 84
104. Art, Ecology, and Infrastructure .....Patricia Johanson 85
105. Sustainability: The Toolmaker and the Tools .....Robert Eugene Turner 86
106. Art as a Verb: Large-Scale Artworks That Solve Site Issues by Eco-Artist ..... Stacy Levy 87
107. To See a World in a Grain of Sand-----Discussion on the Physical Approach of Terrestrial Ecosystem Research .....Weiming Chen, Xu Ming 87
108. Assessment of Land Degradation and Improvement in Dryland Ecosystems ..... Chao Li 89
109. Dynamic Appraisal of Land Ecological Security for Sichuan Province Based on Matter-element Model ..... Hai Huang 90
110. Study on Control and Simulation of Groundwater Level in Lysimeter .....Hongjuan Li, Xinwen Wang 90
111. The Uses of Artificial Fenced Degraded Grassland in Semi-arid Region of China - case Studies in Yanchi, Ningxia ..... Kebin Zhang 91

112.Innovated Practice for Integrated Land Treatment in Loess Plateau and Desertification Area of North of Shaanxi Province ..... Liqiang Bai 92
113.Evaluating Ecosystem Services in Qinghai Province, China Using Process-based Models .....Ming Xu 92
114.SOC Accumulation, Climate Variability and Crop Production in Tanzania's Semi-arid Agro-ecological Zone: A Case Study of the Kongwa District .....Msafiri Yusuph Mkonda 93
115.Cost-Benefit Analysis of Agricultural Green Development Project in the Karst Rocky Desertification Area： A Case Study in Chunfeng Village .....Shuifa Ke, Ruhe Yan 94
116.Study on Land Management Policy and Capacity Building to Adapting Climate Change in Western China .....Shuirong Wu[1], Ji Lu[1], Shirong Liu[2] 94
117.Drying Climate and Herdsman of Typical Steppe Area in Inner Mongolia, China ..... Suying Li, Jiajia Wu, Lijuan Ren, Ran Wang, Li Yang, Ying Chang 95
118.The Content and Dynamic State of the Soil Active Organic Carbon at Different Degeneration Stage in Gahai Wetland .....Xiaolei Zhou[1], Weiwei Ma[2], Jiajia Wang[2] 96
119.Using Saker Falcon (Falco Cherrug) as an Index for Sustainable Land Management on the Qinghai-Tibet Plateau .....Xinhai Li, Yang Liu, Zhongru Gu, Xiangjiang Zhan 97
120.Mine Ecological Restoration Research in the Inner Mongolia Grassland Area ..... Xusheng Wan[1], Dianmo Li[2], Zengming Song[1], Xinrong Wan[1], Anna Waitkus[3], Zhenqi Hu[4], Xingfang Ge[5] 97
121.Charactering Drought with the Change of Rainfall-Runoff Relationship: A Regional Case in the Loess Plateau, China .....Yuan Zhang 98
122.Effects of Arbuscular Mycorrhiza and Earthworm on Pollination in the Marjoram András Báldi, Krisztina Bereczki, Gergely Boros, Krisztina Szabó, Rita Engel 99
123.MiniCity: An Ecosystem Services Driven Design and Test Run of a Compact Urban Model .....Daniela Angela Ottmann[1], Joerg Baumeister[2] 99
124.Effects of Terracing Practices on Soil and Water Conservation in China: A Meta-Analysis .....Die Chen[1], Wei Wei[1], Liding Chen[1], Yang Yu[2] 100
125.Leaf Non-structural Carbohydrates Storage and N, P Stoichiometry in Response to Light Acclimation in Two Subtropical Shade-Enduring Tree Species Seedlings .....Hongtao Xie, Xiangrong Cheng 101
126.Study on the Characteristics and Screening Methods of Cadmium Enriched by Endophytic Bacteria in Tagetes .....Lidong Cao 102
127.Construction and Application of Coupling Model of Ecosystem Services and Livelihoods in the Perspective of Targeted Poverty Alleviation .....Lilei Zhou, Dongjie Guan 103
128.Ecological Planning in Xilingol League Based on Urban Ecosystem Services .....Meng Zhang, Yinjie Zhang, Ailing Piao, Xueling Zheng 103

129.Methane Oxidation in Paddy Soils of North-east China Using DNA Stable Isotope Probing .....Nasrin Sultana 104
130.Evaluation of Cultural Service of Urban Green Space in Residential Areas with Different Density，by Using Zhengzhou City as a Case Study .....Qizheng Mao, Yu Lu 105
131.Application of Volunteered Geographic Information in Measuring Urban Park Use: A Case Study in Beijing .....Sai Zhang, Weiqi Zhou 106
132.Growth of Street Trees: A Case Study of Ginkgo Biloba L. In Kyoto City, Japan .....Tasuku Shoda, Junichi Imanishi 106
133.Sustainability Measurement on Landscape Patterns of Wetland Parks Based on Key Ecological Process .....Ting Zhou, Junsong Xu 107
134.Greenhouse Gas Emissions and Net Carbon Sink of Forestry in China ..... Weiwei Liu, Xiaoke Wang, Fei Lu 108
135.Spatial Characteristics of Recreational Service Flow of Urban Park and Associated Physical and Non-Physical Factors ..... Wenping Liu, Weijuan Chen, Chenlu Dong 108
136.Interannual Variations in Growing-Season NDVI and Its Correlation with Climate Change in the Southwestern Karst Region of China .....Xiaojuan Xu, Huiyu Liu, Zhenshan Lin 109
137.Preliminary Estimate of Air Particulate Matter Removed by Tree Leaves in Beijing .....Xiaoke Wang, Yingshi Song 110
138.Ecological Stoichiometric Characteristics of Leaves, Root, Litters and Soil in Response to the Plant Functional Traits in Desertified Region..... Yang Yang 111
139.Effect of the Beijing-Tianjin Sandstorm Source Control Project on Ecosystem Carbon Sink .....Yanni Gao, Bo Yang, Linbo Zhang 112
140.Effects of Elevated Temperature and Water Stress, on the Rice Brown Planthopper, Nilaparvata Lugens (Stål) .....Ye Tan, Zengrong Zhu 112
141.Distribution Characteristics of Soil Labile Carbon in Subtropical Mountainous Meadow -- A Case Study of Wugong Mountain ..... Yun Niu, Zhi Li, Xu Chen, Dekui Niu, Xiaomin Guo, Yuanqiu Liu 113
142.Olfactory Responses of Stegobium Paniceum to Different Chinese Medicinal Material Volatiles Mixed with Feces Cues .....Can Li, Yu Cao, Daxing Yang 115
143.Oryza Sativa Cropping Impact on the Air Quality of a Natural Park Ecosystem ..... Carmen Capilla 115
144.Miaozihu Island and Qingbang Island Ecological System Carrying Capacity Evaluation .....Chao Fan, Xiaohui Zhao, Feng Gui 116
145.Evaluating Eco-capitals for Watershed Sustainability Using the Three-dimensional Ecological Footprint Model .....Dewei Yang 117
146.Biodiversity in Corporate Social Responsibility Agenda: Analysis of Global Scenario vis-à-vis Indian Initiatives .....Dipankar Saha 118
147.Assessment of Erosion Control and Coastal Protection in Estuarine and Coastal

Wetland .....Fang Ge, Bo Tian, Yunxuan Zhou 119
148.The State of the Art of the Biological Control of Ryegrass Pest in New Zealand Pastoral Ecosystems Federico Tomasetto[1], Stephen L Goldson[1], Jason M Tylianakis[2] 120
149.Estimate of Cultivated Land Resources Potential Based on Binary Logistic Regression Model in Hilly Area of Taihang Mountain
.....Hui Gao, Jintong Liu, Limei Tan, Lipu Han 121
150.Based on the Improved Three-Dimensional Ecological Footprint Model China's Natural Capital Spatial Pattern of Dynamic Research .....Jia Shi 122
151.Factors Influencing Economic Value of Ecosystem Services in a Natural Reserve in North China Jiaohui Fang[1], Yiran Zhang[2], Yanran Li[1], Hao Chen[1], Jian Liu[1] 122
152.A Possible Linkage between Land-Use Intensity and Natural Disaster Risks: A Consideration for the Eco-DRR at Global Scale
..... Kei-ichi Okada, Yuta Kobayashi, Akira S. Mori 123
153.The Role of Spatial Heterogeneity in Modulating Water-related Ecosystem Services in Yihe River Basin Luyi Liu, Huimin Liu, Jiayan Ren, Ziqi Bian, Shengyan Ding 124
154.Innovating Current Ecosystem Management Through the "Laws Divine and Human"（Dao De Jing/ Tao Te Ching） .....Ping Fang 125
155.Structure of Coastal Pine Forests at Two Regions with Different Social Conditions in Tokushima Prefecture, Shikoku, Japan
.....Takeshi Sasaki, Fumika Asanami, Mahito Kamada 125
156.Priority Management of Migrant Waterbirds Habitat Suitability on Coastal Zone with Multi Temporal Data .....Ting Zhang, Bo Tian, Yi Xin Zhao, Ying Niu 126
157.The Simply Analysis of Liabilities in Natural Resources Asset Balance-Sheet
.....Wenpeng Du 127
158.Tradeoffs and Time Lag in Ecosystem Services during Degradation and Restoration Processes in a Freshwater Lake of Northern China
..... Yanran Li[1], Hui Wang[1], Renqing Wang[1], Yiran Zhang[2], Jian Liu[1]128
159.Applications of Floristic Quality Assessment in the Vegetation Integrity Assessment in Riparian Area of Hai Basin, China ..... Ying Ren[1], Ping He[2] 129
160.Telecoupling in Ecosystem Services: A Case Study of Xishuangbanna
..... Zhuoya Zhang[1], Xin Yang[2], Nanjun Lang[2], Wen Ye[2] 130
161.Telecoupling in Spatiotemporal Variations of Ecosystem Service Based on RS: A Case Study of Xishuangbanna
...Zhuoya Zhang, Xin Yang, Nanjun Lang, Wen Ye, Yinying Qiu, Jianguo Liu 130
162.Multinational Collaborations in Ecology and Environmental Science within Asia: Current Status and Pathways Forward Eben Goodale[1], Uromi Manage Goodale[1], Aiwu Jiang[1], Myung-Bok Lee[1,] Christos Mammides[1], Madhava Meegaskumbura[2], Tharaka M. T. S. Priyadarshana[1], Qiao Xie[1] 132
163.First Steps towards Developing a Common Global Ecology Curriculum

..... Julia Clause[1], Rachel White[2], Shishir Paudel[3] 132
164.Environmental Education in the Sacred Woodlands of Korhogo (Ivory Coast) and Adoption of Environmental Behavior by the Insider Kabran Aristide DJANE 133
165.Evaluation of Urban Sustainable Development from the Perspective of Coupling and Coordination——A Case Study of Yangtze River Delta
..... Kena Mi[1], Rulong Zhuang[2], Jun Gao[1] 134
166.Synthesis Centers - Critical Research Infrastructure to Support Future Research
..... Marten Winter 135
167.How Did Rural Landscape Under Human Intervention Change in Japan? : A Case Study in Tsushima City, Nagasaki Prefecture Natsuko Shigehara, Shozo Shibata 136
168.Deep Learning and Deep Ecology: Complexity Science and Holism in the Context of Big Data .....Peiyuan Liu[1], Zhouyuan Li[2] 137
169.Countermeasures of Adaptive Environmental Management Based on Historical Review in Dianchi Lake Watershed .....Qing Feng, Jing Xiong 137
170.An Eco-geographic Approach to the Distribution of Pre-Industrial Civilizations
..... Xin Chen 138
171.Conservation Practices Are Pushing the Yangtze Finless Porpoise to an Even More Dangerous Situation in Poyang and Dongting Lakes
.....Yi Han, Zhigang Mei, Kexiong Wang, Ding Wang 138
172.Digital Cameras as a Tool for Assessing Vegetation Phenology and Integration with Satellite Image Analysis .....
173.A Reum Kim, Chi Hong Lim, Dong UK Kim, Song Hie Jung, Dong Min Woo, Chang Seok Lee 140
174.Effects of Land Use Change on Ecosystem Service Value of the Small Sanjiang Plain since the Mid-1960s .....Dan Chen, ShuWen Zhang 140
175.Watching Grass Grow: Successes and Limitations of Image-Based Methods for Monitoring Grassland Phenology
..... Dawn M. Browning[1], Andrew Richardson[1], Craig Tweedie[2] 141
176.UAV-HiRAP: A Novel Method to Improve Landscape-Level Vegetation Classification and Coverage Fraction Estimation with Unmanned Aerial Vehicle Platform
. Haozhou Wang[1], Feng Wang[1], Xueling Yao[1], Yue Mu[1], Yongfei Bai[2], Qi Lu[1] 142
177.Satellite Ecophysiology —the Remote Sensing from Single Leaf to Global Scales
.....Hibiki M. Noda 143
178.Sensitivity Analysis of the Canopy Scale 3D Sun-Induced Chlorophyll Florescence Model at Various Forest Structures
.....Hideki Kobayashi[1], Tomomichi Kato[2], Yuma Sakai[2], Wei Yang[3] 145
179.Using Solar-Induced Chlorophyll Fluorescence to Estimate Gross Primary Productivity of a Temperate Forest .....Jingfeng Xiao[1], Xing Li[1], Binbin He[2]145
180.Accurate Detection of Spatio-Temporal Variability of Growing Season in Boreal

and Temperate Forests by Analyzing in Situ- and Satellite-Observed Remote-Sensing Data Shin Nagai[1], Syunsuke Tei[2], Kenlo Nishida Nasahara[3], Yongwon Kim[4] 146

181. Study on Coupling Relationship between Land Use Change and Population- a Case Study of Dehui City ..... Qing Wang 147

182. Monitoring Decadal Changes of Understory Vegetation in Boreal Forests Based on MODIS BRDF Products..... Wei Yang[1], Hideki Kobayashi[2], Akihiko Kondoh[1] 147

183. Estimation of above Ground Biomass and Carbon Using Airborne LiDAR Data in Temperate and Tropical Forest
..... Woo-Kyun Lee, Eunji Kim, Mihae Yoon, Sungeun Cha 148

184. Remote Sensing Assessment Model and Method of Ecological Security for Highly Developed Urban
..... Xiaoyuan Zhang, Shudong Wang, Lifu Zhang, Xia Zhang, Taixia Wu 149

185. GLOBMAP LAI: A Long-Term Global Leaf Area Index (1981-2015) with Separation of Overstory and Understory for Needleleaf and Deciduous Broadleaf Forests
..... Yang Liu[1], Ronggao Liu[1], Jan Pisek[2], Jing M. Chen[3] 150

186. Forest Canopy Structure Analyzed by UAV-SFM: Toward Understanding the Relationship between Forest Structure and Species Diversity .....
Yayoi Takeuchi[1], Habura Borjigin[1], Nobuko Saigusa[1], Masato Hayashi[2], Kaoru Niiyama[3], Tamotsu Sato[3], Toshinori Okuda[4], Hamdan bin Omar[5], Azharizan bin Mohamad Norizan[5] 151

187. The Potential of Solar-Induced Chlorophyll Fluorescence for Retrievals of Vegetation Photosynthetic Capacity ..... Yongguang Zhang[1], Luis Guanter[2] 153

188. Spatial Modelling of Biodiversity in Alpine Landscapes: From Species to Ecosystem Services ..... Antoine Guisan 155

189. Mountains Are Forever ..... Laszlo Nagy, Eva Spehn 155

190. As Forest Go, Will Forest Bees? ..... Lindsie Marie McCabe, Neil S. Cobb 156

191. Soil Carbon Stocks along an Altitudinal Gradient of Pinus Hartwegii Lindl., the Altitude Pine in Central Mexico .....
Marlin Perez-Suarez[1], Lizbeth Carrillo-Arizmendi[2], J. Jesus Vargas-Hernandez[3] 157

192. The Impacts of Climate Change and Nitrogen Deposition on the Plant Diversity and Biomass of Alpine Ecosystems on Qinghai-Tibetan Plateau
..... Shikui Dong, Wei Sha, Zhenzhen Zhao, Yuhui Han 157

193. Abiotic and Biotic Factors Affecting the Soil Bacteria Community along the Qinghai-Tibet Railway ..... Siran Lu, Jun Yang 158

194. Patterns of Soil Bacterial Richness and Composition Tied to Plant Richness, Soil Nitrogen, and Soil Acidity in Alpine Tundra .....
Xia Yuan[1], Joseph Knelman[2], Deli Wang[1], April Goebl[2], Eve Gasarch[2], Timothy Seastedt[2] 159

195.The Effect of Species Loss Order on the Dilution Effect in the Tibetan Alpine Meadows .....Xiang Liu 159
196.Explaining the 4270 M Limit of an Evergreen Oak in Yunnan, China .....Yang Yang[1], Christian Körner[2] 160
197.Vegetation Analysis of the Qinghai - Tibet Highway Corridor Based on the Comparative Analysis of Normalized Difference Vegetation Index (NDVI) .....Yangang Yang, Xueping Chen 161
198.Tracing the Response of Alpine Biota to Ongoing Climate Change across the Urals - A Unique 1500 Km Long Latitudinal Transect in Northern Eurasia .....Yuri Mikhailov[1], Pavel Moiseev[2], Dmitry Moiseev[2] 161
199.Is Seed Germination Affected by Microsite Characteristics After the Removal of Understory Vegetation? .....
Yuriana Martinez[1], Silvia Castillo-Argüero[1], Alma Orozco-Segovia[1], Ana Mendoza-Ochoa[1], Alejandro Zavala-Hurtado[1], Roberto Lindig-Cisneros[2], Ernesto Vega-Peña[2] 163
200.Ozone Exposure and Flux-Based Response Relationships with Photosynthesis, Leaf Morphology and Biomass in Two Poplar Clones .....Bo Shang, Zhaozhong Feng, Pin Li 165
201.Assessing Impacts of Nitrogen Deposition on Forest Ecosystems: Systematically Biased by Experimental Simulation? .....Enzai Du 165
202.Comparison of the Growth of Acer Saccharinum L. And Amorpha Fruticosa L., the Invasive Alien Species of Woody Plants, Due to Climate Change .....
Jaekeun Lee[1], Young ho Jung[1], Seung yun Lee[1], Kyu tae Cho[1], Younghan You[1], Sanghun Lee[2] 166
203.Differential Responses of Peach (Prunus Persica) Seedlings to Elevated Ozone among 13 Cultivars Are Related with Leaf Mass per Area, Antioxidant Enzymes Activity Rather Than Stomatal Conductance .....
Lulu Dai[1], Pin Li[1], Bo Shang[1], Shuo Liu[1], Aizhen Yang[2], Younian Wang[2], Zhaozhong Feng[1] 167
204.Dimethylsulphoniopropionate Formation and Dimethyl Sulphide Emission in Higher Plants .....
Mauro Centritto[1], Matthew Haworth[1], Giovanni Marino[1], Stefano Catola[1], Cecilia Brunetti[1], Francesco Loreto[2] 168
205.Effects of Foliar Trichomes of Tillandsia on the Retention and Resuspension of Atmospheric Particulates .....Peng Li, Wei Zhang, Ruiwen Zhang, Mintian Gu, Guiling Zheng 168
206.PM2.5 Dry Deposition Velocity on Plant Leaves: An Indirect Experimental Method ..... Shan Yin, Xuyi Zhang, Chunjiang Liu 169
207.Drought Alleviated the Adverse Impact of Elevated O3 on Urban Trees 170
Sheng Xu, Donglan Xiong, Xingyuan He, Wei Chen, Xian Wu, Yanqing Huang
208.Ozone Fluxes and GHG Balance in a Spanish rice Paddy Field.....

Vicent Calatayud[1], Arnaud Carrara[1], Ana Mejide[2], Esperanza Calvo[1], Ana López-Ballesteros[2], Ramón López[1], Zhaozhong Feng[3], Penélope Serrano[2] 171

209.Elevated Ozone Exposure Inhibits Whole-Plant Hydraulic Conductance and Disturbs Water Loss Regulation of Six Temperate Tree Species in China .Weiwei Zhang 172

210.Changes in Isoprene Emission from Single Leaves and Whole Plants of Two Hybrid Poplar Clones Exposed to an Ozone Concentration Gradient .....Xiangyang Yuan, Shuo Liu, Bo Shang, Pin Li, Zhaozhong Feng 172

211.Spatio-Temporal Pattern of Ozone Weekend Effect, Beijing .....Xiuling Zhao, Lijian Han, Weiqi Zhou 173

212.Quantifying Particulate Matter Accumulated on Leaves by 17 Species of Urban Trees in Beijing, China .....
Yansen Xu[1], Wen Xu1, Li Mo[2], Mathew R. Heal[3], Xiaowu Xu[4], Xinxiao Yu[4], Zhaozhong Feng[1] 174

213.Agricultural Land Use Affects N2O Production Pathways in Subtropical Acidic Soils in China ..... Yi Zhang[1], Jinbo Zhang[2], Zucong Cai[2], Wei Zhao[3] 175

214.The Impact of Environmental Regulations on TFP of the Electric Power Industry-Evidence from Thermal Power Companies .....Yifei Zhang 176

215.Simulation of Indirect Carbon Loss Caused by Fire Emissions of Ozone and Aerosols .....Xu Yue 176

216.Ecological Effects of Greenbelt Designation in Korea .....

217.Chang Seok Lee, Dong UK Kim, Song Hie Jung, Chi Hong Lim, A Reum Kim, Dong Min Woo 178

218.Security Pattern Construction Based on Ecological Protection Redlines in China

219.Changxin Zou[1], Naifeng Lin[1], Junhui Liu[2], Lixia Wang[1], Yan Wang1, Dong Liu[1] 179

220.Effectiveness of Land Sparing Strategies in Preventing Land Conversion and Deforestation: A Case Study in Protected Areas of Xishuangbanna, Southern China .....Chaya Sarathchandra[1], Rhett harrison[2], Jianchu Xu[3] 180

221.Lichens and Forest Macrofungi in Mamparang Mountain Range, Northern Luzon: Emerging Species and Parameters for Environmental Monitoring and Assessment .....
Crusty Estoque Tinio[1], Nelson Pampolina[2], Pastor Malabrigo[2], Juancho Balatibat[2], Dianne Joy Aguilon[2], Paulina Bawingan[3], Paulina Bawingan[3], Jennifer Niem[4], Manuel Baldovino[4], Ramil Rodriguez[5], Ana Marie Carino[6], Jovito Flores[7], Jonathan Hernandez[2], Janine Kaysee Soriano[2], Bonifacio Labatos[7], Jason Magdaong[7] 180

222.Spatial Variability of Meadow Soil Nutrients on Wugong Mountain Based on GIS and Geostatistic ..... Dekui Niu, Zhi Li, Yuan, Xiaomin Guo 182

223.Efficacy of Conservation Strategies for Endangered Oriental White Storks (Ciconia Boyciana) Under Climate Change in Northeast China

..... Haifeng Zheng, Guoqiang Shen, Xu Xu 183
224. Volatile Chemicals Emitted by Halymorpha Halys (StåL) (Hemiptera: Pentatomidae): Weapon for Defence or Cue to the Parasitoid ..... Jinping Zhang[1], Yongzhi Zhong[2], Lili Ren[3], Rui Tang[4], Haixia Zhan[5], Guohua Chen[2], Feng Zhang[1] 184
225. Institutional Construction of Ecological Protection Redlines in China ..... Jixi Gao 184
226. A Review on Eco-environmental Quality Assessment .....Mingye Chen 185
227. Fish Egg Dynamics in the "Man-Made Flood Pulse" in the Middle Yangtze River down the Three Gorges Reservoir, China ..... Qihong Yang[1], Jiasheng Wang[2] 186
228. Ecological Protection Redlines Identification: A Case Study Analysis ..... Yan Wang[1], Changxin Zou[1], Junhui Liu[2], Lixia Wang[1] 187
229. The Study on Temporal and Spatial Evolution Characteristics of Regional Ecological Land Based on Type Differentiation Yao Lu, Xiaoshun Li, Ao Tang, Xin Chen 188
230. Ecological Redlines and Conservational Effectiveness of Ecosystem Services in China .....Yihe Lv[1], Liwei Zhang[2], Bojie Fu[1] 188
231. Building Ecological and Community Resilience in the Hindu Kush Himalaya ..... Eklabya Sharma[1], Neera Shrestha Pradhan[2], Nand Kishore Agrawal[2], Arabinda Mishra[2] 190
232. Is the Growth of Birch at the Upper Timberline in the Himalayas Limited by Moisture or by Temperature? .....Eryuan Liang 190
233. Effects of Soil Warming, Rainfall Reduction and Changing Water Table Level on CH4, CO2 Emission and Pore Water DOC Concentration of Zoige Peatland in China .....Huai Chen1, Gang Yang2, Ning Wu1 191
234. Fungal Community Changes and Assembly Processes along Retreating Glacier Soils .....Jianqing Tian, Na Jiang, Bing Wu 192
235. Grassland Degradation and Restoration in Tibet Plateau .....Kai Xue, Kui Wang, Yanfen Wang 193
236. Warming and Grazing Accelerate Plant Organic N Uptake in Alpine Meadow ..... Lili Jiang 193
237. Response of Spatial-temporal Changes of Vegetation Coverage to Soil Moisture in Tibetan Plateau ..... Long Xia[1], Ningxiao Song[1], Pei Leng[2], Fenyan Wang[3], Binyan Hao[3] 194
238. More Resilience for Better Adaptation – Sustainable Management of Ecosystems in the HKH Region .....Ning Wu 195
239. Integrated Management Strategies for Adaptation to Climate Change Impacts on Alpine Grassland Ecosystems in Northern Tibet, China ..... Qingzhu Gao 196
240. Increase in Ammonia-Oxidizing Microbe Abundance during Degradation of Alpine Meadows May Lead to Greater Soil Nitrogen Loss .....Rongxiao Che, Yanfen Wang, Xiaoyong Cui 196

241.Ecological Gradient Analyses of the Balakot Forests District Swat in the Hindu Khush Range of Mountains ..... Shujaul M Mulk Khan[1], Ahmad Zeb[2] 197
242.Rewetting Decreases Carbon Emissions from the Zoige Alpine Peatland on the Tibetan Plateau .....Xiaoming Kang, Lijuan Cui 198
243.Nutritional-balanced Production of the Tibetan Alpine Pastoral Animal Husbandry Industry: Theory, Technology and Practice ..... XinQuan Zhao[1], Shixiao Xu[2], Liang Zhao[2], Huakun Zhou[2], Yushou Ma[3], Quanmin Dong[3], Jianjun Shi[3] 198
244.The Effects of Extreme Drought on Ecosystem Carbon Fluxes in Zioge Alpine Peatland .....Yanbin Hao[1], Yuan Zhang[1], Xiaoming Kang[2] 199
245.Across-Scale Responses of Vegetation Phenology to Global Changes .....Yangjian Zhang 200
246.Monitoring and Modeling the "Water- Cryosphere- Atmosphere- Biology" Multi-sphere Interactions over the Third Pole region ..... Yaoming Ma 201
247.The Impact of Permafrost on Ecosystem Resilience of Alpine Grassland and Implementation in the Source Regions of Yangtze and Yellow Rivers ..... Yiping Fang 201
248.Comparison of the Microclimate Regulation Functions of Urban Forests in Harbin and Changchun, Two Provincial Capital Cities in NE China ..... Bo Zhang[1], Hailiang Lv[2], Qiong Wang[2], Wei Zhou[3], Lu Xiao[3], Xingyuan He[2], Wenjie Wang[3] 203
249.The Difference of Mineral Soil Carbon Sink between Broadleaved Plantations and Coniferous Plantations in 4 Soil Types in Northeastern China ..... Chenhui Wei[1], Zhongxue Pei[2], Manli Ren[2], Jiali Lu[2], Xingyuan He[1], Wenjie Wang[1] 204
250.Survival, Growth, and Nutrient Changes in Transplanted Ornamental Tree Seedlings Cultured Under Longer Photoperiod . Hongxu Wei[1], Xingyuan He[2] 205
251.Analysis on the Growth and Health of Street Trees Based on the Baidu Street View in Harbin City ..... Hongyuan Wang[1], Bo Zhang[1], Lu Xiao[1], Wei Zhou[1], Yang Yang[1], Jinghua Zhang[1], Xingyuan He[2], Wenjie Wang[1] 205
252.Surface Soil Carbon Stabilization and Microbial PLFA Composition in Temperate and Sub-Tropical Oriental Oak Stands of East China .....Hongzhang Kang, Wenjuan Yu, Huanhuan Gao 206
253.Relation between Urban Greenness and Air Quality Indexes in China's 27 Provincial Capital Cities ..... Jinghua Zhang[1], Lu Xiao[1], Panli Tian[1], Xiao Liu[1], Yang Yang[1], Xingyuan He[2], Wenji Wang[1] 207
254.The Associations of Arbuscular Mycorrhiza and Host Plant Were Shaped by Drought Conditions .....Laiye Qu, Yamin Zhang 208
255.Urban-Rural Difference of Soil Properties and Tree Species Composition and Their

Coupling Relationship in Harbin City, Northeastern China .....
Lu Xiao, Wenjie Wang, Xingyuan He, Hailiang Lv, Chenhui Wei, Wei Zhou, Bo Zhang, Zhaoliang Zhong 209

256. Spatial Variations of Urban Forest Health in Shenyang, Northeastern China .....
Panli Tian[1], Lu Xiao[1], Hongyuan Wang[1], Jinghua Zhang[1], Wei Zhou[1], Yang Yang[1], Xiao Liu[1], Xingyuan He[2], Wenjie Wang[1] 210

257. Impacts of Urbanization on Glomalin Related Soil Protein in Northeast China .....
Qiong Wang[1], Wei Zhou[2], Chang Zhai[1], Chenhui Wei[1], Bo Zhang[2], Lu Xiao[2], Hongyuan Wang[2], Xingyuan He[1], Wenjie Wang[1] 211

258. Soil Nitrogen Availability Affects Belowground Carbon Allocation and Soil Respiration in Hardwood Forests of New Hampshire, USA
Ruth Yanai[1], Kikang Bae[2], Hongzhang Kang[3], Timothy Fahey[4], Melany Fisk[5] 212

259. Stoichiometry of Deciduous Tree Seedlings Grown in Different Soils Exposed to Free-Air Ozone for Two Growing Seasons
.. Takayoshi Koike, Cong Shi, Saki Fujita, Tetsuto Sugai, Toshihiro Watanabe 212

260. Variation of Glomalin Related Soil Protein in Urban-Rural Gradients at Harbin City, Northeast China .....
Wei Zhou, Qiong Wang, Hailiang Lv, Chenhui Wei, Bo Zhang, Lu Xiao, Xingyuan He, Wenjie Wang 213

261. Urban Greenness Comparison of 31 Provincial Capital Cities in China and Their Geographic-Social Variation Patterns Based on Internet-Street-View Picture Analysis .....Wenjie Wang, Lu Xiao, Xingyuan He 214

262. Semi Variogram Analysis on the Spatial Heterogeneity of Urban Tree Characteristics in Harbin City .....
Xiao Liu[1], Wei Zhou[1], Hongyuan Wang[1], Lu Xiao[1], Jinghua Zhang[1], Yang Yang[1], Panli Tian[1], Xingyuan He[2], Wenjie Wang[1] 215

263. Mapping street trees and their ecosystem services using Google Street View
.....Xiaojiang Li 216

264. The Influences of Fire to Forest Carbon, Plant Diversity, and Community Structure in Daxing'an Mountain Region of Northeastern China .....Yang Yang 216

265. Effects of China National Nature Protection Programe on Carbon Sequestration, Diversity Conservation, Structural Alternation and Their Associations in Northeastern China .....
Zhaoliang Zhong, Jianyu Zhang, Hongju Du, Lu Xiao, Yang Yang, Wenjie Wang 217

266. Spatiotemporal Pattern of Urban Forest Structural Attributes in Response to Rapid Urbanization and Urban Greening Zhibin Ren, Xingyuan He, Haifeng Zheng 218

267. Effects of Doubled CO2 Concentration on Contents of Active Ingredients in Lycium Barbarum Fruit .....Bing Cao, Lihua Song 220

268. Ecophysiological Responses of Camellia Japonica (Naidong) to Different Water and Light Conditions

.....Cuiju Liu, Xiao Guo, Qinghua Liu, Qingchao Liu, Kuiling Wang221
269.Water Use Strategies among Different Functional Types Plant in a Monsoon Evergreen Broad-Leaved Forest at Dinghu Mountain of China
.....Deqiang Gao, Qing Xu, Shirong Liu222
270.Preliminary Assessment of Biodiversity/Ecosystems Vulnerability by Climate Change and Suggestion a System of Mitigation Measures for Them, Case Study: Hanoi City, Vietnam .....Doan Huong Mai 错误!未定义书签。
271.Climate Change and Korean Red Pine Dieback
.....Eun-Sook Kim[1], Jaebeom Kim[1], Jong-Hwan Lim[2] 224
272.Dynamic of CO2 Fluxes and Productivity in Tropical Ecosystems: A Case Study of Sudanian Forests and Savannas in Benin (West Africa)
.....Expedit Evariste Ago[1], Euloge Kossi Agbossou[2] 224
273.Susceptibility of Different Mangrove Forests to Sea-level Rise at a Lagoon in China .....Haifeng Fu, Mao Wang, Wengqing Wang 225
274.Effects of Nitrogen and Phosphorus Addition on Aboveground and Belowground Biomass in a Meadow Steppe of Northeast China .....
Haiying Cui, Wanling Xu, Jing Gao, Wenzheng Song, Xue Dong, Mingming Zhao, Wei Sun 226
275.Built-up Resilience to Climate Change in Peatlands .....
Hongjun Wang[1], Jianqing Tian[2], Mengchi Ho[1], Neal Flanagan[1], Rytas Vilgalys[1], Curtis J. Richardson[1] 227
276.Isolation and Identification of Aeromonas Media Inhibiting N2O Emission from Soil and Mitigation Mechanism Analysis .Hongsheng Wu, Suyun Chen, Ji Li 227
277.The Dominant Species Stipa Grandis Was Depressed by Nitrogen Deposition
.....Hongxiang Zhang[1], Yingzhi Gao[2] 228
278.Relative Importance of Climate Changes at Different Time Scales on Net Primary Productivity --- A Case Study of the Karst Area of Northwest Guangxi, China
.....Huiyu Liu 229
279.Responses of Soil Respiration to Nitrogen Deposition on the Sanjiang Plain Wetland in the Northeast of China .....Jianbo Wang, Hongwei Ni 230
280.China Subtropical Pine Ecosystem Is an Energy-Limited System Rather Than an Environmental-Factors Limited System .....Jianguo Huang, Xiali Guo 231
281.The Effect of pH on Daphnia Pulex, Daphnia Pulicaria and Daphnia Pulex-Pulicaria ..... Jiaxin Bai 231
282.Light Stress and Nitrogen Deposition on the Physiological and Ecological Characteristics of Camellia Japonica (Naidong)
.....Jikai Yang, Cuiju Liu, Xiao Guo, Qingchao Liu 232
283.Rainfall Changes and Nitrogen Deposition Alter Leymus Chinensis Biomass Allocation in Songnen Grassland .....
Jinwei Zhang[1], Yujie Shi[1], Gaohua Fan[2], Yuheng Yang[1], Siyu Hou[1], Ge Yan[1], Guangyin Li[1], Chunsheng Mu[1] 233

284.Zonal Vegetation Distribution and Water Niches of Dominant Shrubs in the Coastal Chenier Island of the Yellow River Delta
.....Jingtao Liu[1], Jinfang Zhu[2], Yanyun Zhao[3], Jingkuan Sun[1] 234
285.Seasonal Variation in Ecosystem Energy and Water Vapor Exchange over a Typical Plantation Affected by Periodic Drought
.....Jingyong Ma, Tianshan Zha, Xin Jia, Peng Liu, Yujie Bai, Yajuan Wu 235
286.Storm Events Restructured Microbial Community and Their Biogeochemical Potentials at Headwater Streams .....Jinjun Kan 236
287.Past and Future Influence of Climate Change on Spatially Heterogeneous Vegetation Activity in China ..... Kewei Jiao, Jiangbo Gao, Shaohong Wu 236
288.The Potential of Sun-Induced Fluorescence for Monitoring Heat Stress on Wheat in the Indo-Gangetic Plains, India
.....Lian Song, Yongguang Zhang, Xin Qian, Ji Li, Han Li 237
289.Influence of Climatic Variables on Season Based Agricultural System in Satkhira District, Bangladesh .....MD. Younus Mia, Juthi Rani Mitra, Shimul Roy 238
290.Studies on Forest Ecosystem Physiology: 1. Marginal Water Use Efficiency
.....MengPing Chen[1], Zhenghong Tan[1], Shuangxi Zhou[2] 239
291.Effects of Elevated Atmospheric CO2 on Dissolution of Geological Fluorapatite in Water and Soil.....Mu Su, Zhen Li 240
292.The Spatial Differentiation of Household Carbon Emissions in Xiamen
.....Pan Chen[1], Xiaoqing Shi[1], Guoqin Zhang[2], Ning Huang[3] 240
293.Global Warming, Grain Production and Its Efficiency: A Case Study in Major Grain Production Region ..... Pei Wang, Xiangzheng Deng 241
294.Effects of Spring and Summer Drought on Carbon Flux in a Semiarid Shrub-Land Ecosystem Dominated by Artemisia Ordosica, Northwest China
..... Peng Liu, Tianshan Zha 242
295.The Effect of Land Management, Landholder, and Accessibility on the Fire Occurrence in Various Land Covers in a Tropical Peatland
.....Prayoto[1], Masae Ishihara[2], Nakagoshi Nakagoshi[1] 243
296.Responses of Soil Microbial Community to Intensified Rainfall after Spring Drought in a Subtropical Forest ...Qian Zhao[1], Shuguang Jian[2], Weijun Shen[2] 244
297.The Role of Extracellular Enzymes Differs in Priming of Soil Organic Matter Decomposition Depending on Temperatures
.....Qianyuan Liu, Xingliang Xu, Huimin Wang 244
298.Snow Damage Strongly Reduces the Strength of the Carbon Sink in a Subtropical Evergreen Forest .....Qinghai Song 245
299.The Effects of Ozone on Phenolics and Enzymes in Soybean Leveas.....246
..Rongrong Tian, Yan Wang, Wei Wang, Bing Mao, Hongyan Wu, Tianhong Zhao
300.Threats to the Biodiversity in the Western Ghats Mountain Forests from Changing Environment and Climate: Challenges in Adaptation
.....Shadananan Nair Krishnapillai 246

301.Effects of Microcystis Aeruginosa on the Life History Traits and SOD Activity of Daphnia Similoides
..... Shuixiu Peng, Ping He, Qi Liu, Daogui Deng, Chenchen Zhang, Jie Cao 248
302.A Synthesis Analysis of Carbon Storage in the Grasslands of China
..... Suizi Wang, Jiangwen Fan 248
303.GHGs Emissions from Tropical Rainforest and Rubber Plantation
..... Wenjun Zhou, Yiping Zhang, Liqing Sha 249
304.Ecological Implication of Different Plant Responses to Leakage of High Soil CO2 Concentrations from Carbon Capture and Storage Sites
.....Wenmei He, Youjin Kim, Xuanlin Chen, Gayoung Yoo250
305.De Novo Transcriptome Analysis of Mangrove Kandelia Obovata Reveal Potential Molecular Mechanisms on Coastal Environment Adaptation .....
Wenyue Su, Congting Ye, Qian Zhou, Haihui Fu, Yingjia Shen, Qingshun Quinn Li 251
306.Higher Phenotypic Plasticity Does Not Confer Higher Salt Resistance to Robinia Pseudoacacia Compared with Amorpha Fruticosa .....
Xiao Guo[1], Xiaohuang Ren[2], Franziska Eller3, Mingyan Li[2], Renqing Wang[2], Ning Du[2], Weihua Guo[2] 252
307.Response of Calcareous Foraminifera to Ocean Acidification, Preliminary Laboratory Experiments and Improvements Xiaohui Zhao, Chao Fan, Feng Gui 253
308.Transcriptome Characterization Reveals Potential Pathways of Viviparous Embryo Development in Mangrove Kandelia obovata
Xiaoxuan Zhou, Wenyue Su, Congting Ye, Yingjia Shen, Qingshun Quinn Li 253
309.Typical Mountain Forest Ecosystem——Lacustrine Sediments Records of Holocene Vegetation Evolution Signals in Fanjingshan
.....Yang Gao, Kangning Xiong, Yina Lv 254
310.Terrestrial Net Ecosystem Primary Based on Remote Sensing and Ecosystem Process Model in Three-River Headwaters, Qinghai .....Yihan Yang 255
311.The Tolerance of Tropical and Subtropical Plants to Extreme Chilly Events Is Related to Their Native Distribution .....Yin Wen, Kunfang Cao 256
312.Response of ChlF Energy Partitioning of Xerophytic Plants to Rainfall Pulse in Semi-Arid Area of Nothwest China..... Yini Han 257
313.Abundance-Weighted Trait Variation along Large-Scale Abiotic Gradients: A Comparison of Wetland and Terrestrial Habitats .....
Yukun Hu[123], Guofang Liu[2], Yaobin Song[1], Xu Pan[3], Ming Dong[12], J Hans C Cornelissen[4] 258
314.Global Forest Bird Extinction Risks Driven by Climate Change .....
Yusuke Yonekura[1], Shota Nishijima[2], Yuta Kobayashi[1], Hirofumi Kondo[1], Keiichi Okada[1], Haruka Ohashi[3], Akira S Mori[1], HIroyuki Matsuda[1] 258
315.Surface Conductance for Evapotranspiration of Tropical Forests: Calculations,

Variations, and Controls ..... Zhenghong Tan 260
316.Elevated Temperature Reduces Settlement and Survivorship of the Moon Jellyfish Aurelia Sp.1 Planulae Zhijun Dong[1], Lei Wang[2], Qingqing Liu[1], Tingting Sun[1] 260
317.Soil Fungal Community Structure and Diversity in Response to Nitrogen Addition and Increased Precipitation in a Stipa Baicalensis Meadow Steppe ..... Zhuo Li, Xin Liu, Fu Xing, Ying Gao, Zunxing Zhu 261
318.Characteristics of Nitrogen Mineralization in Degraded Meadow Soils in Wugong Mountain ..... Ziwen Zhao[1], Xueling Zhang[2], Xiaomin Guo[3] 262
319.The Trait Variation in Temperate Canopy Tree Species and Their Responses to Climate Change from NE China ..... Da Yang[1], Guangyou Hao[2] 264
320.The Impacts of Robinia Pseudoacacia on Functional Structure of Plant Community in Different Vegetation Zones of Yanhe River Catchment ..... Duoju Zhu[1], Zhongming Wen[2] 265
321.Ecological Risk Assessment in Arid Inland River Basin in Xinjiang Guili Sun 266
322.Socio-Economic and Technical Determinants for the Adaptation of Native Hardwood Forests of Temperate Zones under a Scenario of Global Change ..... Ignacio J. Diaz-Maroto, Pablo Vila-Lameiro 266
323.Changes in the Land-Use and Natural Forest Regeneration in the Native Forests of Northwest Mountains of the Iberian Peninsula ..... Ignacio J. Diaz-Maroto[1], María Consuelo Diaz-Maroto[2] 267
324.Numerical Simulation of the Feedback of Land-Cover Change on Regional Climate in the Loess Plateau ....Jiaojiao Guo[1], Fei Wang[1], Entao Yu[2], Kai Jin[1] 268
325.Temporal Acclimation and Adaptation in Needle Photosynthesis and Respiration of Larix Gmelinii: A 30-Year Common Garden Experiment .....Kuixian Quan, Kuanchuan Wang 270
326.Carbon Sequestration Potential of Pinus Roxbrughii in Garhwal Himalaya ..... Munesh Kumar 270
327.Effects of Different Substrate Quality on Leaf Weight Loss and Nutrient Variation of Tailed Leaves in Mixed Decomposition Process Rong Dong, Yanling Xiao 271
328.Analysis and Prediction about Land Use Change in Area along the Belt and Road Initiative Based on CA-Markov Model ..... Xi Zhou 272
329.Effects of Enhanced UV-B Radiation and Nitrogen Deposition on ChlorophyII Fluorescence Parameters of Invasive Plant Triadica Sebifera .....Xiang Zheng 273
330.Modeling the Effects of Climate Change on Carbon Dynamics and Forest Composition in a Mid-Subtropical Mixed Forest ..... Yu Wu, Feng Liu 274
331.Beta Diversity of Vaccinium Uliginosum Communities at Different Spatial Scales: Influences of Forest Type and Latitude ..... Yukun Hu[1], Yusong Jin[2], Dandan Liu[1], Jing Wang[1], Yinghua Lin[1], Guang Liu[3], Yunhui Zhang[4] 275
332.Photosynthetic Acclimation of an Evergreen Broadleaved Shrub (Ammopiptanthus

Mongolicus) to Seasonal Climate Extremes in a Cold Desert Ecosystem .....
Zhengzhen Li[1], Ximeng Li[2], Kennedy Rubert-Nason[3], Qiong Yang[4], Qiang Fu[1], Jingchao Feng[1], Sha Shi[1] 275

333. Understanding Phylogenetic, Spatial and Intraspecific Variation in Wood Densities of Tree: A Global Synthesis .....
Chandan Kumar Pandey[1], Kartik Teegalapalli[2], Jayashree Ratnam[2], Mahesh Sankaran[2] 277

334. Biogeographic Mechanisms for the Global Patterns of Terrestrial Carbon Fluxes .....Guirui Yu, Zhi Chen 277

335. Coordinated Distributed Experiments 2.0: A Standardized Research Methodology for a Global Ecological Experiment Network
..... Ji Li[1], Lauchlan Fraser[2], Xiaoyong Cui[3] 278

336. Threshold Responses of Soil Organic Carbon Content and Composition to Multi-Level Nitrogen Addition in a Temperate Needle-Broadleaved Forest
.....Jing Geng[1], Junhua Fang[1], Lanshu Cheng[2] 279

337. Soil and Vegetation Carbon Turnover Times from Tropical to Boreal Forests .....
Jinsong Wang[1], Jian Sun[1], Jianyang Xia[2], Nianpeng He[1], Meiling Li[1], Shuli Niu[1] 280

338. Linking Global Patterns in Nitrogen Resorption with Litter Decomposition .....Lingli Liu, Meifeng Deng 280

339. Primary Production, Carbon Distribution and Carbon Budget of Subalpine Forest in Mt. Halla. ..... RaeHa Jang[1], Sanghun Lee[2], YoungHan You[1] 281

340. Responses of Soil and Air Temperature to Solar Radiation and Their Diurnal Cycles .....Tianxiao Ma, Runkui Li 282

341. Study on the Mechanism of Ecosystem Development in the Agro-Pastoral Ecotone of Northern China .....
Xiajie Zhai, Kun Wang, Ding Huang, Shiming Tang, Lizhu Guo, Jianxin Guo, Yuejuan Yang, Huan Zhao, Jiahuan Li 283

342. Responses of Carbon Hydrolase Kinetics to Nitrogen and Phosphorus Additions in Temperate and Subtropical Forest Soils in Eastern China .....
Xinyu Zhang, Chuang Zhang, Yang Yang, Shuli Niu, Hao Yang, Guirui Yu, Dashuang Tian, Yuqian Tang, Shuang Liu, Xiaomin Sun 284

343. Global-scale Responses of Plant Biomass to Global Warming: From Leaf Traits to Biodiversity .....Xuhui Zhou, Junjiong Shao 286

344. Vegetation and Soil Environmental Conditions Impact Nitrogen-Cycling Microbial Abundance along Soil Depths in Temperate and Subtropical Forest Soils in China .....
Yuqian Tang[1], Guirui Yu[1], Xinyu Zhang[1], Qiufeng Wang[1], Jianping Ge[2], Shuang Liu[1] 287

345. Influence of Climate Impact on Habitat of the Endangered Korean Long-Tailed Goral (Naemorhedus ..... Caudatus)

..... Baek-Jun Kim[1], Sanghun Lee[1], Hang Lee[2], Kon Joon Bhang[3] 289
346. On How Big Data and E-Research Infrastructure Can Help Advance Our Understanding of Climate Change Impacts on Species and Ecosystems: The Biodiversity & Climate Change Virtual Laboratory .....Brendan Mackey 289
347. A Rapid Assessment on the Impacts Induced by Climate Change on Birds' Conservation Priority in China .....Cheng Wen 290
348. How Does Contemporary Climate versus Climate Change Velocity Affect Endemic Plant Species Richness in China? .....Chunjing Qiu[1], Zehao Shen[1], Yue Xu[2] 291
349. Modelling Climate-Induced Range Shift of Native Tree Species in the UK ..... Enrico Simonetti[1], Laura Poggio[2], Alison Hester[2], Roberto Canullo[1], Alessandro Gimona[2] 292
350. Habitat Fragmentation Restricts Gene Flow and Adaptation near the Edge of Species Distribution in an Endangered Salamander ..... Hisanori Okamiya, Hirotaka Sugawara, Tamotsu Kusano 293
351. Testing Niche Conservatism and Biogeographic Equilibrium for Plant Species with Long Invasion History: The Peruvian Peppertree in Mexico .....Jorge E Ramírez-Albores 294
352. From South America to the World, the Invasion of the Monk Parakeet (Myiopsitta Monachus) .....Jorge E Ramírez-Albores 295
353. Identifying in Situ Climate Refugia for Threatened Plants and Animals .....Linda Beaumont, Manuel Esperon-Rodriguez, John B Baumgartner 295
354. Explaining the Species Richness Pattern and the Response to Climate Change for Woody Species in Southwestern China ..... Minggang Zhang[1], Keping Ma[2] 296
355. Stronger Recovery Ability from Defoliation in an Alien Species Robinia Pseudoacacia Compared with a Phylogenetic Related Native Species Sophora Japonica in Well-Watered ConditionsMingyan Li[1], Xiao Guo[2], Weihua Guo[1], Ning Du[1] 297
356. Mapping Changes in Continental Extent Endemism under Climate Change Using the Biodiversity and Climate Change Virtual Laboratory and Biodiverse .....Shawn Laffan[1], Willow Hallgren[2], Brendan Mackey[2] 298
357. How Might Climate Change Affect the Distribution of Nepalese Tigers and Snow Leopards? ..... Willow Hallgren[1], Brendan Mackey[1], Jean-Marc Hero[1], Dibesh Karmacharya[2], Anish Joshi[3], Tingbao Xu[4], Nicolas Rakopopare[1] 298
358. Effects of Climate Change on Distribution Patterns of Chinese Giant Salamander (Andrias Davidianus) in China . . . . . Ying Li1, Tian Zhao2, Jianping Jiang 300
359. Modelling the Spatial Distribution of Plateau Pika (Ochotona Curzoniae) in Qinghai Lake Watershed, Northeast Qinghai-Tibet Plateau Using BIOMOD ..... Yujun Ma, Yinan Wu, Wenling Liu 301
360. Disentangling Critical Drivers of Stem CO2 Efflux from Pinus Elliottii Trees in

Subtropical China
.....Jie Tu[1], Xiaohua Wei[2], Houbao Fan[3], Jianping Wu[3], Qingbao Pei[3] 301
361.The Impact of Objective Function Weight on hydrological calibration of PEST-HSPF .....Jincheng Li, Wei Gao, Xuexiu Chang 302
362.Comparetion of 12 Empirical Equations for Potential Evapotranspiration Calculating with Data from 11 Climate Zones in China .....Lingling Zhao 303
363.Analysis of Spatio-Temporal Distribution of Rainfall Causing the Landslide in Lanzhou City in the Recent 25 Years .....Mingming Zhang[1], Shuwen Yang[2] 304
364.Responses of Streamflow and Sedimentation to Precipitation and Forest Changes from 1965 to 2011 at Watershed Level .....Ping Zhou[1], Zhiyong Liu[2] 305
365.Runoff and sediment Characteristics and Response to Climate Change and Human Activities along the Yellow River in Ordos ─A case study in Ten Great Gullies
.....Tong Liu 305
366.Estimating Litter Carbon Stocks on Forest Land in the Qinling Mountains of China
..... Wanlong Sun, Xuehua Liu 306
367.Effects of Hypoxia on Survival of Greater Yellow Croaker (Larimichthys Crocea) at Different Conditions of Temperature and Fish Weight ..... Xiaolian Gu 307
368.Changing Land Use and Its Impact on the Habitat Suitability for Wintering Anseriformes in China's Poyang Lake Region .....Xuguang Tang 308
369.The Risk of Vegetation Drought under Varying Climate Conditions over China
.....Zhiyong Liu 309
370.Disentangling Critical Drivers of Stem CO^2 Efflux from Pinus Elliottii Trees in Subtropical China
.....Jie Tu[1], Xiaohua Wei[2], Houbao Fan[3], Jianping Wu[3], Qingbao Pei[3] 310
371.The Impact of Objective Function Weight on hydrological calibration of PEST-HSPF .....Jincheng Li, Wei Gao, Xuexiu Chang 311
372.Comparetion of 12 Empirical Equations for Potential Evapotranspiration Calculating with Data from 11 Climate Zones in China .....Lingling Zhao 311
373.Analysis of Spatio-Temporal Distribution of Rainfall Causing the Landslide in Lanzhou City in the Recent 25 Years .....Mingming Zhang[1], Shuwen Yang[2] 312
374.Responses of Streamflow and Sedimentation to Precipitation and Forest Changes from 1965 to 2011 at Watershed Level .....Ping Zhou[1], Zhiyong Liu[2] 313
375.Runoff and sediment Characteristics and Response to Climate Change and Human Activities along the Yellow River in Ordos ─A case study in Ten Great Gullies
.....Tong Liu 314
376.Estimating Litter Carbon Stocks on Forest Land in the Qinling Mountains of China
..... Wanlong Sun, Xuehua Liu 314
377.Effects of Hypoxia on Survival of Greater Yellow Croaker (Larimichthys Crocea) at Different Conditions of Temperature and Fish Weight ..... Xiaolian Gu 315
378.Changing Land Use and Its Impact on the Habitat Suitability for Wintering Anseriformes in China's Poyang Lake Region .....Xuguang Tang 316

379.The Risk of Vegetation Drought under Varying Climate Conditions over China .....Zhiyong Liu 317
380.Ecosystems Sustainability: Channelling Observation and Experimentation to Better Understand and Face the Complex Future Trends ..... Abad Chabbi, Margaux Dillon 319
381.A Forest of Stars: Eco-Evolutionary Dynamics as a Cosmological Analogue .....Barry W. Brook, John Dickey, Andrew Cole, Jessie C. Buettel 320
382.Landuse Change Trends in Southern Sichuan Rural Areas, China: From the Observation of a Small Scale Landscape Change .....Dunlian Qiu 320
383.Creating an Integrated Network from Long-Running Ecological Research Studies in Australia to Improve National Ecological Understanding and Management ..... Emma Burns[1], Aaron Greenville[2], Christopher Dickman[2], Graeme Gillespie[3], Peter Green[4], Ary Hoffmann[5], David Keith[6], David Lindenmayer[1], Daniel Metcalfe[7], John Morgan[4], Jeremy Russell-Smith[8], Glenda Wardle[2] 321
384.Global Synthesis of the Spatio-Temporal Distribution of Antibiotics in Different Environmental Mediums .....Fangkai Zhao, Lei Yang, Shoujuan Li, Long Sun, Liding Chen 322
385.Broad and Deep in Observation Network: Lessons Learned from Satellite Ecology Initiative .....Hiroyuki Muraoka 323
386.Are Declining Populations of Wild Geese in China "Prisoners" of Their Natural Habitats? .....Hui Yu[1], Lei Cao[2] 324
387.Dynamics of Eco-Evolutionary Patterns in Forest Ecosystems .....Jessie C. C. Buettel, Barry W. Brook 325
388.Copper Pollution Increases the Resistance of Soil Archaeal Community to Changes in Water Regime .....Jing Li 325
389.Assessing Ecosystem Health Changes of Lake Poyang, Using Aquatic Ecological Integrity Indices from 2010-2015....Lingyan Qi, Jiacong Huang, Junfeng Gao 326
390.Phenotypic Plasticity in Two Mollusk Sister Species across Their Range Overlap Area: A Physiological Perspective
Marco A Lardies[1], Bernardo O Broitman[2], Nelson A Lagos[3], Moises Aguilera[4] 327
391.Long-Term Ecosystem Research (LTER) - Streamlining Continental and Global Scale Ecosystem Research by Combining Primary Investigator Driven Bottom-Up and Interoperability Focussed Top down Approaches ..... Michael Mirtl 328
392.Biodiversity in Limestone Quarries: Species Richness and Flora Diversity in Forest Fragments and Reforestation Sites across Two Philippine Biogeographic Subregions .....
Perry Sim Ong[3], John Michael M. Galindon[1], Maria Dolores C. Tongco[2], Jay S. Fidelino[3], Mariano Roy Martin Duya[3] 329
393.Linking Plant Functional Traits to Shifts in Subtropical Forest Composition Under Climate Change .....Qing Ye 330
394.Phylogenetic Determinants of Latitudinal Variation in Absorptive Root Traits from

Boreal to Subtropical Forests .....
Ruili Wang[1], Qiufeng Wang[2], Ning Zhao[3], Zhiwei Xu[4], Xianjin Zhu[5], Cuicui Jiao[2], Guirui Yu[2], Nianpeng He[6] 331

395. Assessing Elements of Change in a Tropical Mangrove: Multidimensional Relationships between Mollusc Assemblages and Habitat Complexity across Spatiotemporal Scales
.....Shuhaida Shuib, Nur Syuhaidah Muhd Zee Hood, Khairun Yahya 332

396. Establishing Plant Aridity Sensitivity Using Stable Carbon Isotopes on Bioclimatic Gradients .....
Stefan Caddy-Retalic[1], Francesca A McInerney[1], Kristine Nielson[1], Andrew J Lowe[1], Margaret Byrne[2], Stephen van Leeuwen[2], Iain Colin Prentice[3], Glenda M Wardle[4] 333

397. Shrub Encroachment and Its Ecological Impacts on Temperature Grasslands in China
.. Haihua Shen, Luhong Zhou, He Li, Leiyi Chen, Pujin Zhang, Jingyun Fang 335

398. Ecosystem Dynamics in the Returning Rangeland to Grassland programs, China
.....Haiyan Zhang 336

399. Assessing Impacts of Grazing Intensity on Vegetation Characteristic and Soil Chemical Properties of Alpine Meadows in Eastern Part of Qinghai-Tibetan Plateau
.....Ji Lei[1], Xiangyang Hou[1], Qin Yan[1], Youmin Gan[2] 336

400. Effects of Altered Temperature and Precipitation on Ecosystem Respiration in Alpine Meadow on the Central Tibetan Plateau
..... Jingxue Zhao[1], Tianxiang Luo[2], Yanhong Tang[1] 337

401. Nitrogen Addition Deteriorates Nematode Community through Increasing Litter Accumulation .....Jushan Liu, Xiaoxi Liu, Ying Chen, Deli Wang 338

402. Grazing Effects on Soil Respiration in Kubuqi Desert of Northern China .....
Li Gao[1], Qingfang Zhu[1], Zhijian Yan[1], Yuqing Wang[1], Thomas A Monaco[2], Hui Wang[1], Xiangyang Hou[1] 339

403. Climatic Variations in Recent Years on the Tibetan Plateau and Its Effect on Annual NEE and Ecosystem Respiration - an Example in an Alpine Meadow .....
Mingyuan Du[1], Yingnian Li[2], Fawei Zhang[2], Hongqin Li[2], Liang Zhao[2], Song Gu[3], Seiichiro YONEMURA[4], Yanhong Tang[5] 340

404. Microclimate and Livestock Grazing Influence CO2 Fluxes in an Alpine Grassland on the Qinghai Tibetan Plateau 341
Mitsuru HIROTA[1], Minhai Wan[1], Yingnian Li[2], Mingyuan Du[3], Yanhong Tang[4]

405. Soil Organic Matter Properties in an Alpine Grassland Used as Summer Pasture on the Qinghai Tibetan Plateau .....
Nobuhide Fujitake[1], Kyoko Kitamura[2], Beibei Han[2], Takashi Suzuki2, Miyuki Kondo[3], Haihua Shen[4], Yingnian Li[5], Yanhong Tang[6], Mitsuru Hirota[7] 342

406. Comparison of Ecological Status after Restoration in Hulunbeier of China

..... Seunghyuk Lee1, Yonghan You2 343
407.Does Precipitation Drive Facilitation by Alpine Cushion Plants in Dry Himalayas? .....Tianxiang Luo[1], Rita Ale[2], Lin Zhang[3], Xiang Li[4] 343
408.The Relationship between Grassland Species Richness and the Management in Long-Established Golf Cources in Japan .....Toshikazu Matsumura[1], Yoshinobu Hashimoto[2], Yoshihiro Sawada[3] 344
409.Long-Term Overgrazing Effects on Stem Elongation and Internode Allometry: Insights from a Natural Pasture Grass .....Xiliang Li 346
410.Ecological Principles of Grassland Management in Tibetan Plateau .....Xinquan Zhao 346
411.Earlier Leaf-Flushing Suppressed Ecosystem Productivity by Draining Soil Water in Mongolia 347
Zhen Yu[1], Chaoqun Lu[1], Peiyu Cao[1], Hanqin Tian[2], Amy Hessl[3], Neil Pederson[4]
412.Modelling the Impacts of past and Future Climate Changes on Watershed Vegetation Dynamics in an Arid Environment .....
Decheng Zhou[1], Lu Hao[1], Peilong Liu[1], Cen Pan[1], John B Kim[2], Yiongqiang Liu[2], Ge Sun[2] 349
413.Disentangling the Interactions among Climate and Management Drivers in Grassland Ecosystem Changes Frank Yonghong Li[1], Paul D Newton[2], Mark Liefferring[2]350
414.Changing Relationships between Ecosystem Leaf Area and Evapotranspiration over Time and Space ...Ge Sun[1], Steven G. McNulty[1], James Vose[1], Lu Hao[2] 351
415.Foliar N and P Stoichiometry of Functional Groups on Qinghai-Tibet and Inner Mongolian Plateaus .....Hailing Yu[1], Jiangwen Fan[2] 351
416.Will Changing Drought Regimes Create Novel Forest Ecosystems in the Southern United States? .....James Vose 352
417.Biomass Increment and Mortality Losses in Tropical Secondary Forests of Hainan, China .....Junfu Zhao, Zheng-Hong Tan 353
418.Response of Alpine Vegetation Dynamics to Climate Variations and Human Disturbances in a Mountainous Watershed, Northwestern China .....
Lu Hao[1], Decheng Zhou[1], Peilong Liu[1], Cen Pan[1], Suyun Li[1], Yongqiang Liu[2], Ge Sun[2] 353
419.Potentialities of an Automated Chamber Network for Estimation of CO2/CH4 Sink/Source of Asian Terrestrial Ecosystems .....
Naishen Liang[1], Munemasa Teramoto[1], Yiping Zhang[2], Kentaro Takagi[3], Jin-Sheng He[4], Yanan Wang[5], Sheng-Gong Li[6], Jingyun Fang[4], Shilong Piao[4], Jiye Zeng[1] 354
420.Spatiotemporal Trends of Land Degradation and Its Driving Mechanism in Arid Land of Asia .....Nan Shan 355
421.Effects of planting Density on Soil Moisture and its Temporal Stability in Rocky Mountain Area of Northern China .....Shengping Wang356
422.Unexpected Consequences of Climate Change and Variability on Forest Structure,

Function and Management .....Steven George McNulty, Ge Sun358
423.Variation and Driving Factors of Soil Moisture at Multi-Scales--A Case Study in Loess Plateau of China .....Wenwu Zhao, Xiao Zhang, Yuanxin Liu 358
424.Time-Frequency Analysis of Environmental Controls on Net Ecosystem CO_2 Exchange over a Temperate Semi-Arid Shrubland
.....Xin Jia, Tianshan Zha, Shan Wang 359
425.Spatial-Temporal Dynamic and Climate Response of Water-Use Efficiency in the Yangtze River
..... Yaquan Chang, Haozhou Wang, Zenxin Zhang, Shanshan Jiang, Wei Du 360
426.Recent Trends in Vegetation Greenness in China Significantly Altered Annual Evapotranspiration and Water Yield .....Yibo Liu1, Jingfeng Xiao2 361
427.Biodiversity of the natural vegetation and its main influencing factors in western Inner Mongolia
Chongyao Yang[1], Engui Li[1], Huiying Chen[1], Jinghui Zhang[2], Yongmei Huang[3] 363
428.高寒草甸退化与恢复过程中土壤微生物群落功能多样性分析 363
Fei Li[1], Tianhua Jia[2], Shanshan Li[3], Yanfu Bai[2], Cancan Guo[2], Zhanhuan Shang[2]
429.Flexible Nitrogen Use of Common Plant Species Haiyan Ren, Guodong Han 364
430.Changes in Soil Microbial Functional Diversity Induced by the Introduction of Black Locust along an Environmental Gradient Jing Zhang, Zhongming Wen 364
431.The Relationship between Functional Diversity/Species Diversity of Grassland Communities and Runoff Sediment Yield in Loess Hilly Region .....Tao Yu 365
432.Farmers' Environmental Perception and Adaptation of Different Livelihood Strategies in Desert Steppe .....Yingying Bian, Naiping Song 366
433.Population Changes behind Grassland Degradation in the Developing Countries
..... Yintai Na[1], Hoshino Buho[1], Sai Xiyalatu[2] 368
434.Analyzing Spatial Patterns of Urban Carbon Metabolism and Distribution of Ecological Relationships: A Case Study of Yangtze River Delta, China
.....Chuyu Xia, Yan Li, Yanmei Ye, Zhou Shi 369
435.Litters of Different Landscape Plant Species Affect Earthworm (Eisenia fetida) Survival and Growth .....Daoming Wu, Qifeng Mo, Shucai Zeng 369
436.Urban Metabolism Process Based on Emergy Analysis: A Cased Study of Shanghai
.....Fan Zhang[1], Jinyan Zhan[2] 370
437.Influences of Urban Expansion on Cultivated Lands in China
.....Fang Liu, Zengxiang Zhang, Xiao Wang, Xiaoli Zhao 371
438.Litterfall and dynamic of Evergreen Broad-leaved Forest on Jinyun Mountain
.....Fang Yuan[1], Chao Yang [1], Yongchuan Yang[1], Liang Zhao[2] 372
439.Analysis on the Influencing Factors of New-Type Urbanization Development in Qingdao ..... Ganlin Mao, Jiazhen Liu, Yongjin Chen 373
440.Characterizing the Impact of Urban Morphology Heterogeneity on Land Surface Temperature in Guangzhou, China ..... Guanhua Guo 374
441.Effects of Foliar Trichomes of Tillandsia on the Retention and Resuspension of

Atmospheric Particulates
.....Guiling Zheng, Wei Zhang, Ruiwen Zhang, Mintian Gu, Peng Li 375
442.Evaluation and Function Zoning of Ecological Environment in Urban Space
.....Haixia Zhao, Yan Liu 375
443.Quantifying the Effects of Impervious Surface Pattern on the Spatial Distribution of Urban Waterlogging Risk Area ..... Hui Zhang[1], Cheng Li[2], Zhifeng Wu[3] 376
444.A Synthesis Analysis of Methods for Quantifying Social Factors in Social Ecological Systems .....Jiang Peng, Yang Jun 377
445.Quantifying the Evenness and Fragmentation of Urban Greenspace in 9 Chinese Cities .....Jing Wang, Weiqi Zhou, Yuguo Qian 377
446.Vegetation Change of the Slopes of the Nanjido Nonsanitary Landfill in Seoul, Korea .... Jong Yup Kim[1], Seok Cheol Park[2], Jeong IN Kwak[3], Bong Ho Han[4] 378
447.Characterization of the Vascular and Cryptogamic Flora of the Green Roofs of Geneva (Switzerland)
.....Julie Steffen, Mariane Hédont, Patrice Prunier, Sophie Rochefort 379
448.The Quantitative Evaluation and Promotion Strategy of Ecological Carrying Capacity in Economically Developed Areas --A Case Study in Shaoxing, Zhejiang
.....Juwu Wang, Junbang Wang 380
449.Developing Partnerships to Enhance Pollination Services in Urban Areas
.....Katherine Baldock 381
450.Tapping the Potential of Urban Green Spaces to Provide Ecosystem Services and Achieve Sustainable Urban Development in Pakistan..... Khalid Farooq Akbar 382
451.A Practice of Species Recovery Project in Unban Area—Take Chinese Water Deer Reintroduction in Shanghai as an Example .....Min Chen, Endi Zhang 383
452.Population Dynamics of Scattered Tree Species in the Urban Area of Kyoto, Japan
..... Motonori Kimura[1], Shozo Shibata[2] 384
453.Public Behavior, Awareness, and Perception of Household Solid Waste Recycling in Urban Areas of China: A Case Study .....
Peiming Zheng, Hui Wang, Xiao Liu, Kun Zhang, Lidong Cao, Jianli Wen, Ning Wang, Fengchuan Wang, Shuping Zhang, Renqing Wang 384
454.The Cooling Effect of Water Landscape in High-density Urban Built-up Area—A Case Study of the Center Urban District in Guangzhou .....
.....Qifei Zhang, Zhifeng Wu, Guanhua Guo 385
455.A Case Study on Linkage between Urban Form and Commuting Traffic CO2 Emission Quanyi Qiu, Yao Qian, Dingkai Chen, Qianyu Li, Luyan Wang, Xinyi Yang 386
456.The Effect of Urban Landscape Pattern Evolution on Urban Heat Island Based on Observed Data .....Shiqiang Sun, Juhui cen 387
457.Exploring the Spatial Distribution of Heavy Metal in Peri-Urban Topsoil of Eastern China ..... Shoujuan Li, Lei Yang, Fangkai Zhao, Long Sun 387

458.Urban Ecosystem Health Assessment for Typical Cities along the Belt and Road
..... Shuhuan Chen[1], Meirong Su[2] 388
459.Greening Evaluation Integrated with Human Benefits in Three-Dimensional Thinking
..... Tingwen Luo[1], Chujun Wen[1], Ping Luo[1], Yao Yao[1], Lin Xiao[1], Yali Xu[2] 389
460.Effects of Foliar Trichomes of Tillandsia on the Retention and Resuspension of Atmospheric Particulates
.....Wei Zhang, Ruiwen Zhang, Mintian Gu, Guiling Zheng, Peng Li 389
461.Investigation of the Impact of Urban Vegetation on PM2.5 Based on Remotely-Sensed Measurements: A Case Study in Shenzhen, China
.....Weimin Wang[1], Hong Liang[1], Lijun Yang[1], Lihuan He[2] 390
462.Effective Measures of Revegetation along the Corridor of Qinghai Tibet Highway
..... Xueping Chen, Yangang Yang, Xinjun Wang, Jiding Chen, Yaping Kong 390
463.Burgeoning Demand Drives Substantial Increases in Ecosystem Services Value Following Rapid Urbanization .....
Yanqiong Ye[1], Brett A Bryan[2], Jia'en Zhang[1], Jeffery D Connor[3], Lili Chen[1], Zhong Qin[1]391
464.Ecological Transportation Construction and Urban Environment Optimization
.....Zhilong Zou 392
465.Analyzing Changes of Urban Green Spaces in 28 Megacities between 2005 and 2015 .....Conghong Huang, Jun Yang 394
466.How Is the Spillover Effect of Urban Green Space Cooling in a 4D Scale?
..... Fanhua Kong, Haiwei Yin 394
467.How Does Spatial Configuration of Trees Affect Urban Heat Mitigation Independent of Coverge? ..... Jia Wang[1], Weiqi Zhou[1], Mary L. Cadenasso[2] 395
468.Urbanization Impacts on Cooling Effects of Green Space ..... Jian Peng 396
469.Productive City——A New Mode of Urban Ecosystem
..... Jie Zheng[1], Yukun Zhang[2] 396
470.Dynamic Characterization of Resilience in a Metropolitan City
.....Jing Fu, Jun Gao 398
471.Thermal Environment of Zen Gardens in Kyoto, Japan: As a Guide for Designing Urban Spaces ..... Lihua Cui 398
472.Patch Size of Trees Affects Its Cooling Effectiveness: A Perspective from Shading
..... Min Jiao, Weiqi Zhou, Zhong Zheng, Jia Wang, Yugou Qian 399
473.The Ecosystem-Service Performance Analysis of the Three-Hills and Five-Gardens Area in Beijing, China .....Qing Chang 400
474.Ecological Effects of Green Space Dynamics on Urban Heat Islands
.....Ranhao Sun 401
475.Evaluation of the Seed Supply Potential on a Roof by Using Artificial Perches
.....Takahiro Sugano, Shinjiro Sakai, Junichi Imanishi, Shozo Shibata 402
476.Exploring GIS Model of Urban Heat Island and Scenario Approach of Ecological

Planning: A Case Study of Jiuquan Downtown, China
.....Tianxiang Yang, Qiang Zhang 403
477.Temporal and Spatial Characteristics of Spontaneous Plants Niche Width and Niche Overlap in Beijing Olympic Forest Park
.....Xiaopeng Li, Fan Zhao, Sijia Wu, Li Dong 404
478.Assessing Structure, Function and Value of Street Trees in Dalian, China
..... Xueyan Wang, Wei Chen, Xingyuan He 405
479.Building Urban Landscapes That Facilitate Biological Adaptation in Organisms
.....Amy K Hahs[1], Mark J McDonnell[2] 406
480.Comparing How Urban Context Influences Functional Traits across Taxonomic Groups .....
Amy Hahs[1], Myla Aronson[2], Ela Carpenter[3], Eliana Geretz[4], Julie Goodness[5], Adriana Hemontes[6], Kirsten Jung[7], Madhusan Katti[8], Sonja Knapp[9], Johan Kotze[10], Chris Lepczyk[11], Ian MacGregor-Fors[12], Scott MacIvor[13], Marco Moretti[14], Max Pianka[15], Allyson Salisbury[16], Caragh Threlfall[17], Chris Trisos[18], Nick Williams[19], Charlie Nilon[20] 407
481.The Influence of Multiple-Scale Habitat Structure on Bird Community in Urban Parks .....Gang Yang 408
482.No Evidence of Adaptation to Ecological Traps in Urban Odonates
..... Giovanna Villalobos-Jimenez[1], Rochelle Meah[2], Christopher Hassall[1] 409
483.Effects of Dissolved Organic Matter from Sewage Treatment Plant on Plankton Community in Large Urban River.....
Jin Meiyan[1], Oh Hye-Ji[1], Oh Jong-Min[1], Chang Kwang-Hyeon[1], Kim Yong-Jae[2] 410
484.Comparison of Resistance against Environmental Stress Factors between Endemic Fish Species in Asian Countries and Invasive Largemouth Bass.
... Jong-Mo Suh[1], Kwang-Hyeon Chang[1], Kwang-Seuk Jeong[2], Yusuke Oda[1] 411
485.Spectral Characteristics of Purple Sunbird Calls in Urban Habitats of Delhi, India
..... Manoj Singh[1], Krishan Kumar[1], T K Roy[2] 412
486.Spatial and Temporal Effects on Railway Use and Movement by Grizzly Bears in Banff National Park ....Sonya Pollock[1], Jesse Whittington[2], Colleen St. Clair[1] 413
487.Vascular Plants Established on the Masonry Stonewall for Regional Biodiversity Conservation and Enhancement in Urban Chongqing, China
..... Ting Li[1], Yongchuan Yang[2], Liang Zhao[3] 413
488.The Influences of City- and Local-Scale Factors for the Urban Thermal Environment\ .....Xiaofang Hu, Weiqi Zhou, Yuguo Qian 415
489.Photosynthetic Responses of Urban Greening Trees to Light Intensity and CO_2 Concentration under Different Types of Pavements
..... Xuming Wang, Xiaoke Wang, Yuanyuan Chen 415
490.Human-Modified Landscapes: A Potential Habitat for Conservation of Baya Weaver (Ploceus Philippinus) in Northeast India

.....Yashmita Nitin Ulman, Awadhesh Kumar, Madhubala Sharma 416

491.Microclimatic Variations of an Abrupt Urban Forest Edge
.....Yingnan Li, Youngkeun Song 417

492.Estimation of Multiple Environmental Stress Using Biomarkers: Quantitative Approach Using Daphnia Magna under Temperature Stress and Presence of Kairomones .....
Yusuke Oda[1], Jong-Mo Seo[1], Masaki Sakamoto[2], Kwang-Seuk Jeong[3], Kwang-Hyeon Chang[1] 418

493.The Effect of Urban Expansion on Waterfowls in Kunming City, SW China
..... Zhaolu Wu[1], Kang Luo[2], Haotian Bai[2] 419

494.Effects of Thinning on the Understory Vegetation Community and Its Photosynthetic Characteristics in a Subtropical Pinus Massoniana Plantation
.....Chuanpeng Cheng 420

495.Variation of Tree Allometry across Forests in Central Africa and Its Consequences on the Estimation of Biomass and Carbon Stocks
.....Grace Jopaul Loubota Panzou 420

496.Experimental Throughfall Reduction Barely Affects Soil Carbon Dynamics in a Warm-Temperate Oak Forest, Central China .....
Haibo Lu[1], Shirong Liu[1], Hui Wang[1], Junwei Luan[2], Andreas Schindlbacher[3], Yanchun Liu[4], Yi Wang[2] 421

497.Effects of Nitrogen and Phosphorus Additions on Soil Prokaryotic Communities in a Tropical Forest .....
Hui Wang[1], Xiao Zhang[1], Shirong Liu[2], Jiangming Mo[3], Xiangzhen Li[4], Qinggong Mao[3], Jingxin Wang[5], Zuomin Shi[1], Lei Liu[3], Wei Zhang[3], Xiankai Lu[3] 422

498.Extreme Atmospheric Nitrogen Deposition Event Affect Methane Oxidation in Moist Acidic Tundra
.....Jaehyun Lee[1], Juyoung Seo[1], Seunghoon Lee[2], Hojeong Kang[1] 423

499.Whole Ecosystem Warming and Elevated CO2 Treatments in a Forested Boreal Bog – Initial Results from the First Two Years of Treatments .....
Jeffrey M Warren[1], Mirindi E Dusenge[2], Paul J Hanson[1], Eric J Ward[1], Stan D Wullschleger[1] 423

500.Long-Term Tree Biomass Recovery in an Australian Tropical Forest Following Logging and Different Intensity Silvicultural Treatments
.....Jing Hu, John Herbohn, Jack Baynes, Robin Chazdon 424

501.Effects of Stand Age on Carbon Storage and Belowground Carbon Allocation in Three Temperate Forest Types in Northeastern China
.....Jinyan Yang[1], Yujie He[2], Robert Teskey[3] 425

502.Above- and Belowground Plant Functional Traits and Soil Properties Predict Grassland Greenhouse Gas Emissions .....
Jonathan Richard De Long[1], Benjamin G. Jackson[2], Anna Wilkinson[1], William J

Pritchard[1], Simon Oakley[3], Kelly Mason[3], Thomas Cornulier[4], Nicholas J Ostle[5], David Johnson[1], Elizabeth M. Baggs[6], Richard D. Bardgett[1] 427

503.Soil Nitrogen Determines Greenhouse Gas Emissions from Northern Peatlands under Concurrent Warming and Vegetation Shifting .....Junwei Luan[1], Jianghua Wu[2], Shirong Liu[3], Nigel Roulet[4], Mei Wang[2] 428

504.Growing Season Methane Emissions from a Permafrost Peatland and a Freshwater Marsh in Northern China .....Li Sun, Changchun Song, Chao Gong 429

505.Effects of Thinning on Carbon Budgets in a Coniferous Plantation in Subtropical China Mingjie Xu, Huimin Wang, Fengting Yang, Yuebao Di, Chuanpeng Cheng 429

506.A Comparative Analysis to Quantify the Biogeochemical and Biogeophysical Cooling Effects on Climate of a White Mustard Cover Crop..... Morgan Ferlicoq[1], Tiphaine Tallec[1], Dominique Carrer[2], Aurore Brut[1], Gaetan Pique[1], Nicole Ferroni[1], Eric Ceschia[1] 430

507.Understanding Soil Carbon Dynamics in a Warm Temperate Oak Forest and Tropical Plantations by Manipulated Warming and Drought .....Shirong Liu 431

508.Response of Microbial Activity and Methanogens Community on Invasive Plant under Warming in a Salt Marsh Ecosystem .....Sunghyun Kim[1], Weixin Ding[2], Hojeong Kang[3], J Patrick Megonigal[4] 433

509.Effects of Remediation Plants on Soil Rhizosphere Microbial Communities and Functions in Ganzhou Rare Earth Mine Tailings .....Wei Dong, Siyu Li, Meng Li 433

510.Estimating Vegetation Biomass Using Very High Resolution Satellite Image in a Karst Watershed of Guizhou Province, southwestern China .....Xin Xu, Libin Li, Jian Ni 434

511.Effects of Manipulated Nitrogen Deposition on Soil CO_2 Emission and Related Biochemical Properties in N-Rich City Lawn .....Xinyu Jiang[1], Jiong Cheng[1], Lixiang Cao[2], Renduo Zhang[3] 435

512.Phragmites Australis Meets Suaeda Salsa on the "Red Beach": Effects of an Ecosystem Engineer on Salt-Marsh Litter Decomposition ..... Xu Pan[1], Lijuan Cui[1], Ye Liu[2], Wei Li[1], Xiaodong Zhang[1], Andreas Prinzing[3], Johannes H. C. Cornelissen[4] 435

513.Ecosystem Biomass and Carbon Pools in an Age-Sequence Warm Temperate Pine Forests ..... Yali Song[1], Hairong Han[2], Fengfeng Kang[2], Xiaoqin Cheng[2] 436

514.The Attenuation Soil Respiration Response to Soil Warming in a Transitional Oak Forest in Central China Yi Wang[1], Yanchun Liu[2], Junwei Luan[1], Shirong Liu[1] 437

515.Effects of Management Practices on Soil Organic Carbon Pool and Greenhouse Gas Emission in Chinese Chestnut Plantations .....Yongfu Li438

516.Latitudinal Patterns of Soil Microbial Carbon Utilization Ability along the NSTEC .....Zhiwei Xu[1], Xinyu Zhang[2], Guirui Yu[2], Nianpeng He[2] 439

517.Estimation of the Punjab Urial (Ovis Vignei Punjabiensis) Population Using Non-Invasive Genetic Sampling Amna Arshad Bajwa, Saher Islam, Wasim Shehzad 441

518.Finding the Essential: Improving Conservation Monitoring Across ScalesCarlos .....António Guerra, Henrique Pereira 441

519.The Global Virome Project: A Network of Viral-Diversity Monitoring ..... Carlos Zambrana-Torrelio[1], Yasha Feferholtz[1], Brooke Watson[1], Erica Johnson[1], Kevin Olival[1], George Gao[2], Dennis Carroll[3], Peter Daszak[1] 442

520.The Relationship between Community Structure of Ground-Dwelling Vertebrates and Habitat Types in the Wanglang Natural Reserve ..... Cheng Li[1], Juan Li[2], Pingchun Liang[3], Junlian Zhao[3], Junda Wang[2], Pingjian Jiang[1] 443

521.Freshwater Biodiversity Observation Network .....Eren Turak[1], Aaike De Wever[2], Jeanne Nel[3]444

522.Progress toward the Construction of China Butterfly Diversity Monitoring Network .....Fangzhou Ma, Haigen Xu 445

523.Promoting the Biodiversity Monitoring of Birds in China through the Camera-Trapping Network: Status, Challenge and Outlook .....Fei Duan, Sheng Li 446

524.Population Ecology of Bufo Gargarians Minshanica in Zoige Wetland：Based on Artificial Cover .....Gang Wang[1], Cheng Li[1], Jun Wu[2], Jianping Jiang[1], Feng Xie[1] 446

525.China Biodiversity Observation Network: Overall Design, Field Protocols and Recent Achievements ..... Haigen Xu[1], Lei Cai[2], Peng Cui[1], Jun Wu[1], Fangzhou Ma[1], Jiaqi Li, Mingchang Cao[1], Yi Wu[3], Hui Ding[1], Zhi Wang[1] 447

526.A Preliminary Report on Wildlife Camera-Trapping Monitoring by Systematic Sampling in Kuankuoshou Nature Reserve, Guizhou Province .....Haijun SU, Guangrong Li, Mingming Zhang, Cansi Hu 449

527.GEO BON: Developing Biodiversity Monitoring for Global Conservation Targets .....Henrique Pereira 449

528.Amphibian Monitoring in Mountains around Sichuan Basin in Southwestern China .....Jianping Jiang, Cheng Li, Feng Xie, Bin Wang, Tian Zhao, Jiongyu Liu 450

529.An Overview of mammal Biodiversity Monitoring Network in China .....Jiaqi Li 450

530.Building an Interoperable Network of Biodiversity Observation Systems in support of Conservation and Sustainable Development .....Laetitia M. Navarro[1], Michael Gill[2] 451

531.Publishing open biodiversity data in ecology: standards and benefits ..... Laetitia Navarro[1], Kyle Braak[2], Andrea Hahn[2], Markus Döring[2], Dmitry Schigel[2] 452

532.Diversity and Monitoring of Butterfly along Danjiang River Basin in Shaanxi

(Province), China
.....Lijun Fang[1], Yujun Zhang[1], Changping Ding[2], Shaoli Mao[1], Xuan Lv[1] 453
533.Sea Turtle Hotspots and Their Connectivity in the Gulf of Mexico and the Caribbean .....
Ma. De los Ángeles Liceaga-Correa[1], Eduardo Cuevas[1], Abigail Uribe-Martínez[1], Vicente Guzmán-Hernández[2], Raúl de Jesús González-Díaz-Mirón[3] 454
534.The Species Richness, Community Structure, and 10-Year Changes of Large Mammals in Southwestern China: Are We Looking Towards a Brighter Future?
.....Sheng Li[1], Xiaoli Shen[2], William J. McShea[3], Dajun Wang[1], Keping Ma[2] 455
535.Vertically Alternative Distribution Research of Amphibians in Leigongshan Nature Reserve .....Shize Li, Wei Gang 456
536.Developing Biological Survey Design for Systematically Obtaining Habitat Map .....Takashina Nao 457
537.Amphibian Species Contribute Similarly to Taxonomic, but Not Functional and Phylogenetic Diversity .....Tian Zhao, Bin Wang, Cheng Li, Jianping Jiang 458
538.Status of Vascular Plant Species on Hainan Island
.....Xiaobo Yang, Chenyu Kai, Lidong Hai, Deng Qin 458
539.Design of Essential Biodiversity Variables Based on Genetic Information: Progresses and Perspectives .....Yun Cao[1], Dandan Yu[2], Haigen Xu[1] 459
540.The Saturniidae of Barro Colorado Island, Panama: A Model Taxon for Studying the Long-Term Effects of Climate Change? .....Yves Basset, Greg Lamarre 460
541.The First Step for Butterfly Monitoring in China: Overview of Jiangsu Butterfly Monitoring Scheme (2010-2016) .....Z.H Li 461
542.Discussion on the Important Role of "Water" in the Operation of Human Living Community .....Changwu Zou 462
543.Simulation of C&N Cross-media Metabolism in Municipal Solid Waste Treatment System and Study on Management approach for Ecosystem Health Optimization
.....Chen Chen, Zongguo Wen, Wenting Zhang 462
544.A Study on the Relationship between Living Vitality and Living Community Structure .....Chen Feng 463
545.An Integrated Specification for the Nexus of Water Pollution and Economic Growth in China: Panel Cointegration, Long-Run Causality and Environmental Kuznets Curve
.....Chen Zhang, Yuan Wang, Xiaodong Zhu 464
546.An Assessment of Status of Community-Based Forest Enterprises and Their Impact on Local Community .....Digambar Singh Dahal 465
547.Effects of Living Community on Sustainable Development of Agriculture
.....Fang Liu 466
548.Egfc Promotes Bone Fracture Healing .....Hongting Jin[1], Yalin Zou[2] 467
549.Creation of an Artificial Tropical Rainforest Community
.....Jianwei Tang[1], Yangyang Yang[2] 468

550.The Embodiment of Living Vitality of Rubber and Tea Plants in Different Living Community Structures ..... Li Liu 468
551.Assessment of Ethno-medicinal Plant diversity Of Una and Hamirpur District of Himachal Pradesh: A Case Study .....Ramchand Bhatti, Anand Narain Singh 469
552.The Protective Mechanism of Preconditioning of EGFC in Acute Middle Cerebral Artery Occlusion .....Ruihua Zhang 470
553.Living Community Structural Levels Determine the Expression of Biological Vitality ..... Shu An 471
554.Decoding the Theory of Living Community from Signaling Pathway Point of View .....Tianrui Xu 471
555.Health and Life of Community .....Yaling Zou[1], Wenpei Zhu[2] 471
556.Living-Community Theory and Sustainable Development .... Yaozong Feng[1], Tianrui Xu[2], Yalin Zou[3], Fang Liu[3], Shu An[4], Chen Feng[4] 472
557.Relationships between Disease Diversity in Livestock and the Ecology and Phylogeny of Wildlife Assemblages ..... Yingying Wang[1], Kevin Matson[2], Herbert Prins[2], Gerrit Gort[2], Zheng Y.X. Huang[1], Fred de Boer [2] 473
558.A Study on Technology of Living-Community Information for Removing Browning in Tissue Culture ..... Yulin Huang, Baoming Yang 474
559.Integrated Sustainable Development Evaluation Based on Human Well-Being Indices and Pressure Indices: A Case Study of the South China Sea Neighboring Countries .....Zheng Zang 474
560.Responses of Seven Hydrolytic Enzyme Activities to Fertilizations of Mixed Inorganic and Organic Nitrogen in Songnen Meadow Steppe, Northeastern China ..... Baoku Shi, Junmei Zhang, Chengliang Wang, Wei Sun476
561.Effects of Litter Manipulation and Topography on Soil Nitrogen Cycling in a Temperate Deciduous Forest .....Edith Bai, Weiwei Dai 477
562.The Impact of Arbuscular Mycorrhizal Fungi on the Abundance of Ammonia-Oxidizing Bacteria and Archaea under Nitrogen Addition ..... Fuwei Wang[1], Jinjin Tao[1], Zhen Li[1], Hui Guo[1], Yi Wang[2], Shuijin Hu[3] 477
563.The Frequency and Freezing Temperature of Freeze-Thaw Cycles Affect the Quantity, Composition and Stability of Soil Dissolved Organic Matter .....Haohao Wu[1], Xingkai Xu[1], Weiguo Cheng[2] 478
564.Relationship between Aboveground Biomass and Measures of Structure and Species Diversity in Quercus Mongolica-Dominated Forest, Mt. Jeombong .....Heon Mo Jeong, Inyoung Jang, Seungbum Hong 480
565.Study on Interspecific and Intraspecific Allelopathy of Pinus Thunbergii, Pinus Densiflora and Pinus Tabuliformis ..... Yuelin Hou, Yuan Gao 481
566.The Inventory, Dynamics, and Temperature Sensitivity of Soil Organic Carbon across Tibetan Permafrost Regions .....Jinzhi Ding, Yuanhe Yang 481
567.Relationship between Mangrove Produced Phenols and Fraction of Dissolved Iron

in Mangrove Soil ..... Ko Hinokidani, Yamato Sawada, Yasuhiro Nakanishi 482
568. Response and Feedback of Soil Carbon Emission to Global Warming in East Asian Region .....
Naishen Liang[1], Yiping Zhang[2], Kentaro Takagi[3], Sachinobu Ishida[4], Masahiro Takagi[5], Munemasa Teramoto[1], Jiye Zeng[1] 483
569. Influence of Land Use and Soil Properties on Soil Priming Effect: A Worldwide Analysis .....
Nazia Perveen[1], Fontaine Barot[2], Weixin Ding[3], Tanvir Shehzad[4], Fontaine Sébastien[5] 484
570. Effects of Partial Throughfall Exclusion on Litter Decomposition in Natural Evergreen Broad-Leaved Forest in the Rainy Area of Western China .....
Shixing Zhou, Congde Huang, Bohan Han, Yongxiang Xiao, Jiandong Tang, Yuanbin Xiang, Chao Luo 485
571. The Response of Soil Microbial Community and Soil Aggregate to New Carbon Input ..... Shuxia Jia, Bingjie Sun 486
572. Varying Effects of Six Gramineae and One Leguminous Grassland Species on Soil Organic Matter Cycling
..... Tanvir Shahzad[1], Sabir Hussain[1], Faisal Mahmood[1], Sebastien Fontaine[2] 487
573. Spatio-Temporal Patterns of Soil Organic Carbon and pH in Relation to Environmental Factors in the Black Soil Region of Northeastern China .....
..... Yang Ou 488
574. Manipulated Throughfall Reduction Increased Soil Labile Organic Carbon Fractions by Reducing Aggregate Stability in a Southern Subtropical Pinus Massoniana Plantation ..... Yujing Yang[1], Shirong Liu[2], Hui Wang[2] 489
575. Shifts in Boreal Peatland Structure and Function in Response to Press and Pulse Disturbances ..... Catherine M Dieleman, Merritt R Turetsky 491
576. Alternative Stable States in the Boreal Biome: How Many Are There?
..... Chi Xu 492
577. Interactive Effects of Water Table Draw down and Warming on Vegetation and Carbon in Boreal Peatlands .....
Eeva-Stiina Tuittila[1], Raija Laiho[2], Lauri Mehtätalo[1], Petra Straková[3], Kari Minkkinen[3], Timo Penttilä[2], Hannu Fritze[2] 492
578. Permafrost Thaw and Its Consequences for Ecosystem Functioning in the Arctic .
Ellen Dorrepaal[1], Gesche Blume-Werry[1], Sylvain Monteux[1], Eveline Krab[1], Konstantin Gavazov[1], Maria Väisänen[1], Laurenz Teuber[1], Carolina Olid Garcia[1], Margareta Johansson[2], Frida Keuper[3], James Weedon[4] 493
579. Lowering of Water Table on Boreal Peatlands Makes Forestry Use Possible– with Some Future Challenges! .. Harri T. Vasander[1], Meeri Pearson[2], Raija Laiho[2] 494
580. Can Early Warning Signals Be Used to Anticipate Tipping Points in Heterogeneous (Peat) Landscapes? .....
Jelmer Nijp[1], Arnaud Temme[2], George van Voorn[3], Ryan Teuling[1], Merel Soons[4],

Jakob Wallinga[1], Lammert Kooistra[1] 495

581. Temperature and Vascular Plants Affect Soil Organic Carbon in Alpine Peatlands Juul Limpens[1], Lilli Zeh[2], Theresa M Igel[2], Judith Schellekens[3], Luca Bragazza[4], Karsten Kalbitz[2] 496

582. Interactions between Plant Species Composition, Nitrogen and Weather Conditions and Its Consequences for Greenhouse Gas Exchange in a Boreal Mire ..... Mats Nilsson[1], Magdalena Wiedermann[2], Lars Ericson[3] 497

583. Shrub - Tree Interactions in Boreal and Subarctic Ecosystems: Paving the Way for Forest Advance? ..... Milena Holmgren, Juul Limpens 498

584. The Role of Roots in Tundra Vegetation Change with Climate Warming ..... Peng Wang[1], Monique Heijmans[2], Liesje Mommer[2], Juul Limpens[2], Jasper van Ruijven[2], Frank Berendse[2], Ake Nauta[2] 498

585. The Harvesting and Its Natural Recovery of a Subalpine Oak Quercus Aquifolioides Forest: Driving Forces in Restructuring Soil Microbiota and Understory Vegetation on the Eastern Tibetan Plateau ..... Qinli Xiong[1], Lin Zhang[2], Kaiwen Pan[2], Xingjin He[3], Yang Xiao[4], Xiaoming Sun[2], Xiaogang Wu[2], OluanyaAbiodun Olatunji[2], Hui Sun[3] 499

586. Nitrogen Status and Major N Sources of Three Plants in Permafrost Peatlands of Great Hing'an Mountains, Northeastern China ..... Rui Li[1], Xueyan Liu[1], Xianwei Wang[2], Xinchao Sun[1], Chaochen Hu[1] 500

587. Responses of vegetation to climate change in the permafrost peatlands of Great Hing'an Mountain, Northeast China ..... Xianwei Wang, Changchun Song, Wenwen Tan, Shifu Xi, Xinhou Zhang 501

588. Linking Plant Community Composition and Soil C Pool, N Availability and Enzyme Activity in Boreal Peatland of Northeast China ..... Yanyu Song, Fuxi Shi, Jiusheng Ren 502

589. Transformation of the Slovak Karst Land Cover (Slovak Karst) ..... Alena Gessert, Veronika Straková, Zdenko Hochmuth 503

590. Tourism in Karst Ecosystem: Economic Development and Sustainability of Lijiang River Tourism ..... Azim Mallik[1], Yuefeng Yao[2] 504

591. Integrated Emergy and Economic Evaluation of Three Typical Rocky Desertification Control Modes in Karst Areas of Guizhou Province, China ..... Fang Cheng[1], Hongfang Lu[1], Hai Ren[1], Lang Zhou[1], Linhai Zhang[1], Jie Li[2], Xingjiang Lu[3], Dewu Huang[4], Dan Zhao[5] 504

592. Tradeoff Mechanism for Soil Conservation and Water Retention in a Karst Peak-Cluster Depression Basin in Southwest China Jiangbo Gao, Wenjuan Hou, Huan Wang 505

593. Some Features of Limestone Soil in Karst Ecosystem ..... Jianhua Cao, Yang Hui, Zhu Tongbing, Huang Fen, Bai Bing 506

594. Mapping Karst Rocky Desertification in Yunnan Fault Basin, southwest China

Using Landsat 8 Images .....Jie Pei, Li Wang, Ni Huang, Zheng Niu 507
595.The difference of Vegetation Index Distribution Characteristic in Karst Region and Non-karst Region of Southwest China .....
.....Jienan Tu, Liqiang Tong, Dandan Zhang 508
596.Improving Ecosystem Services in a Karst Region, southwest China .....
.....Kelin Wang 508
597.The utilization of HCO3- by Chlorella and its influence on the carbon sink in a karst reservoir .....Jianhong Li, Tao Zhang, Junbing Pu 509
598.Isotope Hydrogeochemistry of a Typical Subterranean Stream in Southwest Karst Areas, China .....Tao Zhang 509
599.The Potential Role of Extreme Climate Events in Control of Karst Rocky Desertification .....Xiangfei Yue 510
600.Comprehensive monitoring of carbon flux on an abandoned karst ecosystem in southwest China .....Yanwei Wang 511
601.Soil Available Nutrient Deficiencies Limit the Recovery of Degraded Karst Vegetation Yuguo Liu[1], Changcheng Liu[2], Long Wan[3], Ming Cui[1], Jinxing Zhou[3], Ke Guo[2] 512
602.Rooting Depth Determined with Caves and DNA, and Implicating Water Use under Karst Terrain ..... Yuqing Huang 512
603.Use of Unmanned Aerial Vehicles for Oblique Imaging Karst Rocky Desertification Assessment in Southwest of China Zhiming Zhang[1], Hu Sun[2] 513
604.Ecosystem Service Values Experienced Great Changes in the Rocky Desertification Area under the ICRDK .....Jinxing Zhou, Hongyan Guo 514
605.Tree Crowns Scale Differently Across Latitudes
.....Can Lai, Tommaso Anfodillo, Sudip Pandey, Amos Maritan 516
606.Wood Functional Anatomy Predicts Tropical Rainforest Tree Growth Better Than Other Functional Traits
.....Deborah Mattos Guimaraes Apgaua, David Tng, Susan GW Laurance 516
607.Tropical Trees Adapt in Functional Leaf-Stem Mass Balance, but Risk Collapse Due to Functional Unbalance under Drought and Warming ..... Frank Sterck 517
608.Environmental Drivers of Canopy Height Variability in the Tropical Dry Forest in Coastal Oaxaca, southern Mexico
.....Jorge A. Meave[1], Silvia H. Salas-Morales[2], Edgar J. Gónzalez[1]518
609.Comparative Phenology and Growth between Lianas and Trees in Two Neo-Tropical Forests .....
Jose A Medina[1], Karel Haan[1], Stefan Schnitzer[2], S J Wright[3], Frans Bongers[1], Frank Sterck[1] 519
610.Canopy Transpiration of Woody Angiosperms in Tropical Forests with a Seasonal Drought Is Regulated by Plant Hydraulics and Trunk Capacitance
..... Kunfang Cao[1], Yajun Chen[2], Zafar Siddiq[2] 520
611.Comparing Canopy Trees and Lianas in Tropical Forest - Understanding

Performance from Allocation, Physiology and Anatomy to Whole Plants
.....Lan Zhang[1], Yajun Chen[2], Frans Bongers[1], Keping Ma[3], Frank Sterck[1] 521
612.Effects of light on the growth and death of different branching units in crowns of Sakhalin Spruce .....Lei Chen, Akihiro Sumida 522
613.Systemic Signaling in the Photosynthetic Induction Phase of Calamagrostis Angustifolia Wetland on the Sanjiang Plain .....Nan Xu 522
614.Application of UAV-Borne LiDAR in Deriving 3D Structures of Forest
.....Qinghua Guo[1], Tianyu Hu[1], Yanjun Su[2], Guangcai Xu[1] 523
615.Effects of Fire on Understory Birds in Montane Forest, North-Eastern Tanzania
.....Rajabu Mapunda 524
616.Scaling of Individual Tree Crowns Drives Overall Forest Structure
.....Tommaso Anfodillo[1], Giacomo Sellan[2], Amos Maritan[1] 525
617.Aboveground Biomass Production of a Meadow Steppe in Northeast China Is More Sensitive to Spring Drought than Summer Drought
.....Bo Meng, Shangzhi Zhong, Hua Chai, Shuixiu Li, Wei Sun 526
618.Drought Responses of Two Genetically Differentiated Telopea Speciosissima Populations under Elevated [CO2] and Temperature
.....Guomin Huang[1], Paul Rymer[2], Honglang Duan[1], David Tissue[2] 527
619.Understanding Plant Water Use Efficiency: Environmental Dependence of Leaf-Internal CO2 Concentration in Theory, Data and Simulation .....
Han Wang[1], Iain Colin Prentice[2], Trevor Keenan[3], Tyler Davis[4], Ian Wright[5], William Cornwell[6], Bradley Evans[7], Changhui Peng[8] 528
620.Does the Intensity of Drought Matter During the Drought-Induced Mortality of Tree Seedlings in Subtropical China?
.....Honglang Duan[1], Yue Xu[2], Juxiu Liu[2], Houbao Fan[1] 528
621.Drought Resistance Advantage of Endophyte-Infected over Endophyte-Free Leymus Chinensis Is Reduced by Arbuscular Mycorrhizal Fungi Inoculation .....
Hui Liu, Wei Chen, Rihan Wu, Man Wu, Yong Zhou, Anzhi Ren, Yubao Gao 529
622.Responses of Populus Euphratica on River Drying in the Lower Reaches of Peacock River，Xijiang
.....Jiazhen Liu, Yongjin Chen, Shuhui Jing, Ruoang Feng, Ganlin Mao 531
623.Revisiting the Soil-Plant-Atmosphere Continuum (SPAC) .....John Grace 531
624.Drought Stress Release Increased Growth Rate but Did Not Affect Levels of Storage Carbohydrates in Scots Pine Trees
Leonie Schönbeck, Arthur Gessler, Andreas Rigling, Marcus Schaub, Mai-He Li 532
625.Response of Tropical Forests to Drought: Current Progress and Future Perspectives
.....
Oliver Binks[1], Lucy Rowland[2], Antonio Lola da Costa[3], Yadvinder Malhi[4], Maurizio Mencuccini[5], David Galbraith[6], Alex Oliveira[3], Andrew Pullen[7], Chris Doughty[8], Daniel Metcalf[9], Steel Silva Vasconcelos[10], Leandro Ferreira[11], Rafael

Oliveira[12], Patrick Meir[1], John Grace[13] 533

626.Effects of Manipulated Drought and Re-Watering on Photosynthesis in C3 and C4 Grasses in a Meadow Steppe of Northeast China .....Shangzhi Zhong, Yueqiao Xu, Wei Sun 534

627.A Comparative Research on Ecological Adaptability between Alien and Native Woody Plants in Warm Temperate Region ....Xiao Liu, Qiang Li, Ning Wang, Ning Du 535

628.Competitive Interaction between Mixed-Planting Maize Cultivars Enhanced Yield and Water-Use Efficiency in a Semi-Arid Region .....Xiaolin Wang 536

629.Grass Diversity Increased under Drought in a Savanna Ecosystem, southwest China ..... Yanqiang Jin, Jing Li, Chenggang Liu, Yuntong Liu, Yiping Zhang, Liqing Sha, Aiguo Chen, Peiguang Li 537

630.Combined Stress of High Temperature and Drought on Photosynthesis and Antioxidant Enzyme System of Poplar Seedlings ....Yongbo Wu, Yanhong Zhang 537

631.Contrasting Effects of Different Drought Strength on Soil Respiration in Savanna Ecosystem, southwest of China ..... Yuntong Liu, Jing Li, Yanqiang Jin, Yiping Zhang, Qinghai Song, Wenjun Zhou, Xiang Zhang, Aiguo Chen, Peiguang Li 538

632.Can Kentucky's Wetland Restorations Meet Functional Goals? .....Brian C Reeder 539

633.The Relationship of the Light Environment and the Forest Floor Vegetation between Monolayered and Multilayered Forests .... Chiho Shimada[1], Keiko Nagashima[1], Kennichi Takada[2], Kazuhiro Tanaka[1] 539

634.In Search of Candidate Species for Phytostabilization of Copper Mine Tailings Dams in Zambia .....Emma Sandell Festin 540

635.Evaluation on the Effect of 50 Years' Forest in Main Tree Species of Taishan Mountain .....Xu Hanchi, Yuan Gao 541

636.Vertical Gradient Characteristics of Plant Diversity and NPP in Tuoliang National Nature Reserve, China .....Hongzhu Liang, Jintong Liu, Xiaorong Li 542

637.Survivorship Characteristics of Phytoplankton Assembles in Ballast Water: An Implication for Ballast Water Management .....Huixian Wu, Chen Chen, Qiong Wang, Lin Yuan, Liang Liu, Junzeng Xue 543

638.Vertical Distribution Patterns of Soil Microbial Communities along Soil Profile in the Loess Plateau .....Jian Zhang[1], Ming Xu[1], Xiao Zou[1], Jizheng He[2] 544

639.Fish restoration in China .....Jianbo Luo[1], Xuehua Liu[2], Yingren Li[2] 544

640.Analysis on the Spatial Pattern of Small-Scale Ant Community in Greater Xing'an Mountain ..... Jing Wang[1], Dandan Liu[2], Yongjie Huang[1], Huiren Li[3], Fangrui Liu[3], Xueshuang Liu[3], Lizhong Wang[3], Yinghua Lin[1] 545

641.A Comparison of Microbial Communities of Natural Seawater and Ballast Water during a Land-Based Experiment by High-Throughput Sequencing ..... Junzeng Xue, Huixian Wu, Yuhao Shao, Qiong Wang, Lin Yuan, Liang Liu 545
642.Ecosystem Resilience Characteristics and Mechanism of Closed Mines in the Loess Plateau ..... JX Mi, SL Zhang, HP Hou, LM Zhang 546
643.Early Stage Vegetation Recovery in Forests Damaged by Oak Wilt Disease and Deer Browsing: Effects of Deer-Proof Fencing and Clear-Cutting .....Keiko Nagashima, Tomotaka Shimomura, Kazuhiro Tanaka 547
644.Using the Plant Biodiversity and Nitrogen Application for Increasing the Pastoral Ecosystem Function in Inner Mongolia .....Keyu Bai[1], Xuejuan Tang[1], Devra Jarvis[2], Yunhui Yang[1], Lijun Xu[1] 548
645.Spatial Characteristics of Cyclobalanopsis in China .....Lichuan Qiu, Tao Liu, Hong Chang, Xiaoyuan Wu 549
646.Evaluation on Ecological Security in the Soft Rock Ecological Fragile Area of Ordos Plateau, China .....Lingran Meng, Jihong Dong 550
647.Response of Soil Properties and Soil Community in Riparian Wetland to Different Water Level and Land Utilization along the Songhua River of Northeast China ..... Lixia Wang, Yang Ou 550
648.Leaving Your Ancestral Neighborhood Makes You Leave Your Ancestral Ecosystem Functioning: Decomposition of Oak Litter .....Pan Xu[1], Andreas Prinzing[2] 551
649.Patterns of Plant Beta-Diversity along Longitude and Highway Interference in the Alashan Desert of Inner Mongolia, China Shuai Li, Xiaoxia Gao, Shikui Dong 552
650.The Recovery of Plant Diversity in Secondary Forests in China: A Meta-Analysis .....Xiaofei Liu, Xuehua Liu 552
651.Diversity and influencing factors on spontaneous plants distribution in urban park at different spatial scales .....Xiaopeng Li, Fan Zhao, Sijia Wu, Li Dong 553
652.Vegetation Restoration Associated with Soil Variability in Open-Pit Mine Areas in the Yunnan Province, southwest China .....Xiaoyun Hou, Shiliang Liu, Fangyan Cheng, Yueqiu Zhang 554
653.Comparing the Effects of Species Diversity and Genetic Diversity of Stipa Grandis of Steppe on Community Productivity in Microcosms ..... Xue Yang[1], Yaobing Qu[1], Man Wu[1], Jinlong Wang[2], Zhulin Wang[2], Siqi Wang[2], Nianxi Zhao[1], Yubao Gao[1] 555
654.Plant and Animal Diversity Responding to Different Forest Restoration Schemes in the Qinling Mountains, China ..... Xuehua Liu[1], Xiaoming Shao[2], Xiaofei Liu[3], Xiaodong Jia[3], Wanlong Sun[3], Qiong Cai[4], Yun Zhu[4], Baisuo He[5], Xiangbo He[6] 556
655.Effects of Different Desertification Grassland Restoration Approaches on Plant Diversity .....Yange Wang, Xinchao Liu, Hailian Sun 557

656.Scale-Dependent Effects of Landscape Pattern on Plant Diversity in Hunshandak Sandland ..... Yu Peng 558
657.Alien Aquatic Plants in Ponds of a Large European City: From Diagnose to Risk Assessment Aurelie Boissezon, Beat Oertli, Véronique Rosset, Christiane Ilg 559
658.Effects of Soil Nutrient Heterogeneity on the Foraging Behaviour of Invasive and Native Plants .....Baoming Chen, Jinquan Su, Shaolin Peng 560
659.Restoring to What? Challenges of Assembling Native-Dominated Plant Assemblages in Degraded, Drought and Fire-Prone California Landscapes ..... Carla M. Marie D'Antonio, Stephanie Ma, Edith Allen, Michala Phillips, Madeline Nolan 560
660.The Effect of Elevated Temperatures on the Interspecies Competition Pattern between Phragmites Australis and Spartina Alterniflora in the Salt Marsh of the Yangtze Estuary, China ..... Chao Zhang, Kaiyun Wang 561
661.Effect of Stellera Chamaejasme L. On Plant Community and Soil Spatial Heterogeneity in a Typical Steppe of Inner Mongolia .....Chen Chen, Fu Xing, Ying Gao 562
662.Community Structure and Composition of Early Spring Herbs in Response to Ambrosia Trifida L. .....Chenyang Xue 563
663.Interaction of Invasive Plant and Rhizosphere Microbiota ..... Daolin Du, Wei Fu, Ning Wang, Yulong Huang, Jun Wu, Fang Pang, Shanshan Qi, Zhicong Dai 564
664.Coexistence via Coevolution Driven by Chemical Competition between Invasive and Native Plants ..... Fangfang Huang[1], Richard Lankau[2], Shaolin Peng[3] 564
665.Effects of Environmental Variables on the Distribution of Spartina Alterniflora at Different Spatial Scales .....Haibo Gong, Huiyu Liu, Lihe Li 565
666.Biological Control of the Invasive Weed Xanthium Italicum Morretii .....Hua Shao 566
667.Establishment of the Invasive Praxelis Clematidea Increases the Chemically Recalcitrant Rather Than Labile Soil Organic Carbon in a Tropical Savanna ..... Hui Wei[1], Jialin Xu[1], Guoming Quan[2], Jiaen Zhang[1], Zhong Qin[1] 567
668.Selection Effect and the Maintenance of Community Productivity and Exotic Resistance ..... Huixuan Liao, Shaolin Peng 568
669.The Study on Ecophysiological Responses by Light Quantity of Ambrosia Trifida L., Korean Invasive Species. ..... Jae-hoon Park, Young-Han You 569
670.Effects of Submergence Level and Fluctuation Frequency on the Invasive Riparian Plant Alternanthera Philoxeroides .....Jian Liu, Haijie Zhang, Renqing Wang, Xiao Wang 569
671.Predicting Alien Herb Invasion with Machine Learning Models: Biogeographical and Life-History Traits Both Matter ..... Leiyi Chen 570
672.Regulation of Reestablishment of Invasive Alien Species Senecio Madagascariensis Poir. Using Bamboo Chips and Other Control Treatments

.....Michiro Fujihara 571
673.Affection of Invasive Plant (Ambrosia Trifida) on the Performance of an Endangered Plant, Polygonatum Stenophyllum in Korea
.....Young-Han You[1], Sanghun Lee[2], EuiJoo Kim[1] 572
674.Spatial Distribution of Spartina Alterniflora in the Coastal Areas of China
.....Mingyue Liu, Weidong Man, Mingming Jia, Zongming Wang 572
675.Life History Differences Influence the Impact of a Novel Predator on Two Sympatric Prey .....Noelikanto Ramamonjisoa 573
676.Exploring Exotic Plant Invasions on a Biogeographic Scale
.....Robert Pal[1], Huixuan Liao[2], David U Nagy[3] 574
677.Effects of Clonal Integration of Alternanthera Philoxeroides in Fungi Pathogen Resistance ..... Shanshan Qi, Qi Chen, Youye Song, Yuanyuan Lu, 575
678.Invasive Spartina Alterniflora Influences Benthic Food Web by Different Pathways in Different Subhabitats .....Sikai Wang[1], Jihua Wu[2] 576
679.Integration of Biological Control and Ecohydrological Assessment in Facilitating Restoration of Riparian Ecosystems Invaded by Tamarix ..... Tom L Dudley 577
680.Ecological Traits of Invasive Plant Hypochaeris Radicata L. - How It Became Successful Invader in Jeju Island. .....Uhram Song 578
681.A New Strategy for Controlling Invasive Weeds:Selectng Valuable Legume Forbs to Defeat Them
..... Weihua Li, Chenbing Jiang, Cui Wang, Jiayi Wang, Changlian Peng 578
682.Prefer Plants and Parasitic Site of Invasive Cuscuta Pentagona Engelm
. Young Ho Jung, Jaekeun Lee, Kyu Tae Cho, Seung Yun Lee, Young Ho You 579
683.Effect of Cotyledon Damage on the Early Growth of Sophora Alopecuroides L. Seedling .....Zhao Yu, Liu Ying, Shangtian Cui 580
684.Interspecies Correlation between Native and Invasive Plants under the Artificial Wetland Forests in the Dianchi Lake Areas, SW China
..... Zhaolu Wu, Yuan Lei, Liangzao Wu 581
685.The Interaction between Solidago Canadensis and Root-Associated Bacteria .....
Zhicong Dai, Ning Wang, Wei Fu, Fang Pang, Jun Wu, Shanshan Qi, Daolin Du 582
686.Effects and Environmental Fate of the Application of Gallant (Haloxyfop) to Control Spartina Alterniflora in the Yangtze Estuary, China
.....Zhiyuan Zhao, Lin Yuan, Wei Li, Hui Li, Xiaojing Zhu 583
687.Bacteria Diversity in Rhizosphere and Surrounding Bulk Soil of Senecio Vulgaris L. (Asteracea) .....Zhongsai Tian, Lin Xu, Liang Feng, Dandan Cheng 584
688.Developing Priorities for Karst Conservation .....Alice Hughes 585
689.Disturbance-Responsive Traits in Assigning Conservation Status of Plants: Gesneriaceae of China Fang Wen[1], Azim Mallik[2], Longfei Fu[1], Yigang Wei[1] 585
690.Fate of Malaysian Karst and Similar Ecosystems in the Changing Climate:

Indicator Models from Smaller Arachnid Orders, Pseudoscorpiones and Harvestmen .....
Faszly Rahim[1] Nurul Aiman Aqilah Danny-Hamidon[1], Adam Suffi Nordin[1], Abdul Aziz Md Yunus[1], Syafina Ilyana Suzyrman[1], Muhammad Taqiuddin Mazlan[1], Muhammad Faris Adly Hamidon[2] 586

691.Effect of Different Specifications of Cuttings and Seasons on Rooting of C. Migao Cuttings .....Jia Li, Jiming Liu, Mingming Deng, Lixia Li, Xiaolong Huang 587

692.Study on Population Characteristics of Artificial Poplar in Linzhi .Jingli Xue 588

693.Genetic Diversity Detected with ISSR Marker in Cinnamomum migao Populations .....Lili Xia, Liuji Ming, Huangxiao Long, Dengming Ming, Li Jia 588

694.Response on Biomass and Leaf Microstructure of Blumea Balsamifera L. DC. Seedling to Water Stress
.....Mingming Deng[1], Jiming Liu[2], Xiaolong Huang[3], Jia Li[4], Lixia Li[5] 589

695.Leaf Anatomical Structure and Photosynthetic Physiology Responses of Akebia trifoliatas under Drought Stress .....
Zhenghua Wu [1], Lifei Yu[1], Lingbin Yan [1], Chen Zhou[2], Jiali Li[1], Xian Leng[1], Wuying Yi[1], Guojun Cai[1], Jianli Zhang[1], Fajian Pi[1], Lixin Shu[1] 590

696.The Growth and Physiological Characteristics of Cinnamomum Migao Seedling with Different Phosphorus Conditions
.....Xiaolong Huang, Jiming Liu, Lixia Li, Mingming Deng, Jia Li 591

697.A Novel Approach for Biodiversity Pattern Research
.....Xueqin Deng, Yaqi Zhao, Zhaohua Lu, Mengli Zhang 591

698.Decline of Soil Depth and Water Availability Restrict the Stomatal and Vein Development of Two Mixed Grasses in Karst System
.....Yajie Zhao, Zhou Li, Jing Zhang, Haiyan Song, Jinchun Liu 592

699.Nutrient Cycling in Substratevegetation Systems of Rock Slopes
.....Yang Hao 593

700.A Preliminary Study on Species Diversity of Sygara Mountain Moss Plant
..... Yulong Shi 594

701.Effects of Tourism Disturbance on Soil Hydrological and Physical Characteristics of Subtropical Mountain Meadow
..... Zhi Li, Dekui Niu, Xiaomin Guo, Wenyuan Zhang, Dongnan Hu 595

702.Restoration Potential of Bamboo Plantations under Rehabilitated Coalmine Spoil in a Dry Tropical Region of India: An Implication for Ecological Restoration
..... Anand Narain Singh, Ram Chand Bhatti 596

703.Addressing the Threats to Mammals in Tea Garden Agroforestry System in Assam, India: A Case Study
.....Awadhesh Kumar, Yashmita Nitin Ulman, Madhu Bala Sharma 597

704.Assessing the Ecological and Environmental Security Risk in Xinjiang Production and Construction Corps Based on the PSR Sustainability Framework
.....Dongzhi Liu, Zhaoyang Wang, Guang Yang, Xinlin He, Junfeng Li 598

705.Land-use Changes Cause Rapid Loss of Seagrass Resources: Case in Guangxi Province, China
.....Guanglong Qiu[1], Zhinan Su[2], Hangqing Fan[1], Meiqiu Wei[2], Meng Li[3] 599
706.Benefit Assessment on Soil and Water Conservation and Ecological Restoration on the Loess Plateau of China .....
Guobin Liu[1], Zhouping Shangguan[1], Wenyi Yao[2], Qinke Yang[3], Guoliang Wang[4], Xiaohu Dang[5] 600
707.Using Landsat Images to Quantify Different Human Threats to the Shuangtai Estuary Ramsar Site, China .....Hao Yu, Bai Zhang, Zongming Wang 600
708.Geochemistry of Potentially Toxic Trace Elements in Soils of Mining Area: A Case Study from Zangezur Copper and Molybdenum Combine, Armenia .....
Hrant Khachatryan[2], Karen Ghazaryan[1], Hasmik Movsesyan[1], Naira Ghazaryan[1] 601
709.Assessing Anthropogenic Impact on Deep Water Methane Seep Ecosystem: The South China Sea Case .....Hsuan-Wien Chen[1], Zheyu Lin[2], Hsing-Juh Lin[2] 602
710.Effect of Transgenic Insect Resistant Gene Poplar 741 on Arthropod Community Structure and Dynamics .....Jie Liu 603
711.Impact of Shifting Cultivation on Biodiversity and Carbon Stock in North-East India .....Joli Borah, David Edwards, Karl Evans 604
712.Water Quality Analyzing at Lake Maninjau, Indonesia
.....Luki Subehi, Fachmijany Sulawesty, Tri Suryono, Sulastri Sulastri 605
713.Long-Term Changes in Water Quality in Lake Biwa with Special Reference to Organic Matter Dynamics, Microbial Ecology and Diversity .....
Shin-ichi Nakano[1], Kazunide Hayakawa[2], Yoshikuni Hodoki[1], Yusuke Okazaki[1], Indranil Mukherjee[1], Shohei Fujinaga[1] 606
714.Determining the Impact of Free-Ranging Livestock on Wild Ungulates in Wanglang National Nature Reserve, SW China
..... Weichi Li[1], Xiaoli Shen[2], Chunping Luo[3], Sheng Li[1] 607
715.Effect of Soybean Cultivation on Soil Collembola Community in Sanjiang Plain Wetland, Northeast China .....Yongjing Dou, Donghui Wu, Liang Chang 608
716.High-mountain Lakes and Karstic Aquifers – Two Contrasting and Endangered Ecosystems from Slovenia ..... Anton BRANCELJ 610
717.Population Genetics Structure of Daphnia Galeata
..... Boping Hanq[1], Lei Xu[1], Luc De Meester[2] 611
718.Distribution, Leaf Diversity and Quality of a Chinese Endangered Aquatic Vegetable Brasenia Schreberi
..Changfang Zhou, Chun Xie Wenlin Wang, Yu Zhou, Kemu Zhu, Zixuan Xu 612
719.How Do Fish Communities Respond to Anthropogenic Stressors in Lakes Along the Eastern Route of China's South-to-North Water Diversion Project (SNWDP)?
.....Chuanbo Guo, Yushun Chen, Songguang Xie 613
720.Periodic Wind Mixing Enhances Cyanobacterial Dominance in Large, Shallow,

Eutrophic Lake Taihu, China .....Hai Xu 613
721.Pattern of Relationship between Feeding Structure and Prey Selectivity in Rotifers: Applicability of Functional Feeding Group (FFG) of Zooplankton Community and Diversity . Hye-Ji Oh[1], Jeong Hyun-Gi[2], Chang Kwang-Hyeon[1], Jo Hyunbin[3] 614
722.The Impacts of Saline Mine Drainage from the Talvivaara Mining Complex on Cladoceran and Diatom Communities in Lake KivijäRvi
..... Jaakko Johannes Leppänen, Jan Weckström, Atte Korhola 615
723.Temperature Adaption of Daphnia Galeata Based on Life Table Experiments
..... Jiexiang Zhang, PAJK Franja, Qiuqi Lin, Dumont Henri, Boping Han 616
724.A General Modelling Framework for Metapopulation Dynamics in Size-structured Riverine Networks .....Jinbao Liao, Zhichao Xu 617
725.Spatial and Temporal Distribution of Phytoplankton during the Transition Levels between River- and Lake-type in Lake Poyang: A Yangtze-connected Lake
.....Jinfu Liu, Yuwei Chen 617
726.iTRAQ-based Proteomics Analysis Revealed the Embryo Teratogenic Mechanism of Cyanobacteria Exudates on an Endangered Native Fish
..... Jinmei Zi[1], Xiaoai Wang[2], Xuexiu Chang[1] 618
727.Disturbance-induced Phytoplankton Regime Shifts and Recovery of Cyanobacteria Dominance in Two Subtropical Reservoirs
..... Jun Yang, Jun R. Yang, Alain Isabwe, Hong Lv 619
728.Influences of Environmental Factors on Macroinvertebrate Assemblages: Difference between Mountain and Lowland Ecoregions, Wei River, China
.....Kai Chen[1], Shengli Li[1], Lizhu Wang[2], Beixin Wang[1] 620
729.Low Dose of Yttrium Enhanced Tolerance of Submerged Macrophyte Potamogeton Crispus L. To Heavy Metal Nickel .....Kai Lyu 621
730.Effect of Water Level Fluctuations on Variations of Anabaena Abundance and Its Heterocyst in Poyang Lake
..... Kuimei Qian[1], Lingyan Qi[2], Xia Liu[2], Yuwei Chen[2] 621
731.Warming and Oligotrophication Cause Shifts in Freshwater Phytoplankton Communities Laura Verbeek, Andrea Gall, Maren Striebel, Helmut Hillebrand 622
732.Formulating a List of Sites of Waterbird Conservation Significance to Contribute to China's Ecological Protection Red Line ..Lei Cao[2], Lu Zhang[1], Xin Wang[1] 623
733.Large-Scale Patterns in Microbial Biodiversity in Lakes and Reservoirs across China .....Lemian Liu[1], Lihua Ju[1], Jun Yang[1], David M. Wilkinson[2] 623
734.Spatial and temporal distributions of bacterioplankton in a large plateau lake of southwest China
.....Li Chen , Yineng Jiang, Tao Zhang, Ningjing Bai, Guangjie Chen 624
735.Spatial Variation in Fish Otolith Elemental Fingerprints: Implications for Connectivity Assessment and Sustainable Management Lifei Wang[1], Xuefeng Wang[2] 625
736.Comparison of Two Summer Phytoplankton Metacommunities in Low Land and

High Land Lakes: The Roles of Environmental and Spatial Elements .....Lijuan Xiao 626

737.Source-Based Fish Trophic Guilds, Energy Consumption and Indicators along a Large Subtropical River .....
Lin Wang, Sai Wang, Jinpeng Tang, Shengxing Long, Shuailei Liu, Jingjing Fan, Yang Yang 627

738.De Novo Assembly of Transcriptomes Reveals Diverse Responses of Mixotrophic Ochromonas to Toxin-producing and Toxin-free Microcystis .....Lu Zhang, Zhou Yang 628

739.Association between Temporal and Spatial Beta Diversity in Phytoplankton .....
Min Zhang, Feizhou Chen, Xiaoli Shi, Zhen Yang, Yongjiu Cai, Jinlei Yu, Fanxiang Kong 629

740.Congruence of Fish, Macroinvertebrate and Diatom in Streams at Xishuangbanna, Upper Mekong River Basin, China .....Ning Ding, Beixin Wang 630

741.Seasonal Fluctuations of Phytoplankton Distribution and Environmental Drivers in an Arsenic-Contaminated Large Lake of Southwest China .....
Ningjing Bai, Chen Li, Yineng Jiang, Tao Zhang, Guangjie Chen, Jiangshuang Tao 631

742.Mechanisms of Coexistence in Species Rich Tadpole Communities in Madagascar .....Noelikanto Ramamonjisoa[1], Yosihiro Natuhara[2] 632

743.Changes in Inundation Area and Water Quality Drive Declines in Waterbird Abundance and Diversity in Yangtze River Floodplain Wetlands .....
Qiang Jia[1], Xin Wang[1], Yong Zhang[2], Lei Cao[1], Qinglong Wu[3], Zhandong Sun[3], Anthony Fox[4] 633

744.Environmental DNA Reflects the Spatial and Temporal Distribution of Common Prawn, Palaemon Paucidens, in Lake Biwa .....
Qianqian Wu[1], Toshiyuki Ishikawa[2], Satsuki Tsuji[3], Hiroki Yamanaka[3], Toshifumi Minamoto[1] 633

745.Trophodynamics of Autochthonous and Allochthonous Carbon in a Large Cross-Border River (China): Implications from Resource Availability and Hydrological Regime .....Qiong Zhou, Yuanyuan Zheng 635

746.Niche Partitioning of Aquatic Invertebrates on Leaf Litters .....Rhak Yeon Choi, Ho Choi, Jae Geun Kim 635

747.Spatio-temporal Patterns in the Relationship between Productivity and Diatom Diversity in Fuxian Lake, SW China .....Rui Li, Guangjie Chen, Yineng Jiang, Li Chen, WenGang Kang 636

748.Effects of Fish Culture on Water Quality and Wild Fish Communities in Urban Lakes Rui Wang, Yingxue Zhang, Wentong Xia, Xiao Qu, Chuanbo Guo, Yushun Chen 637

749.Spatio-temporal Patterns of Fish Diversity in the Three Gorges Reservoir and Implications for Ecosystem-based Fisheries Management .....

Shaowen Ye[1], Yuxi Lian[1], Sibao Chen[1], Chuansong Liao[1], Xiujiang Zhao[2], Jiashou Liu[1], Zhongjie Li[1] 638

750.Novel Thoughts on Algal Inhibition Potential of Hydrophyte Allelopathy in Shallow Eutrophic Chaohu Lake .....
Shengpeng Zuo, Shoubiao Zhou, Jianchun Xie, Liangtao Ye, Xiaofeng Jiang, Wenxiu Hong 638

751.Locations in Dendritic Stream Network and Environmental Gradients Determine the Meta-community Structures and Types of Macroinvertebrate and Diatom .....Siwen He, Beixin Wang 639

752.Biogeography and Environmental Structuring of Phytoplankton in Subtropical Alpine Lakes of Southwest China
Tao Zhang, Li Chen, Guangjie Chen, Yineng Jiang, Ningjing Bai, Yuanyuan Liu 640

753.Community Architecture and Competitive Hierarchies in Lagoon Ecosystems: Body Size Implications .....Vojsava Savina Gjoni, Alberto Basset 641

754.Do Hatchery-reared Mandarin Fish Siniperca Chuatsi (Basilewsky) Affect the Growth and Feeding of Wild Congeners?
.....Wei Li, Tanglin Zhang, Zhongjie Li, Jiashou Liu, Shaowen Ye 642

755.Impacts of Invaders: Detrital Processing, Climate Change and Community Impacts ....William N. W. Fincham[1], Helen E. Roy[2], Lee E. Brown[1], Alison M. Dunn[1] 643

756.Using Resting Eggs in Sediments to Track the Changes of Zooplankton Biodiversity .....Xiaodong Jiang 644

757.Diversity in Phytoplankton Communities: A Field Test of the Intermediate Disturbance Hypothesis .....Xiaofei Liu, Xuehua Liu, Lin Wu 645

758.Biogeography and Genetic Diversity of an Endemic Copepod Species (Phyllodiaptomus Tunguidus) in China .....
Xiaoli Zhang, Huiming Li, Lei Xu, Shaolin Xu, Qiuqi Lin, Dumont Henri, BoPing Han 646

759.Spatial Distribution and Beta Diversity of Phytoplankton in Tibetan Plateau Lakes: Nestedness or Replacement? .....
Yang Yang[1], Ren Hu[1], Qiuqi Lin[1], Juzhi Hou[2], Yongqin Liu[2], Bo-Ping Han[1] 646

760.Study on Morphological Variation among Fourteen Population of the Culter Species .....Ying Xiong, Jiashou Liu, Tanglin Zhang, Zhongjie Li 647

761.Watershed Ecology of Eriocheir Sinensis Stock Enhancement Management: Based on the Migration Routes .....Yu Gao 648

762.Costs and Trade-offs of Grazer-induced Defenses in Scenedesmus .....Yuan Huang, Xuexia Zhu, Zhou Yang 649

763.Comparison of Diatom Diversity and Community Changes in Response to Multiple Stressors in Two Large Plateau Lakes of Southwest China .....Yuanyuan Liu, Guangjie Chen 650

764.Differential Bioaccumulation of Essential Versus Nonessential Heavy Metals in the

Food Web of Three Gorges Reservoir (China): Implication from Spatiotemporal Pattern, Affecting Factor and Health Risk Assessment
..... Yuanyuan Zheng, Qiong Zhou 651

765. Responses of Population Dynamics and Life Table of the Rotifer Brachionus Plicatilis Exposed to Phaeocystis Globosa in Pure and Mixed Diets with Green Algae
..... Yufei Sun, Zhou Yang 652

766. Allelopathic Effects of Submerged Macrophytes on Phytoplankton
..... Yunni Gao, Jing Dong, Qinqin Fu 652

767. Effects of Hydrological Differences on Macrobenthic Fauna in the Three Gorges Reservoir Based on Biomass Size-spectra
..... Zhenbing Yang[1], Bo Zeng[2], Feng Lin[2], Yuanyuan Liu[2] 653

768. Fishing and Life History Traits Effects on the Spatial Mean-variance Relationship in Fish Chih-hao Hsieh[1], Ting-Chun Kuo[1], Sandip Mandal[2], Atsushi Yamauchi[3] 655

769. Effects of Synchrony on Taylor's Law .....
Daniel Reuman[1], Lei Zhao[1], Lawrence Sheppard[1], Philip Chris Reid[2], Joel E Cohen[3] 655

770. When Can We Use Taylor's Law as an Early Warning Signal for Critical Transition?
..... Jiang Jiang 656

771. Power-Law Size Distribution Predicts Mean-Variance Scaling of Individual Aboveground Mass of Woody Plants in a Tropic Forest
.....Jiangshan Lai[1], Xu Meng[2] 657

772. Chagas Disease Vector Control and Taylor's Law
.....Joel E. Cohen[1,] Ricardo E. Gürtler[2] 657

773. Proximate Determinants of Empirical Taylor's Law Slopes
..... Lei Zhao[1], Lawrence Sheppard[1], Philip Reid[2], Daniel Reuman[1] 658

774. Mean and Variance of Catch per Unit Effort of Fishes Collected Along Texas Coast
.....Masami Fujiwara 659

775. A New Target Function for Parameter Estimates Based on the Taylor's Power Law
.....Peijian Shi 659

776. Applying Taylor's Power Law to Yield Data in a Long-Term Experiment Reveals Decreasing Crop Yield Stability ..... Thomas Felix Döring[1], Moritz Reckling[2] 660

777. Can Taylor's Power Law Extensions Act as Potential Indicators for Diagnosing Human Microbiome Associated Diseases? Zhanshan (Sam) Ma[1], Lianwei Li[1], Lin Dai[2] 661

778. Regeneration of Oak in Central Himalaya: A Hope for Thriving Future
.....Abhishek Kumar Verma, Satish Chandra Garkoti 662

779. Using Long-term Demographic Data to Gain Understanding on Species Distribution and to Find High Fitness Areas .....

780. Carolina Ureta, Carlos Martorell, Ángela P. Cuervo-Robayo, María Del Carmen

andujano, Enrique Martínez-Meyer 662
781.Phenological Mismatch Undermines Mimetic Relationships in Insect Populations ..... Christopher Hassall, Jac Billington 663
782.The Hidden Impact of Biological Invasions in Ecology and Evolution: a General Model of Hybridization
..... Claudio Quilodran[1], Juan Montoya[2], Mathias Currat[2], Tim Coulson[1] 664
783.Coupling Chronosequences and Short-Term Surveys to Understand Long-term Environmental Change in Population Dynamics
..... Edgar J. González, Jorge A. Meave 665
784.Migration plasticity in ungulates: will it translate in resilience to global change?
..... Francesca Cagnacci[1], Wibke Peters[2], Mark Hebblewhite[3] 666
785.Trait-mediated Demography: How Trait Changes Relate to the Dynamics of Species Abundances
..... Jason I Griffiths[1], Frank Pennekamp[2], Owen L Petchey[2], Dylan Z Childs[1] 666
786.Carbon or Nutrient Limitation Can Not Explain Formation of Latitudinal Distribution Range Limit of Woody Species Jianfeng Liu, Jingpin Lei, Zeping Jiang 667
787.No Response to Climate Change Induces Potential Risk of Mistiming for Russian Barnacle Geese ..... Jie Wei, Yali Si 668
788.Effects of Climatic Oscillations on the Phylogeography of Moustache Toads (Anura: Megophryidae: Leptobrachium) in Southern China
..... Jun Li, Shichao Wei, Mengling Hu, Zhenhua Luo, Mian Zhao, Hua Wu 669
789.Water Depth Affects Reproductive Allocation and Reproductive Allometry in the Submerged Macrophyte Vallisneria natans
..... Lei Li[1], kuan jia Chen[2], ping zhi Song[2] 670
790.The Significance of Using a Video Recording Method in Assessing Crab Populations: Outlooks from a Tropical Region
..... Nur Hannah Abd Rahim[1], Shuhaida Shuib[2], Nurul Salmi Abdul Latip[2] 671
791.Spider Distribution and Influence of Some Ecological Factors
..... Ogonna Daniel Nwankwo[1], Sylvanus Chima Ewuim[2] 672
792.Effects of Human-mediated Mutualism Disruption on the Population Dynamics of a Tropical Tree ..... Orou G Gaoue 673
793.Evolutionary Rescue ..... Quanguo Zhang 673
794.Effects of Field Biases on Our Understanding of Animal and Plant Demography Worldwide ..... Rob Salguero-Gomez 674
795.Stochastic Population Dynamics: Methodological Insights from a Long-Lived Perennial Herb ..... Satu Ramula[1], Natalie Z Kerr[2], Elizabeth E Crone[2] 675
796.University of TurkuSynergistic Effects of Temperature Variation and Density on the Life History Traits of Aedes Aegypti
..... Soumyajit Banerjee, Gautam Aditya, Goutam Kumar Saha 676
797.Utilizing Population Patterns and Behavioural Ecology in Assessing Uca

Population in a Tropical Mangrove
.....Syakirah Aina Mohd Rashid, Shuhaida Shuib, Khairun Yahya 677
798.Theoretical Analysis of Population Projection in Random Matrix Models
.....Takenori Takada 678
799.The Distribution Pattern Shift of the Yangtze Finless Porpoise in the Yangtze River between 2006 and 2012: Implications for Reserve Managemen
.....Zhigang Mei, Mao Chen, Kexiong Wang, Ding Wang 679
800.Stability of a Two-species System Having Both Intra- and Inter-Specific Non-Monotonic Functions .....Chuan Yan, Zhibin Zhang 681
801.The Convexity of Density Dependence and Regulation of Large Herbivore Populations .....Guiming Wang 681
802.Cultivated Walnut Trees Showed Earlier but Not Final Advantage over Its Wild Relatives in Competing for Seed Dispersers
.....Hongmao Zhang[1], Wei Chu, Zhibin Zhang[2] 682
803.The Effects of Variability on Species Interactions and Single Species Dynamics
..... Marcel Holyoak[1], William C Wetzel[2] 683
804.Evaluating the Reversibility of Abrupt State Shifts: An Experimental Approach in a Coral Reef Community .....
Russell J Schmitt, Sally J Holbrook, Thomas C Adam, Andrew J Brooks, Samantha L Davis 683
805.Non-linear Dynamics of Coral Reef Communities: An Experimental Approach to Assessing Tipping Points
....Sally J. Holbrook, Russell J. Schmitt, Thomas C. Adam, Andrew J. Brooks 684
806.Feasibility of Integrated Multi-trophic Aquaculture (IMTA) in Ge Heyan Reservoir, China .....Ting Yuan 685
807.The Ecological Thresholds of Salt-marsh Vegetation in the Yangtze Estuary, China
.....Wei Li, Lin Yuan, Hui Li, Zhiyuan Zhao, Xiaojing Zhu 686
808.The Interaction Effect in Linear Models .....Xinhai Li 687
809.How Does Ecological Non-Monotonicity Attribute to the High Uncertainty and Complexity of Ecosystems? .....Zhibin Zhang, Chuan Yan 687
810.Biodiversity and Species Interactions in the Forest Canopy: Achievements and Horizons .....Akihiro Nakamura[1], Louise A. Ashton[2] 689
811.Plant Richness and the Environment in the PáRamo Ecoregion
.....Gwendolyn Peyre[1], Henrik Balslev[2], Xavier Font[3], Juan Sebastián Tello[4] 689
812.Nitrogen Demanding and Fixation Abilities Lead to the Spatial Distribution Pattern and Neighbor Species Richness of Legumes
Han Xu[1], Matteo Detto[2], Suqin Fang[3], Yangpeng Li[1], Yide Li[1], Fangliang He[3]690
813.Elevation Is a Stronger Driver of Plant Taxonomic, Phylogenetic, and Functional Diversities than Asymmetric Competition and Succession in Hainan Tropical Forests
..... Huafeng Wang[1], Yu Zhang[2], Cynthia Ross Friedman[3], Xiaobo Yang[1] 691

814.Functional Traits of Epiphytic Bryophytes and Their Responses to Simulated N Deposition .....Liang Song, Xi Chen, Xian-Meng Shi 691
815.Relative Importance of Tree Diversity, Size and Competition in the Short and Long Term Growth in a Primary Tropical Forest .....Martin Svatek et al. 693
816.A Study of Cryptocarya (Lauraceae) in Southeast Asia Based on Morphology and Phylogeny ...Meng Zhang, Tetsukazu Yahara, Keiko Mase, Shuichiro Tagane 693
817.Complex Interactions between Host Plant and Multiple Fungal Guilds in a Subtropical Forest .....Pu Jia[1], Marc Cadotte[2], Wensheng Shu[1] 694
818.Variation in Woody Plant Functional Traits of the Karst Hills, Guilin, Southwest China .....Shichu Liang, Runhong Liu, Yong Jiang 695
819.Non-dominant Tree Species Are Indispensable for Conserving Epiphytic Lichens in Subtropical Forests .....Su Li 696
820.Recovery of Logged-over and Dioxin Affected Forest in Dong Nai Biosphere Reserve, Vietnam .....Tran Lam Dong 696
821.Exploring the Functional Trait Relationships Across Intraspecific, Interspecific and Community Levels in Tropical Cloud Forests .....
Wenxing Long[1], Yadong Zhou[2], Brandon Schamp[3], Runguo Zang[4], Xiaobo Yang[5], Menghui Xiong[1] 697
822.Dormancy and Germination of Firmiana Danxiaensis
.....Xiaoying Luo[1], Qianmei Zhang[2], Hai Ren[2], Guohua Ma[2] 698
823.Responses of Plant Functional Traits and Soil Environmental Factors to Slope Aspect in Karst Hills of Guilin, China
.....Yong Jiang[1], Yuan fang Pan[1], Xing bin Chen[2], Run hong Liu[1] 699
824.Flexibility in Daily Time Budget of Assamese Macaques Inhabiting Karst Forest of Guangxi, China .....Zhonghao Huang[1], Qihai Zhou[2] 700
825.From Inferior to Superior: Plasticity in Root Vertical Distribution of a Bunch Grass in Arid Vegetation Patches ..... Bin Chen 701
826.Soil Characteristics and Zonation of Phragmites Latifolius and Phragmites Australis Communities at Tidal Marsh .....Bo Eun Nam, Jae Geun Kim 702
827.Effects of Nitrogen Deposition on the Biomass of Stipa Krylovii and Allium Polyrhizum .....
Fang Li, Yantao Song, Yunna Wu, Guangwei Huo, Fengjie Zhang, Xiaoguang Wang 703
828.Richness of Bacteria and Hazard Quotients of Human Health of Various Heavy Metals in Soil ..... Han Cui 703
829.Spatial Variation in Food Web Structure of Floodplain Wetlands in Lake Poyang .....Huan Zhang[1], Xiubo Yu[1], Yifei Jia[1], Jun Xu[2] 704
830.Differences in Physicochemical Soil Characteristics of Phragmites Japonica and Phragmites Australis Habitats .....Hyunjun Park, Boeun Nam, Jaegeun Kim 705
831.Predation Risk Affects Growth and Reproduction of an Invasive Snail Pomacea Canaliculata and Its Lethal Effect Depends on Prey Size

.....Jiaen Zhang[1], Jing Guo[1], Pablo Rafael Martín[2], Chunxia Zhang[1] 705
832.The Different Responses of Microcystis Aeruginosa and Scenedesmus Quadricauda to Antibiotics Pollutants
.....Jingjing Li, Jingjing Chao, Jingmei Zi, Xuexiu Chang 706
833.Effects of Salt Stress, Storaged Time, Seed Mass on Seed Germination Rate and Germination Vigor of Leymus Chinensis
.....Junfeng Wang, Yunna Ao, Yujie Shi, Mengxing Liu, Donghao Zhou 707
834.Peinobiomes: Ecological and Evolutionary Community Assembly under High Nutrient Stress .....Ladislav Mucina 708
835.Comparing Plant Species Diversity of Forests at the 1910 and 1977-78 Eruption Sites on Mount Usu .....Lea Végh, Shiro Tsuyuzaki 709
836.Temperature Constraints on High Elevation Bee Communities in Response to Functional Trait Diversity .....Lindsie M. McCabe, Neil S. Cobb 709
837.Experience of Inundation or Drought Alters the Responses of Plants to Subsequent Water Conditions
.....Shu Wang, Ragan M. Callaway, Dao-Wei Zhou, Jacob Weiner 710
838.Trophic and Non-trophic Connections and Their Role in the Stability of Food Webs: An Antarctic Example.....
Vanesa Salinas[1], Georgina Cordone[2], Tomás Marina[2], Santiago Doyle[1], Leonardo Ariel Saravia[1], Fernando Roberto Momo[1] 711
839.Competition Ability of Dominant Species under Grazing Intensity Gradient in the Inner Mongolia Typical Steppe: A Review .....Wenjing Ma, Jin Li 712
840.胡杨群落空间分布格局与土壤盐分关系的研究 .....Xiangyu Ma 713
841.How Small Habitats Environment Changes Can Alter the Phenotypic Plasticity of Grasshopper? .....Xinghu Qin[1], Oscar Eduardo Gaggiotti[2], Zehua Zhang[3] 713
842.Physiological Response of Two Xerophytic Plants (Artemisia Ordosica and Salix Psammophila) to Prolonged Summer Drought .....Yajuan Wu 714
843.Plant Community Shifts under Soil Acidification in a Semiarid Grassland on the Loess Plateau .....
Yanan Wei[1], Yi Zheng[1], Li Zhen[1], Meng Shu[1], Fuwei Wang[1], Yi Wang[2], Shujing Hu[3], Hui Guo[1] 715
844.A Rough Detection on Extracellular Metabolome of Cyanobacteria Microcystis Aeruginosa ..... Ying Pei, Xuexiu Chang 716
845.The Relationship between Regional Industrial Organizing Levels and Ecological Economic Efficiency .....Baolong Han, Zhiyun Ouyang, Wenjing Wang 717
846.External Factors on Product End-Of-Life Strategies beyond the Product Itself
.....Bin Lu[1], Xiaolong Song[2], Jianxin Yang[1] 717
847.Effectiveness of Cross-boundary Environmental Policy in Beijing-Tianjin-Hebei Region .....Chang Yu 718
848.Taking the Stock of Industrial Ecologists ..... Gang Liu 719
849.Life Cycle Assessment of Polyester-Cotton Product ..Hong Kang, Yun Zhang 719

850.Challenges and Opportunity of Life Cycle Analysis in a Fast Economy Transition ..... Jianxin Yang 720
851.CO2 Emission Patterns of Chinese Urban Household . Jingru Liu, Ning Ding 721
852."The Tragedy of the Planet"? – Characterizing Climate Change as a Tragedy of the Commons Type of Challenge ..... Kasper Dalgas Rasmussen[1], Anders Winther Mortensen[1], Henrik Wenzel[2], Gang Liu[3] 722
853.Understanding Industrial Ecosystem Complexity .....Lei Shi, Yang Li 723
854.An Assessment Method of Material Flow Analysis of Urban Household .....Li Yan, Jing Ru Liu 723
855.Exploring the Potential of Urban Planning to Reduce Household GHG Emissions—a Case Study of Xiamen City ..... Lilai Xu, Shenghui Cui, Jianxiong Tang 724
856.China's Regional Ammonia Emissions: Characteristics, Interregional Transfer and Mitigation Policies .....Miaohong Yang[1], Shenghui Cui[2] 725
857.Environmental Impacts of Shifting to Healthy Diet: Case of China ...Pan He[1], Giovanni Baiocchi[1], Klaus Hubacek[1], Kuishuang Feng[1], Yang Yu[2] 726
858.Integrating Input–Output Analysis Carbon Footprint: The past, Present, and Future ..... Qifeng Zhang, Kai Fang 726
859.Determinants of GHG Emissions from China's Electricity Industry .....Sai Liang[1], Shen Qu[2], Ming Xu[2] 727
860.How the Transitions in Iron and Steel and Construction Material Industry Impact on CO^2 Emissions in China? Analysis from an Inter-Sectoral Linked Perspective .....Shangwei Liu, Xin Tian 728
861.Assessment of Promoting Industrial Symbiosis for Chemical Industrial Park: A Case Study of Puyang .....Shanshan Wang, Zhili Wu, Ruiqin Zhang 729
862.Phosphorus Sustainability of Food Consumption in China's Urbanization ..... Su Xu, Shenghui Cui, Wei Huang 730
863.A Material Flow Analysis of Distributed Photovoltaic Application in Beijing with a Bottom-up Approach.....Tao Wang, Xin Tong 731
864.Changing Nitrogen Cascade in Urban Food System under Rapid Urbanization .....Wei Huang, Bing Gao, Shenghui Cui, Yanmin Li 732
865.Linking Industrial Ecology and Urban Ecology to Make Cities More Sustainable .....Weiqiang Chen 733
866.Progress in Policies and Research of Life Cycle Assessment for Green Development in China ... Wenjie Liao[1], Hongtao Wang[1], Li Zhang[2], Xiaoqian An[1], Xiaohong Zhang[3] 734
867.Co-evolution of Policies of Circular Economy and Eco-industrial Parks in China .....Wenting Jiao 735
868.Study on Suitable Scale for Sustainable Development by Coupling Energy Science

and Economic Science with Material Scarcity as Pivot
.....Xiao Li, Zhenggang Liu 736
869.Carbon Footprint of Residential Buildings in Xiamen City：A Household Survey Based Approach .....Xiaomei Yan, Shenghui Cui 737
870.The Evolution of Industrial Symbiosis Reexamined in the Network of Industry Space .....Yang Li, Lei Shi 738
871.Industrial Diversity and Its Relationship with Industrial Metabolism in China – a Preliminary Result .....Ye Liu, Lei Shi 739
872.Research on Key Material Flow Analysis on Chinese Typical Industrial Park — a Case Study of Tianjin Economic-Technological Development Area
.....Yu Qi, Tan Zhu 740
873.Research and Application of Ountain Area Highway Landscape Aesthetics
.....Zhaoming Wang, Shegang Shao, Yi Shen 741
874.Ramet Size Determines Benefits of Clonal Integration in Homogeneous Environments: Evidence from a N-Based Model ..... Bicheng Dong 742
875.The Effects of Clonal Division of Labour and Hormonal Promotion on the Invasion of Alien Clonal Plants
.....Daolin Du, Wenhua You, Shanshan Qi, Zhicong Dai, Daoguo Xi 742
876.The Conservation Dilemma of Sterile Clonal Species: Examples from South-Eastern Australia ..... Elizabeth James 743
877.Adaptive Plasticity of the Riparian Plant Polygonum Hydropiper to Flooding
.....Fangli Luo 744
878.Accumulated Parental Effects on Clonal Offspring Performance: Experimental and Simulation Evidence .....Feihai Yu[1], Bicheng Dong[2] 745
879.Habitat Selection and DNA Methylation of Clonal Plants
..... Fu Xing, Ying Gao, Chen Chen, Zhuo Li 746
880.Root-Sprouting After Disturbance: Characteristics and Ecological Significance
.....Jana Martinkova, Jitka Klimesova 747
881.Differential Effects of Ammonium and Nitrate on Growth Performance of Stoloniferous Herb Glechomalongituba Suffering from Heterogeneous Cd Stress
.....Jinsong Chen 748
882.Clonal Growth in the Deep-Time Fossil Record: Evidence from a 410-Million-Year Lycopsid Plant and Its Roles in the Earth System .....Jinzhuang Xue 749
883.Do Clonal Growth Organs Differ by Their Ecology?
.....Jitka Klimesova, Tomas Herben 749
884.Poa Alpina, a Seed- and Bulbil- Producing Apomictic Plant with High Adaptive Potential .....Juerg Stoecklin 750
885.Spatial Expansion Strategy of Leymus Chinensis in Response to Grazing and Saline-Alkali Stress in Songnen Grassland .....
Jun Liu[1], Luhao Qu[1], Long Bai[1], Jiyun Yang[1], Yue Huang[2], Zhifeng Xun[1], Jiale Yan[1], Zongting Zhang[3] 751

886.Spatial Distribution of Dwarf Bamboo Shoots in an Abandoned Coppice Forest at Early Successional Stages .....Jun-Ichirou Suzuki 752
887.Environmental and Phylogenetic Analysis of Distribution Pattern of Clonal Plants in China .....Ming Dong[1], Duo Ye[2] 753
888.Clonal Integration and Plant Invasions: The Case of Carpobrotus Edulis .....Sergio Roiloa 753
889.The Effects of Climate Change on Growth Response and Ecological Niche Breadth of Hibiscus Hamabo Endangered Plant .....Soo In Lee, Kyu Tae Cho, Young Han You 754
890.Effects of Clonal Growth on Plant Sexual Reproduction .....Wanjin Liao 755
891.The Clonality and Invasiveness of Solidago Canadensis under Experimental Warming and Nitrogen Addition .....Weiming He 756
892.Divergent C: N Stoichiometry between Diploid and Tetraploid Stoloniferous Plants of Fragaria across China .....Yaobin Song1, Shuang-Li Tang2, Jun-Min Li3, Ming Dong1 756
893.Latrine-Site Use of Small-Clawed Otters (Aonyx Cinereus) in Tropical Rice Fields: Effects of Landscape and Local Environmental Factors .....Aadrean Aadrean, Nisikawa Usio 758
894.Interdisciplinary Collaboration in a Landscape Ecological Approach to the Development of an Urban Ecological Network for a Compact City .....Abdul Rahim Hamid, Puay Yok Tan 759
895.Farmers' Contributions to the Conservation of Tree Diversity in the Groundnut Basin, Senegal .....Antoine Sambou 760
896.The Geographic Patterns of Alpine Flora in China in Relate to the Environmental and Spatial Factors.....Caifang Luo, Zehao Shen 760
897.Using Population Genomics to Assess the Biodiversity Dynamics of an Endemic Ant Radiation in Fiji Clive T Darwell, Alexander Mikheyev, Evan P Ecoonomo 761
898.Impacts of Urban Expansion on Biodiversity Ecosystem Services in Jinghong County, China, from the 1970s to 2030 .....Fangyan Cheng, Shiliang Liu, Xiaoyun Hou, Shikui Dong, Yueqiu Zhang 762
899.The Effect of Grazing Intensities on Red-Footed Falcon Invertebrate Prey Abundance ...Fehervari Peter, Saliga Rebeka, Puskás Gellért, Aniko Kovacs-Hostyánszki 763
900.Limits to Biodiversity Conservation in Alpine Tundra Are Rooted in Theoretical Landscape Ecology .....George P Malanson[1], Daniel B Fagre[2], Dale L Zimmerman[1] 764
901.Spatial and Temporal Linkage of Stream-Riparian Food Webs by Seasonal Migration of Aquatic Insects .....Hiromi Uno 765
902.Conservation beyond Protected Areas: Case Study for Sarawak, Malaysia .....Hon Jason765

903.Historical Continuous Cover Dynamics of Sagebrush Steppe in the Western United States from 1984–2015: Pattern, Drivers, and Impacts .....Hua Shi 766
904.Spatial Variation of Biodiversity in the Bailongjiang Watershed of Southern Gansu Based on InVEST Model and Landscape Pattern Index .....
Jie Gong, Yuhcu Xie, Lingling Zhang, Jinxi Zhang, Xuecheng Ma, Dongqing Liu 767
905.Population Changes of Bufo Bufo Gargarizans in the Wetland of Nearby Seomjin River in Korea and Its Habitats Conservation
.....Jin Seok Jeong, Sun Ho No, Young Han You 768
906.The Impact of Future Urban Expansion on Natural Reserves in China
..... Jingyi Yang, Jun Yang 768
907.Landscape Changes in Coastal Areas after the 2011 Tsunami and Subsequent Restoration Construction .....
Keitarou Hara[1], Yi Zhao[2], Hidetake Hirayama[1], Noritoshi Kamagata[3], Yunqing Li[4], Mizuki Tomita[1], Yoshihiko Hirabuki[5]769
908.Effects of Vegetation Management to Exterminate Invasive Alien Species Rudbeckia Laciniata in the Semi-Natural Grassland on the Kirigamine Heights, Japan
..... Kumiko Okubo（Yoshida）, Taichi Watanabe, Shunsuke Fujima 770
909.Plant Functional Traits and Species Distribution at Snowfields and Periglacial Patterned Ground at Glacier National Park, Montana, USA
..... Martha Elizabeth Apple, Macy K Ricketts 771
910.An Ecological Effectiveness of Different Forest Management Regimes in Bangladesh-A Solution for Biodiversity Conservation .....
Mohammad Belal Uddin[1], Manue[l], Jonas Steinbauer[2], Carl Beierkuhnlein[2], Anke Jentsch[2] 772
911.Effects of Urban Land Cover Types and Characteristics on Avian Species Richness and Occupancy in a Subtropical Urbanized Landscape in Asia .....
Myung-Bok Lee, Indika Peabotuwage, Hao Gu, Wenjing Zhou, Eben Goodale 773
912.Effect of Slope Gradient and Vegetation Cover on Sediment Yielding Characteristics of the Riparian Slope .....Qinghe Zhao, Zihao Cao 774
913.Plant Diversity of Indian Hot Desert Landscape: Ecosystem Abridging Livelihood Support and Sustainability .....Ramkrishna Bhatt**,** Dipankar Saha 775
914.Dead Wood as a Keystone Structure for Conservation of Forest Biodiversity
.....Sebastian Seibold[1], Roland Brandl[2], Lenore Fahrig[3], Jörg Müller[4] 776
915.Landscape Change and Multi-Scale Landscape Connectivity Alteration Associated with Dam Construction .....Shiliang Liu, Fangyan Cheng, Deng Li 777
916.Fire Affects a Globally Endangered Bird in Differrent Ways across Its Range
..... Simon J Verdon**,** Simon J Watson, Michael F Clarke 778

917.Biodiversity, Exotic Invasion, and Landscape Settings ..... SongLin Fei 778
918.A Study on the Characteristics of Breeding Ecology of Oriental Scops Owl (Otus sunia) in South Korea ..... Sun-ho No, Young-han You 779
919.Pedodiversity and Its Controlling Factors in Mountainous Area: A Case Study of Taihang Mountain, China ..... Tonggang Fu, Jintong Liu, Lipu Han, Jianjia Zhu, Hongzhu Liang, Hui Gao, Xiaorong Li 780
920.A GIS-based Mapping and Estimation the Current Forest Landscape State and Dynamics ..... Vera Ryzhkova 780
921.Changes in Habitat Suitability for Cervidae in the Lesser Xing'an Mountains, Northeastern China ..... Wen Wu, Yuehui Li, Yuanman Hu 781
922.Thermal Landscape Pattern Change in Response to Land Use Changes of Beijing within the Six-Ringed Road in Recent Twenty Years ..... Xinling Wu**,** Dan Meng, Siyao Yang 782
923.Regional Development Optimization Strategy for Ecological Sustainability – a Case Study in the Southwest China ..... Xue Wu[1]**,** Shiliang Liu[1], Fangyan Cheng[1], Xiaoyun Hou[1], Yueqiu Zhang[1], Shikui Dong[1], Guohua Liu[2] 783
924.Spatial-Temporal Dynamics of Upland Meadow Coverage and Its Response to Climatic Change ..... Xueling Zhang[1]**,** Ying Zhang[2], Dekui Niu[2], Xiaofeng Ye[3], Wenyuan Zhang[4], Zhi Li[4], Zhenzhen Li[4], Xiaomin Guo[4] 784
925.Assessment on the Gross Primary Productivity of National Forest Nature Reserves in China Yao Li[1], Yao Zhang[2], Yuanwei Qin[2], Jinwei Dong[2], Jun Ma[1], Xiangming Xiao[2] 785
926.An Assessment of Mammalian Diversity in Agroforestry Systems of Assam and Implications for Management ..... Yashmita Nitin Ulman, Madhubala Sharma, Awadhesh Kumar 786
927.Effects of Human Settlements on Waterbird Abundance at a Ramsar Site in the Yangtze River Floodplain ..... Yong Zhang[1]**,** Lei Cao[2], Anthony David Fox[3], Qiang Jia[4], Changhu Lu[1], Herbert H.T. Prins[5], Willem Fred de Boer[5] 787
928.Biodiversity Assessment in Abandoned Settlements with Indicator Plant Species ..... Yoshiko Kobayashi[1]**,** Keita Fukasawa[1], Akio Asahara[2], Akio Takenaka[1] 788
929.Precipitation Regulate the Family Age-Temperature Relationship with Chinese Evergreen Broadleaved Woody Plant Species ..... Yue Xu[1], Zehao Shen[2], Runguo Zang[1], Youxu Jiang[1] 789
930.Identity and Specificity of the Mycorrhizal Fungi Associated with Platanthera Chlorantha Cust. Ex Rchb. ..... Yuling Jiang, Bo Qu 790

931.Linking Terrestrial Biodiversity and Historical Land-Use Transitions
..... Yuta Kobayashi, Kei-ichi Okada, Akira S Mori 791
932.Habitat Selection of European Nightjar Caprimulgus Europaeus in the Managed Temperate Coniferous Woodlands
.....Zbigniew Kasprzykowski[1], Monika Broniszewska[2], Michał Polakowski[3] 791
933.The Potential Spatial Distribution Patterns and Effects of Invasive Species Tithonia Diversifolia in Yunnan Province, southwest of China
..... Zhiming Zhang, Yupeng Geng 792
934.Biodiversity and the Functioning of Managed Forests .....Akira S Mori 793
935.An Assessment of Mammalian Diversity in Agroforestry Systems of Assam and Implications for Management
.....Awadhesh Kumar, Yashmita Nitin Ulman, Madhu Bala Sharma 793
936.Diurnal Variation in Dung Beetle Community Dynamics in Two Tropical Habitats: Is Competition a Driving Force? .....G Asha, Palatty Allesh Sinu 795
937.Engineering Improved Ecosystem Function Using Plant Traits and Environmental Heterogeneity. .....
Jeremy T Lundholm[1], Amy Heim[1], Nick Williams[2], Garland Xie[3], J Scott MacIvor[3] 796
938.Biodiversity Holds Promise for the Restoration of Polluted Ecosystems: A First Field Experiment .....Jintian Li, Wensheng Shu 797
939.Agricultural Land-Use Legacies and Habitat Restoration Shape Diversity and Composition of Plants and Soil Microbes .....Nash Turley[1]**,** Lars A. Brudvig[2] 797
940.Assesing the Efficacy of Manipulative Nutrient Addition Experiments on Mollusc Assemblages in a Tropical Mangrove Ecosystem
.....Nur Lisa Azlan, Shuhaida Shuib, Nurul Salmi Abdul Latip 798
941.Evaluation of Diversity of Butterflies and Their Host Plants along an Urban-Rural Landscape: A Spatial Scale Approach towards Conservation
.....Samrat Chakraborty, Debalina Ghosal, Sanjay Sarkar, Soumyajit Banerjee 799
942.Phylogenetic Diversity and the Function of Green Roofs .....
Scott MacIvor, Carlos A Arnillas, Nicholas Sookhan, Garland Xie, Marc W Cadotte 800
943.Ants Indicate Brunt of Urbanization ..... T.P. Rajesh, Palatty Allesh Sinu 801
944.Indicators for Monitoring of Landscape Planning in Germany
..... Ulrich Walz[1], Wolfgang Wende[2], Christian Stein[2] 802
945.Bird Community Disassembly after Habitat Fragmentatio .....
Xingfeng Si[1]**,** Marc Cadotte[2], Di Zeng[1], Andres Baselga[3], Yuhao Zhao[1], Jiaqi Li[1], Yiru Wu[1], Siyu Wang[4], Ping Ding[1] 803
946.Minute Ecological Variations across Endau-Riau Region Informs Ease of Unity for Termite Diversity and Pest Management Albeit Oil Palm Intensification .....
Faszly Rahim[1], Abdul Aziz Md Yunus[1], Nurul Aiman Aqilah Danny-Hamidon[1], Muhammad Asyraff Yusoff[1], Andi Saputra[2], Izfa Riza Hazmi[2] 805

947.Varying Agricultural Intensity Causes Structural Differences in Interspecific Networks of Ground Beetles (Coleoptera: Carabidae) ..... Gabor Pozsgai, Li-Lin Chen, Minsheng You 806

948.Bayesian Networks for the Analysis of Ecosystem Services Trade-Offs in Silvopastoral Systems ..... Graciela Mónica Rusch[2], Carlos Pérez Carmona[1], Mayécor Diouf[3], Cristina Armas[4], Joseph Saturnin Diémé[5], Dioumacor Fall[3], Francisco I. Pugnaire[4], David N. Barton[2] 807

949.Spatio-Temporal Patterns of Cropland in Korean Peninsula during 1990~2015 ..... Hao Yu 808

950.Biodiversity in Homogeneous Agricultural Landscapes. What Actions Can Be Taken to Improve Its Conservation? ..... Jose Alberto Gobbi[1], Marcelo Wilson[1], Maria Sasal[1], Emanuel Gabiud[1], Silvana Sione[2], Noelia Calamari[1], Jose Oszust[2] 809

951.Application of Space-For-Time Substitution Method in Validation of Long-Term Biomass Predictions of a Forest Landscape Model ...Jun Ma[1], Xiangming Xiao[2], Yuanman Hu[3], Russell Doughty[2], Rencang Bu[3] 810

952.Spatiotemporal Dynamics of Coastal Wetlands and Reclamation in the Yangtze Estuary during 1960s-2015 Based on Remote Sensing ..... Lin Chen, Chunying Ren, Bai Zhang, Zongming Wang 811

953.Ecological Intensification and Biodiversity: The Case of Pollination Services .....Lucas Alejandro Garibaldi 812

954.Interactions and Feedbacks between Land Use Change, Species Richness and Productivity: An Integrative Approach through Meta-Analysis. ..... Maria Alejandra Parreno, Bernhard Schmid, Michael Schaepman, Norman Backhaus, Owen Petchey 813

955.Agricultural Landscape Pattern and a Case Study toward Enhancement of Ecosystem Service in China ..... Rongzhen Yu 813

956.Key Indirect and Direct Drivers in Relation to Nature's Benefits to People: A Multi-Scale Approach to Assess Ecosystem Services Shifts and Changes across Landscapes ..... Sandra Luque 815

957.Different Response Patterns of Epigaeic Spiders and Carabids to Environmental Factors in an Intensively Cultivated Agricultural Landscape .....Xiang Li, Yunhui Liu 815

958.A Unique Method to Trace the Dynamic Expansions of Spartina Alterniflora .....Yaqian Wu, Bangqian Chen, Xiangming Xiao 816

959.Simulating Land-Use Change and Its Effect on Biodiversity Conservation in a Watershed in Northwest China.....Youjia Liang, Lijun Liu 817

960.Integrated Soil, Water and Vegetation Hazard Mapping for Sustainable Agriculture in the Context of Land Degradation Nutrality in Iran .Ali Darvishi Boloorani 818

961.Land Degradation Neutrality in the Contest of Sustainability Policies

.....Anna Luise, Marina Vitullo, Marco Di Leginio 818
962.The Challenges of Soil Sustainability in Pakistan under Changing Climatic Conditions ..... Azeem Khalid 819
963.Quantifying Erosion and Its Impacts on Soil Quality in Wind-Water Erosion Crisscross Region of Northwestern China
.....Dengfeng Tuo[1], Guangyao Gao[1], Mingxiang Xu[2] 820
964.Land Degradation Neutrality (LDN) Goals in Drylands. It's Possible? For Whom?
.....Elena Maria Abraham 821
965.An Analysis of Soil-Related-Policies in Italian Rural Development Plans to Achieve Land Degradation Neutrality .....Guido Bonati, Danilo Marandola 822
966.Changing Land Management Institution and Its Effects on the Development of Gully Erosion in Black Soil Area of Northeast China ..... Jiuchun Yang 823
967.Study on Soil Erodibility K Value in Typical Areas of Shaanxi Province
.....Lili Liu, Xiaofeng Wang 824
968.The Development of Sustainable Agriculture in Drylands as a Mechanism to Prevent Land Degradation
. Matthew Haworth[1], Giovanni Marino[2], Francesco Loreto[3], Mauro Centritto[2] 824
969.Remote Sensing for Monitoring and Mapping Land Productivity in Italy: A Rapid Assessment Methodology
..... Maurizio Sciortino, Matteo De Felice, Flavio Borfecchia, Luigi De Cecco 825
970.Controlling Erosion and Fighting Against Desertification in the Loess Plateau: Lessons and Mechanisms .....Wei Wei[1], Liding Chen[2] 827
971.Trace and Heavy Metal Pollution in the Water and Sediment of the Ga-Selati River, Olifants River System, South Africa
.....Abraham Addo-Bediako, Antoinette Jooste 828
972.Operationalizing Landscape Sustainability from a Perspective of Multiple Interacting Social-Ecological Systems: A Modeling Framework and Its Application .....Bingbing Zhou, Jianguo Wu 828
973.Study on accouting of Gross Ecosystem Product based on land over classification in Hebei province in1980-2013
.....Chunfei Hou**,** Daiqing Li, Chaoyang Feng, Weiwei Liu 829
974.Urban Expansion and Regional Sustainability in the Ecologically Vulnerable Areas in China: A Multi-Scale Landscape Perspective to the Agro-Pastoral Transitional Zone in Northern China .....Chunyang He, Meihui Ding, Zhifeng Liu 830
975.Drivers and Interaction of Ecosystem Services in the Agro-Pastoral Transitional Zone of China .....Deyong Yu, Ruifang Hao 831
976.Integrating Ecosystem Services in Landscape Planning Based on Multi-Objective Spatial Optimization and Game Theory .....Haitang Hu[1], Yihe Lü[2] 832
977.Spatiotemporal Pattern of the Global Fine Particulate (PM2.5) Pollution: A Multiscale Landscape Analysis ..... Huanbi Yue 833
978.Linking Biodiversity, Ecosystem Function, Ecosystem Services, and Human

Wellbeing: The Landscape Sustainability Science Paradigm
.....Jianguo (Jingle) Wu 834
979.Landscape Connectivity and Water-Supply Stability in the World Cultural Landscape Heritage of Honghe Hani Rice Terraces .....Jiao Yuanmei 835
980.The Effects of Rapid Urbanization on Vegetation Cover in Metropolises of China over Last Three Decades .....Jiaqiang Du 835
981.Evaluation of Green Appearance Percentage in Recreational Open Space
.....Jie Li, Jun Gao 836
982.Study on the Change of Landscape Space in the Core of the World's Important Agricultural Cultural Heritage ——a Case Study of the Longxian Village in Qingtian County of Zhejiang Province
.....Lingyi Jin [1], Yehong Sun [1], Kai Zhang [2], Wenjun Jiao [3] 837
983.Water Shortages Influence the Sustainable Development of the Drylands of Northern China: Evidence from the Water Stress Index .....Jingwei Li 838
984.Design and Assessment of Urban Stormwater Green Infrastructure to Improve the Health and Well-Being of Residents in Detroit, MI, USA .....
Joan Iverson Nassauer, Natalie R Sampson, Noah J Webster1, Nathaniel Lichten 838
985.Linking Landscape Pattern and Soil Water Conservation in Loess Plateau of China
.....Lei Yang 839
986.The Effects of Green Space on Self-Reported Health at Different Spatial Scales in Singapore .....Liqing Zhang, Puay Yok Tan 840
987.Bamboo Status, Consumption Pattern in and Around Inani Protected Forest of Cox's Bazar, Bangladesh .....
Md. Mahmudul Hasan[1], Md. Munim Hasan Chowdhury[1], S. M. Tanveer Ahmad[1], Md.Sumon Reza[1], Md.Shahadat Hosen[2], Romel Ahmed[1] 841
988.Behind the Rapid Expansion of Urban Impervious Surfaces in China: Major Influencing Factors Revealed by a Hierarchical Multiscale Analysis
.....Qun Ma[1], Chunyang He[1], Jianguo Wu[2] 841
989.Optimization Schemes for Grassland Ecosystem Services under Climate Change
.....Ruifang Hao, Deyong Yu 842
990.Mapping Cultural Ecosystem Services through Crowd-Sourced Information: An Empirical Approach across European Landscapes
.....Sandra Luque, Maxime Lenormand, Patrizia Tenerelli 843
991.Restriction on Urban Sprawl: An Approach Based on Ecological Security Pattern
.....Shuhan Liu, Dongyan Wang, Hong Li, Wenbo Li 844
992.Study on Simulation and Optimization of Landscape Pattern and Urban - Rural Development Strategy in Liaohe Watershed
.....Weiling Liu, Xin Wang, Jiaoqi Zheng, Jiaqiang Du, Linbo Zhang 845

993.Linking Ecosystem Services with Grassland Degradation and Restoration: A Case Study of the Xilin River Basin in Inner Mongolia, China
..... Xuefeng Zhang, Jianming Niu 845
994.Cassification and Tourists `Perception of Soundscapes in the National Park: A Case Study of Yuntai Mountain
.....Xueyan Xu, Yubin Xi, Jun Gao, Xuefei Sun 846
995.Resolving the Relationships between Ecosystems and Human Wellbeing in Semi-Arid Sandy Land .....Yuanyuan Zhao 847
996.Pathogen Transmission in Fragmented C: Incorporating Ecological and Epidemiological Perspectives .....Zheng Huang 848
997.Impacts of Urban Expansion on Ecosystem Services in the Drylands of Northern China: A Case Study in the Hohhot-Baotou-Ordos Urban Agglomeration Region
..... Zhifeng Liu[1], Zexiang Sun[1], Chunyang He[1], Jianguo Wu[2] 849
998.The Influence of Spatial Patterns of Canopy Gaps on Sapling Species Richness in Xishuangbanna Tropical Forest Landscape, southwest of China
..... Zhiming Zhang[1], Luxiang Lin[2] 850
999.Statistical Modeling of Nutrient Delivery from Watershed Landscapes/Sources to River .....Dingjiang Chen 852
1000.Sediment load variation and simulation in the Yarlung Tsangpo River
..... Fan Zhang[1], Xiaonan Shi[1], Chen Zeng[2], Guanxing Wang[1] 852
1001.Roles of Alpine Grassland Vegetation on Hillslope Hydrological Processes in Permafrost Watershed
.....Genxu Wang, Chunlin Sun, Kewei Huang 852
1002.Effects of hydrological gradients on plant functional compositions and ecosystem functioning in Poyang Lake wetland
.....Hui Fu, Guixiang Yuan, Jiayou Zhong, Qian Lou, Chunjing Guo 854
1003.Understanding Eco-Hydrological Processes by Coupling the Carbon and Water Cycles .....Lu Zhang[1], Lei Cheng[2] 855
1004.Global Scale Estimation of Vegetation Dynamics from Microwave Observations for Ecological Monitoring .....Ming Pan[1], Xianli Xu[2] 856
1005.Response of Transpiration to Seasonal Rainfall Redistribution in a Subtropical Evergreen Broad-leaved Forest .....Ping Zhao, Yanting Hu 857
1006.Dynamic Modeling of Climate Change Impacts on Vegetation–hydrological Process in Jinghe Watershed .....Richao Huang, Chen Xi 858
1007.The Determinants on the Hysteretic Relationships between Sap Flow and Meteorology in a Humid Subtropical Catchment
.....Rongfei Zhang, Xianli Xu, Meixian Liu, Yaohua Zhang, Chaohao Xu 858
1008.Application of Biofilm's Carbon and Nitrogen Stable Isotope Ratios as Supplementary Index for River and Stream Ecosystem Assessment .....
Wei Dai[1], Kwang-Hyeon Chang[1], Jin MeiYan[1], Kim Min-Seob[2], Oda Yusuke[1],

Suh Jong-Mo, Oh Hye-Ji[1] 859

1009. An Experimental Investigation of Kinetic Fractionation of Open-Water Evaporation at a Large Lake .....
Wei Xiao[1], Yongbo Hu[1], Shoudong Liu[1], Wei Wang[1], Xuefa Wen[2], Martin Werner[3], Xuhui Lee[4] 860

1010. Spatial Distribution of Qinghai Spruce Forests and the Thresholds of Influencing Factors in a Small Catchment, Qilian Mountains, Northwest China .....
Wenjuan Yang[1,] Yanhui Wang[2], shunli Wang[3], Ashely A Webb[4], Pengtao Yu[2], Xiande Liu[3], Xuelong Zhang[3] 861

1011. Landscape Layout Affect the Karst Depression Ecosystem Waterlogging Tolerance .....Xianli Xu, Feixia Zhong, Wei Luo, Zhenwei Li 861

1012. Relationship between Typical Shrub/Grass Ecosystem and Soil Moisture at Different Scales in the Loess Plateau, China
Xiao Zhang, Wenwu Zhao, Yuanxin Liu, Yue Liu, Qiang Feng, Xuening Fang 862

1013. Shifting Determinants for Long Term Stream Drying: Insights from the Coupled Human and Natural Systems in the Loess Plateau of China
..... Xiaoming Feng, Bojie Fu 863

1014. Ecohydrology of Shrub Encroachment in the Inner Mongolia Grassland
.....Xiaoyan Li 864

1015. Temporal Analysis of Aridity Index in the Changwu Tableland of Northwest China from 1957 to 2013
.....Xiaoyang Han[1], Wenzhao Liu[2], Guangyao Gao[1], Yihe Lv[1], Bojie Fu[1] 865

1016. Stand Transpiration of a Treeline Forest in Tibet
..... Xinsheng Liu[1], Nie Yuqin[1], Zhang Lin[2] 865

1017. The Impacts of Harvesting on Soil Moisture in the Shrub Encroached Grassland of Inner Mongolia Plateau .....Ying Fan 866

1018. Integrated Hydro-biogeochemical Modeling for Investigating Water and Carbon Dynamics in Agricultural Lands .....Yiping Wu 867

1019. Eco-hydrological Process Alteration Response to Landscape Change in a Typically Urbanized Watershed of Beiyun River in Beijing
. Yueqiu Zhang, Shiliang Liu, Xiaoyun Hou, Fangyan Cheng, Zhenyao Shen 867

1020. Variations of Rainfall Redistribution Patterns and Canopy-Derived Dissolved Organic Matter in Three Forest Types along an Elevation Gradient, southwest China ..... Zhaoyong Hu, Genxu Wang, Xiangyang Sun 868

1021. Drought Effects on Tropical Headwater Streams and Sustainability of Ecosystem Services .....Alan P. Covich[1], Todd A. Crowl[2], Omar Perez-Reyes[3] 870

1022. Species and Functional Diversity Recovery of Macroinvertebrate Community in Restored Unban Streams, Puyang County, Zhejiang Province, China
.....Beixin Wang[1], Haiyan Yu[2], Lei Zhang[1], Ning Ding[1], Jian Yu[2] 871

1023. Multiple Stressors and 'Ecological Surprises' in New Zealand's Running Waters:

A Review .....
Christoph D. Matthaei[1], Annika Wagenhoff[2], Jeremy J. Piggott[3], Katharina Lange[4], Colin R Townsend[1], Joanne Clapcott[2], Roger G Young[2] 871

1024. Effects of Cascade Hydropower Dams on the Spatio-temporal Patterns of Fish Diversity in Qingjiang River, Central China .....
Geng Huang[1], Qidong Wang[2], Shaowen Ye[2], Xiaohang Chen[2], Jiashou Liu[1], Zhongjie Li[1] 872

1025. The Effects of Anthropogenic Subsidy and Herbicide on Ecosystem Functioning in Urban and Rural Streams
.....Hongyong Xiang, Yixin Zhang, Ying Hua, Xiang Li, Qingyang Lyu 873

1026. Multiple Stressors & Stream Macroinvertebrate Dynamics: A Mesocosm Experiment Manipulating Sediment Grain Size & Flow
.....Jeremy J. Piggott[1], Matt Ward[2], Lisa Carlin[2], Christoph Matthaei[2] 874

1027. Interactions between Subsurface and River-Riparian Ecosystems under Human Pressure .....
Junjiro Negishi[1], Yuan Yuan Song[1], Natsuki Morisaki[1], Nozomi Watanabe[1], Kazuki Miura[1], Nozomi Aruga[2], hirokazu urabe[3], Futoshi Nakamura[1] 875

1028. The Role of Climate and Physical Factors in the Past, present and Future of Stream Fish community, Taiwan .....Liang Hsien Chen 876

1029. Detect Water Pollution of North Canal River System in Beijing with Micronucleus Test Method .....Mingyu Liu 877

1030. Ecological Effects of Vegetative Filter Strips over Lakeshore in Nansi Lake
.....Qingze Han, Minglei Liu, Min Jiang, Ying Liu, Zhiguo Zhang 878

1031. Health Condition Assessment of Geum-river Aquatic Ecosystems Using the Vegetation and Its Meaning to River Management in Korea.
..... Seung-Yeon Lee, Kyu-Tae Cho, Young-Han You 879

1032. The Appraisal of Stream and River Restoration: A Framework in China
.....Yixin Zhang, Qiaoyan Lin 880

1033. Study of Water Forest Conservation Layout in Karst Desertificated Catchment in Case of Shilin Bajiang Catchment of Yunnan Province, China
.....Yuhui Li[1], Xiaoyue Wu[2], Qiangzhi Ding[3], Rongguang Yang[4] 881

1034. Effects of Anthropogenic Disturbances on α and β Diversity of Fish Assemblages and Their Longitudinal Patterns in Subtropical Streams, China ..Yunzhi Yan 882

1035. Spatial and Temporal Variations of Potential Evapotranspiration in Southwestern China from 1962 to 2013 Dengxiao Lang, Jiangkun Zheng, Jiaqi Shi, Yifan Chen 883

1036. Research on Cumulative Effects of Forest Change on Flow Regimes in Large Watershed Based On River Ecological Protection .....
Dingyuan Ning, Mingfang Zhang, Zuozhu Meng, Yiping Hou, Le Yu, Siyi Ren 884

1037. Understanding Forest and Water Relationships for Sustaining Watershed

Ecosystem Services in the Anthropocene .....Ge Sun, James Vose 884
1038.Divergence in Strategies for Coping with Winter Embolism among Co-occurring Temperate Tree Species in NE China ..... Guangyou Hao, Cunyang Niu 885
1039.Rainfall Redistribution and Throughfall Spatial Distribution in a Larix Gmelinii Forest in the Northern Greater Khingan Range, Northeast China
.....Houcai Sheng, Tijiu Cai, Cunyong Ju, Xiaoxin Sun 886
1040.Combined Effects of Rainfall Regime and Plot Length on Runoff and Soil Loss in the Loess Plateau of China Jianbo Liu, Guangyao Gao, Shuai Wang, Bojie Fu 887
1041.The Development and Application of a Tool for Assessing Streamflow Response to Vegetation Change and Climatic Variability in Large Watersheds
Le Yu, Mingfang Zhang, Dingyuan Ning, Siyi Ren, Yiping Hou, Zuozhu Meng 888
1042.Plant-Soil System Act as Buffer Zone and Its Seasonal Variation Need More Attention .....Long Sun, Lei Yang, Shoujuan Li 889
1043.A Global Review on Hydrological Responses to Forest Change across Multiple Spatial Scales: Importance of Scale, Climate, Forest Type and Hydrological Regime .....Mingfang Zhang[1], Shirong Liu[2] 890
1044.Projecting Water Yield and Ecosystem Productivity to Climate Change across the Australia ContinentNing Liu[1], Richard Harper[1], Shirong Liu[2], Bernard Dell[1] 890
1045.A Multiple Time Scale Modeling Investigation of Leaf Water Isotope Enrichment in a Temperate Grassland Ecosystem
.....Pei Wang, Xiuchen Wu, Jieyu Huang, Qishun Ma 891
1046.Developing Reforestation Systems to Restore Ecohydrological Function in Semi-Arid Australia ..... Richard James Harper 892
1047.Variation of Leaf Turgor Loss Point across China's Forests and Its Relationship with Hydraulic and Economic Traits .....Shidan Zhu 893
1048.Hydrological Recovery in Two Large Forested Watersheds of Southeastern China_importance of Watershed Property in Determining Hydrological Responses to Reforestation ..... Wenfei Liu 893
1049.Soil Erosion Evaluation at Global Scale: A Review
.....Wenwu Zhao, Jing Wang, Yue Liu, Hui Wei, Yaping Wang 894
1050.Forest Cover Change and Water Yield in Large Forested Watersheds: A Global Synthetic Assessment ..... Xiaohua Wei, Qiang Li, Krysta Giles-Hansen 895
1051.The Effect of Forest on Water Resources Regulation in Different Scales in China.
.....Xinxiao Yu 895
1052.Modelling Diurnal and Seasonal Hysteresis Phenomena of Canopy Conductance in an Oasis Forest Ecosystem .....Yan Bai, Xiao Yan Li 896
1053.The Hydrological Response to Climate Variability and Hurricane -Induced Forest Change in a Coastal Experimental Watershed

1054.Yiping Hou, Mingfang Zhang, Le Yu, Siyi Ren, Dingyuan Ning, Zuozhu Meng 897
1055.Zonal Features of Runoff Formation in Central Siberia ..... Alexander Alexandrovich Onuchin 898
1056.Using Flow Duration Curves and Flood Frequency Analysis for Habitat Restoration in the Sacramento River, California Alya Aljafri[1], Eric Berntsen[2] 899
1057.Study on the Key Factors and Controlling Methods of Water Bloom in Hanjiang River, China ..... Bao Qian, Jincheng Wang, Xiao Xiao 899
1058.Development and Evaluation of a Physically Based Multiscalar Drought Index: The Standardized Moisture Anomaly Index .....Baoqing Zhang 900
1059.Spatial Variability in Soil Hydraulic Conductivity and Related Hydrological Response in the Heihe River Watershed, Northwest China .....Chansheng He, Jie Tian, Baoqing Zhang, Lixiao Yang 901
1060.Biocapacity Optimization in Regional Planning .....Dongxia Yue, Jianjun Guo, Kai Li 902
1061.Study of Function Reforging of Urban Water System Health and Related Project Governance Technology .....Fang Liu[1], Wang Miao[2], Shuncheng Li[3] 902
1062.Evaluation of Soil Erosion on Watershed Scale in the Middle Reaches of the Yellow River Basin .....Feiyan Xiao, Xiaofeng Wang, Lichang Yin 903
1063.Effects of Precipitation Variability and Land Use/Cover Changes on Spatio-Temporal Variations of Streamflow and Sediment Load in the Loess Plateau, China ..... Guangyao Gao 904
1064.Evaluating Canopy Transpiration and Water Use of Two Typical Planted Tree Species in the Dryland Loess Plateau of China ..... Handan Zhang, Wei Wei, Liding Chen, Lei Yang 905
1065.Cumulative Effects of Cascade Hydropower Station on the Landscape Patterns in Wujiang Catchment.....Junyao Sun, Wei Li 906
1066.Impact of Floodgates Regulation on Water Quantity and Quality Processes：A Case Study of Wuxi City, China .....Lan Feng[1], Xiaodong Zhu[2] 906
1067.Response of Streamflow to Climate Warming-induced Permafrost Thaw in Large Watersheds in Northeastern China . Liangliang Duan, Tijiu Cai, Xiuling Man 907
1068.Hydrologic Responses to Soil and Water Conservation Policy and Associated Land Surface Change in a Loess Hilly Watershed of China Linjing Qiu, Yiping Wu 908
1069.An Improved Algorithm to Calculate the Water Surface Profile of Natural Mountainous Stream based on Energy Balance Equation .....Meng Zhang[1], Jinhui Sun[2], Bo Zhang[1], Yiping Wu[1] 908
1070.Distribution and Assessment of Surface Water Quality， Heavy Metals in Sediments and Combined Pollution in the Haihe River Basin in China ..... Peiru Kong 910

1071.Using a Hydrodynamic Model to Simulate the Transport of perflUoroalkyl Acids in Xiaoqing River, China .....
Qifeng Li, Tieyu Wang, Yonglong Lu, Pei Wang, Sarvajayakesavalu Suriyanarayanan, Yueqing Zhang, Jing Meng, Yunqiao Zhou 911
1072.Relationship between Groundwater Quality Index of Physics and Chemistry in Riparian Zone and Water Level Change Effected by Operation of Three Gorges Reservoir ..... Qihong Yang, Jiasheng Wang 912
1073.Application of Stable Isotopes Technology in Forest Hydrological Process—A Case Study in Sub-Alpine Forest in Western Sichuan of China .....Qing Xu 912
1074.Habitat Model Development of Mangroves and Its Implications on Watershed Sediment Management ..... Shang-Shu Shih 913
1075.Phosphorus Use Efficiency in the Food Production and Consumption System: Evidence from Zhangzhou Prefecture in China
..... Shenghui Cui[1], Chu-Long Huang[1], Yunfeng Huang[2] 914
1076.Research and Implementation of Ecological Environment Remote Sensing Monitoring System Sihan liu, Xuejun Mao, Yanting Wu, Yipeng Yang, Shaohua Zhao 915
1077.Effects of Vegetation Pattern and Rainfall Intensities on Runoff and Soil Erosion at Loess Slope under Rainfall Simulations
.....Tian Jiao Feng[1], Wei Wei[1], Liding Chen[1], Yang Yu[2] 916
1078.Remote Sensing for Retrieving the Spatial Distribution Characteristics of Snow in the Northern Daxinganling Mountains Xiangzheng Yu, Jiuti Cai, Yongcun Qu 916
1079.Application Progress of Atmospheric Water-vapor Hydrogen and Oxygen Stable Isotopes in Eco-hydrology Research .....Yamin Jiang, Wenjie Liu 917
1080.Variability in Soil Saturated Hydraulic Conductivity and Stormflow under Vegetation Degeneration in Permafrost of the Qinghai-Tibet Plateau, China
..... Yibo Wang 918
1081.Effects of the Three-Gorges Dam on Wetland Distribution on the Middle and Lower Reaches of Yangtze River .....Yingbing Wang, Bin Zhao 919
1082.Which Pollutants in the Rivers of the Bohai Region of China Represent the Highest Risk to the Local Ecosystem.....
Yueqing Zhang[1], Andrew C. Johnson[2,] Monika D. Jürgens[2], Meng Zhang[1], Chao Su[1], Yajuan Shi[1], Yonglong Lu[1] 920
1083.Characteristics of the Soil Water Profile under Different Land Uses in a Small Watershed of the Southern Loess Plateau
..... Zhansheng Ju[1], Wenzhao Liu [2], Qi Zhou[1] 920
1084.Decouples of N and P Cycles in Lake Eutrophication: Evidence from a Watershed-Scale Study
.....Zhichun Lan[1], Yasong Chen, Wei Shi[1], Yingzheng Wan[1], Jiakuan Chen[2] 921

1085.Soil Greenhouse Gas Emissions Should Be Considered for the Assessment of Climate Change Mitigation by Mangrove Wetlands
..Guangcheng Chen[1], Bin Chen[1], Yong Ye[2], Nora FY Tam[3], Shunyang Chen[1]923
1086.Greenhouse Gas Emissions in Coastal Salt Marshes and the Effect of Restoration
.Jianwu Tang[1], Kevin Kroeger[1], Serena Moseman-Valtierra[2], Faming Wang[1] 923
1087.The Contribution of Seaweeds Mariculture to Blue Carbon ....Jihong Zhang 924
1088.Tidal Marsh with Phragmites Australis Exhibits Higher Methane Emission than Those with Suaeda Japonica Due to Biogeochemical and Microbiological Differences .....Jinhyun Kim, Jaehyun Lee, Hojeong Kang 925
1089.Blue Carbon in China: Present and Future
.....Peng Zhao[1], Xuedong Hu[2], Yan Gao[2] 926
1090.Assessment of Urban Low-carbon Development Level
.....Qionghong Chen, Meirong Su, Lingrui Yu 926
1091.Differences in Carbon Sequestration Capacity of Mixed Seagrass Meadows Explained by Differences in Below-Ground Microbial Activity .....
Songlin Liu[1], Zhijian Jiang[1], Yunchao Wu[1], Jingping Zhang[1], Xiaoping Huang[1], Peter Ian Macreadie[2] 927
1092.Benthic Community Metabolisms of Intertidal Mudflats Change along a Latitudinal Gradient .....Weijen Lin[1], Jihua Wu[2], Hsing-Juh Lin[1] 928
1093.滨海湿地“蓝碳”的三维分布格局、碳汇价值及其影响因素分析 以中国盐城为例 .....Zheng Zang 928
1094.Multiple-factors Regulated Carbon Processes in the Coastal Salt Marshes: Implications on Sea-level Rise Impacts .....Zhenming Ge 929
1095.Effect of Eutrophication on Sediment Organic Carbon Sequestration in Tropical Seagrass Bed in China .....
Zhijian Jiang, Songlin Liu, Jingping Zhang, Yunchao Wu, Chunyu Zhao, Zhonglian Lian, Xiaoping Huang 930
1096.Status and Historical Changes of Fish Assemblages in the Three Gorges Reservoir
.....
Chuansong Liao[1], Sibao Chen[2], Shaowen Ye[1], Tanglin Zhang[1], Zhongjie Li[1], Jiashou Liu[1] 932
1097.The Response of the Soil Microbial Food Web to Drought under Different Plant Systems .....Feng Sun[1], Kaiwen Pan[2] 932
1098.Forest Restoration Implications of Drought Tolerance and Associated Vegetation of Tectona philippinensis Benth. & Hook
.....Jonathan Hernandez, Marilyn O Quimado, Pastor L Malabrigo 934
1099.Variations in Chlorophyll Content and Hydrogen Peroxide Production in Wheat and Lettuce in Response to Nanoparticles Exposure
.....Muhammad Arshad, Rafia Rafique 934
1100.Hydrological, Environmental and Spatial Variables Interact to Determine Species, Trait Composition and Beta Diversity of Pelagic Algae .....

Naicheng Wu[1], Yueming Qu[2], Björn Guse[2], Kristė Makarevičiūtė[3], Szewing To[2], Nicola Fohrer[2]935

1101. Watershed-Lake System Responses to Anthropogenic Pressures, Ecosystem Thresholds, and Climate Change: Insights from Lake Champlain, Vermont, USA

1102. Peter D F Isles[1], Andrew W Schroth[2], Donna M Rizzo[3], Yaoyang Xu[4], Asim Zia[5] 936

1103. Spatiotemporal Variations of Major Ions and Their Controlling Factors of the Seti River, Central Himalayas, Nepal .....Ramesh Raj Pant, Fan Zhang 937

1104. The Study on Effects of Toxic Algae on Bacterial Diversity..... Renyan Liu 937

1105. Respiratory Metabolism Responses of Riparian Plant Distylium Chinense to Long-term Submergence .....Xiaoling Li, Haoran Wen, Jin Yang, Gong Chen 938

1106. Conceptual Framework of Homogenizing Ecological Pattern by Extreme Events ..... Yaoyang Xu 939

1107. Quantifying the Influences of Various Ecological Factors on Land Surface Temperature of Urban Forests .....Yin Ren 940

1108. A Bibliometric Study of the Coral Reef in World .....Aiyuan Liu, Yuqing Guo, Jiaying Liu, Shuhong Wang 941

1109. Combined Effect of Drainage, Rewetting and Warming on Peatland Greenhouse Gas Fluxes and Vegetation
Anna Maria Laine[1], Lauri Mehtätalo[2], Anne Tolvanen[3], Eeva-Stiina Tuittila[2] 942

1110. Evaluation of Alternative Habitat for Two Endangered Plant Species Using Habitat Suitability Index .....Bo Eun Lee, Jae Geun Kim 943

1111. Trends and Drivers of Coastal Wetlands Changes in the Yellow River Delta of China from 1970s to 2015 ..... Chunying Ren 943

1112. Policy-driven Wetland Loss to Agricultural Reclamation .....Dehua Mao[1], Zongming Wang[1], Bingfang Wu[2], Yuan Zeng[2] 944

1113. Optimization Program Construction and Evaluation of Coastal Wetland Ecological Network in the Yellow River DeltaDi Zhou, Junbao Yu, Yunzhao Li 945

1114. Ecological Response of Endangered Species, Epilobium Hirsutum L. According to Environmental Conditions .....Eung Pill Lee, YoungHan You 946

1115. Effects of Current Water Level Scheduling on the Seed Germination and Production of the Annual Plant Xanthium Sibiricum in the Water Level Fluctuation Zone of the Three Gorges Reservoir, China Feng Lin, Jianhui Liu, Bo Zeng, Qiaoli Ayi 947

1116. Soil Seed Banks and Their Implications for Wetland Restoration in Sanjiang Plain, Northeast of China ..... Guodong Wang 947

1117. The Characteristics on Landscape Ecology of Four-Spot Midget (Mortonagrion Hirosei Asahina) in Danshui River ..... Gwo-Wen Hwang, Shang-Shu Shih, Szu-Yu Ko, Yi-Bei Lin 948

1118.Invertebrate Assemblages as Indicators of Ecological Condition in Freshwater Wetlands ..... Haitao Wu 949
1119.Spatial Distribution of Vascular Plants in the Water-Level Fluctuating Zone of Jiangjin Section of the Yangtze River and the Influencing Factors for Its Stability ..... Hangang Niu, Liu Mingzhi, Zeng Bo 950
1120.Laws of Vegetation Community Succession and Plant-diversity in Peatlands ..... Hong Yan[1], Boyan Chen[2], Ping Wang[3], Lianxi Sheng[3] 950
1121.Effects of Current Water Level Scheduling on the Seed Germination and Production of the Annual Plant Xanthium Sibiricum in the Water Level Fluctuation Zone of the Three Gorges Reservoir, China Jianhui Liu, Lin Feng, Zeng Bo 952
1122.A Study on the Life Form of Plant in Wolyoung Wetland Conservation Area, Jeongeup, Korea. Ji-Eun Kim[1], Kyu-Tae Cho[1], Chang-Hwan Kim[2], Young-Han You[1] 952
1123.Effects of Rest Grazing on Soil Organic Carbon in the Bog Meadow of Northeast China ..... Mingjun Wang, Guowen Cui 954
1124.Impact of Land Use Change on Soil Organic Carbon Sequestration along a Native Wetland to Cropland Chronosequences ..... Nazia Perveen, Weixin Ding 955
1125.Heterogeneity between Soil Salinity and Nutrients in the Wetland of Yellow River Delta ..... Shuhui Jing, Jiazhen Liu, Yongjin Chen 955
1126.Land Use Dynamic Change and Associated Effects on Eco-Environment in Xianghai Wetland ..... Shuting Bai[1], Shuwen Zhang[2] 956
1127.The Function Zoning Based on the Ecological Sensitivity Analysis: A Case of the Lakeshore in Nansi Lake, China Shuxia Sun, Renqing Wang, Zhiguo Zhang 957
1128.Wetlands Found Newly Through the National Inventory in Korea ..... Song Hie Jung[1], Chi Hong Lim[1,] Dong Uk Kim[1], A Reum Kim[1], Dong Min Woo[1], Dong Kap Kim[2], Chang Seok Lee[1]958
1129.Dynamics of Greenhouse Gases Emission Fluxes of Different Calamagrostis Angustifolia Wetlands in Sanjiang Plain ..... Taorong Zhang[1], Xin Sui[2] 959
1130.Characteristics of Spatial Distribution of Soil Salinity among Different Plant Communities in the Wetland of Yellow River Delta
1131. ..... Tianjv Zhang, Yongjin Chen, Jiazhen Liu 960
1132.Optimization Sampling Strategy When Estimating the Macrobenthic Species Richness in Salt Marsh Wetland: What Is the Minimal Effort Required? ..... Tingting Zhang 960
1133.Influence of Different Habitat Environment on Shoot Length, Biomass and C: N: P Stoichiometry of Four Submersed Macrophytes ..... Wei Li[1], Te Cao[2] 961
1134.Studies on the Biodiversity of Mollusks of Mangrove Area in the West Coast of Hainan Island, China ..... Wei Ma[1], Mao Wang, Wenqing Wang[1], Yi Liu[2] 962
1135.Initial Succession of Macrobenthos Community to an Early Freshwater Released Salt Marsh Wetland: Implications with China's Yellow River Delta Wetland

..... Xiaoxiao Li, Wei Yang 963
1136. Response of Soil Fungal Diversity to Nitrogen Deposition in a Deyeuxia Augustifolia Wetland of Sanjiang Plain, Northeast, China
..... Xin Sui[1], Tao Rongzhang[2], Weihong Ni[3] 964
1137. The Study of Aboveground Biomass Inversion of Reed Wetland Based on MODIS Data in the Western Songnen Plain, China
..... Yanlin Tian, Dehua Mao, Zongming Wang, Mingyue Liu, Weidong Man 964
1138. Research on the "Fertile Effect" Under Tamarix in the Wetland of Yellow River Delta ..... Yongjin Chen, Shuhui Jing, Tianju Zhang 965
1139. Distribution of C, N, P and Decomposition of Droppings in the Rongcheng Swan Lake ..... Yuhong Liu, Bowen Xiao, Rong Yao, Ying Lu, Cheng Chen 966
1140. The Landscape Evolvement and Key Driving Factors of Coastal Wetlands in the Yellow River Delta Yunzhao Li, Junbao Yu, Di Zhou, Chao Zhan, Qing Wang 967
1141. Analysis of Hydrological Connectivity Dynamics of the Wetlands in Honghe National Nature Reserve during the past Three Decades ..... Zhaoqing Luan 968
1142. Effect of Policy Change and Human Activity on Vegetation Pattern and Biodiversity Conservation in Coastal Wetlands: A Case Study in Yancheng, China
..... Zheng Zang, Qi Xia 968
1143. Natural and Constructed Wetlands for Water Quality Improvement: Opportunities and Constraints ..... Brij Gopal 970
1144. The Ecological and Biological Characteristics of Pisonia Grandis
..... Cangyu Li[2], Xinhui Wang[1], Shuguang Jian[1] 970
1145. Assessing River Ecosystem Health: Impacts of Human Activities at Catchment Scale ..... Cheng Xian, Chen Liding, Sun Ranhao 971
1146. Using Environmental DNA (eDNA) to Characterize the Biodiversity in an Aquatic System ..... Chunyan Yang, Wang Cai, Douglas W. Yu 972
1147. Dynamic Simulation of Urban Water Security System and Its Evolution Mechanism in Karst Area ..... Dongjie Guan[1], Yin Su[2], Weici Su[3] 972
1148. Phytoremediation of Cd Polluted Wetland by Arundo Donax. . Gaozhong Pu 973
1149. Land use/ Land cover change and its influence on floating islands in Loktak Lake in respect with biodiversity issues using Remote sensing and GIS Techniques ....
1150. Govindaraju Munisamy[1], Rajiv Das Kangabam[2], Suganthi Kanagaraj[3], Senthamilselvi Singaravelu[4] 974
1151. Study on the Effects of Wastewater Treatment and Resource Utilization of Water Celery ..... Huaming Yao, Shanxin Xu, Xiufang Gao 975
1152. Quantifying the Effects of Impervious Surface Spatial Pattern on the Spatial Distribution of Urban Waterlogging Risk Area ..... Hui Zhang 976
1153. The Effects of Environmental Factors on Ammonia Oxidation Potential of Wetland Sediments ..... Jasmine, Mei Li Hsueh[1], Hsing-Juh Lin[2] 976

1154.Habitat Types of Foraging and Roosting of Wintering Cranes in the Han River Watershed, Korea
.....Jeong-In Kwak[1], Jin-Woo Choi[1], Ho-Geun Yoon[2], Bong-Ho Han[2] 977
1155.Effect of Inorganic Nitrogen Source on Population Growth of Euglena Mutabilis Schmitz from Different Habitat .....Jiaojiao Zheng
1156.Nutrient Reduction Scenario Modeling for the Hyper-Eutrophic Lake Taihu, China .....Jiaoting Peng, Xiaodong Zhu 979
1157.Long-Term Pattern of Anthropogenic Regulation and Ecological Consequences in a Dammed Lake System of Southwest China
.....Jiaoyuan Wang[1], Guangjie Chen[1], Kui Hu[1], Feihong Wu[2] 980
1158.Study on the Effects of Land Use Change on Ecosystem Service Value of the Fenhe River Basin in the Loess Plateau, China ..... Jin Duan 981
1159.Comparison of Inorganic Phosphorus Fractions and Phosphatase Activities in Mid-Temperature Wetlands of Huihe National Nature Reserve, China
.....Jing He[1], Shihai Lv[2], Zhaoyan Diao[2], Derong Su[1] 981
1160.The Metal Contaminants Behavior in the Rhizosphere Micro Interface of Typical Karst Plateau Wetland .....Jingna Du 982
1161.Metagenomics and Metatranscriptomics Follow-Up of Sewage Sludge Bioreactors Confirmed the Efficiency of Nitrifying Bacteria for Optimising the Wet Oxidation Process. Julien Crovadore, Francois Lefort, Aurelie Boissezon 983
1162.Speciation Analysis of Arsenic and Selenium in Bottom Mud and Its Biogeochemical Cycle in Nan Ji Shan Wetland
.....Liang Hu, Wei Li, Wenfei Liu, Jihai Zhou, Yizao Ge, Houbao Fan 984
1163.Hydro-Ecological Regionalization and Ecosystem Management in Large Catchment Based On: A Case Study in Haihe River Basin, Northern China
.....Liding Chen, Ranhao Sun 985
1164.The Importance of DOC from Natural Wetland Ecosystems and Its Relationship with DOC Dynamics in Fluvial
.....Lili Wang[1], Changchun Song[2], Dianlin Yang[1], Jianning Zhao[1] 986
1165.Mangrove Species Maintains Relative Low Nutrient Resorption under Nutrient Enrichment .....Lili Wei 987
1166.Evaluation Research on Resources and Environmental Carrying Capacity of the Wudalianchi ..... Ling Cui 987
1167.Observational Study of Circulation and Salt Stratification over the South Branch of the Yangtze Estuary .....Linjuan Li[1], Jianping Bing[2], Wei Zhang[3] 988
1168.Coastal Exploitation Intensify Spartina Invasion in Yellow River Delta
.....Man Qi, Tao Sun, Yue Zhang 989
1169.Achievements and Problems of the Water Diversion Project in Heihe River Basin
.....Mengmeng Zhang, Shuai Wang, Bojie Fu 989
1170.Remediation of Soil Co-Contaminated with Cd and PAHs by Growing Xanthium

Sibiricum 990
Nasreen Jeelani, Yajun Qiao, Jingjing Li, Penghe Wang, Xin Leng, Shuqing An
1171.Adaptive Traits of Plants Affect Their Performance under Submergence
.....Qiaoli Ayi, Bo Zeng 991
1172.Evaluation of Water Quality and Spatial Distribution of Water Quality in Dry Season in Dongping Lake .....
.....Ruoang Feng, Jiazhen Liu, Yongjin Chen 992
1173.Ecological Water Purification and Restoration of Huaihe River Basin .....
Shuqing An, Hui Zhao, Xuanbo Zhang, Tangwu Yang, Siyuan Song, Yajun Qiao, Dawei Zou 993
1174.Distribution of Soil Inorganic Carbon under Different Landscapes in the Lower Reaches of the Yellow River Delta .....Xianglan Li 994
1175.Interactive Effects of Lead, Zinc and Copper on Growth and Physiological Responses of Mangrove Plant: Kandelia Obovata Xiaoxue Shen, Zhiyuan Niu, Ruili Li 994
1176.Aquatic Eco-Restoration and Agricultural Use for Shallow Pond and Wetland
.....Xiufang Gao 995
1177.Disappeared Biodiversity Hotspots: Implications for Degraded Wetland Restoration .....Yi Qu 997
1178.污水生态处理过程中人工湿地生物作用的研究.....岳莹 王继华 纪垚 997
1179.Effects of Hexavalent Chromium on Antioxidant System and Gene Expression in Marine Medaka (Oryzias Melastigma) Yingjia Shen, Lei Wan, Xiaomin Ni 998
1180.Ecophysiology and Nutrition Responses of Kandelia Obovata Seedlings to Sludge Discharged from Shrimp Pond
..... Yuan Tian[1], Guangcheng Chen[2], Feilong Tang[1], Yong Ye[1] 999
1181.Systematic Conservation Planning for Wetland in China: Identify Biodiversity Conservation Gap. .....Yun Guo[1], Wen Xiao Li[1], Chen Liang[2] 1000
1182.How Distribution Pattern of Soil Microbial Community Structure Driven by Water Table Gradients Lead to Different Decomposition Levels in a Shallow Floodplain Lake Wetland? Guangshuai Zhang, Xiubo Yu, Yu Liu, Ya Li, Quanjun Zhang 1000
1183.Effects of Typical Land-Use Change on Soil Quality in Hainan Province .....
Zhi Wen[1], Zhao He[1], Lei Liu[2], Lijuan Wang[1], Zhiyun Ouyang[1], Hua Zheng[1], Yanmin Li[3] 1001
1184.Pyrodiversity Can Maintain Biodiversity by Moderating Fire-Driven Fluctuations in Habitat Availability .....Brett P Murphy 1003
1185.Fire-Adapted Traits Evolved Worldwide over the Last 100 Million Years
.....Byron B. Lamont[1], Tianhua He[2] 1003
1186.Restricted Dispersal Determines Fine-Scale Spatial Genetic Structure of Group-Living Rodents .....Guiming Wang[1], Wei Liu[2], Xinrong Wan[2] 1004

1187.Wildfire Alters Available Soil Nutrient Composition and Stoichiometry in a Chinese Boreal Larch Forest .....Jianjian Kong[1], Jian Yang[2] 1005
1188.Fire Response to Climate Change in Chinese Boreal Forest and Its Cascading Effects on Tree Recruitment, Succession, and Landscape Dynamics
.....Jian Yang, Wenhua Cai, Zhihua Liu, Lei Fang 1006
1189.The Pivotal Role of Ancient Fires in Evolution of the Earth's Terrestrial Flora
..... Tianhua He, Byron Lamont 1006
1190.Relative Influence of Environment Filtering and Seed Availability on Post-Fire Vegetation Recovery in a Boreal Larch Forest
.....Wenhua Cai[1], Zhihua Liu[1], Yuanzheng Yang[1], Jian Yang[2] 1007
1191.Transcriptome Analysis of Two Radiated Cycas Species in South China Provided Some Insights to Diversifications of the Living Fossile Genus
.....Xinhui Wang, Shuguang Jian, Wei Wu 1008
1192.Species, Phylogenetic and Functional Diversity of Post-Fire Regenerations in a Forest Landscape Affected by Monsoon: The Determinants of Community Assembly .....Zehao Shen, Jie Han, Caifang Luo 1009
1193.Effects of Wildfire on Climate in the Boreal Forest Ecosystems
..... Zhihua Liu 1010
1194.Slash Burning Stimulated Soil Heterotrophic Respiration but Only in a Short-Time in Subtropical Forest in South of China ..... Zhijie Yang 1011
1195.Ecological Processes of Alpine Treelines and Climate Change: An Integrative Understanding from Cell Structure to Ecosystem
.....Eryuan Liang, Yafeng Wang 1012
1196.Permafrost Peatlands Dynamics during the Last Millennia in NE European Russia, Finnish Lapland and Western Canada .....
Hui Zhang[1], Minna Väliranta[1], Sanna Piilo[1], Tiina Ronkainen[1], Matthew Amesbury[2], Angela Gallego-Sala[2], Dan Charman[2] 1013
1197.Genetic Diversity and Phylogeography of Daphnia Similoides Located in the Middle and Lower Reaches of the Yangtze River .....
Jianxun Wu[1], Wenping Wang[1], Daogui Deng[1], Kun Zhang[1], Shuixiu Peng[1], Xiaoxue Xu[1], Ya-nan Zhang[1], Zhongze Zhou[2] 1014
1198.Tracking Traces of Alien Plant Species (APS) in China
.....Kaiyu Chen, Zhaohua Lu, Xin Qin, Miao Song, Lina Yu 1015
1199.World Ecological Modernization Since 1700 .....Lei Liu 1015
1200.Instability of the Spatial Patterns in Forest Resilience over the Tibetan Plateau
.....Ouya Fang, Qibin Zhang 1016
1201.Tree Rings as Records of Changes in Air Quality and past Impact of Human Activities on Environmental Conditions .....
Paolo Cherubini[1], Olivier Bachmann[2], Qiufang Cai[3], Claudia Cocozza[4], Dario Ferreira Sanchez[5], Cristiana Giordano[4], Daniel Grolimund[5], Marcel Guillong, Maihe Li, Hans Linderholm[6], Yu Liu[3], Marco Marchetti[7], Sara Martelletti[8], Renzo

Motta[8], Alessandra Patera5, Annalisa Perone[7], Cristina Salvatici[4], Huiming Song[3], Marco Stampanoni[5], Roberto Tognetti[7], John Innes[9] 1017

1202.Monitoring the Climate Change and Its Impact on Mangrove Distribution over Sundarban Region of India .....Parthasarathi Barik 1018

1203.Ecosystems and Climate Change in British Columbia, Canada over 60000 Years .....Richard Joseph Hebda 1019

1204.Environmental Geography and Dynastic Cycles of Ancient China .....Xin Chen 1020

1205.Conflicts in Conservation and Regeneration of Korean Fir Forests Disturbed by Roe Deer on Mt. Hallasan, Jeju Island, Korea .....Eun-Shik Kim 1022

1206.Hydrological Disaster Risk Assessment on Climate Change in Arid Region .....Guili Sun[1], Yaning Chen[2] 1022

1207.Vegetation Zonation along Altitudinal Gradient on Mount Tabunan Forest Landscape, Cebu Island, Philippines .....Inocencio Jr Buot[2], Geofe Cadiz[1] 1023

1208.Discussion of Differences in Sun-dried Salt Field and Eco-cultural Resources Utilization in Jeungdo and Shineuido, Shinan County, Republic of Korea .....Jae-Eun Kim 1024

1209.How Do We Acknowledge Indigenous Knowledge and Practice in 21st Century Concerns? .....Prisclla Wehi 1024

1210.Community Led Conservation and Restoration of Biodiversity on Private Land, Hoteo Catchment, New Zealand .....Shona Claire Myers 1025

1211.Biocultural Diversity in Island Landscape Ecology .....Sun Kee Hong 1026

1212.Commitment of Ecologists on the Island Environmental Policy in a Case of Yakushima Island, a World Heritage Site, Japan .....Takakazu Yumoto 1026

1213.Agroecological Practices Using Biodiversity and Diversification for the Provision of Goods and Services in Agriculture .....Alexander Wezel 1028

1214.Herbicide-Pesticide Free Innovative Forest Management: The Quebec Experience .....Azim Mallik 1029

1215.Effects of Ducks Excrement on Rice Growth and Methane Emission in Rice-Duck Farming System .....Benliang Zhao, Qibin Shen, Jiaen Zhang, Qiushuang Wang, Wei Tang 1029

1216.Mitigating China's N, P2O5 and Irrigation Water Inputs for Staple Food by Potato as Staple Food .....Bing Gao, Wei Huang, Shenghui Cui 1030

1217.Examining Spatially Varying Relationships between Soil Contamination and Landscape Patterns at Multiple Scales Using Geographically Weighted Regression .....Cheng Li[1], Fangbai Li[1], Zhifeng Wu[2], Jiong Cheng[1] 1031

1218.Optimization of Straw Mulching and Related Parameters in Growth of Young Walnuts (Juglans Regia) with Response Surface Methodology ..... Dagang Song, Kaiwen Pan, Aiping Zhang, Zilong Li, Feng Sun, Xiaogang Wu, Wenkai Chen 1032

1219. Experimental Warming Effects on N2O Emission and Related Soil Microbes under Conventional Tillage and No-Tillage Farmlands
..... Fadong Li[1], Chun Tu[1], Yanhong LI[2] 1033
1220. Impacts of Moisture on Soil Carbon and N2O Emissions in Agricultural Soil in Northwest China ..... Fan Zhang, Yiping Wu, Linjing Qiu 1034
1221. Shoot and Root Biomass Allocation for Different Maize Densities in a Plastic-Mulched Dryland Cropping System
..... Fengmin Li, Ibrahim M. Eldoma, Ming Li, Feng Zhang 1034
1222. Insights in the Mechanism of Proliferation on Special Microbes Mediated by Root Exudates in Radix Pseudostellariae Rhizosphere under Continuous Monoculture Regimes .....Hongmiao Wu, Wenxiong Lin 1035
1223. Spatial-Temporal Changes in Evapotranspiration Based on Crops Planting Patterns in Xinjiang during 1960-2010 .....Jie Bai, Na Na Lv 1036
1224. The Responses of Soil Microbial Activities to Oil, Lead, Cadmium and Their Combined Contaminations .....
Jihai Zhou, Kun Chen, Dongdong Yuan, Xueyan Wu, Rongxia Huang, Jiajie Tang, Houbao Fan 1037
1225. Study on Rhizosphere Ecological Characteristics of Radix Pseudostellariae Monocultured for Different Years .....
Jun Chen, Linkun Wu, Yanhong Wu, Sheng Lin, Xianjin Qin, Hongmiao Wu, Wenxiong Lin 1038
1226. One Year Experiment of Understorey Regrowth Improves Ecosystem Services in Monoculture Rubber Plantations .....
Jutamart Monkai[1], Stefanie D Goldberg[2], Viktor Josefsson[3], Rhett D Harrison[4], Peter E Mortimer[2], Jianchu Xu[1] 1038
1227. Effects of Different Straw Residue Incorporation on Soil Weed Seed Bank
.....Kailing Huang, Yanan Wei, Peng Wang, Hui Guo 1039
1228. Rice-Water Spinach Intercropping Enhance Silicon Uptake, Plant Resistance and Biomass Production of Rice
..... Kunzheng Cai, Chuanchuan Ning, Jiahui Qu, Shiming Luo 1040
1229. Accumulation and Distribution of Calcium and Magnesium in Oat and Their Effects on the Uptake of Sodium, Potassium, and Chloride Ions
Li Pu Han, Jintong Liu, Tonggang Fu, Hui Gao, Hongzhu Liang, Xiaorong Li 1041
1230. Interspecific Root-Root Interactions Are Drivers of Overyielding, Efficient Nutrient Utilization and Improved Soil Fertility in Intercropping ..Long Li 1042
1231. Biodiversity Used in Rice Production in South China .....Luo Shiming 1043
1232. Characterization of Overwintering Behavior and Site of Riptortus Pedestris (Hemiptera: Alydidae) in the Laboratory Experiment and Field Sampling .....
Minhyung Jung, Jung-Wook Kho, Soowan Kim, Jieun Lim, Hong Geun Kim, Doo-Hyung Lee 1044

1233.Nitric Oxide-Induced Regulation of Growth, Ion Homeostasis, Photosynthesis and Mitigation of Salt-Induced Oxidative Stress in Mangrove Species, Kandelia Obovata .....Mirza Hasanuzzaman 1045
1234.The Response of Main Crop Potential Productivity to Land Use Change: A Case Study in Western Jilin, China .....Pu Luoman, Zhang Shuwen 1046
1235.Environmental Evaluation of Rice-Frog Co-Cultivation in Shanghai Suburbs, China .....Qi Zhao, Wenxiao Guo, Yubo Yue, Xiaomei Yi, Linkui Cao 1046
1236.Effects of Sewage Sludge Amendment on Soil Bacteria Community Structure in Three Subtropical Plantations
.....Qifeng Mo[1], Shuangshuang Chu[2], Daoming Wu[2], Shucai Zeng[2] 1047
1237.The Research on the Evaluation System of Agro-Ecology Security in Hubei Province .....Sanman Li 1048
1238.Sewage Sludge Compost Fertilization in Municipal Garden: Effects on Mangifera Communis Growth and Heavy Metal Accumulation
.....Shucai Zeng, Shuangshuang Chu, Xiyuan Yang 1049
1239.Effects of Long-Term No Tillage on Gross Soil N Transformations in the Black Soil in Northeast China
Siyi Liu[1], Xiaoping Zhang[2], Jinbo Zhang[1], Christoph Müller[3], Zucong Cai[1] 1050
1240.Preference of Riptortus Pedestris (Hemiptera: Alydidae) 2nd Instar Nymph on a Gut Symbiont, Burkholderia Sp., in Laboratory Conditions .....
Soowan Kim, Jieun Lim, Minhyung Jung, Hong Geun Kim, Jung-Wook Kho, Doo-Hyung Lee 1051
1241.Relatonship between Flavonoids Content in Alfalfa and Pea Aphid Behavior .....
Sylwia Golawska, Iwona Lukasik, Iwona Sprawka, Cezary Sempruch, Agnieszka Klewek, Adrian Chojnacki 1052
1242.Organic Rice and Fishery Cooperation System- a New Integrated Aquaculture and Agriculture System .....Weibing Guan, Li Wang, Kai Liu 1053
1243.Modeling the Effects of Planting Density on Wood Productivity and Carbon Sequestration of Populus Dehoides Plantations in Northern Jiangsu, China
Weifeng Wang, Jinyan Yang, Shengzuo Fang, Honghua Ruan, Jianhui Xue 1054
1244.An Overview on Payments for Watershed Ecosystem Services in China and Other Countries .....Wenliang Wu 1054
1245.Ecological rice farming in the planting areas of southeast China .....
1246.Wenxiong Lin, Zhixing Zhang, Zhong Li, Saadia Azeem, Muhammad Umar Khan 1055
1247.Study on the Community Dynamics of Xylophagous Insects According to the Thinning History in Larch (Larixkaempferi) Forest in South Korea
.....Won IL Choi, Cha Young Lee, Soojin Lee 1056
1248.Transcriptome Analysis of Pseudostellaria Heterophylla in Response to the Infection of Pathogenic Fusarium Oxysporum .....

Xianjin Qin, Hongmiao Wu, Jun Chen, Linkun Wu, Sheng Lin, Umar Khan Muhammad, Reza Boorboori Mohammad, Wenxiong Lin 1057

1249. No Evident Correlation between Veterinary Antibiotic Degradation Ability and Resistance of Isolated Efficient Degradation Microorganisms for Doxycycline ..... Xin Wen, Yinbao Wu, Yan Wang 1058

1250. Bacillus Stearothermophilus Reduces Ammonia Emissions in Layer Manure Composting ..... Yan Wang, Lulu Bi, Xindi Liao 1058

1251. Impact of Grass Barrier on Runoff, Sediment and Nutrient Loads from Maize Fields in Northeast China ..... Yang Ou 1059

1252. Transcriptomic Analyses for Responses of Saponin Accumulation and Its Heterogeneity in Main Roots of Panax Notoginseng to as Stress ..... Yanqun Zu 1060

1253. Effects of Soil Amendments on Labile Organic Carbon and Soil Enzymes Activities in Upland Red Soil Yinghong Yuan[1], Jihai Zhou[1], Houbao Fan[1], Qianru Huang[2] 1061

1254. Predicting Phenological Changes of Monochamus Alternatus and Monochamus Saltuarius, Vector Insects of Pine Wilt Nematode in Korea, Under the Influence of Climate Change Using Phenology Model . Youngwoo Nam, Soo Jin Lee 1062

1255. Timing and Concentration Effects on the Defense Response of Maize Seedlings after Application of Salicylic Acid to Leaves Yuanjiao Feng, Jianwu Wang 1062

1256. Fall Nitrogen Application Is a Proper Choice to Increase Perennial Grass Seed Yield in Leymus Chenisis Grassland ..... Yujie Shi, Jinwei Zhang, Jiayu Han, Shouzhi Li, Junfeng Wang, Chunsheng Mu 1063

1257. Measuring Agricultural Production Efficiency under Climate Change Mitigation Constraints..... Yuping Bai[1], Xiangzheng Deng[2] 1064

1258. Soil Microbial Community Structure and Catabolic Activity Are Significantly Degenerated in Successive Rotations of Chinese Fir Plantations ..... Zeyan Wu, Wenxiong Lin 1065

1259. Aquaculture and Water Quality Maintenance in Nansi Lake, China ..... Zhang Liyuan, Gao Yuan 1066

1260. The Utilization of Fungi Waste in Large-Scale Broilers Breeding ..... Zhou Jiasheng, Song Hui 1067

1261. Study of the Zoning Planning of Agriculture Heritage Sites ..... Bo Yang[1], Lu He[2] 1068

1262. Preliminary Analysis of Seasonal Growth Rhythm of Timber Volume for Rubber Clone Reken 525 and Correlation with Meteorological Factors ..... Dongling Qi, Rui Sun, Guishui Xie, Zhixiaing Wu 1068

1263. Optimizing Ecosystem Services of Rice Paddy Fields in Taiwan ..... Hsing-Juh Lin 1069

1264. Sustainable Development of Red Soil Upland Ecosystem in South China

.....Guoqin Huang 1070
1265.Design and Functioning of an Information System for Dynamic Management of Rural Ecological Assets .....
Kun Zhang[1], Bin Ding, Xuehui Sun, Ling Chen[2], Yan Xiong, Jianping Guo, Renqing Wang, Shuping Zhang 1071
1266.An Analysis on Crops Choice and Its Driving Factors in Hani Rice Terraces
.....Lun Yang 1073
1267.A Dynamic Eco-Compensation Standard for Hani Rice Terrace System in Southwest China .....Moucheng Liu 1074
1268.A Study on the Investigationof Wild Edible Plants of 4 Main Ethnic Groups in Lahu-Va-Blang-Dai Autonomous County of Shuangjiang
.....Nan Ma, Qingwen Min, Zheng Yuan 1075
1269.Underpinning the Resiliency of Agricultural Heritage Systems, Smallholders, Family Farmers and Indigenous Communities
..... Qingwen Min[1], Su Zhang[1], Nadia Bergamini[2] 1076
1270.Effects of Nematode-Microbe Interactions on Carbon Stability in the Black Soil
..... Shixiu Zhang, Ping Liu, Shuxia Jia, Donghui Wu, Aizhen Liang 1076
1271.Assess the Roles of GIAHS Site in On-Farm Management of Agrobiodiversity in China .....Su Zhang[1], Qingwen Min[1], Keyu Bai[2], Nan Ma[1] 1077
1272.Assess the Role of Folk Religions in the Sustainable Development of GIAHS Systems ..... Su Zhang[1], Qingwen Min[2] 1077
1273.The General Framework for the Monitoring System of Important Agricultural Heritage Systems in China .....Wenjun Jiao[1], Shaohui Liu[2], Qingwen Min[2] 1078
1274.Development of a Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI) for Assessing the River Health in an Agricultural Region, China .....
You Zhang[1], Qi Huang[2], Long Cheng[3], Yongjiu Cai[1], Hongbin Yin[1], Junfeng Gao[1] 1078
1275.The Manifestation of Culture on the Labor Supply and Demand Balancing in Hani Rice Terraces System .....Zheng Yuan 1079
1276.Analysis of the N & P Sequestration in the Main Vegetation Types of Qin Lake Wetland .....Zhiwei Ge, Shuiyuan Fang, Chuan Li, Sai Peng, Rongwei Zhu 1080
1277.Effect of Grain-For-Green Project on Farmers' Operation Modes on the Loess Plateau of China .....Ziting Wang 1080
1278.The Foundations of the Intergovernmental Platform on Biodiversity and Ecosystem Services ..... András Báldi 1082
1279.Governance Dilemma and Socioecological Factors Influencing Sustainable Provision of Ecosystem Services in Mt Marsabit Forest Kenya .....Caroline Achieng Ouko 1083
1280.Regional Assessments of Biodiversity and Ecosystem Services in the IPBES Process: The Europe and Central Asia Assessment as an Example .....Szabolcs

Lengyel 1083
1281.Recent Progress in the IPBES Work Program .....Yi Huang 1084
1282.The Future of IPBES: The Finalization of the 1st Work Programme and the Development of the 2nd Work Programme .....Youngbae Suh 1085
1283.Spatial Analysis of Heavy Metals Contamination of Shallow Groundwater in Relation to Urban Sprawl and Intensive Agricultural Development Jianbing Wei 1086
1284.NDVI-based Vegetation Variation and Its Responses to Climate Change and Anthropogenic Activities in and around Large Cities of China .....Kai Jin[1], Fei Wang[2] 1086
1285.Towards Climate-Sensitive Urban Design-The Potential of Ground and Roof Greenery Lihua Peng, Xiaoshan Yang, Linye Yao, Chunlei Zhu, Zhidian Jiang, Tao Jin 1087
1286.Tscape in Residential Areas on the Cultural Services of Green Spaces, Using Zhengzhou as a Case Studyhe Effects of Cultural Land .....Luyu Wang, Qizheng Ma 1088
1287.The Development of Alien and Invasive Taxa List for Regulation in South Africa .....Moleseng Claude Moshobane 1089
1288.Risk Assessment and Zoning of Flash Flood Disaster in Southeastern Region .....Qi Yue[1], Linbo Zhang[2] 1090
1289.Research on the Dynamic Distribution of Pinus Densata Soil Seed Bank in Milin .....Qing Zhao 1090
1290.Land Development Suitability Assessment of the Pingtan Island Based on Ecological-Economy-Industry Comprehensive Analysis .....Qingsheng Li[1], Jinliang Huang[2], Cui Wang[3], Jinlong Jiang[3] 1091
1291.全球城市不透水面导致土壤碳库损失 ..... Shaohua Wu 1091
1292.Study on the Regulation and Construction of Urban Landscape Pattern for Sustainable Development of Water Environment ..... Xiji Chen[1], Shuo Huang[2], Lishan Xiao[1], Yanwei Sun[3], Yifu Yang[4], Qinghai Guo[5] 1092
1293.Effect of Urbanization on Soil Organic Carbon Fractions and the Carbon Management Index in Remnant Evergreen Broad-Leaved Forests of Pearl River Delta .....Xueying Zhang 1093
1294.Urban Ecological Security Assessment Based on Entropy Weight Method, Taking Shanghai Xuhui District as an Example .....Yi Wen, Jun Gao 1094
1295.Soil Bacterial Community Composition across Land-Cover Types in Urban Areas: A Case Study in Beijing, China ..... Yin hong Hu, Feng Li 1094
1296.Potential Range Expansion of the Invasive Galinsoga Quadriradiata under Future Climatic Change.....Yingbo Yang, Zhihong Zhu, Gang Liu 1095
1297.Assessment and spatiotemporal variation of landscape biodiversity based on InVEST model and remote sensing technology in the Bailong River Watershed,

China ..... Yuchu Xie 1096
1298.Study on Effects of Carbon Emission by Land Use Patterns of Inner Mongolia ..... Yue Wang, Feng Li 1097
1299.Variations in Land Surface Temperature and Cooling Efficiency of Green Space in Rapid Urbanization: The Case of Fuzhou City, China .....Zhaowu Yu, Xieying Guo, Gertrud Jørgensen, Henrik Vejre 1097
1300.Urban Ecological Security Assessment and Forecast of Typical Cities in the Guangdong-Hong Kong-macao Bay ..... Zhenyu Chen, Meirong S 1098
1301.Taxonomic notes on Family Bougainvilliidae (Anthomedusae) from South China Sea .....Chunguang Wang 1100
1302.Chinese Grassland Dilemmas - Working with What You Have David Kemp 1103
1303.Effect of Nonylphenol on Reproductive Toxicity in Intergeneration Zebrafish .....Dong Sun, Qi Chen, Shunshan Duan 1104
1304.The Systematic Conservation and Restoration Planning for Ecosystem Services in Yellow River Delta Wetland ..... Fangwen Zhou 1105
1305.Response of Marine Phytoplankton Community Structure, Composition and Its Change to Climate Change .....Heyang Li**,** Ying Zheng 1105
1306.Taxonomic notes on Family Bougainvilliidae (Anthomedusae) from South China Sea .....Mao Lin 1106
1307.Euphilomedes Biacutidens (Ostracoda, Myodocopida, Philomedidae), a New Species from China Sea ..... Peng Xiang 1109
1308.Phenolic endocrine-disrupting compounds in the Pearl River Estuary: Pollution characteristics of water body, biota and sediment ..... Qi Chen, Dong Sun, Shunshan Duan, Panpan Diao 1110
1309.Wetland Changes Affected by Coastal Reclamation: Cases of China's Major Deltaic Regions .....Tiantian Ma**,** Xiaowen Li 1111
1310.中国主要入海河流污染物和赤潮发生的关系 .....Weibing Guan 1111
1311.滨海入侵植物互花米草的地理变异与遗传分化 .....刘文文 张宜辉 1112
1312.跨区域海湾环境合作管理机制研究 .....丁小芹 张继伟 1113
1313.中英两国海洋环境保护法律体系比较与借鉴 ..丁小芹 张继伟 陈肖娟 1113
1314.Effects of Raising Geese in Corn Field on the Soil Physical and Chemical Properties, Weed Diversity and Maize Growth .....曹舰艇 关法春 1114
1315.Comparison of 5 Aging Structures for Pareuchiloglanis Kamengensis .....Chen Feng 1115
1316.Population Genetic Variations and Phylogeography of Cultrichthys Erythropterus ..... Chendi Wang, Qigen Liu 1115
1317.Diel Variation of Two Filter-Feeding Carps in Catches Captured by Trammel Net in Gehu Lake of Jiangsu Province in China
Dongdong Zhang[1], Youjia Kong[2], Shengpan Han[3], Qigen Liu[4], Zhongjun Hu[5]

1116
1318.The Effect of Algae Cultured with Different N:P Ratios on Nitrogen and Phosphorus Excretion of Two Freshwater Shellfishes ..... Mingxing Zhang[1], Youjia Kong[2,] Xixi Jia[1], Songlin Chen[1], Qigen Liu[1], Zhongjun Hu[1] 1116
1319.Research on Spectrum of Grassland Community in Lhasa River Basin .....Weijuan Li 1117
1320.Study on Interspecific and Intraspecific Allelopathy of Pinus Thunbergii, Pinus Densiflora and Pinus Tabuliformis .....Yuelin Hou 1118
1321.Comparison of Intestinal Index between Silver Carp and Bighead Carp Captured in Gehu Lake of Jiangsu Province, China .....Yuxue Shi[1], Youjia Kong[2], Zhongjun Hu[1], Yu Sun[1] 1118
1322.Study on the Influence of the Three Gorges Dam on Macroinvertebrates in the Tributaries .....Zhenbing Yang, Bo Zeng 1119
1323.Estimating Mangrove Canopy Chlorophyll Content with Proximal and Remote Sensing .....Chen Shi[2], Le Wang[1], Xile Cao[2] 1121
1324.Impacts of Vegetation Species and Rainfall Types on Runoff and Soil Loss Based on the Slope Plot Experiment on the Loess Plateau, China .....Hao Chen[1], Xiaoping Zhang[2] 1121
1325.Monitoring the Spatial Change of Vegetation Phenology in Xiangjiang River Basin Based on MODIS Vegetation Index Time-Series Data .....Huanhua Peng 1122
1326.Changes of the Five Holly Lakes in Tibetan Plateeau Due to Climate Change Affected by Glacier and Permafrost Cover, from 1977 to 2014 Using Remote-Sensing ..... Huiying Li[1], Xiaoyan Li[1], Zongming Wang[2] 1123
1327.新安江土地利用变化及其对水质的影响 .....刘乐 1124
1328.Discussion on Some Issues of Ecological Barrier .....Lichang Yin, Xiaofeng Wang 1124
1329.Remote Sensing Based Observation of Wetland Losses in Sanjiang Plain, China .....Mingming Jia, Zongming Wang, Chunying Ren, Dehua Mao 1125
1330.基于 SolVES 模型的关中—天水经济区生态系统文化服务评估与分析 .....Qiqi Zhao, Jing Li 1126
1331.Measurement of Ground Damages in Mining Areas Based on High- Resolution Remote Sensing Images: Integrating Techniques of Interpretation Knowledge Base, Multiple Masks, and Fuzzy Recognition Shaoliang Zhang, Huping Hou, Yaqing Xu 1126
1332.Study on Allelopathic Effect of Water Extract of Highland Barley Root on Lamiophlomis Rotata .....Shuling He 1127
1333.Study on Dynamics of Habitat Suitability for Waterfowls from 1990 to 2015 in the Ecological Function Zone of Sanjiang Plain .....Weidong Man, Mingyue Liu, Zongming Wang 1128

1334.Determination of Three Components of the Cultivation Morchella in Gannan Plateau .....Wenwen Guo 1129
1335.Applied Analysis for Canopy Multi-Parameter Retrieval of Winter Wheat Using Hyperspectral Vegetation Index
..... Xi Han, Shudong Wang, Xiaoyuan Zhang, Lifu Zhang, Xia Zhang 1129
1336.Study on Flora Spectra and Physiognomy of Subalpine Shrub–Grass Communities in Semi-Arid Valley of Lhasa .....Xingle Qu 1130
1337.基于面向对象的城市不透水面提取方法研究 .....Xiyan Biao 1131
1338.Assessment of the Impact of Urban Expansion and Climate Change on Net Primary Productivity in Guangzhou, China ...Y.Y. Wu[1], Z.F. Wu[2], S.X. Yu[3] 1131
1339.定量评价人类活动对净初级生产力的影响 吴艳艳 [1] 吴志峰 [1], 余世孝 [2] 1132
1340.Evaluating CASA Estimates of Forests Carbon Budgets Using Eddy-Covariance and Biometric Methods .....Yingchun Fu, Chao Ma 1133
1341.Rapid Assessment on the Efficacy of Wetland Conservation System in China Based on GIS .....Yonglin Mu, Li Xiaowen 1134
1342.The Effect of Landscape Patterns Evolution in Puzhehei Karst Lake Wetland Lake Littoral Zone on Water Quality ..... Yu Jing Guo1, Yan Wang[2] 1134
1343.基于 BBNs 的水源涵养服务的空间适宜性研究 .....Zeng Li, Jing Li 1135
1344.Effects of Herbicide from Agricultural Drainage with High Salinity on the Reed Wetlands in Western Songnen Plain, China .....Bolong Wen 1136
1345.Thermal Evolution Offsets the Synergism between Nano-Pollution and Global Warming and Drives yhe Effects on Body Stoichiometry
.....Chao Zhang, Mieke Jansen, Luc De Meester, Robby Stoks 1137
1346.Effects of Nitrogen Deposition on Major Understory Plant Nutrients and Rhizosphere Processes in Chinese Fir Plantation of Subtropical China
.....Fangchao Wang, Fusheng Chen 1138
1347.Effects of Hydrological Processes on Diatom Biomass in a Drinking Water Source Reservoir, China 1139
Guangwei Zhu[1], Chaoxuan Guo[1], Li Yu[1], Hai Xu[2], Mengyuan Zhu[2], Xiang Sun[2]
1348.Effects of Arsenic Contamination on Speciation of Phosphorus in the Sediments of Yangzonghai Lakeshore Wetland ..... Guiying Yang 1140
1349.Study on Photosynthetic Characteristics and Water Use Efficiency of Four Species of Woody Seedlings in Rare Earth Backfilling Haina Zhang, Xianghui Lu, Jiali Liu 1140
1350.荒漠植物花棒根际 AM 真菌生态地理分布研究 ...Haiyue Liu, Xueli He 1141
1351.Effect of Photosynthetic Structure Ratio on Plant Submergence Tolerance
.....Hangang Niu, Bo Zeng, Qiaoli Ayi, feng Lin 1142
1352.Short-Term Vegetation Succession after Ecological Restoration of Slopes in the High-Cold Region of China 1143
Hongyu Zhang, Zhaohua Lu, Xueqin Deng, Yaqi Zhao, Xianwei Liu, Yvsen Dong

1353.Growth Strategies of Woody Seedlings/Saplings Impeded by Dense Dwarf Bamboo in an Old Deciduous Broad-Leaved Forest
. Huimin Huang[1], Qingxue Guo[2], Rong Dong[1], Jinchun Liu[1], Jianping Tao[1] 1144
1354.Characteristics of Phytolankton Functional Groups and their Relationship with Environmental Factors in Shanghai Dianshan Lake
.....Li Yang, Liqing Wang, Wei Zhang 1145
1355.Community Structure of Macrozoobenthos and Its Relationship with Environmental Factors in Lake Dianshan .....Liming Zhu, Ruilei Zhang 1145
1356.Ecology Stability Assessment by GAHP and Fuzzy Mathematics on Mining Waste Dump .....Lina Yu, Zhaohua Lu, Xin Qin, Miao Son, Yao Wang 1146
1357.Regression Analysis between Planktothricoides Biomass and Environmental Factors in Urban Rivers from Shanghai City, China ..... Mengmeng Wang 1147
1358.Adaptive Traits of Plants Affect Their Performance under Submergence
.....Qiaoli Ayi, Bo Zeng 1147
1359.The Landscape Optimization of Ningjiang Basin Based on the Method of Spatial Principal Component Analysis and Minimum Cumulative Resistance Model
Qingpu Li, Zhengdong Zhang, Luwen Wan, Jie Zhang, Chen Ye, Yuchan Chen 1148
1360.Phage-Host Associations in a Full-Scale Activated Sludge Plant: Potential Impacts of Phage Predation on Treatment Performance
..... Ruyin Liu[1], Rong Qi[2], Juan Wang[2], Min Yang[2], Yu Zhang[2] 1149
1361.A Preliminary Study of Periphyton Community Succession in Winter Landscape Water .....Shan Chen, Liqing Wang 1150
1362.不同生活型蚯蚓对污泥处理的效果研究 .....Tianxiang Luo 1151
1363.Effects of Planting Densities on Ulmus pumila Growth and Soil Physico-chemical Properties of Seashore Saline-alkali Land in Jidong ..... Wanyan Song 1151
1364.Potential Ecological Risk of Heavy Metals in Cultivated Soil along an Urban-rural Gradient of Black Soil Region in Northeast China Wenbo Li, Dongyan Wang 1152
1365.Mature Community Structure of Periphytic Ciliate in Scenic Water and Its Relationship with Environmental Factor ..... Xiaomin Wu, Liqing Wang 1153
1366.荒漠花棒丛枝菌根真菌共生特征及地理分布 ..... Yanan Guo, Xueli He 1154
1367.Accumulation and Subcellular Distribution of Cadmium in Salix Variegate
Yuan Liu, Jianping Tao, Wenchao Ma, Danni He, Yongrong Xiang, Hong Wei 1155
1368.Study on Non - point Source Pollution Risk Area and Pollution Path Identification in Wuhua River .....Yuchan Chen, Zhengdong Zhang, Jie Zhang, Chen Ye 1156
1369.Removal of Endocrine Disruptors BPA Erythrina Peroxidase
.....Yunrong Xiang 1157
1370.Could Bighead Carp Be Used to Control the Overgrowth of Phytoplankton in Eutrophic Waters? .....

Zhen Zhang[1], Qigen Liu[1], Jiayong Pan[2], Liping Ren[2], Jinpeng Wang[2], Laisheng Chen[2], Guangxi He[2] 1157

1371.Characteristic of Filtration Rate by Anodonta Woodiana and Its Ability in Improving Water Quality Zhongkui Wu, Xiaochang Qiu, Xiufeng Zhang, Zhengwen Liu 1158

1372.西北荒漠花棒根际土壤微生物群落多样性研究 ...Zike Xuem, Xueli He 1159

1373.Exacerbated Nitrogen Limitation Ends Transient Stimulation of Grassland Productivity by Increased Precipitation .....Haiyan Ren 1160

1374.J200 激光质谱联用元素分析仪在绘制植物叶片的元素三维空间分布图中 .....Hongjuan Li 1160

1375.Floral Diversity between Organic and Chemical Farming Md Shafiqul Islam 1161

1376.Carbon and Oxygen Isotopic Signatures Reveal a Decoupling Between Stomatal Conductance and Photosynthetic Capacity Exposed to an Ozone Concentration Gradient .....Pin Li, Zhong Zhao Feng 1161

1377.Paleoecology of Penguin for the past 3000 Years and Its Association with Climate and Sea Ice Change .....Tao Huang[1], Liguang Sun[2] 1162

1378.The Status of Mangrove Forest at Alas Joyo Segara Anakan, Central Java .....

1379.Tjut Sugandawaty Djohan[1], Krisni Suhesthiningsih[2], Ryannyka Dwi Astuti[1], Djoko Legono[1] 1163

1380.Research on Spectrum of Grassland Community in Lhasa River Basin ..... Weijuan Li 1164

1381.The Use of Carbon Isotopes and Cs-137 to Study Dam Watershed Carbon Erosion Processes .....Xinhui E 1165

1382.稳定同位素红外光谱技术在生态系统水循环过程研究中的应用 .....Xuefa Wen, Xiaomin Sun 1165

1383.Effects of Simulated Warming on Soil Basal Respiration Rate of Forest Surface Layer at Different Altitudes in Sejila Mountain, southeast of Tibet .....Hong Yang, He Man Liu 1166

1384.Cropland Soil Quality Evaluation at a Regional Scale on the Loess Plateau .....Binbin Li[1], Mingxiang Xu[1], Panpan Li[2], Shengmin Zhang[3] 1167

1385.Rice Allelopathy on Weed Control and Underlying Molecular Mechanism .....Changxun Fang, Yingzhe Li, Wenxiong Lin 1168

1386.The Influence of Cultured Turtle Introduction on Rice Yield and Greenhouse Gases Emission .....Feng Li, Qigen Liu 1169

1387.植物叶片光合作用的气孔与非气孔限制研究综述 .....Guanlong Gao 1170

1388.Insights in the Mechanism of Proliferation on the Special Microbes Mediated by Phenolic Acids in the Radix Pseudostellariae Rhizosphere under Continuous Monoculture Regimes .....Hongmiao Wu, Wenxiong Lin 1171

1389.Contributions of Trap Crops to Optimize Agroecosystem for Sustainable Modern

Agriculture ..... Jiaxin Wang 1171
1390.Study on the Renewal Strategies and Methods of Urban Agriculture in Existing Residential Areas ..... Jie Zheng, Yukun Zhang 1172
1391.连作太子参土壤真菌 DGGE 分析及其拮抗菌的筛选鉴定 .....Jun Chen, Linkun Wu, Zhigang Xiao, sheng Lin, Wenxiong Lin 1173
1392.The Overall Effect Assessment of Different Celery Planting Process ..... Mengtian Hu, Baoliang Wang, Xinting Gao 1173
1393.Microbe Assisted Phytoremediation Could Be a Tool for Reviving the Soil ..... Muhammad Umar Khan 1174
1394.Plant-Microbe Assisted Reclamation of the Soil to Obtain Sustainable and Toxic Free Agricultural Products .....Muhammad Umar Khan, Wenxiong Lin 1174
1395.北疆地区棉花作物需水量时空演变及影响因子 .....Nana Luo 1175
1396.Analysis of Spatial and Temporal Characteristics Drought-Flood Based on Standard Precipitation Index in Northern Xinjiang Province in Recent 53 Years .....Nana Luo 1176
1397.Yield and Water Use Efficiency of Dryland Potato in Response to Plastic Film Mulching on the Loess Plateau .....Qiang Li, Hongbing Li, Suiqi Zhang 1176
1398.不同消减处理对连作三七根际土壤酚酸含量及真菌群落影响 .....Sheng Lin, Wenxiong Lin 1177
1399.Temporal Dynamics of Growth and Nutrient Uptake by Neighboring Plant Species: Evidence from Intercropping ..... Weiping Zhang[1,] Guangcai Liu[1], Jianhao Sun[2], Dario Fornara[3], Lizhen Zhang[1], Jacob Weiner[4], Long Li[1] 1178
1400.The Roles of Rhizosphere Microbiomes Mediated by Root Secretions in Consecutive Monoculture Problems of Pseudostellaria Heterophylla ..Wenxiong Lin 1179
1401.不同连作年限太子参块根定量蛋白质组学研究 ..... Xianjin Qin[1], Hongmiao Wu[2], Jun Chen[2], Linkun Wu[2], Sheng Lin[2], Wenxiong Lin[1] 1180
1402.The spatial structure analysis of virtual water for agriculture and crops in Jilin Province .....Xiaolei Xa, Yanji Ma 1181
1403.Impact of Tillage and Nutrient Management Practices on the Spring Weed Seed Bank in a Winter Wheat-summer Maize Rotation Farmland .....Xiuli Ge, NengWei Wang 1181
1404.The Nutrient Losses from Vegetation Coils and Its Effects on Plant Growth .....Yang Hao 1182
1405.Autotoxicity Problem in Ratooning Continuous Monoculture Tea (Camellia Sinensis L.) Gardens .....Yasir Arafat[1], Sheng Lin[2], Wenxiong Lin[2] 1183
1406.Farmers' Adaptation to Aridification in the Agro - pastoral Ecotone in North China .....Yingcheng Liu 1184
1407.Ecological Services Value and Space-time Evolution Analysis of the Qingjiang

Basin, China.....Zhengsong Lin 1185
1408.Introduction of Watershed Ecosystem in Fangshan Distict
.....Chen Cao, Xu Yong Li 1186
1409.京津冀城市群区域生态安全格局协调与优化 .....Guangdobg Li 1186
1410.Analysis of Wetland Landscape Degradation and Its Driving Factors of Beijing - Tianjin - Hebei Region from 1980 to 2015 .....Jinxia Lv, Weiguo Jiang 1187
1411.The Transformation of Nitrogen and Phosphorus in an Urban Scenic Rivcer with Rubber Dams and the Eutrophication Characteristics
.....Linlin bao[1], Xuyong Li[1], Peng Cheng[1], Mengyun Mi[2] 1188
1412.Study on Land Surface Temperature of Beijing-Tianjin-Hebei Region Based on Remote Sensing Images .....Ruimin Liu 1189
1413.Socioeconomic Transition and Associated Impacts on Energy and Water Consumption in Jing-Jin-Ji Region .....Xin Tian, Yan Zhang 1189
1414.京津冀湿地鸟类食物链和栖息地生境修复技术研究
.....Xuehong Bai[1], Wenjie Wang[1], Weiguo Jiang[2] 1190
1415.Understanding the Mechanism of Urban Material Metabolism with MFA and ENA-An Experimental Study for 13 Cities in the Beijing-Tianjin-Hebei Urban Agglomeration ..... Yan Xian Li, Zhang Yan 1190
1416.Study on the Change of Shannon Diversity Index in Beijing - Tianjin - Hebei Region Based on Moving Window .....Yinbing Zhao 1191
1417.Ecological Restoration Technical Plan and Key Demonstration Project of Liuli River Wetland Park .....Yonghong Li 1192
1418.A Comprehensive View of Municipal CO2 Emissions and Efficiency in China: Spatial Pattern and Socioeconomic Factors .....Yunyu Tian 1193
1419.Study on Ecological Security Cooperative Consultation of Beijing - Tianjin - Hebei Urban Agglomeration .....Zhenbo Wang, Chuanglin Fang 1194
1420.The Impact of Precipitation and Urbanization on Changes in Water Storage in Beijing-Tianjin-Hebei Urban Agglomeration
..... Zheng Chen[1], Weiguo Jiang[1], Wenjie Wang[2] 1194
1421.Differentiation of "Black Soil Type" Degraded Alpine Meadows in the Headwaters of the Qinghai-Tibetan Plateau, China
.....Guohua Ren, Caixia Wang, Fengcai He, Jingbin Zhang 1196
1422.Effects of Different Management Regimes on the Soil Seed Bank in Saline-Alkaline Grassland .....Hongyuan Ma 1196
1423.Eco-Evolutionary Dynamics of Plant Community Structure and Function in Tibetan Alpine Meadows
.....Kechang Niu[1], Jin Sheng He[2], Shiting Zhang[3], Martin J. Lechowicz[4] 1197
1424.Effects of Native Community Density on the Invasion of Different Genotypic Diversity of Solidago Canadensis .....Lin Liu, Hongli Li 1198
1425.Effects of Herbivore Assemblages on Nitrogen Cycling in Grassland

.....Ling Wang, Deli Wang 1199

1426. Response of Ecosystem CO2 Fluxes to Grazing Intensity during the Growing Seasons in the Inner Mongolian Meadow Steppe of China .....
Ruirui Yan[1], Huajun Tang[1], Shijie Lv[2], Dongyan Jin[1], Xiaoping Xin[1], Baorui Chen[1], Baohui Zhang[1], Yuchun Yan[1], Xu Wang[1], Philip J Murray[3], Guixia Yang[1], Lijun Xu[1], Linghao Li[4] 1200

1427. Patterns of Grazing-Induced Changes in the Abundance of Arbuscular Mycorrhizal Fungi in a Semi-arid Grassland .....Weiyang Gui 1201

1428. Differential Responses of Canopy Nutrients to Experimental Drought along a Natural Aridity Gradient
.....Wentao Luo[1], Qiang Yu[2], Zhengwen Wang[3], Xingguo Han[3] 1202

1429. Study on Phosphorus of Degraded Meadow Ecosystem in Wugong Mountain
..... Xiaomin Guo, Zhi Li, Shangshu Huang, Dekui Niu 1203

1430. Arbuscular Mycorrhizal Fungi and Plant Functional Group Removal Interactively Alter Plant Productivity in the Typical Steppe
.....Xin Yang[1], Yunting Zhang[2], Gaowen Yang[3], Yingjun Zhang[2] 1204

PLENARY LECTURES

Plenary Lectures

Bee or Not to Be? – Importance of Wild Bees for Well-Being and the Threats of Land Use Change

Anikó Kovács-Hostyánszki

Institute of Ecology and Botany, Hungary

Abstract: Animal pollination is necessary for almost 90% of angiosperm species and three-quarters of the 100 globally most important crop species. As numerous scientific studies and the recent global assessment by Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES) published as 'Assessment Report on Pollinators, Pollination and Food Production' pointed out, both the domesticated honeybees and wild pollinators such as wild bees, hoverflies are endangered by several drivers such as land-use change, land management, plant invasion, pests and climate change, and several species show considerable declines at different parts of the world, including the honeybee. As a consequence their pollination service for crops and non-crop plants can be failed. Therefore to suffice crop yields and the natural assemblages, conservation of pollinators and appropriate management of the semi-natural and the managed agricultural habitats is crucial. My talk will be addressed to 1) wild pollinator focused case studies in Central-Eastern Europe, a region harbouring still diverse wild pollinator communities but facing also different new challenges due to changing economic and environmental conditions; 2) science-policy interface through the work of IPBES and major outcomes of its global assessment on pollinators and pollination; and 3) based on our recent review highlighting ecological intensification as a strategic alternative to ameliorate pollinator decline while supporting sustainable food production, by promoting biodiversity beneficial to agricultural production.

From Vials to Lakes: On the Role of Environmental Complexity for Eco-Evolutionary Feedbacks in Microbial Communities

Bastiaan Ibelings

University of Geneva, Switzerland

Abstract: In this presentation I will explore the importance of environmental complexity - somewhat akin landscape heterogeneity - for microbial biodiversity. In particular I will seek to discuss the feedbacks between (i) environmental complexity, (ii)

the evolution of biodiversity and (iii) species co-existence and the long term maintenance of biodiversity in face of ecological processes like competition and parasitism. I will cover spatial scales ranging from micrometers in glass vials to hundreds of meters in deep alpine lakes and temporal scales from hours to decades. What creates complexity of the environment, which processes contribute? Complexity, amongst others is created through activity of the microbes themselves, so that one could say that it is life itself that generates the conditions for biodiverse ecosystems - through a process known as niche construction. In a heterogeneous and dynamic landscape, diversity is maintained through frequency dependent selection and non-transitivity – as in the game rock-paper-scissors. There are no overall winners which dominate the microbial community under all conditions 1. In lakes the indirect effects of climate warming have greatly altered the physical structure of the watercolumn and have enhanced heterogeneity, arguably allowing the co-existence of more phytoplankton species in alpine lakes at present than in the past 2. Climate change also plays a critical role in the interactions between phytoplankton and parasitic – chytrid – fungi. These host x parasite interactions are crucial for the maintenance of genetic diversity in ecosystems, but here climate change effects on lake ecosystems seem to negatively impact genetic biodiversity 3. In short, I will discuss questions concerning the evolutionary and ecological processes that create and maintain microbial biodiversity as well as the role of a changing environment on these eco-evolutionary feedbacks.

The Science and Practice of Valuing Nature in Decisions

Gretchen C. Daily

Stanford University, USA

Abstract: Over the pastdecade, efforts to recognize and value ecosystems as vital capital assets have been promoted by many as the last, best hope to secure Earth's life-supportsystems and human well-being. Therecognition is now dawning worldwide, and the challenge is to turn it intoincentives and institutions that will guide wise investments in natural capitalon a large scale.

I will discuss astrategy for meeting this challenge, and advances being made on three keyfronts. The first is in characterizingthe production of ecosystem services, in biophysical, economic, health, andcultural dimensions. The second frontieris the integration of this understanding into new, practical tools andapproaches for use in high-leverage decision contexts. The third frontier is in policy and financemechanisms now being implemented around the world.

Six lessons standout in the many pilot demonstrations underway in China and across the worldconcerning the science-policy process; the utility of simple models inreal-world decisions; enabling conditions and local capacity building; thereporting of

values in different metrics (not only monetary); the science gapin linking biophysical change to changes in human well-being; and communicatinguncertainty.
I will concludewith a vision for the work ahead to accelerate and greatly magnify the impactof the revolution underway.

Changing Winter Climate Alter Nitrogen Biogeochemistry in Northern Forest Ecosystems

Hideaki Shibata

Hokkaido University, Japan

Abstract: Nitrogen cycle is key process to support ecosystem productivity and functioning, affected by various natural and anthropogenic disturbances. Climate changes are one of the strong drivers to alter the cycle of nitrogen through various pathways. Changes in temperature and precipitation directly affect soil microbial vitality that contribute to nitrogen mineralization, immobilization, nitrification, denitrification, and leaching in the soil system. Winter climate (i.e., decrease of snowfall, increase of soil freezing-thawing events and/or increase of winter rainfall) has been recognized to influence the microbial nitrogen transformation even beneath the snowpack during the mid-winter. Those perturbations of nitrogen cycle in winter by climate change might cause significant impact for the ecosystem processes during the following growing season. I present the recent research findings on the effect of snowpack decrease and increase of soil freeze-thaw cycle on nitrogen cycles in northern forest ecosystems using in-situ experimental manipulation of snowpack in Hokkaido, northern Japan. The increase in soil freezing-thawing cycles significantly altered soil nitrogen processes especially for net ammonium production as a source of microbial nitrification, plant nutrient uptake and nitrogen leaching from soil system during the following growing seasons. Those impacts would be important to predict future changes of forest structure and functions under various environmental changes not only for climate changes but also change in atmospheric nitrogen deposition. Further knowledge gaps and future research needs will be also addressed.

Ecological Civilisation: A Map for the Future?

Isabel Hilton

Kings College London & China Dialogue Trust, UK

Abstract: This paper will examine the emergence of the idea of ecological civilisation in China's late industrial period, its connections with past thinking on ecology and its

relationship to the particular challenges facing China at the turn of 21st century; it will explore the implications for China's political economy, and ask how applicable this approach is elsewhere.

Generative Models for Ecological Forecasting: How Entire Communities Will Respond to Climate Change

James S. Clark

Duke University, USA

Abstract: Models used to anticipate community responses to climate change, termed species distribution models (SDMs), are increasingly recognized as unreliable and too imprecise to provide guidance—current estimates range from 0 to 50% species loss. SDMs fail to accommodate the joint relationships between species and the multiple scales at which different species are measured. A new, generative model, generalized joint attribute modeling (GJAM), accurately predicts the richness and abundance of species jointly as well as their organization in communities. It fingerprints the environment and location of sampled communities, verifying the capacity to predict new distributions and entire communities with climate change. Precision forecasts for ground beetles, vascular plants, and small mammals in the new National Ecological Observatory Network show that, contrary to previous emphasis on vulnerable high latitudes, community sensitivity is in fact highest in the South. The combination of rapid climate change in the north and high sensitivity in the south makes the velocity of risk highest in the continental interior.

Leveraging Values for Societal Transformations towards Sustainability: Some Bold Propositions

Kai Ming Adam Chan

University of British Columbia, Canada

Abstract: The socioeconomic transformation needed for the world's nations to meet global targets for biodiversity and ecosystem services will likely require more than a steady growth in the current conservation and sustainability efforts. Strategies suggested within the social sciences, including nudge and social practice interventions, seem to require large changes in infrastructure if they are to yield more than marginal change. What then will enable the needed upheaval of infrastructure? In this talk, I argue that we have given too little attention to social infrastructure--the institutional arrangements that specifically leverage widely held pro-sustainability values.

Relational values (values about human-nature relationships) are especially useful here, because they can be broadly enacted via novel norm-setting incentive schemes and finance tools. I will close by proposing a few bold pathways forward--as a starting point for welcome critique and debate.

Understanding Tropical Forests and Climate Change: A Journey along an Elevation Transect in the Amazon and Andes

Norma Salinas

Pontificia Universidad Catolica del Peru, Peru

Abstract: Tropical forests have a major influence on global patterns of biodiversity, ecosystem ecology, productivity and biogeochemical cycles, but they remain relatively understudied. Moreover, our understanding of many global patterns (e.g. of how biodiversity, ecophysiology or ecosystem function vary with latitude) are often influenced by a handful of data points from tropical latitudes (in contrast to swarms of data points from temperate regions). In this talk, I argue that many times the wet tropics are often treated as a warm, wet 'end-point' of most global analyses. However, comparison of tropical with extratropical regions is not straightforward, because of the vast geographical separations involved that lead to complications resulting from both biogeography and climate. I will also talk about the global awareness of the significance of the role that tropical forests play in the global carbon cycle has never been greater, but much uncertainty still exists as to the exact magnitude of this role. And I will close by arguing that our understanding of ecosystem ecology and function can be greatly advanced by considering environmental gradients within the tropics, whether gradients of moisture or of other climate variables. In particular, we propose that tropical montane elevation transects make excellent natural laboratories for understanding environmental controls on ecosystem function, especially temperature and it is a particularly powerful tool to further understanding of the influence of temperature on the biodiversity, ecology, ecosystem function and global change response of forest ecosystems.

China's Research in Ecology - Interface between Science and Policy-Making

Shirong Liu

Chinese Academy of Forestry, China

Abstract: Ecology is traditionally defined as the study of how living and non-living

things interact with each other and also with their environment, while the scope of Ecology is dramatically expanding with cross-scale and cross-disciplinary approaches in response to the complex and emerging regional/global eco-environmental problems. To tackle the existing challenges and cope with uncertainties under climate change, China's ecology research not only aims at the global ecology research frontier, but also emphasizes its role in underpinning the well-informed policy-making and the implementation of national strategies in support of eco-civilization and sustainable development, through provision of eco-friendly philosophy and concepts, ecological techniques and knowledge for national key engineering projects.China's ecology research has accomplished a number of achievements in basic ecology, applied ecology and long term ecosystem research network. The future China's ecology needs highlighting innovative scientific discovery and intrinsic ecosystem mechanism understanding, and interdisciplinary research on multi-processes and multi-scales; emphasizing process-based system modelling and prediction, while bridging ecological science and well inform decision and policy making. China's ecology will continue to attach attention on global change ecology, ecosystem services and ecosystem management, ecology in extreme living environment, degraded ecosystem rehabilitation, conservation biology, invasive species and ecological control, biogeochemical cycles, eco-hydrology and watershed management, epidemic ecology and evolution, urban ecology, eco-civilization and sustainable development.

Ecology on the Light Side: Explorations of Non-Forested Ecosystems

William J. Bond

University of Cape Town, South Africa

Abstract: It will be a talk on those ecosystems that occur in climates and on soils that can support forests but instead support grasslands, savannas, shrublands or open woodlands. I consider them to be a major anomaly to much classic ecological theory and, partly as a result, greatly misunderstood in international policy arenas.

Collating the Global Evidence and Using It to Make Local Conservation Decisions

William Sutherland

University of Cambridge, UK

Abstract: Conservation is difficult, the solutions are likely to vary between locations, there are challenges to doing field tests of conservation interventions and the literature

is difficult to access.

I will describe means of overcoming this problem. This includes the process of Subject-wide Evidence Assessment, a means of carrying out literature reviews on an industrial scale (we have over a thousand reviews on www.ConservationEvidence.com), the Local evidence assessment tool (a means of applying the global evidence to your particular local issue) and decision making processes for incorporating evidence with local experience and values.

I am actively seeking collaborators who are interested in transforming conservation.

Ecosystem Pattern, Services, Challenges and Governance in China

Zhiyun Ouyang

Research Center for Eco-environmental Sciences, Chinese Academy of Sciences, China

Abstract: Covering 9.6 million km^2, China has diverse ecosystems from permanent ice fields to tropical moist forests and holds 15% of the world's vertebrate and 12% of its plant species. Since 2000, government policies have led to rapid urbanization, aspired to protect more land, prevent deforestation, convert agricultural land to forests and restore degraded land — and do so on an unprecedented geographical scale. In 2012, China launched China national ecosystem assessment (CEA) to quantify ecosystem status and trends, and ecosystem service provision between 2000 and 2010.

(1) Changes in ecosystem Patterns. In 2010, grassland occupied 2,836,758 km^2 (30.0%) of China's land surface, followed by forest (20.2%), agricultural land (19.2%), and deserts (13.5%). Shrublands, wetlands, urban areas and others constituted the remaining 17.1%. Between 2000 and 2010, major changes occurred in urban areas and reforest areas.

(2) Changes in ecosystem quality. Overall, ecosystem quality was low. In 2010, high- and moderately high-grade ecosystems only occupied 21.0%, 19.4% and 17.4% of all forests, shrubs and grasslands respectively. Since 2000, 72.3% of forests, 53.1% of shrubs, and 50.3% of grasslands improved.

(3) Changes in ecosystem services. All ecosystem services evaluated increased between since 2000, with the exception of habitat provision for biodiversity. Food production had the largest increase (38.5%), followed by carbon sequestration (23.4%), soil retention (12.9%), flood mitigation (12.7%), sand storm prevention (6.1%), and water retention (3.6%), while habitat provision decreased slightly (-3.1%).

(4) Changes in ecological problems. China still faces serious ecological problems. Soil erosion and sand desertification affected 18.0% and 19.0% of the land in 2010. While from 2000 to 2010, degraded land decreased by 5.6%. Coastal areas experienced serious degradation. Natural wetlands along the coast decreased from 11,923 km^2 to 10,149 km^2, with the net decrease of 14.9%.

(5) Reasons for ecosystem change. Urbanization, ecological restoration and concerns for food security were the major factors changing ecosystem patterns in China. Overall, China's national conservation policies contributed significantly in improving ecosystem pattern, ecosystem quality and provision of ecosystem services.

(6) Policy implementations. The results generated by the CEA have already been applied in China. For example, 49.4% of China's land area has been newly incorporated into Ecosystem Function Conservation Areas (EFCAs). The findings and data set developed by CEA has also applied in national park planning and regional conservation policies.

THEME 1

Ecosystem Services and Management

T1-01: Conservation, Ecotourism and Human Health: Ecological Consequences of Cultural

Dealing with the Problems of Difficult Settlement in our Time: An Ecosystemic Approach

André Francisco Pilon

University of São Paulo, International Academy of Science, Health & Ecology, Brazil

Abstract: To deal with the severe problems of our time and disrupt the systems that drive them, we must consider the prevailing political and economic power asymmetries, the business corporations-oriented public policies, the bigoted paradigms of development, growth, power, wealth, work and freedom embedded the political, economic and cultural institutions and its consequences on public policies, research and teaching programmes.

In "asymmetrical societies", large differences in power between natural persons and legal persons (individuals and corporations), allow business holdings to have a substantial influence on public policies and State affairs; they essentially engineer the laws that legitimize their interests and actions, reinforcing their control on the regulatory agencies that should primarily operate in the public interest in view of a better quality of life.

Instead of dealing with the bubbles (segmented, reduced issues) and trying to solve isolated and localized problems without addressing the general phenomenon, the proposal emphasizes the definition of the problems deep inside the "boiling pot", where the problems emerge, encompassing the current "world-system" with its boundaries, structures, techno-economic paradigms, support groups, rules of legitimation, and coherence.

An ecosystemic theoretical and practical framework is posited for the evaluation and planning of public policies, research and teaching programmes, encompassing four dimensions of being-in-the-world (intimate, interactive, social and biophysical), as they combine, as donors and recipients, to induce the events (deficits/assets), cope with consequences (desired/undesired) and contribute for change (potential outputs).

As a process of reflection on, and appraisal of, assumptions and claims, it encompasses knowledge, values, feelings, beliefs, commitments (intimate dimension); allegiances, solidarity, partnerships, leadership (interactive dimension); cultures, public policies, citizenship, advocacy, mass-media (social dimension); vital needs, natural and built environment, territory, artefacts (biophysical dimension).

As a commitment to evaluation of collective views and practices, it implies transformations, reconsiderations, revisions, and significant expansions in concepts and

ideas along the way of exploration, inquiry, and discovery; it counteracts the political and economic dominant views of "development", usually associated with pollution, corruption, consumerism and the appropriation of thoughts and bodies as commodities for sale.

The objective is to unveil and deal with the "general phenomenon" that generates the contemporary problems that affect our quality of life: in the socio-cultural learning niches heuristic-hermeneutic processes create awareness, interpretation and understanding beyond established stereotypes, from a thematic ("what" is at stake), an epistemic ("how" to understand it) and a practical point of view (how o deal with it).

Education cannot be thought apart, it does not prosper in a context of disparities, social fragmentation and weakening social bonds: creation of choices, generation of capacities, development of motivations depend on cultural, social, political and economical aspects; the quality of institutions and incentive structures are more critical than the quality of individual motives and morals. Public policies, research and teaching programmes should

1) Observe the general phenomenon, instead of reducing it to isolated issues;
2) Combine all dimensions, assessing their deficits and assets, as donors and recipients;
3) Promote their complementarity and dynamic equilibrium;
4) Contribute for the transition to an ecosystemic model of culture.

Key words: Ecosystems, Politics, Economics, Ethics

Efficiencies of Energy Consumption and Carbon Emissions on Tourism Industry in Destination: A case of the WSA in China

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1 Beijing International Studies University, China; 2 Institute of Geographic Sciences and Natural Resources Research, CAS, China

Abstract: For promoting the efficiencies of energy consumption and carbon emission of the tourism industry for destination. The Wulingyuan Scenic Area (WSA) in China was chosen for the case study. With the detailed bottom-up analysis method, the theory of life cycle assessment and material flow, the direct, indirect, and total energy consumption and carbon emissions of the WSA in the tourism industry from 1979 to 2010 were measured. The measuring models for the energy consumption efficiency and carbon emissions efficiency of the tourism industry were established. The results showed the following: (a) main energy consumption from 1979 to 2010 depended on electricity, coal, and diesel, which accounted for 93.90%~99.42% of total energy consumption; (b) the annual growth rate of total energy consumption from 1979 to 2010 was 15.42%, and compared to 8.6×103GJ in 1979, the total energy consumption jumped to 633.7×103GJ in 2010; (c) the components of the total energy consumption in

the tourism industry had a significant fluctuation from 1979 to 2010. The percentage of energy consumption in tourism transportation decreased from 91.10% (7821.30GJ) in 1979 to 54.61% (346.078×103 GJ) in 2010; (d) the proportions of direct and indirect energy consumption in tourism industry from 1979 to 2010 experienced the sharp fluctuation. The proportion of indirect energy consumption to the total was 93.12% in 1979, and the direct one was only 6.82%, but they were flat with 50.29% and 49.71% in 2010; (e) the annual growth rates of direct and total energy consumption efficiencies from 1979 to 2010 were respectively increased by 9.68% and 16.95%. Direct energy efficiencies of the tourism industry in the WSA were $ 148.49 per GJ in 1979 and $ 2604.95 per GJ in 2010 and the total energy efficiency was $ 10.22 per GJ in 1979 and $ 1310.07 per GJ in 2010; (f) the annual growth rates of direct and total carbon efficiencies from 1979 to 2010 were respectively 9.70% and 16.39%. Direct carbon efficiencies of tourism industry were $ 954.44 per ton in 1979 and $ 16853.34 per ton in 2010 and the total carbon efficiencies were $ 85.00per ton in 1979 and $9401.11per ton in 2010.

Key words: Tourism industry, Tourism destination, Carbon emission, Efficiency

Ecotourism as a Way to Build up Partnerships between Kengting National Park and Local Communities- a Case of Shir-Ding

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1 National Taiwan University, China; 2 Dept of Environmental & Cultural Resources, National Tsing-Hua University, China

Abstract: While both mass tourism and indigenous communities being two of major pressures for national parks in Taiwan, this study aims to adopt Kengting National Park and Shir-Ding community as a case study to introduce and analyze the way and effects the national park interacts with local indigenous communities by developing ecotourism together. We used qualitative methods, such as interview, participant observation and focus group in the fields which mainly conducted in 2015 and 2016. There always were conflicts and tensions for land and resources use between Kengting National Park and Shir-Ding community before 2004. It took 5-6 years for an academic team to empower the locals developing a community-based ecotourism scheme sponsored by the Kengting National Park. The locals were able to monitor endangered species and habitats, patrol the trails and be interpreters for tourists. There are several key successful factors for this ecotourism scheme, including initiated and supported by the authority, accompanied and empowered by the academic team, enthusiastic officers, patience and communication, economic incentives, excluding outsiders and a new special community organization. It promoted local supports to the national park,

increase knowledge on protected species and habitats, sharing labors and efforts on park management and create alternative tourism site. Though some criticize that there are limited local participation in decision-making of park management, not enough economic benefits, and few links with local culture, this case demonstrates a new participatory paradigm on management of national parks in Taiwan. Based on the success of Shir-Ding, the Kengting National Park is keen to expand this model to build up a network of community-based ecotourism for more involvement of the locals in park management.

Key words: Capacity Building, Empowerment, Paradigm Shift, Community Monitoring

Higher Q10 of Carbon Decomposition in Finer Soil Particles Does Not Bring a Long-Lasting Dependence of Q10 on Soil Texture

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Abstract: Soil particle-size fractionation is a reliable approach for the division of carbon (C) pools with different stabilities. Our previous study found that C decomposition in fine soil particles had higher temperature sensitivity (Q10) than in coarse particles in grassland and forest soils. However, it is not known whether this phenomenon occurs in cropland soils and whether it leads to a dependence of Q10 on soil texture. We conducted a 107-day incubation of isolated soil particles from cropland soils—including paddy and upland—with contrasting fertilizer applications. The incubation was conducted over three short-term cycles of sequentially changing temperatures between 5 ℃ and 30 ℃ at 5 ℃ intervals. The results indicated that C decomposition was faster in the sand (>50 μm) fraction than in the silt (2–50 μm) and clay (< 2 μm) fractions; however, Q10 was generally higher in the clay fractions than in the other two fractions for all types of cropland soils, which is in accordance with our previous study. A high Q10 in fine particles may be due to its high C availability. Considering the aforementioned Q10 pattern across soil particles, we hypothesized that fine-texture soil should have a higher Q10 than coarse-texture soil. However, we observed this outcome only in the 1st and 2nd temperature cycle but not in the 3rd cycle. In conclusion, C decomposition in finer soil particles with a higher Q10 is likely a widespread phenomenon, but it does not bring a long-lasting dependence of Q10 on soil texture.

Key words: Soil Fractions, Temperature Sensitivity, Soil Respiration, Soil Texture

Impacts of Community Forestry on Biodiversity Conservation in Nepal

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Abstract: Nepal is one of the richest countries in biodiversity due to its unique ecological position and altitudinal variation. The country is one of the pioneers to implement community forestry program under decentralized forest policy regimes in the world. By 2008, approximately one third (34.6%) of forest areas were handed over to local communities for management of forest resources through their collective efforts in order to reduce poverty and integrate the forest benefits in overall economic development process. The objectives of study were to assess Shannon-Weiver species diversity indices as well as Margalef species richness indices and to explore whether or not the change in ownership among various forest governance systems contribute to increase overall biodiversity in forests. This study was focused to address the impacts of community forests in Lamahi-Mahadevpuri Landscape Complex (LMLC) area based on diversity indices and to examine the local people's preference among various forest governance systems adopted in changing socio-political context in Tarai region of Nepal. The hypothesis was set as community forests (CFs) encourage higher species diversity and species richness index than national forests (NFs).

Biodiversity of tree species, measured in terms of Shannon diversity index, in CFs, NFs and LMLC area as a whole were found 2.76, 2.58 and 2.78 respectively which are found to be higher than those values in CFs of Mid-hills of Nepal and also to be higher than those in farmlands of similar geographical areas of Nepal. However, these values were found to be lower than Mudamalai Wildlife Sanctuary of India, similar geographical and climatic conditions as of LMLC. The Margalef species richness index in CFs, NFs and LMLC area as a whole were 6.23, 5.63 and 7.28 respectively. The index values are found to be higher in CFs than NFs of LMLC area.

A total of 49 plant species were found in LMLC area while 34 and 38 species were recorded in NFs and CFs respectively. The species diversity and species richness index of different use types of plant species were found to be higher in CFs than those in NFs. The variance of species diversity index in CFs was found significantly different than in NFs. Despite species diversity, there was no significant difference in variance of species richness index between CFs and NFs.

Among different forest products, an increase in availability of fodder and fuel-wood were found after handing over the area as CFs. Tree species and wildlife were found effectively increased while NTFPs found moderately increased within the CFs after change in ownership as CF governance system. Shorea robusta was found as widely distributed plant species while Pterocarpus marsupium, Asparagus offcinalis and

Panthera Tigris were found as the major key/pristine species in the study area. CF was found as the most suitable governance system than others in LMLC area. Furthermore detail study needs to be conducted in different forest management regimes and in national level for comparison as well as for national database.

Key words: Community Forestry, National Forest, Biodiversity, Species Richness Index

Designing Wildlife-Based Tourism Programmes for Managing Species of High Conservation Value

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1 Minnesota Zoo, USA; 2 Yale University, USA; 3 University of Wellington, New Zealand; 4 Imperial College, UK; 5 Save the Rhino Trust

Abstract: Wildlife-based tourism is widely heralded as a potential conservation tool yet controversy surrounds its actual contributions to conservation. While negative consequences typically target technical problems in delivery, procedural or governance malfunctions such as inadequate and ineffective decision making are often overlooked. Although rarely applied within a tourism context, the policy sciences provide a theoretical and practical framework to understand the context of and improve the content for designing an effective natural resource management policy process. We applied a policy sciences approach to describe how an understanding of decision context embedded within the policy process can help lead to common interest solutions that ultimately improve the general sustainability of wildlife-based tourism. We demonstrate its utility by documenting and appraising a real-world rhinoceros-based tourism enterprise prototype in north-west Namibia operating since 2003. Strengths observed in the decision process were the inclusive nature and participant's willingness to reconcile different perspectives by finding common interest solution based on shared values such as human and rhinoceros well-being. The policy process could have been improved by mandating top management conduct more site visits and more frequent and independent appraisals are compiled. These results suggest a series of prototypical elements that are transferable including the establishment of a shared decision-making arena, adopting a fully inclusive management-oriented research agenda, employing a strategic messaging approach as a means to motivate compliance and possibly increase philanthropic behavior by tourists, and emphasizing a learning approach through role reversal opportunities that harness values for guides and trackers. In order to facilitate replication, attention should target establishing deeper contextual engagements with local community-based institutions who may host emerging tourism tourism enterprises, expanding the research agenda to include tourism's role towards

influencing pro-rhinoceros behavior change in both tourists and local community members. We suggest that conservation tourism, designed and managed holistically as a complex social-ecological system, has the potential to serve as a critical social foundation upon which additional protection measures for high-value, highly-threatened species such as law enforcement can function more effectively.
Key words: Conservation Tourism, Endangered Species, Policy Science, Context

Assessing the Importance of Ecosystem Services for Local Well-Being in Wolong Natural Reserve

Jianying Xu, Qing Wang

Capital Normal University, China

Abstract: Ecosystem service assessments have increasingly been used in environmental management and decision-making process, mainly focused on the biophysical and economic values of ecosystem services. Human well-being is at the core of ecosystem service definition, but there are little studies which explicitly include it as a part of ecosystem services assessments. As key stakeholder group of ecosystem services provision, it is necessary to involve local residents' evaluation of ecosystem service in the ecosystem service management. Our research gives a systematic research about the importance of ecosystem services for local well-being. A total of 24 ecosystem service (8 provisioning ESs, 10 regulating ESs, and 6 cultural ESs) were selected and their importance for individual and social well-being was evaluated respectively in Wolong Natural Reserve. The results show that 90.79% of the respondents can recognize the benefits that ecosystems provide for their well-being. Among the provisioning services, water was considered to be the most important for personal and social well-being, and almost all regulating ESs, with the exception of water conservation, were regarded as significant. The cultural services related to the recreation activities including tourism, relaxation, environmental education, were considered important for both individual and social well-being. Although there is a positive correlation between the individual and social well-being for each ecosystem service, local respondents give higher importance to social well-being than individual well-being. When it comes to the future trends of ecosystem services, it was widely perceived that most of regulating and cultural services would show a trend of increase or stable. On the contrary, five ecosystem services, including traditional crops, gathering, livestock, feed for livestock and soil fertility, were considered to be in decline trend. And maintenance of soil fertility was identified as key ecosystem service among all services. The multiple variance analysis and binary logistic regression method manifest a significant relationship between local residents' evaluation about the

importance of ecosystem services and their socio-cultural and economic characteristics. Gender, age, employment and economic status all have significant effect on local evaluation of the importance of ecosystem service s to their individual and social well-being. Our research is valuable for both ecosystem service evaluation and biodiversity conservation and natural reserve management.

Key words: Ecosystem Service, Well-being, Trend, Wolong Natural Reserve

The Effects of Three Fire Regimes on the Abundance of Hemiptera in a Tropical Humid Savanna (Lamto, Central C ôTe D'Ivoire)

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Nangui Abrogoua University, Ivorian

Abstract: This study proposes to evaluate the effects of three fire regimes (early, mid-season and late) on the abundance of Hemiptera. Three plots of 0.5 ha each, were delimited in three annually burned shrubby savannas of Lamto Reserve (6 °13 ' N, 5 ° 02' W). Thus, one plot for the early fire (November 2014), another for the mid-season fire (January 2015) and the last plot for the late fire (March 2015). The sampling dates have been occurred one day before, one day after and one month after each fire regime. The results show that (1) the abundance of Hemiptera increases one day after each fire regime. The greatest abundance recorded on the day following the mid-season fire. On the other hand, one month after the mid-season fire, their abundance decreases. (2) Thirty-two (32) families were identified and the dominant families are: Aphididae, Cicadellidae, Delphacidae, Diopsocoridae and Psyllidae. Their abundance vary differently according to fire regimes. In general, it appears that to the exclusion of mid-season fire, others fire regimes increase the abundance of Hemiptera.

Key words: tropical humid savanna, fire regimes, Hemiptera, abundance

Environmental Education in Conditions of Qianjiangyuan National Park, China

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IGSNRR, China

Abstract: The purpose of this study is to provide a framework for environmental education in Qianjiangyuan National Park, China. As an important goal of national park and other protected areas, environmental education serves as a tool to support environmental consciousness and improve environmental edification in Qianjiangyuan National Park, which was designed as one of nine national park pilot projects in China.

Through questionnaire and Structural Equation Model, we explore influential factors of environmental education derived from six variables: facility, content, location, and security system. Then, we designed a conceptual framework describing the integration of conservation and nature-enjoying in environmental education. We found two key approaches related to this integration: vision of nature protection which aims to inform audiences of ecological concepts and focuses on school students and vision of sustainability which engages adult audiences. Education for community-based environmental management may be effectively used in environmental education for the realization of goal of Qianjiangyuan National Park.
Key words: Qianjiangyuan National Park, Environmental Education, Structural Equation Model, Framework

Alien Plant Species Association with Recreational Roads in a National Park in the Eastern Himalaya, China

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Abstract: Information on plant invasions in the eastern Himalayan region of China is limited, whereas the region contains a significant floral biodiversity both essential for China and worldwide. This paper for the first time examined the distribution and biodiversity of alien plants in a popular national park in this region with booming tourism since 1990s. Total of sixty one alien plant taxa were found among roadside plant communities, which were frequently disturbed by hikers, pack animals or recreational vehicles in the park. The species predominantly were from America and Europe, and were merely annual or biennial herbs. The most common plants were from families of Compositae, Amaranthaceae and Solanacea. The diversity of alien species varied with the distance from the park entrance. High numbers were found at road heads and ends, which are generally subject to intense human disturbance. Also the average number of alien species varied according to the usage types of road, with motor road and horse-riding trail harboring more aliens than hiking trail. The result highlights the important role of vehicle and pack animal play as alien dispersal vectors in the park, which is an important element for future management. Other actions on invasion management include the development of education program, motivate tourist participating monitoring program, and use native species for re-vegetation to prevent the spread of aliens from the roadside the native plant communities and rugged landscapes.
Key words: Alien Plant, Recreational Road, Distance Pattern, Usage Type, National

Park, The Eastern Himalaya

Factors Affecting Inn Operator's Willingness to Pay Resource Protection Fees: A Case of Erhai Lake in China

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Abstract: Resource protection fee is a form of ecological compensation. The willingness to pay (WTP) such fees is the scientific basis for the ecological compensation standard establishment and an important foundation for the ecological compensation policy implementation. Because of good ecological environment, a large number of inns have gathered around the Erhai Lake in Yunnan, which has become a typical gathering area of inn operator. Taking the operator for research object, a comprehensive analysis of influence factors of WTP for resources protection fee, the model hypothesis of the relationship between perceived benefits, institutional trust, ecological compensation, support attitude and WTP was constructed. The related data obtained through questionnaire survey, study on factors influencing the Inn operator's WTP for resources protection fee by using smartPLS software. 307 analysis of open questionnaire results show that the influence of perceived benefits on inn operator's WTP is not obvious and ecological compensation cognition, institutional trust, and support attitude is significantly related to inn operator's WTP. Furthermore, it is confirmed that supportive attitude plays a partial mediating role in the impact of ecological compensation cognition on WTP. The study results show that there are significant different factors in inn operators and tourists, residents of WTP for ecological compensation fees. This research can further perfect ecological compensation theory, and also have important implications on making the ecological compensation policy.

Key words: Inn Operators, Eco-compensation, Willingness to Pay, Erhai Lake

Economic Value of National-Park Ecotourism Via Human Mental Health

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Abstract: Exposure to nature yields a wide range of mental health benefits. These apply very broadly, though with differences between countries and cultures. Improvements in mental health have substantial economic value, through: reduced

mental healthcare costs, both paid and unpaid; improved workplace productivity, through higher performance, lower stress and reduced absenteeism; and reduced costs of antisocial behavior, both public and private. These costs total over $200 billion p.a. in Australia, well over $10,000 per adult per year. Economic gains from improved mental health associated with ecotourism and other visitation in national parks thus represent a large and quantifiable ecosystem service (Buckley & Brough, https://doi.org/10.3389/fevo.2017.00016). In 2017, we have tested whether park visitors are representative of broader populations, in terms of self-reported quality of life, and use of publicly funded mental health services. We found that park visitors are substantially happier than the broader population. We are currently conducting further analyses to control for socioeconomic differentials in park visitation. Also since that review, we have identified one additional valuation pathway, using quality-adjusted life-years. This approach has recently been applied in the U.K. We have also identified one additional economic category, namely unpaid labor by careers for persons with mental health difficulties. This is valued at $13 billion p.a. in Australia, considerably more than the value of paid mental health treatments. We are currently testing culturally effective social mechanisms to encourage more people to engage in outdoor activities in nature (Buckley, Westaway & Brough, https://doi.org/10.3389/fpubh.2016.00257).

Key words: Conservation, Ecotourism, Health, Culture

Designing Ecotourism in a Chinese Cultural Context for Sanjiangyuan National Park

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Abstract: China has recently declared a three year pilot phase for its first IUCN-II National Park at Sanjiangyuan, Qinghai. This pilot phase includes design and pilot trials for ecotourism plans, products and experiences. These draw upon best practices available internationally for recreational opportunities, visitor management, environmental monitoring, tourism economics, and community involvement, so as to create a new Chinese national-park ecotourism system that is fully integrated with Chinese governance and land tenure systems, and cultural traditions and expectations. The focus is on river tourism, notably rafting on the rivers themselves, and hiking and trekking in the river corridors and nearby mountain ranges. The aim is to create a portfolio of safe, well-managed lifetime-list wilderness experiences for Chinese and international visitors at all skill levels, with a range of different price and luxury options. Sanjiangyuan presents enormous opportunities for park based ecotourism development,

including new employment for local communities, but it also presents challenges in flexible design accommodating local priorities, and the particular concerns associated with remote access, high altitude, and strong seasonality. Detailed plans for the principal river corridors have been created and are currently under discussion with major stakeholders.

Key words: National-park, River-tourism, Conservation, Culture

First Evaluation of the Impact of Catch Activities and Illegal Commercialization on Populations Ofgold Finches (Carduelis Carduelis) In the North-East Algerian Guelma Region

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1 Departement of Biology Guelma University; 2 Annaba University

Abstract: Overexploitation of resources is a very important factor in the erosion of biodiversity. The capture and illegal commercialization of some species of wildlife are serious threats to some species. Algeria is a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1982, in line with this process of protecting wild fauna and flora, the latest update of the List of animal species belonging to wildlife was updated by Executive Decree No. 12-235 of 24 May 2012. In Algeria songbirds are highly appreciated by amateurs as pets, unfortunately the loss of habitats continued repeated forest fires in the Mediterranean region and also the illegal capture of these birds cause serious damage to populations. The elegant goldfinch is the species most prized by amateurs because of these beautiful colors and its very singing, other species like the canary are used for breeding with the goldfinch and thus the creation of hybrids. In order to estimate the impact on populations and also the economic impact of the capture and illegal commercialization of wild birds, a survey was conducted at the level of the bird market, City of Guelma. The results obtained indicate that between 3000 and 12000 goldfinch individuals are emerging are caught every year and about 1200 are sold on this market alone, for the serine the catch is estimated at more than 1000 individuals. The economic impact of this activity is not for the sale of animals.

Key words: Wild Birds, Illegal Capture, Algeria, CITES

Can an Advertising Campaign Reduce Chinese Desire for Elephant Ivory in China?

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1 Sun Yat-Sen University, Singapore; 2 IFAW, USA

Abstract: Poaching of African elephants and smuggling of their ivory have risen sharply since 2007, fueled by a soaring demand for ivory in Asia. Stopping demand for ivory is becoming an essential strategy along with stopping elephant poaching and ivory trafficking in order to save elephants. To reduce consumer demand for ivory, an advertising campaign, aiming to evoke empathy among the public towards elephants by explaining that baby elephants growing tusks could mean the killing of their families, was launched in 2009 in China, a key consuming country and a primary destination for contraband ivory. We present the results from a 2013 evaluation survey on the causal impact of this nation-wide mass media campaign. Using a robust matching technique, we estimate that the odds of seeing the advertisement and self-reported buying ivory in the future is only 0.5 times the odds of not seeing the campaign and purchasing ivory. Further, we find that awareness about the origin of ivory seems to make a significant difference to self-reported future ivory purchasing intentions. The results also shed light on the important role clear government policy making ivory trade illegal in all circumstances combined with increased public concern for elephants could have in dissuading ivory consumption. This is the first ever evaluation of an advertising campaign using messages to evoke sympathy and empathy for elephants and provide robust empirical evidence on the positive effects these messages had in reducing Chinese consumers' stated desire for ivory. At a time when the escalating demand for ivory is threatening the survival of elephants, our study provides an important insights for designing demand reduction campaigns and messages that can potentially influence consumer target audiences' behavior and address an urgent global conservation priority.
Key words: Demand Reduction, CITES, Human Attitudes and Behavior

Concentrations, Distribution and Source Apportionment of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediment Cores from the North of Dianchi Lake

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Nanjing Normal University, China

Abstract: Two sediment cores were collected from the north of Dianchi Lake, Southwest China, in order to establish sources and temporal trends of polycyclic aromatic hydrocarbons (PAHs) in this region. Temporal trends of concentrations of ΣPAH16 in the north of Dianchi Lake are characterized by three stages: a slight variation stage in the deeper segments; a sharply increasing stage; a decreasing trend in the most recent sediments, especially after 2000s. We found the highest total PAH concentration in 1990s, and a decreasing trend from 1990s until present. The increasing economic activity had the largest impact on the PAH vertical distribution. The

implemented measures for pollution control in catchment since 1990s might reduce point source input of PAH in some degree in recently. Sedimentary TOC and TP were considered the important factors that influenced the concentrations of PAHs in this study, and it was found that sedimentary TOC and TP are crucial factors determining the sorption, sequestration, and fate of high molecular weight PAHs. The PAHs in the sediments were dominated by low molecular weight PAHs, suggesting that the primary source of PAHs was low-and moderate temperature combustion processes. However, both the significant increase in high molecular weight PAHs in the upper sediments, suggesting that a change in the sources of PAHs from low-temperature combustion to high-temperature combustion. PAHs in the cores are dominantly pyrogenic in source, they are mainly from the incomplete combustion of liquid fossil fuels (diesel and gasoline for vehicles, crude oil) and vehicular emissions.

Key words: Polycyclic Aromatic Hydrocarbons (PAHs), Sediment Cores in Dianchi Lake, Temporal Trend, Source Identification

The Synergism of Plant-Derived Compounds and Sex Pheromones of Spodoptera Litura

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Abstract: To evaluate the effects of plant-derived chemicals on attractions of Spodoptera litura to sex pheromones, the electroantennogram (EAG) and neuronal (intracellular recording) responses of male moths to mixtures of sex pheromone blends (SPs, $Z9E11^{-14}$: OAc: $Z9E11^{-14}$: OAc = 9: 1) and each plant-derived compounds (benzaldehyde, β-caryophyllene, phenylacetaldehyde, 6Z-nonadienal, linalool, isoamyl isovalerate, longifolene, and β-ocimene) were determined. In addition, the behavioral responses (wind tunnel and field trapping bioassay) of S. litura to the mixtures of SPs and each plant-derived compound were tested to confirm the effects of plant-derived chemicals on their EAG and neuronal responses to SPs. Finally, the SPs and mixtures of SPs and volatiles-induced currents of oocyte expressing the sex pheromone receptor, SlituOR13 were measured by voltage clamp. The results indicated that benzaldehyde, β-caryophyllene, phenylacetaldehyde, 6Z-nonadienal, and linalool significantly enhanced, whereas isoamyl isovalerate significantly decreased the EAG and neuronal responses of male S. litura moths to SPs. Longifolene and β-ocimene have not significant effects on the responses. These results were also evidenced in wind tunnel and field trapping bioassays. Nevertheless, the voltage clamp measures showed that only phenylacetaldehyde and 6Z-nonadienal significantly increased, and the other compounds had not significant effects on the inward current responses of oocyte

expressing sex pheromone receptor to SPs, probably suggesting no essential correlations between olfactory responses and functions of a certain sex pheromone receptor. These findings could not only provide theoretical basis to optimize the strategies using sex pheromones to control S. litura and the other agricultural pests, but also give an insight relationships between the olfactory responses and sex pheromone receptor.

Key words: Plant Volatiles, Sex Pheromones, Synergism, Spodoptera Litura

Study on the Protection and Innovation of Traditional Food Culture from the Perspective of Protection of Agricultural Cultural Heritage

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Abstract: According to the definition of the Food and Agriculture Organization of the United Nations, the agricultural cultural heritage is a unique land use system and agricultural landscape formed by long-term synergistic and dynamic adaptation of human beings and their environment. This landscape is rich in biodiversity and can meet Local socio - economic and cultural development needs. The inheritance and development of traditional food culture plays an important role in the protection of biodiversity of agricultural cultural heritage, the inheritance of culture and the growth of economy. At the same time, the protection and development of agricultural cultural heritage is the basis of the formation and development of local traditional food culture. In this paper, the basic information of the local residents and their cognition and attitudes of the food culture were obtained through questionnaires and interviews. This paper discusses the present situation, value and significance of the protection of food cultural heritage. Through evaluation analysis and cross analysis, The results show that the residents of the case of the local traditional food culture awareness, but agree that the region's food culture and the region's agricultural development is closely related to tourism attractiveness is also an important factor. On the basis of investigation and analysis, the author analyzes the protection and innovation of local traditional food culture from three aspects: local agricultural heritage, traditional food culture and residents' perception.

Key words: Agricultural Cultural Heritage, Traditional Food Culture, Protection, Innovation and Development

A Study on the Measurement of Sustainable Tourism Efficiency and Improving Strategies in China

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Abstract: The United Nations established the year 2017 as the International Year of Sustainable Tourism, thus further enhancing the importance of tourism in society, economy and ecology. Sustainable tourism in China plays a significant role in ecological civilization construction and regional green development. Based on the review of sustainable development at domestic and overseas，this study utilized the DEA model to measure the efficiency of sustainable tourism from 2005 to 2016 with the data of 50 typical tourist cities in China. Additionally, with the method of ESDA-GIS, Trend-surface Analysis and Panel-data Model ， the study explores the temporal and spatial characteristics and the related influencing factors. The results show that the efficiency of sustainable tourism presents an upward trend in China's major tourist cities, which is significantly affected by varieties of factors including economic scale, industrial structure and so on. In the end，the study indicates that optimizing the spatial layout of tourism industry, improving the tourism consumption and allotment market as well as driving tourism administration department's Macro-economic control by big data, can contribute to promote the efficiency of sustainable tourism in China.

Key words: Sustainable Tourism, Efficiency, Measurement

Landscape Evaluation of Hiking Trails in Zhangjiajie National Forest Park Based on Uni-polar EEG Technology

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Abstract: In China, national forest parks are a type of protected areas and there are currently over 800 national forest parks. As the first national forest park in China, Zhangjiajie National Forest Park receives more than 4 million tourists a year. But tourists are not allowed to go out the hiking trail to avoid unnecessary damage to nature. Therefore, as a continuous landscape, the landscape of hiking trails will definitely impact the recreation use intensity of different tour paths.

Traditionally, ways of forest landscape evaluation falls three categories, Descriptive Inventories, Psychophysics, and Surveys and Questionnaires. However, the reliability and validity of the evaluation results may without exception be affected by the

subjective feeling of the evaluator in the process, causing the inconsistency between the actual mental response of the evaluator and the evaluation results. What's more, in the above methods, continuous tour paths are usually needed to be divided into discrete "spots". To reduce the impact of the subjective factors on the evaluation results, scholars, especially Ulrich, have tried a new way of forest landscape evaluation by using physiological means. Unfortunately, the technology equipments couldn't carry around and thus a larger sample in outdoor tests are impossible. Therefore, research in this area remained stagnant by the time. However, portable physiological testing technology has made great progress in 21st century, making it possible to have a larger sample in outdoor tests by using physiological means. This study applied Uni-polar EEG acquisition device (Mindwave brain tester) and did out-door experiments on 410 objects in Zhangjiajie National Forest Park. These objects were grouped by 10 and wore Mindwave brain tester simulating ordinary tourists visiting tour paths in Huangshi Zhai, Jinbian Brook, and Yuanjiajie. The tester sent out an original brain wave signal to the Android cell phone which had already installed a special APP via Bluetooth every second. And then, the original brain wave signals were decoded by algorithm calculation into the attention value and saved in the SD card in the cell phone in text format. From the analysis of the results, it proved that brain wave acquisition device has a very high reliability because the test-retest reliability is 0.6776 and the parallel-forms reliability is 0.933. Then, the continuous changes of tourists' brain wave were recorded in Huangshi Zhai, Jinbian Brook, Yuanjiajie, and Yaozi Zhai in Zhangjaije National Forest Park. It reveals the best landscape quality of the tour paths in Huangshi Village. While the test of the same sample revisiting the same tour path shows that the objects'attention decreases with the increase in the number of visit. Moreover, the decrease is greater and the aesthetic weariness is more obvious in the second visit than the third.

In conclusion, Uni-polar EEG technology can be effectively used in landscape resource management in protected areas and as an important means of controlling recreation use intensity.

Key words: Uni-polar EEG, Conservation, Landscape Evaluation, Hiking Trails

Impact of Tourists' Environmental Awareness on Environmentally Friendly Degree: A Case Study of Qinghai Lake, China

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Abstract: Based on environmental awareness theory and tourists perceive theory, we introduced the tourist environmental awareness, perceived quality, perceived gains and

losses, and the environmentally friendly degree as the structure variables. Meanwhile, the quality awareness was been introduced as an intermediary variable to build a conception framework of the mechanism of impact of environment consciousness on the tourism pro-environmental behavior. Through confirmatory factor analysis and three-phase structural equation model, this paper identified the impact path and strength between these factors and between the factor and its dimension. Furthermore, the mediation mechanism of tourist's perceived quality in the relationship between environmental awareness and perceived value, as well as its potential effect on tourist environmental behavior also been quantified. The Qinghai Lake, located in Tibet plateau, a famous scenic spot, and the ecological sensitive area was been selected as the case area. The results show that: (1) there exists differences in the ways of the influence of environmental awareness on perceived gains and perceived losses respectively. Specifically, the strength of this impact on the latter is smaller than the former. (2) The perceived gains could promote the environmentally friendly behaviors and the perceived losses have a negative impact on the tourism responsible behavior. (3) The mediation mechanism of the perceived quality is substantial and with which the influence of tourists environmental awareness on environmental friendly behavior could be intensified. (4) The influence of perceived quality in perceived-gains-model was higher than that in perceived-losses-model.

Key words: Environmentally Friendly Degree, Tourists, Environmental Awareness, Perceived Quality

Assessment of Local Community Attitudes towards Wildlife Conservation at Mangla Dam, AJK

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Abstract: The success of wildlife conservation depends on perspective of people for conservation. The assessment of local community attitudes for study of wildlife conservation and their perceptions towards natural resource conservation is an important feature for sustainability. Man utilizing natural resources that is increasing tremendously for last century without realizing its importance. Planning and development sector in Pakistan constantly ignoring the vitality of biodiversity and their function for human stabilization environment. The Mangla dam is most neglected wetland of international importance which has not been assigned the status of wetland, even it fulfill the criteria to be a Ramsar site. This wetland is representing a wide variety of biodiversity among them the most prominent are its migratory avian diversity which are tribute to Pakistan. This research resolute the livelihood conditions of the local

communities of villages (Khoi Rata, Dadyal, Kotli and Bhimber) for their dependency on biodiversity of Mangla Dam, from 2013 to 2014. Socio-ecological status was assessed by Participatory Human Resource Interaction Appraisal (PHRIA) method. During consultations a community resource map, pictorial documentation and a capacity-building workshop was organized with engagement and ownership of the community and with respect to the resource management processes and participation. The findings concludes that generally local community was dependent on dam products for use of fuel wood (64 percent), livestock grazing (89 percent), fishing (90 percent), hunting, freshwater turtles trading (03 percent). Poverty status defines that villages around dam range from 15 to 80 percent as the common international poverty line is roughly $1 a day. Although poverty relates to excessive use of natural resources around dam yet the findings also determine that the current frenzy for exploiting natural resources are creating to escalate environmental degradation consequently the rural dwellers were a major contributor to wetland's degradation. The socioecological indicators also accentuate that the management will be operated at local, state, national, and international level. Thus, proper understanding and coordination between the departments will be an important element for management of wildlife with some international status if recognized by Ramsar.

Key words: Wildlife Conservation, Community Assessement, Mangla Dam AJK, Pakistan

T1-02: Ecosystem-service-based Management: Science and Policies

The Varying Impact of Agri-Environment Schemes on Avifauna in Two Regions of Poland

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Abstract: Agri-environment schemes (AES) have been implemented in Poland since 2004, yet the effects of their implementation were not systematically monitored until 2010. For 2011 we compared the number of species, the number of territories of all breeding species, and the number of territories of target species for bird-oriented AES in two regions of Poland: foothill and lowland. We also determined the impact of environmental variables and the AES on the number of territories of the eight most frequent farmland species. More species and a higher number of territories were recorded in the lowland plots than in the foothill plots. The proportion of land under AES at the study plots did not have a substantial impact on the number of species and the number of territories of all species in both regions, while a negative relationship between the number of territories of the priority species and the proportion of land under AES was found for the lowland region. Environmental variables significantly affected the number of territories of two species in the foothill region and three species in the lowland region. The results imply the necessity of verifying AES dedicated to bird conservation. Requirements of AES aimed at too many species and "averaged" for the entire country are ineffective in the case of rare species. In order to increase the effectiveness of AES, they should cover regional variation and be aimed at individual species, not the entire avifauna or not even a group of species, as it was during our studies.

Key words: agri-environment schemes, extensive farming, birds, Poland

Research on Global Biodiversity and Ecosystem Services during 1990–2015: A Bibliometric Analysis

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Abstract: We performed a bibliometric analysis of published biodiversity and

ecosystem services research for the period of 1990–2015, based on the Science Citation Index-Expanded (SCIE) database. Our analysis reveals the authorial, institutional, and spatiotemporal patterns in biodiversity and ecosystem services research and provides an alternative demonstration of research advancements. The growth of article outputs in biodiversity and ecosystem services research did not explode until the 2005. Ecology, environmental sciences, plant science, biodiversity conservations, and marine & freshwater biology were most frequently used subject categories in biodiversity and ecosystem services studies, and ecology, plos one, oikos, journal of applied ecology, and journal of ecology were most active journals in this field. The United States, the United Kingdom, and Germany were the top three contributors in global biodiversity and ecosystem services studies, as they produced more single-country and collaborative articles. The largest contributors among the institutions focusing on biodiversity and ecosystem services studies was Chinese Academy of Sciences, but collaborative articles just a little, and was located at the peripheral position of collaboration networks. By co-word clustered analysis, it confirmed that the terminology preferences changed from the linkages between soil, carbon dioxide enrichment, no-tillage agroecosystems, and species-diversity for the period of 1990–2000, then to the linkages between conservation, patterns, stability, resilience, scale, and plant diversity for the period of 2001–2010, and finally to the linkages between productivity, functional diversity, functional traits, complementarity, plant diversity, species richness, and land use for the period of 2011–2015.
Key words: Biodiversity, Ecosystem services, Bibliometrics, Research progresses

Valuing the Storm Surge Mitigation Effect of Coastal Wetland

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Abstract: Storm surge presents a severe threat to life and property along the coast. Coastal wetlands provide a natural levee for storms by attenuating waves and creating a buffer zone between the landfall location of the storm and populated regions. This paper investigates the contribution of coastal wetland vegetation to hurricane storm surge protection. I analyze 59 tropical storms and hurricanes to have hit the U.S. since 1996, and construct a county-level storm surge damage and coastal wetland distribution dataset using geo-spatial data on land cover across the United States. The main result of the paper is that for coastal communities suffering from storm surge damage, a 1% loss of coastal wetland is associated with a 0.6% increase in property damage, controlling for specific storm and county characteristics, as well as property value under flooding risk. Moreover, the average marginal value of coastal wetland for protecting properties from storm surge is estimated to be about $0.4M per square kilometer along the coast of

the Gulf of Mexico.

Key words: Wetland, Storm Surge, Valuation, Hurricanes

How to Integrate the Value of Ecosystem Services and the National Economic Accounting System? Take Weichang County as an Example

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Abstract: Ecosystem service is the foundation of human survival and development, and the value of ecosystem service and ecological products reflects the ecosystem contribution to human well-being. But how to integrate the ecosystem service value and the national economic accounting system and how to put it management decision are the important scientific problems which guarantee of national or regional ecological security, and they are also the current international forefront topic in ecological research. At present, most countries still use GDP to measure the economic development level of countries and regions, while some scholars tried to use green GDP and the gross ecosystem product (GEP) replace GDP, but whatever GDP or GEP is not enough to reflect the region's social-economic-natural development level. Therefore, this article selects WeiChang County for study area, through estimating the ecosystem services (biological conservation, water conservation, soil conservation, windbreak and sand-fixation and biological carbon sequestration) value, ecological product value and environmental value loss, and on this basis, tried to build an index which called GDEP (Gross domestic and ecosystem product) instead of GDP or green GDP to measure the social-economic-natural development level of regional criteria of assessment, the initial formula of GDEP calculation is GDEP =α GDP＋β GEP-γEnL. The study provided the following results: (1) the ecosystem service value of WeiChang County is about 55.871 billion yuan in 2015 and the ecological product value is about 8.155 billion yuan. The proportion of the value of windbreak and sand-fixation is the largest of Weichang County ecosystem services value, is about 26.75%.(2) the environmental loss value is about 13 million yuan in 2015, while GDEP which deeply Influenced by the gross ecosystem product is about 65.356 billion yuan, as much as seven times of GDP (only about 9.498 billion yuan).(3) the GDEP which considering the economic and social development and even environmental condition can be more objective reflection of the country or region's social-economic- natural development level, but there are still some problems remains to be further studied and discussed, such as the parameter selection

and calculation method choice.

Key words: Ecosystem Services, Human Well-being, Asset Management, Economical Accounting System

Identifying the Supply-Demand Mismatches for Ecosystem Services Management: A Case Study in an Eco-Fragile Region of Loess Plateau, China

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Abstract: A key challenge in Ecosystem services (ES) research is to develop a comprehensive framework, which can integrate the supply-side and demand-side of ES. ES supply-demand mismatch means the differences in quality or quantity occurring between ES supply and demand. The mismatches may cause the unsatisfied ES demand and even be the threats to human well-being, so the identification of the mismatches is necessary to ES sustainable management. In this paper, we introduce a framework to identify the ES supply-demand mismatches to improve ES management with three basic steps: (i) assess the supply of ES by biophysics-related indicators; (ii) assess the demand of ES by social-economic indicators; (iii) compare the supply and the demand to identify the ES supply-demand mismatches. We illustrate this through the two ES in Yulin, an eco-fragile region of Loess Plateau, which is the core region of Green for Grain project. Green for Grain project involves the effort to return cultivated land on steep slopes to perennial vegetation and afforest barren hills and wasteland. As the project proceeds, grain production and carbon sequestration services' changing has caused broad attention. The supply and demand of grain production and carbon sequestration in 12 counties of Yulin from 2005–2013 were evaluated by incorporating multiple data and methods. The supply of grain production was directly derived from the statistical yearbook, and the supply of carbon sequestration was estimated through the Carnegie Ames Stanford Approach (CASA) model. The demand of grain production was captured using human consumption-related indicators and the demand of carbon sequestration was quantified using an indicator based on regional anthropogenic carbon emissions. The results show that the supply of grain production and carbon sequestration fluctuated with the increasing trends, which could be attributed to investments in natural capital (i.e., chemical fertilizer, agricultural machinery power and afforestation). The demand of grain production and carbon sequestration both exhibited significantly increasing trends, which were mainly because of economic development and population growth since 2005. Spatially, the

supply and demand of grain production and carbon sequestration services showed different distribution pattern in 12 counties of Yulin. The mismatch counties of grain production and carbon sequestration services were identified through the ratio map of ES supply and demand, which is helpful to policy makers in managing those services in the eco-fragile region of Loess Plateau.

Key words: Ecosystem services supply, Ecosystem services demand, Supply-demand mismatches

The Building of Ecological Service Assess Index System of Dryland Terrace Agriculture System Based on Coupling Structure

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Abstract: Sheridan County Dryland Terrace Agriculture System, located in Taichang Mountain in the south of Hebei Province, is a kind of typical agricultural production space and bio-cultural landscape. In 2014, it has been named as "China-NIAHS" (China Nationally Important Agricultural Heritage Systems) by the Ministry of Agriculture of China. The spectacular view of dryland terrace was produced by the local people's constantly adapting to the environment and surroundings with great prominent ecological adaptability and cultural creativity. To analyze the agri-ecological functioning of the dryland terrace, the investigator applied the model analysis approach, regarded the DPS ("Donkey-Pepper-Stone") coupling structure model as an analysis unit. The research revealed that the three factors play different roles in the agri-ecological system and the coexist relationship among them is quite strong. In brief, donkeys strengthen the terrace during the farming procedures, and provide growing nutrients for peppertrees. As for pepper trees, the roots of them solidify the structural strength of the stone terrace and offer its leaves as the feed of donkeys. Meanwhile, the stone terrace affords agriculture production space for villagers, on which donkeys (animals) as well as peppers (plants) are fed, with rich ecological functionality and high agricultural production. Based on the analysis result, the investigator set up a coupling factor index system to make quantitative analysis on dryland terrace in different districts in Shexian County and evaluate the overall agri-ecological function. Therefore, the index system is a powerful ecological monitoring and management tool for the dryland terrace agriculture system as well as local reference of payment of ecological service, and the popularization and application of the index system can be conducted among the other agriculture heritage system spots with successful experience in dryland terrace.

Key words: Ecological Service, Dryland Terrace Agriculture System, Coupling

Structure

The Importance of Feedback Links from Ecosystem Functions to Species for Ecosystem Management.

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Abstract: Globally ecosystems are degrading and there is an urgent need for conservation actions to preserve them. These endeavors are increasingly conceptualized within an integrative framework that captures the connections between biodiversity, ecosystem function and the ecosystem services they support. This framework mainly considers the one-way connection from biodiversity through function to services, however many ecosystem functions also support biodiversity. For example, nutrient cycling and pollination are ecosystem functions that provide ecosystem services by supporting agriculture, while they also play critical role in supporting biodiversity as a feedback. However, these feedback links from ecosystem function to biodiversity are rarely addressed within a management context. While incorporating these feedbacks would be ideal, obtaining information on these links between specific function and biodiversity could be both expensive and time consuming. Without further information to guide decision makers on the value of investigating the feedback structures, strategies will be made based on partial information on ecosystem dynamics, which might lead to undesirable ecosystem outcomes. Hence, new modelling methods are required to provide decision-support that will reduce strategy bias and reach better conservation outcomes.

In this study, we focus on understanding the value of ecosystem function feedback links for ecosystem management. Specifically, we quantify value as the improvement in ecosystem management when we consider feedback links and how this varies with the characteristics of the ecosystem and management options available. We propose a network theory approach to capture the trophic interactions between species, and non-trophic interactions among species, ecosystem functions and ecosystem services. We then use Markov Decision Processes (MDP) to model the decision problem, and a genetic algorithm to calculate the value of information (VOI) from reducing our uncertainty about ecosystem function feedback links. We find that the value of understanding these feedbacks is high but the magnitude of this value varies markedly depending on the structure of the ecosystem. Overall our study suggests that managers should consider ecosystem function feedback linkage within ecosystem dynamics to attain better biodiversity and service conservation.

Key words: Optimal ecosystem management, Network theory, Value of information, Optimization

A Comprehensive Eco-Economic Regionalization Method Based on Ecosystem Service Values Assessment: A Case Study from an Urban Area in China

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Abstract: It is an urgency to apply ecosystem service assessment to eco-ecological management and promote sustainable development. Ecological functional regionalization of a region is a prerequisite job. Comprehensive eco-economic regionalization (CEER) is to divide an area geographical zones based on the ecological, economic, and social similarity and disparity. In this study, the CEER model of a typical urban area (Suzhou-Wuxi-Changzhou region) was constructed. Data on 11 selected indicators were gathered for the 28 county-level cities/urban districts. Then they were analyzed through spatial clustering analysis integrated with evaluation of ecosystem services values (ESVs), GIS, and scenario setting. 8 kinds of ESVs were accounted from the matter and value quantity aspects. The results showed that the total ESVs has obvious spatial heterogeneity during the period 2000–2010, and their value variations in the study area experienced an ascending trend from the middle to the periphery area. After that, the study area was assigned to 4 eco-economic zones, namely synergetic development zone, ecological conservation zone, ecological degradation zone, and economic development zone. The regionalization result was able to coincide well with the existing ecological protection planning. It demonstrates the regionalization scheme is very comprehensive, concise and applicable. The work has established a novel methodological framework for CEER of large-scale area, especially a typical urban area in China.

Key words: Eco-economic Regionalization, Ecosystem Service Values, Spatial Clustering Analysis, Urban Area

Construction of Urban Ecological Security Pattern Based on the Least-cost Distance Model

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Abstract: At the current level of accelerating urbanization, regional ecological security

is being seriously damaged. As the benefits people obtained from ecosystems, ecosystem service is the premise and guarantee of ecological security. In order to scientifically construct the ecological security pattern, it is firstly necessary to identify the ecosystem service value in an accurate way. At present, most domestic studies estimate the ecosystem service value based on the research results of Constanza or Xie Gaodi and directly put ecosystem service static value select the estimation of the average value per unit area. Few have taken the importance degree of every single ecosystem service into consideration, simply considering each ecosystem service of equal importance. However, ecosystem is dynamic, and this will lead to the objective difference in the change rate among each kind of ecosystem service. Therefore, the fast decreasing service will not be effectively protected if we simply consider each service of equal importance. In addition, the spatial agglomeration of ecosystem service will also have influence on the recognition of ecological sources by affecting their functions. Taking Liangjiang New Area as the research area, this study first calculated the ecological static service values from 2009 to 2012. We then established two indexes: the significance index based on the average change rate of each ecosystem service and the spatial richness index based on the spatial agglomeration of each ecosystem service, to reconstruct the ecosystem service value in 2012, which was then applied to the reconstruction of low, medium and high levels of ecological security pattern. Thus, the reconstructed ESV was not only qualified with the same currency unit, but also filled with abundant spatial information. The results showed that: (1) the total ecosystem service static values from 2009 to 2012 decreased year by year, among which the food production, soil formation and protection, and carbon fixation had the fastest loss rates. (2) The reconstructed ecosystem service values in 2012 ranged from 201 yuan/hm2 to 23634 yuan/hm^2, while most regions were dominated by low and middle values. (3) The areas of low, middle and high level of security source were 174.73km^2, 208.69km^2 and 222.20km^2. The ecological security patterns of different levels would satisfy the multiple construction needs and provide fundamental assurance for the normal function of the ecological service in the future construction of Liangjiang New Area, which would benefit the sustainable development of the area in the long run.

Key words: Significance of Ecosystem Service, Spatial Richness of Ecosystem Service, Reconstruction of Ecosystem Service Value, Ecological Security Pattern

Assessing the Value of Mangrove for Erosion Protection in Urban Sea: A Case Study of Xiamen Bay

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Abstract: The near shore habitats, such as mangroves, saltmarsh and dunes, are natural assets that protect coastal properties and people by dissipating wave energy and/or acting as barriers against high waves and high water levels. Understanding and measuring the protective benefits these natural habitats provide against erosion and inundation in near shore environments is increasingly important in the face of a changing climate and growing development pressure. Considering that seawalls have been constructed to protect coastal communities in most of coastal urban area, traditional approach measuring the value of protective services in term of the value of avoided property damages is not adequate. This study developed a model to assess the value of mangroves for erosion protection in urban sea in term of reduced probability of dike breaking and the avoided dike restoration costs. The results by employing the model in Xiamen Bay indicated that mangrove can reduce the average wave height and wave energy 36.45% and 52.48% respectively. The marginal value of mangrove for erosion protection ranged from RMB 3.5 to 5.7 per year. These results can inform the development of coastal habitats restoration strategy confronting the challenge of sea level rise and dramatically shrinking of coastal habitats areas due to the human activities.
Key words: Mangrove, Urban Sea, Erosion Protection, Xiamen Bay

Environmental Loss and Damage Assessment in China: Principle, Procedure and Practice

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Abstract: With increased public attention on environmental quality, Chinese government has been implementing stricter environmental regulation and reforming on environmental policy to steer the development towards a more sustainable manner. Ecosystem function and service is highly valued and, on the other hand, the damage of nature resources is heavily punished. Establishing environmental policy compensating for environmental damage were initiated as times requires. Directed by Central Leading Group for Comprehensively Deepening Reforms, pilot program with package of supporting regulations from administration, legislation and enforcement in Ministry of Environmental Protection (MEP) were carried out in 2015. One of the great challenges of compensating policy is the lack of systematic technical guidance to assess environmental loss and damage. In this research, we presented the ecological economic theory underlying damage compensation, and procedures to carry out damage assessment in environmental incident. An investigation in a forestry ecosystem damage caused by illegal coal mining in Baotou, Inner Mongolia Autonomous Region was used

to illustrate damage assessment approach. The damage was evaluated followed by a series of technical guidelines endorsed by MEP: Baseline was defined; Interim loss was quantified using Habitat Equivalency Analysis. Cost of restoration alternatives were calculated respectively using discounting. The resulting report was submitted to the court and served as a reference for compensation.

Key words: Environmental Damage, Damage Assessment, Compensation Policy, Ecosystem Service Valuation

Assessment of the Capital Values of Marine Biological Resources in Sanya

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Abstract: According to the data of national offshore marine environmental survey and evaluation, this paper assessed the capital value of marine biological resources in Sanya coastal waters, including the values of fishery resources and coral reef resources. The distribution density of fishery resources in Sanya sea area is 973.24 kg/km^2 in 2006, and the total fishery resources reserves are 3135.61 tons, mainly including marine fish, crustaceans and cephalopods. Among them, the resource reserves and distribution density of fish are the largest, respectively 835.76 kg/km^2 and 2692.68 tons, which is up to 85.87% of the total resource distribution density and reserves of fishery resources. Cephalopod, approximately 72.31 kg/km^2 and 232.97 tons, is about 7.43% of the total fishery resources. And, the distribution density and reserves of crustacean are the lowest, only 65.17 kg/km^2 and 209.96 tons, which is about 6.70% of the total fishery resources. Therefore, fish is the dominant in the total fishery resources in Sanya coastal waters. In addition, according to the statistics, there are more than 200 species of fish in Sanya sea area, and about 40 species with high economic value. Crustacean has only 8species, including 5 kinds of shrimp and 3 kinds of crab. And, Cephalopod is altogether3 species. It has been also shown that the distribution density and total reserves of fishery resources present distinct seasonal change. There are 734.19 kg/km^2 and 2365.43 tons in spring, respectively. In summer, with 1597.98 kg/km^2 and 5148.40 tons, autumn with 1041.61 kg/km^2 and 3355.90 tons, and winter with 519.18 kg/km^2 and 1672.70 tons. The seasonal variation pattern of fishery resources is summer > autumn > spring > winter.

The values of fishery resources in Sanya coastal waters are evaluated using the evaluation of market price method. In 2006, Sanya offshore fishery resources reserves are 3135.61 tons, which value 71.3145 million yuan. Among them, fish are 2692.68 tons and 60.7199 million yuan; for cephalopod, 232.97 tons and 5.4716 million yuan.

Crustaceans are 209.96 tons and 5.123 million yuan. It can be seen that 85% contribution is from fish in the values of fishery resources in Sanya.

In the marine ecological types of Sanya, the most characteristic is the coral reef ecosystem. The coral of Sanya is the best scenic landscape in Hainan province and even the whole country and also has the most sustainable development value. The coral reef in Sanya belongs to the transitional area of coral reef distributed in China, and is the most close to the typical ocean distribution area, and its status is very important. According to the data, in 2006, the Sanya sea area has been recorded in 81 species of scleractinian coral. The stock of fish resources from the coral reef areas in Sanya is 302.19 tons, and its value is 6.8143 million yuan.

In conclusion, according to our evaluation results, the marine biological resources reserves in Sanya coastal waters are 3437.80 tons, and the total capital values are 78.1288 million yuan in 2006.

Key words: Sanya coastal waters, Marine biological resources, Capital value

The Change of Landscape Pattern in Beijing Fringe Area and Its Impact on the Ecosystem Services: A Case Study in Niulanshan-Mapo Town

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Abstract: The city in China was continuously expanding in recent years, which was affected by the rapid social, economic development and urbanization, especially for the metropolis like Beijing. As urban fringe areas are now in the phase of rapid economic development, human activities, which has significant impacts on the landscape pattern, and causes the changes of the ecological service function. Therefore, it is very crucial and meaningful to study the changes of landscape pattern and the corresponding ecosystem service value in the urban fringe of China. Niulanshan-mapo town was a typical representative of urban fringe area, located in the outside edge of sixth ring road in Beijing, with a distance of 50 km to the center region of Beijing city. So, this study takes Niulanshan-mapo town as an example, in consideration of the important position in the construction of new town located in Beijing fringe area. The Fragstats 4.2 spatial analysis tool was used to determine dynamic index of landscape pattern according to the land use data of 1992, 2001 and 2015.The ecosystem services equivalent factor tables was based on the present studies and we make further revision according to the actual situation of grain production and price in Beijing. Thus, this study investigated the changes of landscape patterns and ecosystem services value in Niulanshan-mapo town during 1992 and 2015. We conducted analysis to reveal the relationship between

landscape index and ecological system using SPSS statistical software. The results showed that landscape pattern changed dramatically in Niulanshan-mapo town. Fragmentation and heterogeneity also increased greatly in this area. Moreover, the dominant landscape types changed from farmland to construction land, and the ecosystem service value increased from 116.09 million yuan in 1992 to 149.92 million yuan in 2015. Meanwhile, the forest ecosystem service value increased from 1109.67 million yuan in 1992 to 8940.98 million yuan in 2015, indicating that the contribution of the forest land to the increase of ecosystem services value was the largest among all the landscape types. According to the analysis on the relationship between landscape index and ecological system, it was beneficial to the increase of ecosystem service value through improving the value of the largest patch index, patch density and diversity index. However, as the landscape pattern varied among different region, the relationship of landscape index and ecosystem services value was different. Hence, it was essential to conduct deep analysis on the degree of influence of the ecosystem service by each landscape index. In conclusion, this study not only analyzed the time and spatial change of land use, but also analyzed the structure change of ecosystem service value change in the rapid development urban fringe region. We determine the major land use types and reasons to generate ecological service value increase or decrease. The findings through this study were that, on the one hand, the interference of the landscape pattern may not necessarily lead to the degradation of ecosystem service function in the context of rapid urbanization. On the other hand, scientific and reasonable planning and protection policy on ecological environment were the main reasons for the increase of land ecosystem service value in Niulanshan-mapo town, a representative of urban fringe area.

Key words: Beijing Urban Fringe Area, Landscape Pattern, Ecosystem Services Value, Niulanshan-mapo Town

The Spatial Dynamics of Reconstruction of Urban Village: A Case Study on Xishan District, Kunming during 2004–2016

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Abstract: As one particular outcome of urbanization in China, ‘urban village’ has attracted more and more attention during city renewal due to its complexity and negative influence on urban development. The spatio-temporal dynamics of urban village reconstruction was investigated in this paper based on GIS analysis. A case study was conducted on Xishan District, Kunming City, China. Three characteristics of urban village reconstruction were found in the study area. (1) The reconstruction

process during 2004–2016 can be roughly divided three stages including ineffective control, rapid development, and sudden termination. (2) The reconstruction was gradually pushed from the outside to the inside of the city center with the restriction of the cost and difficulty rather than the urgency and significance. (3) Only few area has finished the urban reconstruction although most has finished housing demolition. It is suggested that systematic spatio-temporal planning of urban village reconstruction and matched construction and renewal should be addressed in the future to obtain healthy urban development.

Key words: Urban Village, Dynamic Analysis, GIS, Kunming

Effects of Land Use and Climate Change on Ecosystem Services in Central Asia's Arid Regions: A Case Study in Altay

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Abstract: Understanding the effects of land use and climate change on ecosystem services (ES) can provide more scientific and targeted guidance for the sustainable use of ES in arid regions. Altay Prefecture is representative of the mountain-basin system (MBS), and this study focused on changes in ES under land use and climate change in this area from 1990-2010. Firstly, we divided the system three landscape zones: mountain, oasis and desert. We then assessed water yield, soil conservation, crop production and sand fixation in the years 1990, 2000, and 2010 based on widely used biophysical models. Finally, we analyzed the effects of different land use and climate change situations on ES. The results showed that soil conservation in the mountain zone, water yield in the oasis zone, and sand fixation in the desert zone all decreased under the influence of land use change alone, which indicated that land use change increased the risk of soil salinization in the oasis zone and reduced the protection of the oasis zone provided by the mountain and desert zones. The total provision of ES showed an increasing trend under the influence of climate change alone, but spatial differences in climate change created significant challenges for the improvement of productivity in the oasis zone and ecological conservation in the desert zone. We provided a methodology to quantify the influences of land use and climate change on ES, and to identify the location of the influences. This study demonstrated the necessity of improving the ecosystem management strategy for the MBS, and we put forward some targeted suggestions for the sustainable use of ES. Although uncertainties remain, the results of this study can provide valuable reference information for regions with the same MBS structure.

Key words: Ecosystem Services, Land Use Change, Climate Change, Central Asia's

Arid Regions

Transnationally Coherent Sea Shipping Planning in Baltic Sea Region- Design and Results of a Game-Based Quasi-Experiment

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Abstract: In order to increase the MSP authorities in Europe to cooperate over the coming years, from 2016 two MSP projects "NorthSEE" and "Baltic LINes" are initiated by Interreg and led by the German Dederal maritime and Hydrographic Agency, as the first ever joint implementation of integrated MSP projects in the North and Baltic Sea, aiming to increase synergy even across two sea-basins. Both projects work together with expert institutions and sector stakeholders on developing coherent transnational planning solutions on a large (sea) spatial scale.

As part of the two European MSP projects, a "MSP Challenge - Short Sea Shipping Edition" is designed and developed as a 'table top strategy / war game' – for policy-makers and strategists working in the area of ecosystem based Maritime Spatial Planning (MSP), the development of sustainable Blue Growth and (Short Sea) Shipping.

The game is played in the fictional marine area called the 'Rica Sea', an anagram for Rivers and Coastal Areas and used with kind permission of Searica, the EP Intergroup on IMP Seas, Rivers, Islands and Coastal Areas. The RICA Sea is represented graphically on a large table top game board (1.60 x 2.80 m), with a stylized map of the fictional area with three countries – Island, Bayland and Peninsuland– shore the Rica Sea. The countries around it have only recently agreed to start planning their shared uses of the sea, by allocating functions to marine space over time.

During a typical game session of a few hours, up to 20 players are assigned the role of planner or shippers in one of the three countries. The main challenge for the players is to achieve Blue Growth (BG) and Good Environmental Status in their national and shared marine areas through the spatial allocation of economic and ecological functions and the development of short sea shipping.

In 2016 the Short Sea Shipping game was played in several high level project meetings and conferences such as the NorthSEE Kick off, 3rd Atlantic Stakeholder platform Conference and 2nd Baltic Forum by more than 100 international MSP professionals – mainly scientists, policy advisers, and marine spatial and shipping planners – from 18 countries. Data on shipping routes development in the three countries, as well as on the effectiveness of the policy intervention, were collected using pre-game, in-game and post-game questionnaires, combined with the so-called Q Methodology to analysis the

policy perceptions of the environmental impacts and the economic development relevance, in a number of frames that represent participants' opinions that are similar to each other.

The analysis shows that integrated shipping plans at sea lend itself to comparative assessment in real and simulated environments. Observed variety and changes in the game-based intervention provide evidence that the participants engaged in experimentation with different strategies, policy change and policy-oriented learning. The game-based intervention proved an effective and promising method for national/international experimentation and exchange among professional MSP and Short Sea Shipping planners.

Key words: Integrated Ecosystem Based Marine Spatial Planning, Short Sea Shipping Strategy, Socio-Technical Complexity, Game-based Policy Learning

A Rapid Evaluation Method for the Impact of Integrated River Basin Planning on Ecosystem Services

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Abstract: In consideration of the limitations of the traditional material quality evaluation method and the value evaluation method in the evaluation of the impact of integrated river basin planning on ecosystem services, we combine the system decision-making method and fuzzy mathematics and propose a new quality comprehensive evaluation method. Taking the integrated planning of Liujiang river basin as an example, by constructing an index system, defining the index membership and index weight, fuzzy comprehensive evaluation, we achieve a comprehensive comparison and selection of the integrated planning of Liujiang river basin, from the perspective of the influence of river basin ecosystem services.

Key words: Quality Comprehensive Evaluation Method, Integrated River Basin Planning, Ecosystem services, Liujiang River Basin

Ecological Capital: Assessment, Management and Investment

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Abstract: Ecological Capital (EC) is defined as the ecological resources which have direct or indirect contributions to humans' social and economic production and provide benefits for humans. EC is the important component of natural capital. EC value is

defined the monetized benefits for humans from ecological capital, including both the standing stock value of ecological resources and value of ecosystem services. Ecological resources (ER) consists of the living resources and their habitats (i.e. soil, freshwater, air, seawater, surface seabed etc.), as well as the ecosystem that they act as a whole. Ecological (and natural) capital has been become the emerging issue in both scientific and economic communities. The cooperation on marine ecosystem services has already been accepted in the outcome list of 8th Sino-US Strategic and Economic Dialogue in June 2016. Three scientific issues focus on assessment methods, management mechanisms and investment models of ecological capital are preliminarily addressed in this paper. The ecosystem-based management needs mainstreaming of EC in both ecological management and commercial investment activities. The EC theory and approaches may play key role to balance both the ecological and economic benefits from human activities.

Key words: Ecological Capital, Assessment, Management, Investment

World Window: Green Development in Modern Circulation Green Ecological Agriculture in Baiquan County, Northeastern China

Shuqing Wang

The eco-cultural museum of Baiquan County, China

Abstract: This paper tells a story of the modern efficient circulation green ecological agriculture (CGEA) in Baiquan County of northeastern China. It includes four aspects:

1. The CGEA in Baiquan County is sustainable.

The CGEA development pattern is a strategic way to shape the future agriculture in China, it implements green developing pattern, prompts sustainable utilization of agricultural resource, and increases its sustainable development capacity.

The CGEA scientifically plans ecological restoration, improves ecological environment capacity, and develops prosperous ecology in Baiquan County. The CGEA has an abundant database with a beautiful distribution map in the county. There are six kinds of ecological agricultural patterns, six kinds of sand prevention and control patterns, five kinds of water saving and irrigation patterns. The five-dimension Baiquan (i.e., richness, civilization, happiness, greenness and beauty) is the foundation of China that makes China an excellent image over the world.

2. The theory of CGEA means green mountains and wealth.

Agriculture is an industry that is highly dependent on natural resources. The CGEA pattern in Baiquan County provides a Chinese prescription for the world. The top ten eco-economic leading industry construction systems and the economy under forest is a good way to achieve prosperity for the county and to make richness for the people. The

International Eco-Engineering First Prize was given to Baiquan County due to its comprehensive catchment management, including thirty two-word formula, three lines of defenses, three kinds of reservoirs, three kinds of dikes and ten ecological technology support systems as well as its conservation areas for wild deer and wetlands along Shuangyang river.

3. Under the system of CGEN, the blind decision maker should be responsible during his or her lifelong time.

A series of evaluations including comprehensive evaluation on decision makers and responsibility at risk, timely audit and regular evaluation are included for better improvement of CGEN in Baiquan County. It is a key to better develop CGEN and to timely master the ecological red line and the dynamic changes of ecological capacity. Soil erosion results in poverty, while better soil management can make richness. The implementation of CGEN must depend on laws, policy, plan, evaluation, warning, compliance and international cooperation system. The Belgium ecological expert Borr said that "Baiquan County is just an example of eco-agriculture in China, and the control of "non - point source pollution, soil diagnosis, soil toxicology and soil remediation techniques can benefit the world".

Ecological red line is the bottom line to protect CGEA. The practice of CGEA can make people be out of poverty and improve the implementation of ecological compensation process.

4. The eco-cultural museum of Baiquan County makes Chinese be cultural confidence. The museum is the study base for doctoral students in China. It spreads the Chinese culture that plantation of forest and grass makes country be rich, and verse visa. The soil conservation and ecological civilization make a beautiful China. The ecological red line should be remembered in the hearts of everyone. The CGEA can historically transfer the agriculture from the resource-dependent development, emphasizing the requirement of quantity, to sustainable development which emphasizes the quality. Matt, the director of sediment experimental lab in US, said that "the nation could be better if China can popularize the experience and sprit of Baiquan County, northeastern China".

Key words: Baiquan County, Circulation green ecological agriculture (CGEA), Eco-culture

How to Benefiting Local People through a National Park-An Ecosystem Services Approach

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Abstract: About 18% of China is designated to protected areas of some sort, but there is no overarching system for managing them; instead, they are subject to an overlapping mix of polycentric and multi-level administration, hardly reaching an outcome that both biodiversity and treasured human benefits are sustained. In 2016, the Chinese leadership has formally proposed the national park system to initiate the institutional change of conservation management. In the principle of "conservation first and public welfare a priority", WWF China has launched the "China national parks for people" project with Luc Hoffmann Institute (LHI), Beijing Normal University (BNU) and Development Research Center of the State Council (DRC). The project acts as a science-policy-practice interface (SPPI) where the three communities communicate frequently to help defend nature not only for nature's sake, but also for people. Until now, nine national park pilots have been approve. All these pilots are facing the challenge of re-organizing management units across an integrated spatial area according to ecosystem integrity, which is usually composed of previously separated protected areas and communities. Therefore, a spatial integration to conserve a large and healthy ecosystem implies that local communities are more deeply involved in conservation both in space and in management. Since rural people are highly dependent on natural resources for livelihood, a key question emerges that how to guarantee the livelihood of local communities that will be part of a national park. This matters to land use management, payment for ecosystem services and sustainable livelihood, all are part of the institutional change of the national park system construction and is on the agenda of local government. To answer this question, we would like to use an ecosystem services approach for Wuyishan national park pilot. It is located in the southeast China, typical in multi-headed management with a nature reserve, scenic area and forest park somewhat overlapping in the same place. It is also famous for tea plantation, which evolves to a unique landscape. We would go deeper to three aspects: 1) as ecosystem services beneficiaries, what are local people's major demand the relation to human well-being? 2) What are their perception to the management of prioritized ecosystem service within the old protected area systems? 3) What do they think as conflicts between their practice and conservation goals? We have used structured and semi-structured questionnaires to visit more than 350 households both inside and outside of the planned pilot within the administrative boundary. We have a clear map of ecosystem services demand of communities; we find their major concerns are policy change in land tenure, natural disaster prevention and mitigation and standardization of production; there is no major conflicts, but lacking of traditional knowledge/habitat or unclear regulation and implementation of rules. Based on these answers, we have proposed the forest conservation easement for tea plantation aiming to maintain it ecologically compatible to forest conservation and adding value to production through "national park" brand.

Key words: Ecosystem services, National park, Ecosystem service beneficiary,

Livelihood

Economic Valuation of World Cultural and Natural Heritage from Recreational Approach: A Case Study of Mountain Huangshan

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Abstract: World Cultural and Natural Heritage sites are special kinds of tourism resources with non-marketable, scarce, public, non-renewable, and external monopolistic characteristics. It is always a significant challenge for the academic circles to give them suitable protection and efficient use. The article presents an economic valuation of Mountain Huangshan which is a World Cultural and Natural Heritage with distinct qualities and international importance based on 258 completed questionnaires. For this purpose, the use value and non-use value of Mountain Huangshan were calculated using the Travel Cost Method (TCM) and Contingent Valuation Method (CVM) based on the field data of Mountain Huangshan in March 2016. By using statistical analysis, we obtained influence factors. The result shows that economic value of Mountain Huangshan is enormous, 55.81% of tourists are willing to pay for protecting and making Mountain Huangshan to exist forever. Log it regression model and probit regression model indicate the willingness to pay for Mountain Huangshan are affected by education levels, incomes, etc.. The figure of CVM is obviously lower than that of TCM, which means that people do not realize the true values of the environmental resources. This thesis concludes with several suggestions to improve protection and sustainable development of Mountain Huangshan.
Key words: Economic valuation, Travel cost method, Contingent valuation method, Mountain Huangshan

Management of Ecosystem Services from Coral Reef Degradation and Restoration Opportunities in the Gulf of Thailand

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Abstract: The ecosystem services of coral reefs have been examined and the benefits they provide to coastal communities are clearly recognized. Coral reef ecosystems are particularly documented that they can contribute a number of economic benefits, such as reef tourism, recreational fisheries, fisheries production, shoreline protection and

natural pharmaceutical products. Several projects have incorporated ecosystem services coral reef management. Unfortunately, coral reef ecosystem services are threatened by several anthropogenic and natural disturbances. Assessing the economic value of ecosystem services from coral reefs is very important for policy decision making on which have been carried out in many countries. However such information in the Gulf of Thailand, especially in degraded coral communities is limited. This study highlights the importance of this issue through a proposed concept concerning economic valuation of ecosystem services from coral community biodiversity with special reference to the changes in ecosystem services from coral reef degradation and restoration potential in the Gulf of Thailand. We provide a number of case studies for quantifying coral community ecosystem services in the Gulf of Thailand with emphasis on linking coral community conditions with various types of ecosystem services. The coral community management and restoration plans in the Gulf of Thailand show that the coral community in a degraded area and tourism hotspot is the high priority site for coral reef restoration. The national coral reef restoration plan concentrates on using passive restoration to reduce threats from tourism, water pollution, sedimentation and fisheries. The major concerns for active coral restoration are simple and cheap methods, community involvement, high tolerant species to climate change induced bleaching and multi-species transplantation. Improving coral community ecosystem services is an essential task to be integrated in marine and coastal management policies and practices in Thai waters.

Key words: Coral reef, Ecosystem service, Management, Restoration

Synergies between Soil Retention and Water Yield in the Pearl River Delta

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Abstract: In recent years, studies on ecosystem services have highlighted the relationships between multiple services. Increases in one ecosystem service may alter the provision of another. The management of multiple ecosystem services is an essential skill for decision makers. Therefore, the objective of this paper was to analyze comprehensively, the interrelationship between multiple ecosystem services. Firstly, we evaluated the biophysical values of soil retention and water yield using seven series land use data from 2000 to 2012. Secondly, based on present situation analysis, their temporal synergistic relationship was explored using correlation and time trend analyses, and their spatial synergistic relationship was explored using local autocorrelation and the barycenter change method. Finally, panel data were introduced

to establish a quantitative relationship model. The results showed that soil retention and water yield were characterized by an obvious synergistic relationship on a temporal and spatial scale. Moreover, we concluded that the elasticity coefficient of water yield was 0.29%. A 1% increase in water yield would result in a simultaneous 0.29% increase in soil conservation.

Key words: Ecosystem services, Synergy, Soil Retention, Water Yield

Germany's Ecosystem Services - State of the Indicator Development for a Nationwide Assessment and Monitoring

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Abstract: The obligations of the EU Biodiversity Strategy 2020 are generating a need to create national maps and monitoring systems for the state of biodiversity and ecosystem services (ES) on the basis of indicators. There is also a need to integrate biodiversity and ecosystem service indicators as part of the economic accounting systems. The poster gives an overview about the ecosystem services indicators being developed for Germany in the context of research projects. Additionally, it provides the indicator specifications, which are aligned to the CICES and MAES framework concepts.

By way of examples we illustrate the calculation procedure, results and target values. For instance the indicators for the regulation of water erosion and flood prevention are not only suitable for an exemplary illustration of procedure, data selection and data basis in Germany. Furthermore, the examples show how indicators for regulating services can conflict or support the maintenance of biodiversity and other ES. The provisioning service "raw wood production" shows among other monitoring aspects and delimitation from other sustainability and biodiversity indicator systems. For the assessment of the cultural ecosystem service "recreation in the city" we will show results for the indicator 'Accessibility of green spaces' on a national scale.

The presented indicator-based German approach measures and sums up ES in their spatial expression and temporal change and compares them with objectives. As far as possible, this is carried out according to the demand-supply concept. The indicator-based approach helps also to uncover and mark trade-offs or synergies between services. They often appear as status variables that match to different indicator calculations.

Key words: Mapping, Indicators on Ecosystem Services, MAES framework concept, EU Biodiversity Strategy 2020

Ecological Regime Shifts and Changes of Lake Ecosystem Service in a Shallow Yangtze Lake (Taibai Lake, China) over the past 150 Years

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Abstract: Shallow lakes provide a range of ecosystem services such as water supply, biodiversity, aquaculture, tourism, shipping and flood regulation. Over recent decades, many lakes have become severely deteriorated (regime shifted) due to a coupled natural and human disturbance. Given the limited monitoring records (< 50 years), however, we still have little knowledge on how, when and why those lake experienced ecological status shifts, and how the lake ecosystem service changed, i.e. leading to preferable trade-off or enhance the synergies among different service type? Paleolimnological techniques were widely used in understanding the historical environmental and ecological changes. Here, we chose two typical eutrophic shallow lake sited in the middle and lower of Yangtze River, namely Taibai Lake, and acquire geochemistry proxies, grain size, diatom, cladocera and chironomid from a 210Pb and 137Cs dated sediment core. Document records and monitoring data are also included as important marks of social and environmental change. A T-test based algorithm of STARS reveal at least two ecological shifts, respectively in the 1960s and the 1990s. The sudden shift in the 1960s is supposed to be influenced by a dam and sluice construction in the 1950s and another shift in the 1990s should be a critical transition due to the alternation of ecosystem structure for higher fishery production. Correspondingly, Lake Ecosystem service (LES) also experienced significant changes. Prior to 1930s, different types of LES kept relatively stable with low values. With the dam construction in the 1960s, the changed hydrological condition led to gradual increases in both regulation and provision service. However, with much effort on fishery and reclamation, the regulation service of the lake (drinking water provision, water quality and climate regulation) decreased, exhibiting a tradeoff among LES. After 1990s, with intense aquaculture, most types of LSE suffered a further decrease. The long-term records exhibited that ecosystem services in primary productivity and biodiversity maintenance increased (synergies) whereas services in water-purification and climate regulating decreased significantly (tradeoffs) since 1950s, when local people are seeking higher desired services (land/fish ESs) by human "modification" on lake ecosystem. By long-term records, temporal perspectives on such dynamic tradeoffs and synergies relationship among various ESs under the context of different type's resource utilization over time have significant implications for management initiatives.

Key words: Ecosystem service, Palaeolimnology, Tradeoff, Synergy

Study on Marine Ecological Environment Protection with Quality Improvement as the Core

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Abstract: The main goal of ecological environmental protection is to improve the quality of ecological environment. Environmental protection policies should also be made to serve this goal. However, the traditional marine environmental policies, such as environment impact assessment, total pollutant control, are mainly used to prevent project pollution, and don't fully take the actual improvement of the quality of the ecological environment select account. Based on the improvement of marine ecological environment quality, this paper discusses the direction and key points of the reform of marine ecological environment protection.

Key words: Quality Improvement, Marine Environment, Ecological Protection

Problems with Traditional Ecological Service Assessment and Their Solution-A Case Study with Panjin Coastal Zone, Liaoning Province, China

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Abstract: Traditional ecological service assessment rarely take consideration the spatial context of target ecosystems and the urgency of the requirement of a region for the service of interest. The assessment results in some cases are misleading and affect adversely their application values in regional spatial planning for biodiversity conservation, sustainable resources utilization and environmental control and so on, especially at region or landscape scale. The development of a spatial context and service requirement oriented ecological service assessment model framework has, therefore, much academic and practical implication for ecosystem based management. Here we propose a new framework for ecological service assessment on the base of traditional one and apply it to the ecological service assessment in Panjin coastal zone, Northeast China. This framework is expected to help to assess ecological services more scientifically.

Key words: Ecological Service, Spatial Context, Ecological Service Requirement Urgency

Measuring the Value of Coastal Wetland for Typhoon Protection: A Case Study of China

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Abstract: Frequent natural disasters such as typhoons, floods, storm surges threaten seriously the life safety and property security in the coastal zone with high density of population and economic activities. Coastal wetlands can reduce the damaging effects of typhoon on coastal communities by reducing the wind speed, decreasing the water level and flow rate of flood, and absorbing storm energy during Typhoon process. A regression model was developed in this study using 53 major Typhoon hit China since 2000 with the natural log of damage per unit GDP in the Typhoon swath as the dependent variable and the natural logs of wind speed, rain fall, terrestrial wetland area and intertidal wetland area in the swath as the independent variables, which was highly significant and explained 65% of the variation in relative damages. The results show that a loss of 1 km^2 of terrestrial wetland and intertidal wetland in the model corresponded to an average RMB 2.75 million and RMB 67.05 million increases separately in Typhoon damage from specific Typhoon. Using this relationship, and taking account the annual probability of hits by Typhoon of varying intensities, this study mapped the annual value of terrestrial wetland and intertidal wetland by city and by 1km x 1km pixel. The protective value of intertidal wetland is much higher than that of the terrestrial wetland. Coastal wetlands in the China were estimated to currently provide RMB 85.24 billion per year in Typhoon protection services. Confronting the situation that the coastal wetland area shrink drastically due to not placing proper value on them, this result, together with values of other ecosystem services provided by the coastal wetland can inform the development of strategy restoring and preserving coastal wetland.

Key words: Typhoon Protection Value, Coastal Wetland, China

Science Popularization for Marine Environment Protection in China

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Abstract: In China, marine ecological environment problems have been becoming more serious. We are now facing the increasing concentrations of phosphorus and nitrogen in the coastal waters, contamination of various kinds of pollutants, outbreak of red tides, degradation of fishery resources, et al. All these not only restrict the sustainable development of marine economy, but also threaten the health and safety of

people. Some laws and regulations have been launched to protect the marine environment; beside, great progress in related scientific research has been achieved in recent years, which is of importance in resolving the marine environment problems. At the same time, science popularization is also vital for improving the efficiency of marine environment protection. Science popularization can spread scientific knowledge, solve people's doubts, widen their horizon, enhance their ability to solve problems and help them better understand the world. Therefore, it is important for us to promote the scientific popularization work for marine environment protection. Actually, under the guidance of national science policy, we have widely carried out science popularization activities and have made tremendous contributions for enlightening people's mind in marine environment protection. On the one hand, more and more marine research institutes are opening the laboratory to pubic; on the other hand, related scientists are actively taking part in Science and Technology Week, National Science Popularization Day, and other major topic-related public science popularization activities. Some science popularization activities about marine environment protection are suggested below. (1) Exhibition shows. We can prepare some posters about marine environment protection, and post in the schools, squares, resident communities, rural areas. By reviewing the posters, the public can know more about the urgency of protecting marine environment and the major task to be carried out for the protection. (2) Public-oriented lectures. Some people wish the experts and scientists in marine environment may explain their doubts face to face, so lectures or reports are necessary. In the lectures, the experts can tell the public why we need to protect the marine environment, how to protect the environment, and what can our individual do to protect the marine environment, et al. (3) Collaboration with media such as television station, radio station, publishing house. This is practically efficient; it can benefit much more audience to receive the knowledge about marine environment protection. (4) Holding a competition. We can print some questionnaires about marine environment protection; in addition, we can upload the questionnaires to the internet to invite more people participating in the competition. By this, the effect of science popularization for marine environment protection can be enhanced.

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Key words: Science popularization, Marine environment, Environmental protection

T1-03: Can Art Help Science to Think out of the Box?

Dancing with Nature and the Power of Imagination

Bruno Matheus Doedens

SLeM, the Netherlands

Abstract: This presentation will give a cultural perspective on the project Windwerk. Windwerk is a temporary artistic landscape on the beach of the Dutch Wadden Sea island of Terschelling and an experiment in possible new insights in young dune formation. The project has brought together diverse worlds: science and art, culture and nature, education and practice. Bringing these worlds together was not easy but has been particularly valuable. It was a big challenge to bring together the scientific requirements and the artistic wishes. In his presentation Bruno Doedens will explain how a team of scientists and (landscape-) architects together created an extraordinary design for the landscape experiment.

Bruno Doedens will explain how SLeM experimentally investigates the landscape forming processes of the Wadden Sea area. The natural processes become visible, enlarged and enriched by adding a cultural layer to the landscape. The power of imagination is central to the design. By surprising and alienating, the field experiment has been able to captivate the attention of a wide audience, encompassing locals, recreants, students as well as land management organizations. Windwerk has encouraged discussion on possible new forms of management of the coastal zone.

Key words: Dancing with Nature, Power of Imagination, Landscape Experiment, Cultural Landscape Development

Use of Ikebana Art in the Teaching and Research of Mire Vegetation and Ecology

Harri T. Vasander

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Abstract: Ikebana is an old Japanese way of using flowers and branches for decoration purposes. It includes several styles with strict rules but also with flexibility. The concept of time in these artistic works means that there must always be some elements as memory from the past and also promise for the future. Human is considered a messenger between the earth and the sky.

We have used several years the basic rules and philosophy of Ikebana when mire

vegetation and ecology are thought during the summer field course for first year students. First, the ideas behind Ikebana are told during a lecture. Students are sent to a mire area in small groups and each group has its own mire site type. The groups have to compile a Hakoniwa describing their own site type following Ikebana philosophy. Hakoniwa originally means a miniature garden compiled on a shallow tray or a big ceramic vessel. In Japan they consider that compiling Hakoniwas increases your creativity and the sense of beauty. Each work is evaluated and judged by several teachers as there is variation between humans and each teacher is also guiding the groups in the field. There may be quite much discussion between the judges before a consensus concerning the three best works i.e. mire site types is achieved. The works are judged by their artistic values: measures (0-6 points), colour composition (0-6), originality (0-6), and level of difficulty (0-6), scientific values: species level accurateness (0-6), pedagogic values (0-6), ecological accurateness (0-6), and overall impression (0-10). The maximum point number is thus 52. Usually the dividing point number for good works is around 40. The winner group gets a certificate in Japanese and the Ikebana-Hakoniwa exercise has a small impact on the grading of the field course for each student.

For students this kind of approach is new and surprising. They enter to listen a lecture called: "Compiling mire site type models" which for today's students usually means some kind of mathematical modeling. When the lecture starts with the basic rules and philosophy of 1500 years old, they first get confused. In the end of the lecture practical things about gathering peat blocks with plants are given and then they already realize that this kind of group work is going to happen. Usually almost all students are very eager to compile their miniature mire site types and they want to have a masterpiece to win the competition. In the final course evaluations, this group work is always mentioned very positively. Also, when meetings students several years after this basic course they remember Ikebana-Hakoniwa work as the most surprising and creative work from the course. What is more important: they also remember the ecology and species composition of mire site types!

Key words: Hakoniwa, Mire Site Types, Plant Species Compisition, Field Course Teaching

Mobilizing Social Energy and Communicating Landscape Interventions

Hester Ebrich Annema, Elisabeth Floris

StudioHE, the Netherlands

Abstract: Is it possible to actively engage people with landscape management and

landscape transformations in a way that is fun? Can this involvement increase awareness and support for the developments? Can playfully involving people create opportunities for gaining new insights select landscape functioning? These questions are being discussed in this presentation.

It's all about mobilizing social energy. The project Windwerk shows that large groups of people can be actively involved at various stages of a landscape experiment. In an early stage of the project, students investigated with minimal frameworks and guidelines the possibilities for imagining and stimulating dune formation. The final landscape experiment was built with the help of many students, volunteers and scholars. In the 'Windwerklab', people temporarily took on the role of researchers. The active participation created a feeling of pride and responsibility. New stories and values were added to the coastal landscape.

Can we even go further and reach more goals? Can we gain new insights by mobilizing social energy because of the unpredictable character of playing people? Can we reach people who are not interested in nature and culture by transforming landscape interventions into a landscape game? This presentation will end with an interactive discussion on these questions.

Key words: Mobilizing Social Energy, Role of Playing, Landscape Transformation, Communication

Cultural Landscape Development

Joachim Jan Titus Mulder

Sense of Place, the Netherlands

Abstract: A project such as Windwerk where artists and scientists collaborate on an experimental study is not common practice. Windwerk is an outlier both in the world of science and the world of art. Finding funding as well as a platform is difficult for pioneering projects. Windwerk has been made possible through the efforts and work of the foundation Sense of Place (S.O.P). S.O.P supports and develops experiments in the landscape of the UNESCO World Heritage Wadden Sea area by facilitating collaboration between artists, landscape architects, researchers, users, entrepreneurs and governments. The experiments often provide new insights for the management of the landscape. The foundation supports the project makers in the further development of the temporary experiments landscape interventions. The presentation will focus on the working methods of the foundation and its role in the realization and further development of innovative projects such as Windwerk. In addition, Joop will discuss the role such projects play in enhancing the perception and appreciation of the Wadden Sea area.

Key words: Sense of Place, Cultural Landscape Development, UNESCO World Wadden Sea Area, Facilitator

Reconciling Science with Art: Testing Scientific Hypotheses in an Experimental Dune Landscape in the Netherlands

Juul Limpens[1], Bruno Doedens[2], Machiel Spaan[3], Hester Anema[4,] Elisabeth Floris[4]

1 Wageningen University, the Netherlands; 2 SLeM, the Netherlands; 3 M3H Architects, the Netherlands; 4 StudioHE, the Netherlands

Abstract: Using art to communicate environmental science to a broad public is becoming increasingly popular. Nevertheless, true integration between these two disciplines proves challenging: seldom being both art and science to the same degree. Is that even possible? Can a work of art also be a natural science experiment? Can a visually attractive artwork contribute testable data and yield new hypotheses? In some cases it can, as illustrated by the landscape-scale artwork AND experiment Windwerk. This presentation will give a scientists perspective on Windwerk, explaining how teaming up with artists helped accomplishing an experiment on dune-building at a hitherto unprecedented scale. The presentation will follow the set-up of the experiment, paying attention to the advantages and disadvantages of combining artistic and scientific design, touch briefly upon the scientific quality of the results and explore to what extent this playful approach to science sparked new ideas and workable hypotheses. The presentation will end with an interactive discussion on which elements are key to make a successful combination of both art and science.

Key words: Art, Science, Landscape, Coastal Ecosystems

Value Deconstruction of "Life Aesthetics" Derived "Living Environmentalism"

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Abstract: The study of living environmentalism in environmental education began in twentieth century, 70 - 80s, and was initiated by the Japanese scholar Niao Yue hao. He distinguishes living environmentalism from natural environment protectionism and modern technicalism, and believes that living environmentalism is the theory that pays most attention to the protection of the living system of the local people". The study of life aesthetics began in 1980s. This theory attempts to explore the communication or unity between the living world and the aesthetic activities.

This paper constructs a bridge between aesthetics and environment education from the view of living. The following aspects are expounded: 1. the critique of the metaphysics of traditional classical philosophy and aesthetics. 2. The necessity and similarity of the dual choice from a historical and logical viewpoint. 3. The ecology of living aesthetics and the value deconstruction of the living environmental education. 4. The regional deconstruction of living aesthetics and living environmentalism. 5. The spirit value deconstruction of the contemporary life both domestically and abroad. 6. The technical support of the living environmentalism and the aesthetics isomorphism of living aesthetics.
Key words: Life Aesthetics, Living Environmentalism, Value Deconstruction

The Scientist and the Artist

Matthijs Schouten

Staatsbosbeheer, the Netherlands

Abstract: Comparative philosophers have pointed out that two paradigms can be distinguished in the way in which we interpret reality. One paradigm proceeds from the principle of differentiating between phenomena; reality is divided separate entities which can be named and classified. This principle is of great significance in science. Within this rational paradigm, relationships between phenomena are described by laws which can be expressed in scientific terms. The most outstanding one is E=MC2.
The other paradigm, which features most prominently in the arts, is not so much about rational differentiation but about experienced coherence and connection. Here one enters the world of imagery and metaphor: story, myth, poetry, visual images. These do not represent descriptions of reality but above all references to what is seen as its essence.
It is an interesting phenomenon that many a scientific discovery did not emerge from the first paradigm. It arose from what could be called a sort of inspiration, which is primarily part of the second paradigm, and only after that it was it was translated into rational and scientific terms. Therefore, it is of importance to investigate how science can benefit from a closer collaboration with the arts.
Key words: Art, Science

How to Facilitate Science-Art Interactions in Graduate Programs?

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Abstract: Art-based projects have become increasingly popular to communicate environmental science to the broad public. We performed two teaching experiments with different levels of interdisciplinary collaboration as part of a master's level course, to explore ways of fostering the use of art to communicate nature conservation science. Teams of science graduate students worked either alone or in collaboration with art students on one environmental trend of their choice (resilience of socio-ecological systems, ecosystem approach, protection vs. management, valuing nature-conservation policy). Here we reflect on these experiences based on systematic assessment of how students, scientists and artists perceived the learning process and outcomes.

Key words: Art-science Collaborations, Teaching Interdisciplinarity, Environmental Sciences

T1-04: Remote Sensing for Ecosystem Services

Assessment of Terrestrial Ecosystems Biodiversity Based on IUCN Protocol and Remotely Sensed Data

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Abstract: Ecosystem biodiversity is the macro level of biodiversity which is generally known important to human as it provide services and products for life's basic demands. The ecosystems of high biodiversity are characterized with plenty area, suitable environment, fluent material and energy cycle through the definition of ecosystem which can persistently sustain its characteristic native biota. However, the biodiversity around the world have suffered a great loss for the dramatically transformation of ecosystems. To assess risks to ecosystem biodiversity, IUCN launched an official global standard for assessing the risk of ecosystems, namely IUCN RLE Criteria. The protocol is a new global framework for monitoring the status of ecosystems, which aims to support resource allocation, management decisions and protection by identifying ecosystems at risk of biodiversity loss. Based on the four key characteristics of an ecosystems, this protocol applied five criteria in assessment of ecosystem risk: (i) ecosystem's historical, current and future decline in spatial distribution (Criterion A); (ii) the extent of occurrence and area of occupancy of ecosystem (Criterion B); (iii) the decline in key abiotic (Criterion C); (iv) the decline in biotic processes (Criterion D); (v) quantitative estimates of the risk of ecosystem collapse (Criterion E). As the macro ecosystems and the goal of global RLE, these criteria are hardly acquired just by the in situ measurements. Remote sensing, the most powerful technology for earth observation at macro-scale, may be the most potential tool to support the assessment of ecosystem risk. Time series of satellite images are one of data source for ecosystems mapping which provide the variables for Criterion A1 and Criterion B. Based on the driving force model and distribution model of habitats, the Criterion A2 and A3 are available for assessment. The suitable environment and process of ecosystem lead to health status of ecosystems and ecological parameters derived from remote sensing are always applied to represent the status of ecosystems. Reversely, through the status of ecosystems, the degradation of environment and process may be plausibly acquired with the time series parameters of remote sensing. Combined with remote sensing and the response model of ecosystems to environment, assessors have access to the Criterion C. Integrating ecological model and remote sensing, the Criterion D and E may also be available.The case study in Southwestern China has been conducted to explore the feasibility of above ideas based on remote sensing and IUCN protocol. The

hierarchical assessment with remotely sensed data was proposed to provide the RLE with spatial information. The results showed that remote sensing is the most useful tool to make the criteria of IUCN available which play important role in the assessment of ecosystem biodiversity. And hierarchical assessment can significantly provide the IUCN RLE with spatial information which lead to efficient allocation of conservation resource.

Key words: Ecosystems Biodiversity, IUCN Red List of Ecosystems, Remote Sensing, Cological Model

Increased Forest Areas in Tropical Hainan Island, China, through Data Fusion and Analysis of PALSAR, PALSAR-2, and Landsat Imagery during 2006-2015

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Abstract: Accurately monitoring forest dynamics in the tropic regions is essential for ecological studies and forest management. In this study, we combined imagery from Phase-Array L-band Synthetic Aperture Radar (PALSAR), PALSAR-2, and Landsat in 2006-2010 and 2015 to identify tropical forest dynamic. Forest and non-forest (F/NF) maps were generated through analyses of PALSAR, PALSAR-2, and Landsat data using a pixel- and phenology-based algorithm. Those pixels with high biomass sugarcane and banana, which are widely distributed in tropics and subtropics, were also identified by analyses of Land Surface Water Index (LSWI) and Normalized Difference Vegetation Index (NDVI) from Landsat imagery, and thus were excluded to reduce commission error of forest maps. The resultant PALSAR/Landsat-based F/NF maps in 2010 and 2015 yield high overall accuracy (OA) of 92%-97% when validated with ground reference data generated from manual and computer random sampling. The PALSAR/Landsat-based F/NF map in 2010 shows good spatial and aerial agreements with 30-m optical-based F/NF maps of fine Resolution Observation and Monitoring-Global Land Cover (FROM-GLC, OA=88%), GlobeLand30 (OA=90%) and 1-km F/NF map of National Land Cover Dataset of China (NLCD). The PALSAR/Landsat-based annual F/NF maps (2007-2010) shown good spatial-temporal consistent, and better than the results from the Japan Aerospace Exploration Agency (JAXA) PALSAR-based F/NF maps (OA=82% in 2010). The areas of forest gain, loss, and net change in Hainan Island from 2007 to 2015 were 4.15 x 105 ha (+2.17% yr^{-1}), 1.79 x 105 ha (-0.94% yr^{-1}), and 2.36 x 105 ha (+1.23% yr^{-1}), respectively. About 95% of forest gain and losses occurred in those areas with an elevation less than 400-m, where deciduous rubber, eucalyptus plantations, and urbanization expanded rapidly.

This study demonstrates the potential of PALSAR/PALSAR-2/Landsat image fusions for monitoring forest dynamics in the tropical regions.

Key words: Forest Loss and Gain, Tropical Forest, Image Data Fusion

Land Cover Mapping and Forest above Ground Biomass Estimation in China

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Abstract: 1. CHINA LAND COVER MAPPING：Land cover and change directly reflect the regional differences of the service functions and carbon budget of terrestrial ecosystems. With the rapid development of China's economy and the implementation of ecological restoration projects at the nation-wide, land cover has changed significantly, and it brought a great changes of the terrestrial ecosystems. In order to meet needs of Chinese ecological assessment and terrestrial ecosystem carbon budget estimation, the land cover data of China in 2010 (ChinaCover2010) has been produced mainly based on domestic HJ^{-1} satellite remote sensing data. The first level type of the classification system of ChinaCover2010, which has 6 types, is consistent with the IPCC. The second level class, which has 38 sub-types in China, is generated by the LCCS (Land Cover Classification System) of FAO (Food and Agriculture Organization of the United Nations), with global uniform code. The classification methodology is the combination of object-oriented automatic segmentation, decision tree based classification and field work based manual modification. Entire China has been divided to 835 working blocks for classification and individual team. In order to establish the classification rules, training samples of land cover have been obtained by field survey at nation-wide. The decision tree of classification has been established for each block. The preliminary result of classification has been mainly verified and modified based on 111,126 field samples the accuracy of ChinaCover2010 has been validated with sample point gathered independently from remotely sensed data of high spatial resolution and field works. For accuracy assessment, 31,658 independent field samples were separately collected. The accuracy of the ChinaCover2010 data is 94% and 86% for first and second level classes, respectively. The results show that HJ^{-1} satellite data is good data to produce the nation-wide land cover data set. With more ground survey data and user feedback, the data will continue to be revised and modified and improved. 2. FOREST ABOVE GROUND BIOMASS ESTIMATION：Based on the type and location of forest in China, total 8 districts were separated for building the AGB estimated models, and 5 typical forest study sites (100kmx100km) were selected for collecting the airborne LiDAR data (100-200km^2), also 26 general forest study sites

(50kmx50km) have detailed field measurements. Firstly, the forest AGB was estimated in the flight area. Tree height and density were extracted from LiDAR point clouds. A stepwise regression model was built combining field-measured AGB, canopy height percentile and crown density. For each typical study site, according to the forest classification and AGB estimation in the LiDAR flight area, a scaling model was used for retrieving the AGB at 30m scale by Landsat TM data. Finally, a scaling model combining 30m AGB, 250m MODIS time series data, continuous canopy height map, fraction of vegetation cover and forest classification data was built up for mapping the AGB in each district.

Key words: Land Cover, Above Ground Biomass, China

Remote Sensing Application for Rangeland Monitoring of Mongolia

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Abstract: Mongolia has a nomadic animal husbandry which directly depends on the climatic situation over a year. There are 2600 type species in Mongolian pasture, however, only about 600 palatable species are available for livestock and the total pasture capacity of the country is 50 to 60 million in sheep unit. Currently, pasture monitoring observation at Soum level (fenced and unfenced) and 1500 ground points covers following parameters during vegetation growing season such as phenology (main species), growth condition, plant height, biomass, plant coverage (green, litter, bare), plant damage. The remote sensing application for pasture monitoring is a most effective for the whole territory of Mongolia. In the study, to monitor the pasture vegetation coverage of Mongolia have been used the normalized difference vegetation index (NDVI) data derived from Terra/MODIS data. Our aim of this study, to calculate their correlation of established data of remotely sensed and ground observation data. According to the long-term NDVI changes over different natural zones of last 17 years, in all zones, NDVI have been decreased in during growing season.

Key words: NDVI, Biomass, Remote Sensing, Rangeland and Pasture

The Impact of Management Modes on Ecosystem Service Values

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Abstract: Ecosystem services represents the diverse values that ecosystems provide to humanity, which are necessary for human well-being, health, livelihoods, and survival.

Interest in ecosystem services values (ESV) has grown quickly since the publication of 'Millennium Ecosystem Assessment'. Attentions have been paid to the estimation of ecosystem service values, the influence of land use and land cover changes (LULUC) on ESV, the impact of population density changes on ESV, and the effects of information, value-deliberation and group-based decision-making on ESV etc. However, few attention has been paid on the impact of management modes on ESV. In China, there is a special organization called the reclamation region which has different management modes with the agricultural region. The reclamation region includes state-owned, farm areas with detailed land planning and the operation is based on an enterprise mode, where farm governors decide the crop types and species, and farm workers obey these decisions to plant crops. In the agricultural region, the farmland is collectively owned and farmers control the land use, management, and benefit rights. In this study, Landsat Thematic Mapper (TM), Operational Land Imager (OLI) and Unmanned Aerial Vehicles (UAV) images were used to obtain the LULUC of the Fujin city in four periods (1986, 1995, 2005, 2015). Then we modified the methods developed by Costanza et al. by net primary productivity (NPP) to estimate the ESV in different years. Finally, we compare and analyze the impact of management modes on the changes of ecosystem services values and ecosystem services structure. The results show that cropland increased quickly at the expense of wetland, forest and grassland both in the agricultural region and the reclamation region. Paddy increased more quickly in the reclamation region than in the agricultural region. Different management modes greatly influence the changes of changes of ESV as well as ecosystem service structure especially the changes of food production function.

Key words: Remote Sensing, Ecosystem Services, Different Management Modes, Sustainable Development

Evaluation of Urban Ecological Risk during the Industrial Transformation and Upgrading

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Abstract: Urban ecological risk is an effective tool to evaluate the effect of industrial transformation and upgrading. The evaluation index system of urban ecological risk was established in this paper in the pressure - state - response framework. The entropy weight method was adopted to determine the weights of each indicator. And the comprehensive index was calculated to quantify the urban ecological risk levels. Finally, the learning vector quantization neural network method was applied to investigate the change trend of urban ecological risk during the industrial

transformation and upgrading. By choosing Dongguan as the case, it is found that the urban ecological risk fluctuated in the process of industrial transformation and upgrading, during which the grade of urban ecological risk kept at a high level from 1999 to 2004 and decreased fast from 2005 to 2008, but rose in 2009, and then declined from 2010 to 2014. The urban ecological risk management measures were also put forward according to the reason of the change of urban ecological risk.

Key words: Industrial Transformation and Upgrading, Urban Ecological Risk, Learning Vector Quantization, Dongguan

Net Primary Productivity of Alpine Vegetation and Its Responses to Climate Change through Models Comparison in Qinghai, Qinghai-Tibetan Plateau

Hui Ye, Bangjun Wang

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Abstract: It is still one of the hottest topics to quantify the magnitude and uncertainty of the net primary productivity (NPP) of the alpine vegetation and its response to climate in Qing-Tibet Plateau. Three ecosystem process models (CEVSA, AVIM2, BEPS), two production efficiency models (GLO-PEM 5.0, CASA), and a coupled model of remote sensing with ecosystem process (GLOPEM-CEVSA) were compared in this study. The NPPs from different models were linearly correlated with the field measured NPPs of different grass types with a R2 of 0.31 ~ 0.59 (significant level $p < 0.07$) for CEVSA, BEPS, CASA, GLOPEM 5.0, and GLOPEM-CEVSA. The NPPs modeled were ranged from 41.21 to 172.78 g C $^{m-2\ a-1}$ with a mean of 115.81 g C $^{m-2\ a-1}$. The effects of the two climate factors, temperature and precipitation, on NPP were analyzed. NPP was significant linearly correlated with temperature ($p < 0.01$) with a slope of 2.11 ~ 28.36 g C $^{m-2\ a-1}$ ℃$^{-1}$ on the 400 mm precipitation line for all compared models. The sensitivity of NPP to precipitation varied greatly depending on different models. As a whole, the NPP increased with precipitation (> 300 mm), and reached a steady or even down at about 550 mm of precipitation. Linear regression of NPP with precipitation showed that the NPP might increase 10.1 ~ 65.5 g C $^{m-2\ a-1}$ with the increase in precipitation of 100 mm. Those results will improve understanding to the mechanism of ecosystem productivity in Qing-Tibet Plateau.

Key words: Net Primary Productivity, Qing-Tibetan Plateau, Model Comparison, Climatic Factors

Characteristics of Land Use/Cover Change in the Three-River Headwaters Region after Implementation of Ecological Projects

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Abstract: The Three-river headwaters region (TRHR), located in the hinterland of the Qinghai-Tibet Plateau, is the source region of the Yangtze River, Yellow River and Lancang River, known as "China's water tower". It is an important ecological barrier, and the eco-environment in the TRHR is highly fragile and sensitive to climate change. Because of the combined effect of global warming and increasingly frequent human activities, the natural ecosystems in this region have undergone severe degradation in recent decades. Since 2005, when the Ecological Protection and Construction Master Plan of Qinghai Sanjiangyuan Nature Reserve has been approved, the ecosystem condition here has appeared an “initially contained, partial improvement” trend. Based on the TM (Thematic Mapper) images with 30 m spatial resolution in 2004 (June, July, August and September of 2003, 2004, and 2005), and HJ^{-1} images (mini-satellite constellation for environment and disaster monitoring) with 30 m spatial resolution in 2012 (July, August and September of 2012), the LULC datasets (1:100,000 scale) were developed for the TRHR for the two above-mentioned time periods based on the Chinese LULC classification system using human-computer interactive interpretation. Using GIS overlay function, the characteristics of land use/cover change was analyzed spatially on a pixel-by-pixel basis between the LULC maps. The results showed that the main ecosystem in the TRHR is grassland ecosystem, followed by the other ecosystem which consist mainly of bare rock, water bodies and wetlands ecosystems, and desert ecosystems. From 2004 to 2012, under the combined effect of the warm and humid climate, the reduction of livestock and the implementation of ecological projects, the land cover and macro ecology situation has been improved in the TRHR. The main manifestations of LULC changes were in the form of expansion of water and wetland ecosystems, shrinkage of desert ecosystems, and increase of grassland coverage; changes of forest and grassland ecosystem occurred mainly in the central and eastern parts of the region, and changes of water and wetland ecosystems mainly occurred in the vast western and northern parts of the region, change of desert ecosystem mainly occurred in the central and west parts of the region. The improvement in the core area of the nature protection area was the most obvious, followed by the buffer area and experimental area. Among different project areas, except for Maixiu, the macro ecosystem of all project areas has been improved. Among different river basins, the macro ecosystem in the Yellow River basin had the most violent structure change, and the improvement there was the most obvious.

Key words: Land Use/Cover Change, Spatial Pattern, Temporal Process, The Three-River Headwaters Region

One Method of Rapid Evaluation of Wetland Area Change

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Abstract: Abstract：Wetlands play an important role in maintaining ecological sytem structure and function. In recent years, the wetland area is constantly changing as the natural climate change and the impact of artificial transformation which results in soil erosion and consequent a series of ecological effects such as the destruction of habitat surrounding species. Currently, the state has formulated the policy of strengthening the protection and management of wetland. It is an important prerequisite for compiling major ecological restoration plans and accurately grasping wetland resources and ecological changes. However, due to the large number and wide distribution of wetlands, it is hard to assess the dynamic growth and consumption of the area because it will spend much time and money. So we would like to use RS combined with GIS for Rapid assessment. Taking the survey of wetland area in Qingdao as an example, we use the functional characteristics of Arcgis to establish the remote sensing interpretation mark according to the basic principle of remote sensing image interpretation. We took the boundary of the wetland as the survey boundary and the Landset 8 image of the region composite with 543 bands as the base data. After processing of geometric correction and registration the data add to the database of assessment. Then we obtained the difference between the two period raster data and named it as Xi. According to the criterion, we set a threshold value X and use binary classification method to determine. If Xi> X is 1 and it means the area of wetland is reduced. Otherwise it is zero. Firstly, several wetland areas in Qingdao have changed and it have changed a greater degree in the wetland area which within the coast of 500m. Secondly, most of the wetlands real estate, real estate development centers and large commercial clusters. Thirdly, muddy beaches and estuarine should become the key object of wetland protection; wetland construction should focus on herbal marsh, estuary and muddy beach. Finally, it proves that the combine use of RS and GIS technology can achieve a rapid assessment of wetland area changes.

Key words: Area change, Rapid evaluation, RS / GIS

Analysis on Leaf Area Index of Vegetation in Shanghai, Huangpu District

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Abstract: Vegetation leaf area index (LAI) is extremely important as a parameter in vegetation canopy structure. The leaf area index can reflect the vegetation growth status, function and benefit information. In the field of crop science, ecology, environmental studies LAI has a very wide range of applications. Retrieval and validation of the vegetation leaf area index is one of the hot spots in the research area. At home and abroad, a large number of scientists have devoted themselves to the research on the extraction method of vegetation leaf area index. In this study, we take Huangpu District Shanghai as the research area, with Landsat-5, Landsat-7, landsat-8, GF^{-1}, using the method of remote sensing inversion, calculate the vegetation leaf area index of Huangpu District in 2000, 2005, 2009, 2013, and 2015. And classify the remote sensing images of five periods of Huangpu District different type of land using. On the other hand, doing regression analysis between the types of land use and vegetation leaf area index. The results show that the land use changes in the type of change does not influence the leaf area index directly. At the same time, temperature, relative humidity, precipitation and the vegetation leaf area index were analyzed in same way, the results show that the influence of the temperature on the leaf area index of Huangpu District was the greatest.

Key words: Huangpu District, Vegetation Leaf Area Index, Regression Analysis

Global Retrieval of Land Surface Phenology from MODIS Data

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Abstract: Accurate depictions of land surface phenology (LSP) are critical for understanding the effects of climate change on carbon cycle, water cycle and energy exchange of terrestrial ecosystem. Satellite data provides the ability to extract the LSP at global scale. But the varied vegetation growth trajectories, the data availability in monsoon regions and the difficulty for identifying the vegetation growth baseline under the influence of snow cover hindered the global retrieval of LSP. Currently, the inflexion-based and the threshold-based approaches are two widely-used approaches for extracting the LSP. The former uses the inflexion point of vegetation growth curve to decide the phenology date, while the latter uses the predefined percentage of

vegetation growth amplitude to do it. However, the former suffered from getting a mathematic curve to fit well the varied vegetation growth trajectories, while the latter suffered from determining a meaningful threshold to decide the LSP. Besides, the data availability of MOD09A1 in monsoon regions was decreased by the MODIS cloud mask, which easily misidentified the sparse valid observations in rainy season as clouds. To solve these problems, several techniques were used to improve global LSP retrieval. First, we demonstrated the equivalency of 9.18% to the inflexion point for extracting the LSP which indicated obvious vegetation growth transitions, and used the locally adjusted cubic-spline capping (LACC) approach to fit the varied vegetation growth trajectories, which performed well for gap filling, key point protection and noise resistance. Second, we increased the data availability by using the inflexion-based cloud detection (IBCD) approach to identify the over-detected clouds in MODIS cloud mask. Last, we used the minimum NDVI composition technique to determine the vegetation growth baseline. Through these three improvements, the global LSP product was generated from 2000 to 2016 at 500m resolution (named as GLOBMAP-LSP). This product was validated with the ground phenology from phenological networks in America, Europe and China. Global patterns indicate gradual transitions of the LSP from the low latitudes to high latitudes in Northern America (> 30 ℃) and in Eurasia (> 40 ℃), from the east of China to the west of India, from the equator to the low latitudes of Africa, and from the central to the coast of South America and Africa. Comparison with the MCD12Q2 phenology product demonstrated the improvement of this product, especially for the Indian monsoon region, where the valid percentage of the extracted SOS was increased from 29.33% to 74.66%. This product would facilitate the understanding of climate pattern and climate change at global scale, and help to predict the future climate change.

Key words: Land Surface Phenology, Vegetation Growth Trajectory, Remote Sensing, Climate Change

Assessment of Eco-Environmental Quality in Hainan Island Based on Landsat 8 Operational Land Imager Data

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Abstract: Land use monitoring over large area and its eco-environmental quality assessment are the preconditions for land use change research based on remote sensing data. Here Landsat 8 operational land imager data was used to extract land use pattern and evaluate the eco-environmental quality of Hainan Island in 2015 by the decision tree classification method. The results revealed that (i) with the decision tree

classification method established for Hainan Island, the overall accuracy was 86.10% and kappa was 0.81, which meant the classification results could be used for land use analysis. (ii) Rubber plantation was mainly distributed in three counties of Hainan Province, i.e., Danzhou, Qiongzhong and Baisha. Forest land focused in the central mountainous area and northeast part of the island. Arable land, building and bare land were mostly located in the coastal areas, and two reservoirs (Songtao and Daguangba) predominated in the water area of the island. (iii) Synthesis evaluation model of eco-environmental quality in Hainan Island was built based on four indices, i.e., habitat quality index (HQ), normalized difference vegetation index (NDVI), normalized difference moisture index (NDMI) and normalized difference soil index (NDSI). And the results showed that the eco-environment was good for the island but with obvious spatial difference. That is, the eco-environment quality was excellent in the central mountainous area and good in the platform rounding the mountainous area, whereas the quality was normal in the coastal areas.
Key words: Landsat 8, Land Use, Eco-Environmental Quality, Hainan Island

Estimating Soil Sand Content Using Thermal Infrared Spectra in Semi-Arid Grassland of North China

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Abstract: The soil sand content is an important indicator for soil desertification in grassland. The characteristics of sandy are crucially driven by dominant mineral, quartz (SiO_2), which lacks any distinctive Si-O bond related spectral features within the VNIR-SWIR. The thermal infrared shows good advantages to extract information from sandy soil due to the silicate residual radiation bands between 8 and 9.5μm. The aims of this study are to demonstrate the characteristic of emissivity spectra of soil with different sand content value, and explore the potential of thermal infrared technology in soil sandy prediction.48 samples were prepared with the surface chestnut soil and the underlying sand collected from the Hulunbuir grassland of North China. These soil sediment concentrations of the samples range from 0% to 100% and follow the normal distribution. The Turbo FTIR portable infrared spectrum radiometer was used to acquire emissivity spectral curve of soil samples. The SAR (Spectral Absorption Ratio) is determined based on the characteristic at silicate residual radiation region of emissivity spectrum. Furthermore, linear model was established according to the relationship between SAR and soil sediment concentration. The experimental results show 1) there is a signification negative correlation with correlate coefficient value of 0.89 between soil sediment concentration and emissivity spectrum in the 8.1-10.2μm

region; 2) The SAR based on emissivity/depth at 8.46 um and 8.89 um were proposed to establish the linear prediction model, which error of external validation are both within 16%.This study indicated that using soil thermal infrared spectral data can achieve the prediction of soil sediment concentration accurately. It would provide the theoretical basis and technical support for monitoring desertification in grassland areas.
Key words: Thermal Infrared Remote Sensing, Sand Content, Spectral Characteristic, Spectral Absorption Ratio

Surface Modelling of Biodiversity and Ecosystem Services

TianXiang Yue

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Abstract: If a unified term, ecological surface, is used to represent a surface of an ecosystem service, a surface of a driving force or a surface of biodiversity, we can state that an ecological surface is uniquely defined by both extrinsic invariants and intrinsic invariants of the surface, which can be simulated with an appropriate method for integrating the global and local information, such as high accuracy surface modelling (HASM), when the spatial resolution of the surface is fine enough to capture the attributes of interest. Ground observation is a source of the intrinsic invariants. Satellite observation is an important source of extrinsic invariants. Ground observations are able to accurately estimate ecosystem services and driving forces of ecosystem changes at sample plots, but these sample plots are too sparse to support the spatial simulation of changes of ecosystem services with required accuracy. Satellite remote-sensing can supply spatially continuous information about the surface of ecosystem services, which is impossible from ground-based investigations, but their descriptions incorporate considerable uncertainty. This oral presentation is to present the progress in the method for high accuracy surface modelling (HASM) as well as its applications to simulating biodiversity and ecosystem services as well as driving forces of their changes. The applications include spatial interpolation, downscaling, upscaling, data fusion, and data assimilation.
Key words: Surface Modelling, Biodiversity, Ecosystem Services

Integrative Approaches of Ground Spectral and Remote Sensing for Estimating the Aboveground Plant Biomass of Alpine Grassland in Qinghai-Tibet Plateau

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Abstract: Estimating aboveground plant biomass is key for sustainable grassland management and rational conservation planning, especially for fragile regions. However, the traditional measurement of aboveground plant biomass with clear cutting in the sampling quadrats in traditional way is very time and labor consuming. The estimation of aboveground plant biomass with modern remote sensing techniques is often challenging due to poor availability of high-quality images and accuracy of data analysis. In this study, we experiment a novel method to integrate ground spectral with remote sensing to estimate the aboveground plant biomass of the grasslands through 1200 samplings at 172 sites cross the vase areas of Qinghai-Tibetan Plateau. We found that the relationship between the aboveground plant biomass of the grasslands and spectral field-NDVI (R2) are quite good. So we generate a regression model and applied this model to calculate the aboveground plant biomass. This model could also be applied to estimate the aboveground plant biomass of the grassland ecosystems in other regions.

Key words: Aboveground Biomass Modeling, Ground Spectral, Remote Sensing, Qinghai-Tibet Plateau

Soil Stored Most of Carbon in Grassland Ecosystems on the Loess Plateau

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Abstract: Abstract: Carbon stored in grassland ecosystem plays an important role in global carbon balance, it not only offer C element for grass growth and soil microbial activities, but also is one of the main C source for atmosphere. In this study, we acquired C density of 223 sampling sites of grassland on the Loess Plateau. Combined

with Digital Elevation Model (DEM), Leaf Area Index (LAI), precipitation, biomass and soil organic carbon content, we estimated grassland C density and storage by decision tree model. The results show: from north to the south of the Loess Plateau, carbon density increased, and the estimated C storage of grassland ecosystem was 1.283 ~ 1.379 Pg. Typical steppe stored C the most, and on the contrast, steppe desert stored the least. Soil stored most of the C on the Loess Plateau, and belowground biomass (BGB) stored C more than aboveground biomass. The uneven distribution of C may due to the severe soil erosion, and this study offered a reference for further C loss on the Loess Plateau.

Key words: Grassland, Carbon, Loess Plateau, Decision Tree

Forest Biodiversity Mapping Using Airborne LiDAR and Hyperspectral Data

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Abstract: Monitoring forest biodiversity plays an important role in managing and conserving forest resource. A new method called “spectranomics” that map forest species diversity based on leaf biochemical and spectroscopic traits using imaging spectroscopy has been developed. In this study, we use this method combined with the airborne imaging spectroscopy (PHI-3 with 1m spatial resolution) data to detect the relationship among the spectral, biochemical and taxonomic diversity of tree species based on 20 dominant canopy species collected in the Longmenhe Forest Nature Reserve of China. Seven optimal biochemical components (chlorophyll, carotenoid, water, specific leaf area, nitrogen, cellulose, and lignin) have been selected to indicate the forest biodiversity, which could detect maximum 14 species (Zhao et al., 2016). Consequently, seven vegetation indices were derived to represent the above corresponding biochemical components, and scaled from the canopy down to leaf scale via dividing by leaf area index (LAI). In addition, we used the morphological crown control method based on watershed algorithm to isolate individual tree crown by LiDAR (> 4 points/m2). Finally, a self-adaptive Fuzzy C-Means (FCM) clustering algorithm was applied to determine the optimal clustering numbers (i.e. species richness) and Shannon-Wiener index for each moving 30 x30 m moving window based on the isolated individual tree height and seven biochemical indices. The results showed that combined LiDAR and hyperspectral data could well predict forest species diversity at regional scale (R2=0.83 for Shannon–Wiener index, P< 0.001).

Key words: Forest Biodiversity, Biochemical Components, Lidar, Imaging

Spectroscopy

The Dynamic of Temporal and Spatial Patterns of Vegetation NPP in the Yunnan - Guizhou Plateau

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Abstract: Based on the annual NPP data of MOD17A3, the temporal and spatial patterns of vegetation NPP in Yunnan - Guizhou Plateau were studied by GIS spatial analysis and mathematical statistics. The results showed that the average net primary productivity (NPP) in the past 15 years was 767 g/m2 a; annual average NPP of the vegetation in the Yunnan - Guizhou Plateau showed the high spatial heterogeneity that the highest is in the southwest, the smaller in the northeast and the smallest in the middle. There were significant differences in vegetation NPP in different land use types, the woodland is the highest, followed by grassland, crop and natural vegetation mixed, permanent wetland, agricultural land and shrubbery, etc. Vegetation NPP decreased slightly during the study period. The vegetation NPP decreased significantly in the southwestern and southern regions, and increased significantly in the north and central regions.

Key words: NPP, Remote Sensing Data, Temporal and Spatial Variation, Yunnan-Guizhou Plateau

Study on the Change of Island Ecosystem Services Based on Remote Sensing

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Abstract: Chinese government put forward strategies of "improving the ability of Marine resources development, developing Marine economy, protecting the Marine ecological environment, firmly safeguarding national Marine rights and interests and the construction of Marine power", and in "along the way" under the background, the island development activities will be more and more frequent, but the island ecosystem was fragile and environmental capacity lowed, scientific and reasonable intensity of island development is the foundation of the sustainable utilization of islands. From the perspective of ecosystem services, combining with the characteristics of island ecosystem and reference to previous research results, the article build the island ecosystem service classification system. Through two phase of the remote sensing data,

the Dongtou district island ecosystem service value and island development strength were evaluated. The research draw the following conclusions:

In 2004-2013, island land ecosystem service total value of the Dongtou islands decrease, and the tread displays in: First, island ecosystem service value of each island declined in varying degrees, such as, Damen island island ecosystem service value reduction in maximum, and DaQu Island, Nance Island and Qingshan island island ecosystem service value of no change or changed little; Second, the island continent ecosystem service type value decreasing degree of different. The island island ecological system for various types of service value reduce degree from high to low in turn is: regulating services, support services, supply and cultural services.

In 2004-2013,the coastal ecosystem service value of Dongtou District Island showed a decreasing trend, mainly displays in: First, every island offshore ecosystem service value different degrees of loss, Zhuangyuanao Island offshore ecosystem service value loss most, reduced 10074.67 million yuan and other sea island offshore ecosystem service value loss is less; Second, the island coastal ecosystem services value differently loss, according to the proportion of each type of service value loss from high to low in turn is: regulating services, support services, supply and cultural services.

Key words: Island, Ecosystem Services, Remote Sensing

Mapping the Distribution and Abundance of Mangrove Species in Futian Mangrove National Nature Reserve, Shen Zhen, Using WorldView-2 Data

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Abstract: Mangrove ecosystems dominate the coastal wetlands of tropical and subtropical regions throughout the world. Mangrove species compositions and distributions are essential for conservation and restoration efforts. Remote sensing techniques represent a cost-efficient means of mapping and monitoring mangrove forests at large scales. The characters that the mangrove forests are composed of fewer species and their patchy distribution has provided favorable conditions to identify individual mangrove species. The advent of very high spatial resolution multispectral data and robust machine learning regression algorithms such as support vector machines (SVM) has provided new opportunity for the accurate mapping of species within mangrove forests over large areas. Geographic Object-Based Image Analysis (GEOBIA) is becoming more prevalent in remote sensing classification, especially for high-resolution imagery. This study explored the effectiveness of GEOBIA in company with SVM machine learning regression algorithms in mapping mangrove

inter-species obtained from WorldView-2 high-spatial-resolution imagery in Futian Mangrove National Nature Reserve. During field visits, GPS locations of five dominant mangrove species that in the top canopy with appreciable distribution were taken, including Kandelia candel, Avicennia marina, Aegiceras corniculatum, Bruguiear gymnorrhiza and Sonneratia apetala. The classification result showed that total area of mangrove forest covered about 89.1 ha, Kandelia candel is the most dominating specie with area of 51.2 ha, followed by Avicennia marina and Aegiceras corniculatum with area of 12.0 ha and 17.1 ha respectively. However, the human-planted species, Bruguiear gymnorrhiza and Sonneratia apetala are less and concentrated distributed. The overall accuracy of our mangrove map was 0.902, the Kappa coefficient was 0.859. Additionally, GEOBIA has higher capability than pixel-based analysis for discriminating among mangrove species in this study, it was suggested that GEOBIA should be considered in most cases for high-resolution imagery mapping.

Key words: Mangrove, Futian Mangrove National Nature Reserve, WorldView-2, GEOBIA

Grassland Coverage Estimation Using Chinese GF^{-1} Satellite Data and Unmanned Aerial Vehicle Photogrammetry from Large Surface Mining Affected Area

Zonglei Cai, Nisha Bao, Fan Li

Northeast University, China

Abstract: The monitoring and estimation of plant coverage is essential, which would indicate the condition of grassland affected by human activates including mining and grazing. Fractional vegetation cover (FVC) is an important surface parameter for characterizing land surface vegetation cover as well as the most effective indicator for assessing surface mining affected environment. The aims of this study is to indicate the potential ability of Chinese GF^{-1} satellite imagery combining with UAV photogrammetry in grassland FVC retrieval at the surface mine area of north prairie in China. UAV has advantage to acquire large scale ground sampling data, furthermore, to validate the remote sensing results. GF^{-1} PMC (Panchromatic Multi-spectral Camera) multi-spectral imagery acquired at July 21st, 2016 was chosen in this study, which is 8m spatial resolution and 4 bands of red, green blue and near infrared. Ground sampling and observation experiment was from July 12nd to 14th, 2016. Ground sampling is aligned according different land use, including grazing land, mining area, sandy land and fenced pasture. A total of 7 sampling plots with 60m * 60m were chosen, which is about 7 times as big as the GF^{-1} pixel size. UAV of Phantom 3 was used to collect a set of aerial images above sampling plot 100m. The GF^{-1} multi-spectral imagery was

preprocessed by radiometric calibration and geo-correction using ground control points. The UAV imagery was geo-corrected based on ground control points. OTSU method was conducted to extract FVC automatically from UAV photogrammetry. The Support Vector Machine (SVM) models is established based on the different vegetation indices from GF^{-1} multi-spectral data and ground data from UAV to retrieval grassland cover. The results showed that soil-adjusted vegetation index (SAVI) from GF^{-1} can produce high accuracy (R2=0.956， RPD=4.857， RMSE=3.232) based on SVM model. Therefore, the Chinese GF^{-1} data can provide grassland cover with high accuracy based on SVM model. It was found that this method was spatially consistent, allowing accurate vegetation mapping over the entire grassland. This provides evidence that images acquired using a low-cost camera onboard a UAV flying at low altitudes are a suitable tool to use to discriminate grassland cover. This opens the doors for the utilisation of this technology in precision grassland restoration and management which accurate vegetation fraction mapping is essential for crop-weed classification.

Key words: Fractional Vegetation Coverage of Grassland, GF^{-1} Data, UAV, SVM

Changes of Waterbird Habitat Suitability in the Sanjiang Plain of China

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Abstract: In the past decades, waterbirds habitats have been seriously damaged in the Sanjiang Plain of China due to substantial wetlands shrinkage. Identifying suitable habitats is critical to wetland management and restoration. In this study, by developing an object-oriented segmentation approach in conjunction with geographic information systems (GIS) spatial analysis and remote sensing image data, we analyzed and assessed changes of the suitability of habitat for waterbirds in the Sanjiang Plain, China. The results indicated that during the period 1992–2012, the habitat area in good and fair suitable grades decreased by 12,960 km^2 (23.39%). In 1992, the good and fair suitable grade area occupied 50.84% of the total land area of the Sanjiang Plain with numerous large patches. However, during the past 20 years, the habitat area in good and fair suitable grades declined in the whole region and many large patches disappeared. In 2012, the good and fair suitable grade area only covered 38.95% of the study region. In contrast, the habitat area with poor suitable and not suitable grades increased from 53,343 km^2 in 1992 to 66,248 km^2 in 2012 (24.19%).

Key words: Habitat Suitability, Remote Sensing, Spatial Analysis, Sanjiang Plain of China

T1-05: EcoScience + Art: Interdisciplinary Collaboration between Ecosystem Science and Art to Enhance Ecological Communication and Resilience

Art, Law, Ecosystem Resilience and the Blued Trees Symphony

Aviva Alexandra Rahmani

University of Colorado at Boulder, USA

Abstract: This presentation will describe how artist Aviva Rahmani's The Blued Trees Symphony has pursued a mission to replace a dysfunctional legal system that supports an obsolete fossil fuel economy with visionary art in collaboration with trees. It represents a paradigm for resilience by recognizing our interdependence with other life. That interdependence is addressed by bridging the original premise of copyright law, as the "spirit" of art and Earth Rights, which acknowledges our need for our cultural relationships to nature. The completed works are transdisciplinary synesthetic art installations. They are deliberately placed in the path of proposed natural gas pipelines in the United States and are conceived together as one sonified biogeographic sculpture.

The work was inspired by Alberta, Canadian sculptor Peter Von Teisenhausen, who copyrighted his entire ranch in 1996 to stop natural gas corporations from taking his land. The company voluntarily withdrew, but his concept was never tested in court.

This project responds to the fact that pipeline accidents can contaminate watersheds, endanger human health and destroy habitat, but despite rising localized resistance to their presence, corporations are crisscrossing North America with forty-four new high velocity pipelines. This symphony contests how fossil fuel corporations have invested in disinformation, and taught learned helplessness.

The American legal avenues to take land for gas pipelines exercise the right of eminent domain, which states that private land may be "taken" if the government can prove it serves the public good. In these cases, public good is narrowly defined to protect the economic interests of large corporations. A legal test case is being sought to challenge current environmental policies with community activism. A collective narrative will build arguments for a wider definition of public good in the court of public opinion before litigants enter a courtroom.

Copyright law states that a creative expression has protection from destruction. Earth rights states that ecosystems have rights to protection. The success of the Symphony's argument is based on the spiritual implications of art and earth rights, in contrast to the interests of private profit alone. The goal is to connect this spiritual dimension to the

judicial means to protect watersheds from habitat destruction.
The United Nations Intergovernmental Panel of the Parties (IPCC) says the "cultural aspirations of a people" are equivalent to economic rights in any discussion about the impacts of fossil fuels. Cultural rights include the artistic expressions that mend conflicts, define a society and defend earth rights. At each site, local musicians and artists are encouraged to develop, improvise upon and to record the unique expressions of the basic themes expressed by the tree-notes by interpreting a simple melodic refrain. Each measure contributes to the whole Symphony. The result is a continental scale musical composition- installation that is a template for including art in sustainable ecosystem relationships. In this way, The Blued Trees Symphony weaponizes an originalist interpretation of copyright law and transdisciplinary art to protect the resilience of human life on earth.
Key words: Transdisciplinary, Policy, Biogeographic, Fossil Fuels

Reading the River

Basia Irland

University of New Mexico, USA

Abstract: As founder of the Art and Ecology Program at the University of New Mexico, I have worked closely with colleagues across disciplines to enhance and enrich the dialogue and begin to break down the academic silos that are so prevalent on university campuses. My art practice focuses on international fresh water issues and each of the following four projects are done in collaboration with scientists.
For many years, I have conducted research and produced art about waterborne diseases in collaboration with parasitologists and epidemiologists. The creative process takes numerous forms, including video documentaries such as "Bilharzia Blues: An Integrated Artistic/Biological Approach to Schistosomiasis in Egypt, Ethiopia and Nepal," which was produced on a grant with the chair of biology at UNM. In Nepal, we researched the ecology of the schistosomes, which are infecting, not only the local populous, but also elephants in the Rapti River region. There is a series of scrolls depicting the waterborne pathogens, which are photographed floating in rivers and are exhibited in galleries and museums. The scrolls created while in India and Nepal are made using sari silk, since this fabric can be doubled over and used as a filter for polluted water. Also, new songs are composed with local musicians to help educate the public about how to avoid contracting schistosomiasis.
I blog for National Geographic about global rivers I know and love, which are written in the first person, from the perspective of the river. Each blog is a collaborative effort with numerous scientists who assist with vital information about a specific river. Through social media I reach a far wider audience that I can by writing academic papers

published in reviewed journals.

"Ice Receding/Books Reseeding" are ephemeral ice book sculptures embedded with native riparian seeds, which are launched rivers to address restoration efforts and the serious concerns of climate change. I work closely with botanists to ascertain the best seeds for each riparian zone. There is deep community involvement in the entire process, with hundreds of local citizens participating in an educational experience to learn first-hand about their watershed.

"A Gathering of Waters" is an extensive series of projects connecting local citizens to their river through direct involvement of handing a canteen person-to-person along the entire length of a river and writing in a logbook about their experience. Participants include hydrologists, farmers, biologists, majordomos, politicians, Tribal members, artists, and academics of many disciplines. Accompanying each "Gathering" is a portable backpack, which functions as the repository for maps, data, photographs, and water and clay samples. The repository for the Oconee River in Georgia was created in the shape of a navicula, because I was collaborating with a biologist specializing in algae and diatoms. For the Portneuf River in Idaho, I worked with a civil engineering professor to create a Raster grid depicting the annual stream flow in this river. For many of these projects I am invited by both art and biology departments at universities, thereby enhancing communication about resilience (buoyancy) through collaborative efforts.

Key words: Rivers

Sustainable Stormwater Management Using a Floating Treatment Wetland— A System Approach

Brendan McAndrew, Changwoo Ahn

George Mason University, USA

Abstract: Stormwater runoff from urban areas is recognized as a chronic source of pollution reaching natural waterways. Increasing populations and the associated land use changes suggest that the volume of urban runoff and the pollutants it carries will increase the foreseeable future. Nutrient pollution by nitrogen and phosphorus, caused primarily by the excessive use of artificial fertilizers, is of principal concern as it can contribute to degradation of downstream aquatic ecosystems. As a result, a variety of technologies have been developed to manage the quantity and quality of urban stormwater runoff. Stormwater wet ponds, for example, temporarily capture runoff following a storm. While the primary function of wet ponds is to attenuate runoff volume, they can also improve water quality by capturing sediments and nutrients such as nitrogen. However, nitrogen removal performance is inconsistent due to poor pond

design and/or lack of maintenance. Retrofitting ponds to improve their nitrogen capture performance can be expensive prompting research into low cost, sustainable alternatives.

In this study we investigated the sediment and nitrogen removal performance of a relatively young technology known as floating treatment wetlands (FTWs) which utilizes an artificial floating island to support the hydroponic growth of emergent macrophytes on a pond or lake. As the plants grow, nitrogen is removed directly from the water column and sequestered in biomass. Furthermore, the roots and FTW structure accumulate sediment and may serve as a surface for biofilms that can further enhance nitrogen removal. To date, few studies have investigated the effectiveness of FTWs on real-world stormwater systems. We deployed a 50m2 floating treatment wetland for 137 days on a ~7100m2 stormwater wet pond located within an urban university campus near Washington, D.C. The FTW was stocked with 1510 plants from five native wetland species which allowed us for comparison of nitrogen capture performance between species. Biomass production on our FTW ranged from 16.94 g/m2 to 88.55 g/m2 while the nitrogen uptake rate by the plants ranged from 0.003 g/m2/day to 0.016 g/m2/day. Biomass production and nitrogen capture of our FTW was low compared to similar studies, but still within the range of observed performance.

A dynamic system model was then created to simulate the nitrogen capture performance of the plants on the FTW. The model, calibrated with data from our FTW study, was used to estimate nitrogen capture performance across a range of design parameters (i.e., surface area coverage, deployment period, etc.) to determine conditions that maximize FTW nitrogen capture. Simulation results suggest that pond surface area coverage, plant density, and biomass production rate are the primary factors influencing nitrogen capture. At ~1% surface area coverage, the model estimates our FTW removed up to 0.16% of the pond nitrogen. When FTW surface coverage is increased to 25%, the model estimates removal of up to 5.2% of pond nitrogen.

These results, while modest, suggest FTWs may provide a sustainable means of removing nitrogen from urban stormwater. In addition, the FTW improved pond aesthetics, attracted wildlife, and educated the public on stormwater issues.

Key words: Stormwater, Runoff, Floating Treatment Wetland, Nitrogen

Conversation on Systems Thinking Between an Ecologist and an Eco-Artist: A Reflection on Urban Rain by Jackie Brookner (1945-2015)

Changwoo Ahn

George Mason University, USA

Abstract: Through this talk I will present my discussion notes and reflection on my meeting with the late Jackie Brookner whose art work provided ecological functions based upon the perspectives of system ecology. Brookner's book "Urban Rain: Stormwater as Resource" was especially instrumental when I introduced my students to interdisciplinary approach to stormwater issues while I designed the Rain Project. Two amazing pieces of her artwork, one was a large steel fingerprint and the other a rectilinear-type slate, are located at the new Roosevelt Community Center building near Coyote Creek, in San Jose, California. These installations as well as functional structures were designed to collect and filter rainwater from the roof of the community center. Brookner's "biosculptures™" were also known to reduce the volume, and improve the quality of the rainwater, before it entered the storm sewer system. The excellent examples of stormwater art projects provided not only aesthetics but ecosystem functions.

My visit back in the summer of 2014 with Jackie in New York City to learn more about her thoughts and work led to a few hours of conversation and discussion on her work while sharing our thoughts on ecosystem restoration and experiences with environmental stewardship. Jackie really saw art as a tool for putting cultural, social, historical, and geographic contexts in any kind of ecosystem restoration work to facilitate much needed engagement and participation of local communities. We shared the idea that art could be instrumental for furthering ecological science, restoration practices, and their communication

Brookner and I had also addressed "systems thinking" to be able to navigate the complex issues and ideas relating to environmental degradation and problems. We talked about Thich Naht Hahn and his Zen Buddhist teachings as a spiritual guide for our work and lives. Thich Naht Hahn has written about "interbeing" especially at the beginning of his book, titled "The Heart of Understanding". Interbeing is a word that you cannot find in the dictionary. However, if we combine the prefix "inter-" with the verb "to be," we have a new verb, inter-be. It conceptualizes the importance of realization that everything is connected to one another, the very core idea and teaching of system ecology. It means that there is no independent self – that the perception of self, of "me", of "mine" is an illusion. This indicates the very nature of "dependence" and "connectedness" of everything, which is deeply embedded in systems thinking. Although Brookner and I came from different disciplinary angles, having the conversation on these was invaluable to me. It validated my ideas for the urgent need of educating and sharing systems thinking and approaches to the practices of higher education, not only in ecological restoration practices. Brookner's whole systems approach signified how social, cultural, and ecological aspects of ecosystem restoration and interdisciplinary approaches in education could be integrated. This aligns well with my approach as a system ecologist to look at the linkages/interactions between socio-economic and ecological/environmental realms to address complex

environmental (ecological) problems.

Key words: Systems Thinking, Jackie Brookner, Urban Rain-Stormwater Art, System Ecology

Innovating Interdisciplinary Higher Education in Environmental Sustainability for Better Science Communication and Ecological Literacy

Changwoo Ahn

George Mason University, USA

Abstract: I will present the past four years of efforts made to improve ecological literacy and communication in college education through the case of a lecture series combined with campus-wide, interdisciplinary environmental student projects. There are a number of benefits in art-science collaboration in education. Artistic efforts can involve students in exercising their creativity, which can contribute to successful training of innovative scientists. Both artists and scientists share a common goal to depict and analytically explain our experiences, and represent in varying forms the outcome of imagination. Innovation in science often is linked to urges to express oneself artistically. Incorporating art in (ecological) science education can help students to enhance their intuition since creativity and intuition are critical elements in scientific discovery and advance. It is only through interdisciplinary collaboration, particularly in education and scholarship, which we may be able to train a generation of system thinkers who can navigate through the disciplinary boundaries to address pressing questions relating to environmental/ecological sustainability. For example, restoring impaired ecosystems require a great deal of effective communication skills to bring the communities together, which I believe art can facilitate more effectively. The collaboration between scientists and artists can offer communities a cultural and visual context for engaging scientific data and principles, making science more accessible especially in a post-truth world and thus eventually transforming our environmental stewardship

I designed an interdisciplinary, on-campus, student project, titled 'The Rain Project' and conducted with students from a number of disciplines (e.g. environmental science, art, civil engineering, biology, communication, and film/media) as an urban wetland restoration model as well as a collaborative pedagogical approach between ecological science and art at George Mason University (GMU), Virginia, U.S.A. A group of students participated in designing and constructing a floating wetland for a campus stormwater pond as part of sustainable stormwater management. The Rain Project introduced students to new learning strategies that connected "systems thinking" with

art, ecological science, and restoration practices. Another new on-going project titled 'The Dirt Project' that aims to address the impact of urbanization and climate change through a hierarchical observation and investigation of soil colors and their variations will be discussed as well. These projects have numerous implications for college education, scholarship, and service while presenting a novel way of higher education for ecological awareness and literacy. As a symposium organizer I will also address a threading theme of art-science collaboration that may help to train the next generation to be able to both think differently and communicate effectively.

Key words: Art-Science Collaboration, Ecological Literacy, The Rain Project, Interdisciplinary Education

WATERWASH: Interweaving Culture and Science in Wetland Habitats

Lillian Ball

Waterwash Projects, USA

Abstract: Lillian Ball's WATERWASH projects are collaborations between the artist, the community and nature itself. These dynamic landscapes restore vital ecosystems and rebuild a sense of public ownership and responsibility for native habitats in diverse locations from New York to Lumbini, Nepal. Cultural resources play a major role, involving stake-holders from the original conception of the projects. These projects extend the feminist concept of maintenance art to the ecological scale, by removing invasive species and cleansing polluted ¬ waterways with native plants. In the process, Ball makes visible the invisible cycles of nature, creating an educational tool and an invitation for community stewardship.

At the original WATERWASH prototype, a public access boat ramp on Mattituck Inlet, contaminated runoff that would otherwise flow Long Island Sound from a county road is filtered through permeable recycled glass pavement and a bioswale composed of native wetland plants. A larger wetland/grassland design at WATERWASH Bronx River diverts stormwater from the 30,000 square foot parking lot of huge retail outlet into a native plant wetland that removes hydrocarbons and other pollutants before the water reaches the river. The construction of this unique wetland park was funded by the New York State Attorney General's office through a grant from the Bronx River Watershed Initiative. E Design Dynamics and Dr. Franco Montalto, of Drexel University's department of Environmental Engineering were part of the team invited by Ball to participate in the grant for hydrological design. They also installed monitoring equipment that recorded velocity and flow even during Hurricane Sandy, producing a scientific report that proves how efficient the project actually is.

The project's location, in the low-income South Bronx, also has the lowest ratio of parks to people in New York City. In the development of this project, Ball collaborated with Rocking the Boat, a local non-profit to provide jobs and environmental education to local youth. Thanks to a 25-year legal agreement, the youth continue to do the maintenance on this private property which functions as public space. The building was recently sold and indications are that the new owners will be even more involved and provide stewardship funding. Several music and dance performances and local events have been scheduled using the site. It has been visited by varied groups such as the Department of Environmental Conservation, Parsons School of Design, and the Yale School of Forestry. It was the recipient of a NYS Assembly award citation for its Green Infrastructure, and integrated community cultural approach. WATERWASH Bronx River continues to offer extensive outreach opportunities demonstrating how wetlands act as a natural buffer for sea level rise and storm surge, while improving water quality through habitat creation for both humans and wildlife.

Key words: Green Infrastructure Stakeholders, Art/Culture, Stewardship

A Dryland Re-Vegetation in Northern China: Success or Failure? Quick Transitions or Long Lags?

Ning Chen

Lanzhou University, China

Abstract: 1. Intensified anthropogenic activities have degraded many ecosystems, motivating the use of restoration to regain key ecosystem functions and services and to stem biodiversity losses. Restoration is particularly difficult when human activities have pushed an area a new self-reinforcing state.

2. This study investigated a long-term restoration project in a dryland ecosystem of the Tengger Desert in Northwest China. Portions of this landscape have transitioned from a vegetated state to a bare state. Bare state have persisted for the last two centuries, despite close proximity to vegetated areas as a source of plant propagules, suggesting a potential shift in feedbacks to stabilize bare areas. We analyzed annual changes in shrub and grass cover for 49 years after restoration infrastructure that altered external conditions (i.e., reducing erosion and wind speed) and system state (by planting shrubs).

3. After 45 years the re-vegetation project was successful in restoring the system to a state similar to the native vegetation, with high grass cover (30%–50%), low shrub cover (8%–10%), and a thick biological soil crust (biocrust).

4. However, the shift to high grass cover did not begin until year 37 of the project. In the interim, shrub cover was high (15%–20%) and grasses were subdominant (0%–25%).

The shift from shrub to grass dominance was abrupt, registering statistically significant nonlinear changes over time and relative to biocrust thickness. We attribute the long time lag and a threshold relationship between biocrust and vegetation cover. As biocrust grew slowly, it took over 30 years before this threshold was reached.
Synthesis and applications. This study is one of the longest reported case-studies of dryland restoration. Altering external conditions and system state was successful in pushing the ecosystem out of a self-reinforcing, bare state. However, this process exhibited a long time-lag, suggesting that it could take decades to determine whether dryland restoration efforts would succeed. The results indicate that persistence might be critical to forcing desired state transitions and that dryland restoration can proceed as a series of time lags, punctuated by abrupt changes in ecosystem state.
Key words: Restoration, Transient State, Biological Soil Crust, Time Lag

Art, Ecology, and Infrastructure

Patricia Johanson

PRATT Coalition, USA

Abstract: Aesthetics plays a crucial role in my environmental projects by engaging the audience, encouraging them to form personal connections, and leading them a dialogue with environmental issues, such as storm water purification, flood control, wetlands sewage treatment, land reclamation, harnessing geothermal energy, and the importance of preserving wildlife habitat and endangered species. All of my large-scale projects design functional urban infrastructure as accessible public parks, trails, and environmental sculpture, combining sustainable solutions with high visibility and public discussion. They are designed as complete ecosystems, linked to their surroundings, and feature educational programs and community involvement. FAIR PARK LAGOON in Dallas, Texas (1981-86) is a municipal flood basin and home to numerous wildlife species. The lagoon both protects its surroundings from inundation, while revealing the effects of inclement weather, as water levels rise and fall, stimulating dialogue about these issues. At ELLIS CREEK WATER RECYCLING FACILITY in Petaluma, California (2000-2009), municipal sewage is processed through sequential constructed wetlands that double as a public park with four miles of trails, and wildlife sanctuary that provides food and habitat for endangered species. Recycled water is sold by the city, and productive agriculture occupies land not engaged in the sewage treatment process, while wetlands plants in the configuration of a flower cleanse storm water. THE DRAW AT SUGAR HOUSE in Salt Lake City, Utah (2003-2017) is a diversion dam for the ten thousand year flood, safely channeling water off the Wasatch Mountains, under an eight-lane highway, down a narrow “canyon” between tall buildings, and back into a creek. It is also a public park, nature trail, and

wildlife corridor, with habitat niches woven throughout the sculptural walls of the dam and spillway. A cultural narrative based on local pioneer history, environmental and educational programs are incorporated into this five-block long flood control sculpture. MARY'S GARDEN in Scranton, Pennsylvania (2008-2017) reclaims land devastated by coal mining, restoring surface flow and providing geothermal energy and storm water purification, while supporting the educational programs at Marywood University.
Key words: Infrastructure, Flood Control, Wetlands Treatment, Parks

Sustainability: The Toolmaker and the Tools

Robert Eugene Turner

Louisiana State University, USA

Abstract: A sustainable eco-civilization is not necessarily a high-quality one, but it could be. We could, for example, 'survive' on the desperate earthly edge as remnants in a self-fouled and deteriorating environment. Why won't a future sustainable system be just another industrial model of mass efficiency and throughput? Perhaps the incompatible outcomes are a choice between the sometimes nearly invisible civilizing aspects of culture nurturing respect, equality, and cooperation on one hand, and the greed and self-indulgences undermining social tolerance, empathy, and cooperation - and that ends up promoting violence and dehumanization. The human heritage is subtle, indestructible, and worth nurturing if we want that hospitable sustainable system. But, assuming that a passive social osmosis will be sufficient to sustain justice and fairness dismisses the many historical examples. A culturally-rich and truthful narrative overrides the maladaptive dissonance existing within sustainable systems. Eco-civilization examples from China (stuttered technological changes), Balinese water temples (water allocation), Palau coral reef fisheries (harvest restrictions), and North America (native governance) are used to build upon that range from 100 to 10,000 years. This narrative is anchored in personal and group initiatives, incorporates appreciation of an evolved heritage, and is informed by intentional social learning within groups and occasional social punishment. The continuous re-creation and invention of the cultural nuances for a crowded planet will be at local and global scales, chaotic, intense – and necessary.
Key words: Eco-Civilization, Sustainability, Governance, Culture

Art as a Verb: Large-Scale Artworks That Solve Site Issues by Eco-Artist Stacy Levy

Stacy Levy

Artist, USA

Abstract: In contemporary culture, art is a commodity that has been defined by its lack of function. Large-scale earthworks of the 1960s and '70's were built to sit passively on the site and be seen. In the past two decades, art has taken a new direction that includes action. Art has become a verb and not just a noun, creating environments for people to engage with nature. This new form of art interacts with nature directly rather than just depicting it. I will investigate how artists share a sense of civic responsibility towards nature and the imperative to make visible the interconnectivity of humans and nature. I will explore the varied ways that large-scale land artworks have incorporated function on a site. I will take a detailed look at my projects that have created solutions to environmental issues on the site: including stormwater runoff and eutrophication, as well as mining pollution and habitat loss. Art can take the first steps to redesign the structure of our relationship with nature by creating a direct interaction between nature and people and revealing the depth of our connectivity Art has the power to both introduce those often invisible natural processes while simultaneously creating solutions that sustain nature in our Anthropocene environment.

Key words: Art, Anthropocene, Solutions to Environmental Issues, Large-Scale

To See a World in a Grain of Sand-----Discussion on the Physical Approach of Terrestrial Ecosystem Research

Weiming Chen, Xu Ming

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Abstract: Whether it is quantum biology, ecology and ecology energy quantum and so on, and is not in cross disciplinary curry favour by claptrap, looking for a shortcut to evade the crucial point. There are so many fields of ecology and other subjects that we don't even know how to define the boundaries of ecology.

Talk about the use of hydrology. The latent heat flux of forest system, including evapotranspiration and evaporation. The observation results at home and abroad, the role of forest heat balance components accounted for the proportion of net radiation, latent heat flux is generally accounted for 60% of net radiation to 70%, more than 60% of consumption in the plant transpiration, the sensible heat flux from 20% to 30%, following the changes of heat storage and energy flux of 10% The new supersedes the old. The net radiation in China northeast grassland 49.81% for latent heat; 49.24% of

the net radiation for sensible heat exchange. Most of the energy dissipated by the plant in the form of transpiration, with less than 1% of the energy to maintain the growth of its own structure. Therefore, most of the energy is consumed by the forest ecosystem. The results showed that the correlation between tree species richness and annual evapotranspiration was the strongest. And the primary productivity and the annual evapotranspiration also has good correlation, visible plant evapotranspiration is not a simple energy consumption, but the energy dissipation process to maintain orderly structure, but also the important instructions of plant development.

The difference between life and non-life is precisely because life exists in the middle of the quantum world and the classical world". So no water, no stone, no air can find the boundary, and that's what I want to explore.

Key words: Quantum Ecology, Ecophysics, Rmodynamics, Complex Systems

T1-06: Sustainable and Climate Smart Land Management to Enhance Dryland Ecosystems Services

Assessment of Land Degradation and Improvement in Dryland Ecosystems

Chao Li

Natural Resources Canada, Canada

Abstract: Land degradation is a significant challenge for many countries, and China suffers greatly from land degradation for over 45% of the lands. As a result, how to assess the degradation and its improvement becomes a significant methodological challenge for the "PRC-GEF Partnership on Land Degradation in Dryland Ecosystems". This presentation is to highlight some technological tools that could provide solutions in meeting this methodological challenge, especially some new development in this field.

At the national or regional scale, implementation of remote sensing technology-based monitoring systems appears the most powerful and cost-efficient due to the large area involved. This approach has become increasingly possible owing to the fast growing availability and acceptability of various remote sensing data. With this regard, an overview of applications of remote sensing technology will be presented, ranging from satellite imageries, to airborne and terrestrial technics of data collections and processing. Airborne LiDAR technology has been proven to be a suitable tool in applications to various fields including forestry and forest sciences. Some examples will be presented to show the usefulness of this technology.

A wide range of analytical and statistical methods can characterize the regional land conditions using spatial data collected at a given time. Research development in landscape ecology has extensively contributed to this field thus can help illustrating the land degradation. Some software packages are designed to perform spatial pattern analysis for generating a wide variety of metrics at the levels of patch, class, and landscape.

Multiple data collections from the same area can facilitate the effort of detecting changes, thus supply a way of assessing the improvement of land degradation conditions. Significant changes are usually easy to detect and characterize through comparison of imageries from the same area at different times; however, most changes are small or even tiny that are uneasy to detect and thus present considerable technological challenges. For forest lands, research has shown that value-based variables might be more sensitive to changes than volume-based variables hence the

small changes could be detected with a higher probability.
Key words: Dryland Ecosystems

Dynamic Appraisal of Land Ecological Security for Sichuan Province Based on Matter-element Model

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Abstract: Improper Land use has led to a series of ecological problems such as soil and water loss, land dissertation and land pollution since the past century. Land ecological security has attracted much interest as a key factor for land sustainability issues. This research aims at how to establish the appraisal index and adopt scientific method for the objective appraisal of land ecological security, together with the countermeasures. Based on analysis of the land use and ecological environment situation of Sichuan Province, the paper adopted the conceptual model of "Driving forces–Pressure–State–Influence-Response" (DPSIR) to set up the land ecological appraisal index system. The matter-element model was put use to the appraisal of land ecological security of Sichuan Province. Research results showed the land ecological kept improving from 2006 to 2015. But it is not optimistic yet because it is still graded "Sensitive". The countermeasures were given for maintaining land ecological security and land sustainability for Sichuan Province. The conclusion is drawn that DPSIR model and matter-element model are scientific and feasible for the appraisal of land ecological security.
Key words: Land Ecological Security, DPSIR Model, Matter-element Model, Sichuan Province

Study on Control and Simulation of Groundwater Level in Lysimeter

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Abstract: Abstract: It is a challenge to keep the conditions inside of lysimeter same as field. Keep the low boundary condition in the bottom of lysimeter or groundwater level same as that in the field is the basis in the water balance study. The lysimeter designed in this paper could measure the phreatic evaporation directly except the runoff on the surface. Its high precision weighting system can measure dew deposition as well.
Key words: Lysimeter, Simulation, Groundwater Level, Runoff, Dew Deposition

The Uses of Artificial Fenced Degraded Grassland in Semi-arid Region of China - case Studies in Yanchi, Ningxia

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Abstract: The Yanchi County, Ningxia, is located in the semi-arid desertifaction region, the vegetation of grassland is easy to be damaged, because of the fragile ecological environment. In order to analyze the structure and variation of plant communities in the research area, samples of the plant population were recorded according to species, abundance, coverage, height, and biomass. They were analyzed in respect to diversity indices, principal component analysis and polar ordination， and we analyzed the surface crust by infiltration experiments.The results showed that:

(1) The number of species of sample area E2 was the lowest, and the dominant position of species in the genera (leguminosae and compositae) in all kinds of sample areas were gradually weakened. The diversity index, and evenness index of E2 was the lowest, and the advantage of concentration index was the highest. In all sample areas, the diversity index was significantly correlated with the evenness index and the richness index. In the applying binary of β diversity, Cody index(βC), as well as βCJ and βCS derived from Jaccard and Sorenson similarity indexes(Cj and Cs), were able to reflect the community changes as the time gradient. In the numerical data measure, with the relative coverage and importance value as an index to measure, the result was more reasonable.

(2) The results of principal component analysis showed that the main environmental factors affecting the plant communities in the artificial cultivating area was soil moisture content at the depths of 20~30cm. The figures of polar ordination showed that the quadrats forming sample E were the most similar, for the time of cultivating was so long and there was no human disturbance.

(3) The stability ratio of each sample plots were 37.82/62.18， 36.46/63.54， 35.75/64.25 and 38.12/61.88, which indicated that the vegetation of artificial cultivating area in Yanchi was not stable, but the method of cultivating can availably improve the stability of vegetation community.

(4) In the artifaical cultibating area of Liuyangbu, the coverage of soil crust has a significant negative correlation with vegetation coverage and infiltration depth. The crust hindered the recovery of vegetation, so the time of cultivating should not be too long. From the rate of change in biodiversity of the sample plot which was loughing again, the best time of cultivating in Yanchi was 3 to 5 years. Closed after 3-5 years should be allowed appropriate grazing and human disturbance.

Key words: Artifical Fenced Grassland, Diversity, Principal Component Analysis, Soil

Crust

Innovated Practice for Integrated Land Treatment in Loess Plateau and Desertification Area of North of Shaanxi Province

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Abstract: The ecological situation of loess plateau and desertification area in North of Shaanxi was described and major ecological projects implemented for the target of ecological improvement were introduced. The update data and information from survey and forest inventory displayed the great achievements made in integrated land treatment in loess plateau and desertification area of Shaanxi, with the green land showed in the map advancing 400km northward, indicating the trend that ecological situation in North of Shaanxi is changing totally better and part of the area is on a track of virtuous cycle.

Key words: Loess Plateau, Innovated Practice

Evaluating Ecosystem Services in Qinghai Province, China Using Process-based Models

Ming Xu

CAS, China

Abstract: Evaluating ecosystem services (ES) informs ecosystem management planning and provides a base for making eco-compensation policies. We estimated the major components of ecosystem services using process-based ecosystem and soil erosion models. We found that the annual ES value was, on average, 676.1 Billion RMB from 1998 to 2012 (based on 2012 prices), 3.9 times of the GDP of the province in 2012. More than 70% of the ESs were consumed outside of Qinghai Province. Grassland ecosystems in Qinghai provided 46% of the total ESs, followed by wetlands (21%), forests (16%), deserts (6%), and croplands (4%). Other ecosystems, such as residential areas and glaciers, contributed the rest 7%. By ES categories, hydrological regulation accounts for 22% of the total value, followed by biodiversity protection value (15%), pollution mitigation (13%), soil conservation (12%), fresh water (8%), hydropower production (8%), cultural value (7%), oxygen production (6%), and carbon sequestration (3%). The traditional ecosystem products, provision value, only accounts for 6% of the total ES value. We also estimated the ecological assets (EA) value of the province and found that the total EA value was 18.4 Trillion RMB in 2012, of which

carbon assets accounted for 38.7%, land assets accounted for 24.2%, nutrients 17.5%,wild plants and animals 12.1%, fresh water 6.7%, and traditional products only 0.8%.

Key words: Ecosystem Service, Eco-compensation, Ecological Assets, Ecosystem Model

SOC Accumulation, Climate Variability and Crop Production in Tanzania's Semi-arid Agro-ecological Zone: A Case Study of the Kongwa District

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Abstract: Various ecological and environmental indicators including climate change, soil fertility, water availability and proper agronomic practices that form optimal agricultural systems are needed to be integrated for increasing agricultural productivity in the Tanzanian semi-arid agro-ecological zone. Among these indicators, climate change and soil fertility are the major limiting factors to affect crop yields in this semi-arid agro-ecological zone. To improve crop productivity, this study assessed the accumulation of soil organic carbon (SOC), the trend of climate variability and crop production in the Kongwa District, a semi-arid zone in central Tanzania. In doing so, climate data and soil samples were collected from two representative villages of Mnyakongo and Ugogoni. Household surveys, informative interviews, physical observations, group discussions and literature reviews were employed for data collection and crosschecking. The Walkley-Black Method was used for SOC analyses while the SPSS v. 20, Mann-Kendall and Sen's Slope Test for climate, crop yields and climate-smart agriculture analyses. Qualitative data were analyzed using the theme content analysis and Community-based Risk Screening Tool-Adaptation and Livelihoods (CRiSTAL). Results showed that the accumulation of SOC was significantly greater in soils under organic fertilization (1.15 and 0.80 MgC ha^{-1} at soil 0-20 cm and 20-30cm depth) than under no-fertilization (0.35 and 0.30 MgC ha^{-1} at 0-20 cm and 20-30 cm) and decreased with increasing soil depths. So did the crops yields (2tn ha^{-1} under organic fertilization vs. 0.87tn $ha^{-}1$ under no-fertilization). The mean annual rainfall or temperature (1980–2015) fluctuated at a decreasing (R2 = 0.21) or an increasing trend (R2 = 0.30). Meanwhile, crop yields of maize, sorghum or millet fluctuated at a decreasing trend at R2= 0.07, 0.05 or 0.85, respectively. In whole, rainfall variability positively correlated with SOC or crop yields. Thus, to increase crop production, there is an immediate need to apply manure, irrigation and drought-tolerant crop seed. These results confirm that the studied semi-arid areas are among the most

vulnerable regions to climate change impacts. Given to this vulnerability, this study proposes a district adaptation plan to increase the resilience of smallholder farmers. Similarly, it calls for more proactive practices to intervene the authentic and potential consequences in the country. A serious action to improve agronomic practices, mitigate and adapt to climate change impacts should concurrently be a priority in semi-arid areas to limit the level of vulnerability.

Key words: Agro-ecosystems, Climate, Soil Organic Carbon, Tanzanian Semi-arid Areas

Cost-Benefit Analysis of Agricultural Green Development Project in the Karst Rocky Desertification Area：A Case Study in Chunfeng Village

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Abstract: The main purpose of the study was to calculate the cost-benefit of agricultural green development project in the karst rocky desertification area. As a demonstration site of the "Climate Resilient Sustainable Land Management in Western PRC Project", Chunfeng village in Junlian county Sichuan province had carried out a series of green development activities, for example, interplanting Chinese herbs under forest. To different scenarios, favorable local-scale cost–benefit relationships were mainly found when considered over the long term, it means negative returns on investment for the first three years. In addition to the subsidy factor, adopting the locally acquainted and advantaged Chinese herbs, incorporating multiple participant subjects, are both vital to raise project vigor. For the risk behind the rapid crop type transformation and unlimited sprawl, environmental impact must be evaluated further, and enhance the scientific knowledge in ecology protection, and optimize management in an adaptive and dynamic way.

Key words: Cost-Benefit, Land Sustainable Management, Rocky Desertification, Green Development Demonstration

Study on Land Management Policy and Capacity Building to Adapting Climate Change in Western China

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Abstract: Land and terrestrial ecosystems in Western China are vulnerable to climate change through changes in local conditions and increased risk of natural disturbances, which in turn creates additional challenges to sustainable development. Adaptation can help reduce this risk and reduce the impacts of climate change. This study presented the impact of climate change on land use in western China and the land management policies related to climate change adaptation, and analyzed the main challenges in land use management for adapting climate change. Based on the experiences of land management in six western provinces under the PRC-GEF Partnership on Land Degradation in Dryland Ecosystems (PRC-GEF Partnership), this study also pointed out the needs of capacity building in adaptive dryland management, proposed the priority areas of improving the locals' capacities in adapting climate change in western China. The conclusions showed that some policies need to be updated in order to improve efficiency of dryland ecosystem restoration and sustainable land management.
Key words: Land Management Policy, Climate Change Adaptation, Capacity Building, Western China

Drying Climate and Herdsman of Typical Steppe Area in Inner Mongolia, China

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Abstract: It is urgently need to assess the impact of climate change on Herdsmen living in the grasslands. The typical steppe in Xilinhot of Inner Mongolia is the most representative vegetation types in the temperate grasslands of the northern China. Aridity Index was referred to as the dry degree of climate in this article, and it was combined with temperature and precipitation. The objective of this paper was to indicate what happens to the climate and the understanding of herdsmen. Combining with geostatistics, GIS and remote sensing, climatic data at 7 sites across the region were used to analyse the spatio-temporal trends. The results showed that climate of the region was significantly represented a warming and drying trend. Moreover, the survey randomly chose 65 herdsmen to conduct by the questionnaires on there cognition and measures to drought risks in the grassland region. The results were showed as follows: 69.2% of the herdsmen realized that the drought could impact their livestocks and livelihood. Education Level (correlation coefficient = 0.302), per capita income (correlation coefficient = 0.404) and per capita number of livestock (correlation coefficient = 0.357) significantly influenced their cognition to drought. According to the survey, five major measures were taken to react to the drought, which were purchasing forages (100.0%), selling livestock (80.0%), shifting to the other

pastures (33.8%), keeping livestock in corrals (30.8%) and doing part-timejobs (16.9%). Contingency Table Analysis on the survey data showed that the drought measures were influenced by many factors. The herdsmen who had higher education level tended to shift to other pastures (54.5%). The elder herdsmen would keep livestock in sheepfolds or shift to the others pastures (37.5%). The herdsmen with higher per capita income generally reduced the loss by renting pastures or shifting to the other pastures (53.3%). The herdsmen who heldless grassland tended to keep their livestock in sheepfolds (46.7%) or do part-time jobs (33.3%). Meanwhile, the herdsmen who possessed more livestock barely do part-time jobs and those who clearly cognized the drought had a high rate to shift to other pastures (40.0%). The research on the cognition and measures to drought could provide a theoretical foundation for the establishment of a sustainable development of grassland region.

Key words: The Typical Steppe, Herdsman, Drying Climate, Measure to Drought

The Content and Dynamic State of the Soil Active Organic Carbon at Different Degeneration Stage in Gahai Wetland

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Abstract: Abstract: According to the study of the typical marshy meadows in Gahai wetland, and by the method of combing outdoor observation of specialized meadows and indoor analysis, we studied the contents and dynamic states of active organic carbon in soil at Gahai wetland's different degeneration stage. And the results are: the content of the active organic carbon in soil of marshy meadows appears a trend of up-down-up, with deepening soil horizon, and it declines overall. With the aggravation of the wetland degeneration. The content of the active organic carbon in soil varies a lot in different soil horizon at the four degeneration stages. In 1-10 centimeter of the soil horizon, the gentle degeneration curve appears like the letter of M. The curves of no degeneration, slight degeneration, and severe degeneration are similar. In 10-20 centimeter of the soil horizon, the curves of different degeneration stages all vary from high to low, and they tend to a gentle trend. In 20-40 centimeter of the soil horizon, the degeneration curve presents the tendency of high-low-high-low.

Key words: Gahai Wetland, Different Degradation Stage, Soil Organic Carbon, Content and Dynamic State

Using Saker Falcon (Falco Cherrug) as an Index for Sustainable Land Management on the Qinghai-Tibet Plateau

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Abstract: The Qinghai-Tibet Plateau has important ecosystem service regarding to water supply and climate regulation in Eastern Asia. The ecosystem stability of this area has been challenged by climate change and human exploitation. It is difficult to assess the status of ecosystem in this large area. We suggest to use a carnivore bird, saker falcon (Falco cherrug), as an index of ecosystem health. Saker falcon's main food is pica, which is an ideal index for grassland status at small scales (a few ha). Saker falcon is highly mobile and can serve as an index at larges scales (millions ha). We have put 8 satellite GPS trackers on different individuals of saker falcons, and recorded their time series locations since 2009. The results indicate that some areas are suitable to the bird, and some areas are less attractive because of ecosystem degradation. The changes of habitat preference and spatial distribution pattern of saker falcon are signs of potential ecosystem degradation and relevant conservation activities should be triggered. The habitat use of the bird also can provide meaningful information for sustainable land management and conservation planning.

Key words: Animal Movement, Satellite GPS Tracking, Habitat Use, The Three River Source Region;

Mine Ecological Restoration Research in the Inner Mongolia Grassland Area

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Abstract: The Inner Mongolia grassland area is the main coal-accumulation area in China, where the natural ecological environment is very fragile. Firstly, through field zoological survey method, this study analyzed the impacts on major animal groups and biodiversity by exploitation of large coal mines in Xilin Gol League of Inner Mongolia. Results showed that in the range of 8 kms from the coal mine, major animal population, vegetation coverage and height increased significantly, in addition, 8 kms outside, the increase is not obvious. In conclusion, the exploitation of large coal mines has a

significant inhibitory effect on the population of major animal and vegetation communities. Secondly, this study analyzed the typical cases and practical experiences of grassland ecological restoration in local mining enterprises. According to these conditions, targeted international advanced experience was introduced to share and reference, in order to formulate the best practices and standards for the ecological restoration of Inner Mongolia grassland.

Key words: Inner Mongolia, Grassland Area, Mine Ecological Restoration

Charactering Drought with the Change of Rainfall-Runoff Relationship: A Regional Case in the Loess Plateau, China

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Abstract: Droughts increased dramatically both in frequency and intensity with global warming, but few studies charactering drought from the aspect of its impact on the ecosystem service, leading to few implications of the research result to resource management. We conducted in the study a regional case in the Loess Plateau of China. By analyzing the change of rainfall-runoff relationship in these drought events, whose drought duration≥5years and mean annual precipitation anomalies≤-5%, we found that multiyear drought may cause rainfall-runoff relationship had a significant descending trend($p<0.05$) compared to other historical records and this situation is likely to happen in the basin with less precipitation. The joint probability and return period gradually increased with the he increase of drought duration and severity, when the drought duration is not less than 6 years and the drought severity is greater than or equal to 0.55((rainfall around ≤212mm), this situation can also led to the change of rainfall-runoff relationship easily. At the same time, the spatial heterogeneity characteristics of different catchments in the Loess Plateau can also be seen by analyzing the spatial distribution of drought return period, and calculated return period of drought events corresponding to watersheds with significant changes in rainfall-runoff relationship. Such studies are essential to further realize water regulation in ecosystem.

Key words: Drought, Rainfall-runoff Relationship, Frank-Copula Function, Return Period

T1-07: Ecosystem Services in the Built Environment

Effects of Arbuscular Mycorrhiza and Earthworm on Pollination in the Marjoram

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Abstract: The understanding of links between below and above ground processes is a key research area. For decades, the functioning of ecosystems was largely studied separately for soil processes and for above ground functions, like pollination. Recent developments in the field shows that there are strong links between soil and above ground functions of ecosystems, requiring further investigations. In addition, besides correlative studies, experiments are needed to explore causal relationships among ecosystems functions. We used a mesocosm experimental approach to study how earthworms and arbuscular mycorrhiza will affect pollination. We had five treatments with sixteen replications in each treatment: sterile soil, soil with arbuscular mycorrhiza type 1, arbuscular mycorrhiza type 2, earthworm, and with both arbuscular mycorrhiza and earthworm. Our study object was the marjoram (Origanum majorana L.), a member of the Lamiaceae family. During the plants flowering from mid-July to the end of August 2016, we recorded the number of pollinator insects as well as the flower visitation rate by pollinators. Our preliminary results show that the number of flower visitation rate was smaller on plants if only arbuscular mycorrhiza or earthworm was added than on the control, but if both mycorrhiza and earthworm was added, flower visitation rate was higher than on the control. These preliminary results indicate an interesting pattern on how a plant respond to different soil organisms, and on how it influence above ground functions.

Key words: Mesocosm, Experiment, Bee

MiniCity: An Ecosystem Services Driven Design and Test Run of a Compact Urban Model

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Abstract: Development of a compacted urban model ‘MiniCity’ driven by ecosystem flows under the prerequisites of the UN Sustainable Development Goals (SDG) based on the comparison and evaluation of the optimised approach of an ecosystem services

(ESS) driven compacted urban model and a conventional urban sprawl settlement.
The research approach follows the question: How can the design of the built environment optimize the regenerative flows of natural resources?
The current literature status quo optimizes individual ESS flows. The interdisciplinary field of urban design/architecture allows the authors an understanding of the built environment beyond its anthropocentric perspective serving human interests towards an integral perspective of multi- centric influences for the shaping of the built environment.
The new model of a 'MiniCity' converts ESS to regenerative multidirectional resource flows for productive urban environments. Here a model design of a vertically stacked urban area is generated based on an existing conventional urban setting. This allows a case study comparison of quantitative and qualitative measures of the existing and new compact urban model. A subsequent testing of resource flows (Nutrients, water, solar, power, wind) against the existing case study leads to an optimised model design for regenerative ESS flows and integration of social/human needs according to SDG11.
Impact:
- Holistic interpretation of the multidisciplinary field of the built environment as part of the ecosystem rather than just the consumer of ecosystem services;
- Enabling ecosystem processes via responsive and adequate design measures
- Urban building solution for future regenerative cities;
- Generate a platform for interdisciplinary (agroecology, permaculture, integrated measures of resources and building structures) discussion and networking at INTECOL 2017.

Key words: Sustainable Urban Development, Ecosystem Services Driven Design, Regenerative Urban Architecture, Ecological Urban Design

Effects of Terracing Practices on Soil and Water Conservation in China: A Meta-Analysis

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Abstract: Terracing has long been considered a powerful strategy for soil and water conservation. However, the efficiency of terracing is limited by many factors, such as climate, soil properties, topography, land use, population and socioeconomic status. The aim of this critical review is to discuss the effects of terracing on soil and water conservation in China by using a systematic approach to peer-reviewed articles published in English and Chinese. 211 individual studies involving six categories of terracing structures (level terraces, slope-separated terraces, sloped terraces,

reverse-slope terraces, fanya juu terraces and half-moon terraces), a wide geographical distribution (northeastern China, southeastern China, southwestern China and northwestern-central China), six land use classes (forest, crop trees, cropland, shrub land, grassland and bare land) and a series of slope gradients ranging from 3 ° to 35 ° were analyzed. Statistical meta-analysis of 601 runoff, 636 sediment and 1880 soil moisture observations confirmed that terracing has a significant effect on soil and water conservation. In terms of different terrace structures, bench terraces resulted in superior runoff control and sediment loss reductions, while fanya juu terraces presented greater efficiency of water conservation. Land use plays a crucial role in the efficiency of terraces for controlling water erosion, with tree crops and forests resulting in the greatest soil and water conservation due to the large aboveground biomass and strong root systems below the ground, which directly reduce the pressure of terraces on rainwater redistribution. In addition, a significant positive correlation between slope gradient (3 ~15 ° and 16 ~35 °) and terracing on water erosion control was observed, and the decreases in water erosion were the highest at the gradients of 26 ~35 ° and 11 ~15 °. This study revealed the effectiveness and variations of terracing on soil and water conservation at the national scale, which can serve as a scientific basis for land managers and decision-makers.

Key words: Terracing, China, Soil and Water Conservation, Meta-analysis

Leaf Non-structural Carbohydrates Storage and N, P Stoichiometry in Response to Light Acclimation in Two Subtropical Shade-Enduring Tree Species Seedlings

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Abstract: Light availability greatly affects plant growth and development, especially in shaded environment, plants have to cope with the reduced light intensity to ensure the normal rate of photosynthesis so as to maintain the dynamic balance of nutrient substances, such as leaf non-structural carbohydrates (NSC), nitrogen (N) and phosphorus (P). To strengthen the understanding on nutrient utilization strategies of two understory shade-enduring plants, we compared the responses of leaf NSC, leaf N and P variations to heterogeneous light conditions. Two subtropical evergreen broadleaf shade-enduring species: Elaeocarpus sylvestris (ES) and Illicium henryi (IH), were chosen to conduct light intensity treatments of five levels (100%, 52%, 33%, 15% and 6% full sunlight, separately) for 30 weeks to identify the effects of light intensity reducing on leaf NSC allocation patterns and leaf N, P stoichiometry characteristics of understory species. We found that ES showed a decreasing trend in leaf soluble sugar,

starch and NSC concentrations when treated with reducing light intensity, while IH presented a slightly increasing trend from 100% to 15% full sunlight until a significant decrease at extremely low light intensity (6%). Soluble sugar/starch ratio of ES decreased while IH kept steadily when confronted with light intensity reduction. Besides, both species exhibited an increasing trend in leaf N and P concentrations but limited leaf N: P ratio fluctuations with reducing light intensities. There were highly significant correlations between leaf NSC variables and N, P stoichiometric variables in both shade-enduring plants, which revealed a trade-off of photosynthesis production between leaf NSC and N, P allocation. Thus, shade-enduring plants readjusted leaf NSC allocation and N, P in response to light acclimation. These results help to enhance the understanding on dynamic balance of leaf NSC and N, P components in carbon metabolism of shade-enduring plants.

Key words: Shade-Enduring Species, Photosynthesis, Leaf N and P, Leaf Non-structural Carbohydrates

Study on the Characteristics and Screening Methods of Cadmium Enriched by Endophytic Bacteria in Tagetes

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Abstract: Abstract: In recent years, more and more serious problem of soil pollution, soil heavy metal pollution is one of the most serious problems, thus, peacock grass, such as black nightshade, soil heavy metal hyperaccumulator people serious. In order to filter out more efficient soil cadmium (Cd) accumulation ability, high tolerance to the environment of the peacock grass endophytic bacteria micro system, s the common market as "hero" and "hero" in several different ways to control the peacock grass species, single species and with corn and tomatoes different crops were selected, mature maidenhair cadmium (Cd) type of plants with high content, through sampling screening, isolation of pure culture and other ways to get tagetespatula endophytic bacteria community, application of 16sRNA technology to analyze the species. The study found that each species has the accumulation of cadmium in soil, which was "hero", "hero" for tomato cropping soil Cd enrichment effect is more obvious. The role of small single "hero". The results of this experiment show that the system has strong enrichment effect on cadmium, which provides a theoretical basis for soil pollution control.

Key words: Peacock Grass, Endophytic Bacteria, Cadmium, 16sRNA

Construction and Application of Coupling Model of Ecosystem Services and Livelihoods in the Perspective of Targeted Poverty Alleviation

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Abstract: Properly handle the relationship between ecosystem protection and poverty alleviation and development in poverty-stricken areas is the basis for building a better-off society in China by 2020, under the background of ecological civilization construction and targeted poverty alleviation. This paper built a poor county identification model based on the vulnerability - sustainable livelihood framework, to identify China's poverty - stricken counties. Based on the "water yield" model of InVEST and the food supply model, the ecosystem provision services for the identified poverty-stricken counties in China were calculated from 2000 to 2015. In addition, by constructing the coupling model, a coupling analysis was accomplished to analyze the relationship between the ecosystem provision services and the livelihoods of the poverty - stricken counties. Finally, this paper revealed the spatio-temporal evolution law of the ecosystem provision services and the livelihoods in China's poverty - stricken counties from 2000 to 2015, which may serve as a scientific reference for the differentiated management of poverty areas.

Key words: Targeted Poverty Alleviation, Ecosystem Services, Livelihoods, Coupled Model

Ecological Planning in Xilingol League Based on Urban Ecosystem Services

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Abstract: Most cities or leagues in Inner Mongolia are the result of resource-based industrialization processes and animal husbandry development, leading to a heterogeneous composition and configuration of urban areas seldom guided by proper urban ecological planning policies. In this paper, we chose Xilingol League as a case study, and put forward a novel ecological planning approach based on ecosystem services for achieving sustainable development in it. An urban ecosystem services simulation model and an urban classification model were used to assess the change of ecosystem services and to guide the future urban ecological planning. The results showed a rapid land use change in different sub-systems of Xilingol League from 2005 to 2015, providing relative values of each type of land per unit in three sub-systems

(core urban area, suburb and rural), and detected the change of ecosystem services in three sub-systems and the change of ecosystem services per capita in the whole administrative urban area. We suggest that (a) long-term, stable, and ecosystem-services-based land use policies and urban ecological planning approaches are needed; and (b) highlight an urban ecological planning approach covering economic, social, and natural dimensions for achieving sustainable development.

Key words: Ecosystem Services, Urban Ecological Planning, Sustainable Development, Land Use Change

Methane Oxidation in Paddy Soils of North-east China Using DNA Stable Isotope Probing

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Abstract: Methane is the second most prevalent greenhouse gas responsible for climate change issues due to its efficiency for trapping infrared irradiation and also reemission of the absorbed radiant energy that causes global warming. Methanotrophic bacteria have the capacity to alleviate CH_4 emissions from rice based ecosystems to the atmosphere. Here, we used quantitative PCR (qPCR), stable isotope probing (SIP) of DNA and high throughput MiSeq amplicon sequencing of the 16S rRNA and pmoA genes to study the methane oxidation potential of paddy soils in North-east China using DNA stable isotope probing. To know the active MOB in total microbimes and their pmoA genotypes, we incubated four paddy soils with ambient CH_4, high 12C-CH_4 and 13C-CH_4 amendment. The results showed that all four soils had strong ability of methane consumption and oxidation rates were significantly enhanced by high 13C-CH_4 amendment. The qPCR of pmoA gene copies increased significantly with high 13C-CH_4 incubated microcosms and pmoA gene copies reaching the peak in "heavy" DNA fractions from 13C-labeled microcosms and "light" DNA fractions for 12C-control in all soils suggesting strong labeling of active MOB community. The pmoA and 16S rRNA gene sequences showed a high diversity of active methanotrophs and type I was dominant than type II in three soils including WC, JW and JG while only soil QA exhibited high abundance of type II- like methanotrophs. With all 13C-labeled methanotrophic 16S rRNA and pmoA gene sequences demonstrated that active MOB were affiliated with type Ia including genera Methylobacter, Methylosarcina, Methylocaldum and Methylmicrobium while Methylocystis and Methylosinus-related to type II methanotrophs. So, our study exposed the dynamics in the abundance, community compositions and activity of type I and type II-like methanotrophs with high 13C-CH_4 amendment that showed strong evidence of

methane oxidation, which enhanced the shrinking of methane emissions to the atmosphere.

Key words: Methanotrophs, CH_4 Oxidation Potential, DNA-Stable Isotope Probing, Paddy Soil

Evaluation of Cultural Service of Urban Green Space in Residential Areas with Different Density，by Using Zhengzhou City as a Case Study

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Abstract: The cultural services of green space in residential areas are essential components of ecosystem service in urban green space, directly or indirectly affect residents' physical and mental health. Based on the face-to-face questionnaire survey, we analyzed and evaluated the cultural services of 45 low-density, medium-density and high-density residential areas in Zhengzhou from four aspects: recreational and entertainment services, educational and cultural services, spiritual services and aesthetic services provided by residential areas. The results showed that there is no significant difference in the frequency and types of recreational and entertainment services among different residential areas. However, the overall satisfaction of residents in low-density and medium-density areas is significantly higher than that of the high-density residential areas. Cultural services in three types of residential areas are low, while the preformats of the communities held less cultural activities, and residents hold low satisfaction for the educational and cultural services. Further, with the increasing coverage of green spaces in residential areas, the aesthetic services performed better. Contrary to our expectations, the frequency of communication in the high density of residential areas, but the higher coverage of green space could obviously ease the pressure of residents. Finally, the residents' overall satisfaction and attribution increased with the increasing green coverage. We suggest increasing the public green spaces and its public activity spaces are an effective pathway to improve the cultural service of green spaces in residential area.

Key words: Urban Ecosystem Services, Cultural Services, Residential Areas, Urban Landscape

Application of Volunteered Geographic Information in Measuring Urban Park Use: A Case Study in Beijing

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Abstract: With the rapid urbanization in China, nowadays people living in urban areas have limited contact with natural environments, under which context visiting urban green spaces/parks as a kind of outdoor recreational activities offers a great opportunity for people to directly experience the benefits that natural ecosystem provides. Existing studies have involved time- and labor-intensive surveys to quantify park use and explored attributes that encourage park visitation. However, this method is not suitable for knowledge on how to quantify park use at a city scale, which lays foundation for investigating park users' preferences and increasing park use. Our study investigated visits to 127 urban parks in Beijing by means of geotagged data from a popular social media website, Sina Weibo. We first compared the differences in the total park visits and the visit intensity among different park types. Then we analyzed the factors that affect park visits using regression techniques. Cultural relic's parks and large urban parks received high visits, meanwhile neighborhood parks had relative high visitation rates per unit of area. The park size, number of accessible bus stops, entrance fee or not and distance to urban center significantly affected park use. The results indicated that improving park maintenance and transport conditions, planning well-managed, accessible small green spaces in residential area were effective to improve park use. Results from our study can provide important insights on urban park management and planning.

Key words: Urban Park, Recreation Demand, Volunteered Geographic Information, Urban Greenspace

Growth of Street Trees: A Case Study of Ginkgo Biloba L. In Kyoto City, Japan

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Abstract: It is well known that urban trees have numerous benefits on urban environment and many studies have analyzed the benefits and carbon storage offered by urban trees. However, the lack of street tree specific data prevents studies from estimating tree growth when analyze benefits and carbon storage associated with street trees. Street tree specific data will help not only further researches to assess benefits of street tree but also urban foresters to predict the growth of street trees and improve the

management and maintenance. It is important to analyze healthy street trees when they are removed in a municipal management because it is usually not happen to destruct street trees for a research propose in Japan. Street trees, which are strongly pruned under municipal managements, are considered to grow in different environment from trees in traditional forests, fields, and parks. However, there is no study on street tree growth in Japan. Therefore, a stem analysis on two street trees (Ginkgo biloba L.) are conducted, which were planted and grown as street trees in Kyoto city, Japan. We compared height and DBH from stem analysis with the estimation from an equation in a literature, developed by using trees in fields in Japan. As a result, it was shown that growth in the total heights of the two street trees was restricted approximately from twenty to thirty years old. The total height prediction from a literature is over 150 present taller than two street trees after thirty years old.
Key words: Street Tree, Tree Growth, Urban Forestry, Ginkgo Biloba L.

Sustainability Measurement on Landscape Patterns of Wetland Parks Based on Key Ecological Process

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Abstract: Wetland, as one of the world's three major ecosystems, is known as the "Earth's Kidney", with important ecological functions and social service value. It is one of the correctly focuses of wetland that how to deal with the relationship between wetland landscape protection and utilization and development, so as to realize the sustainable development of wetland landscape. Haizhu National Wetland Park in Guangzhou was used as the research object. The new pattern analysis method of landscape pattern - landscape process - landscape design was applied, combined with qualitative and quantitative analysis, static and dynamic analysis, to build a measuring model of Wetland Park landscape sustainability. By examining the practice of the development and utilization of the landscape protection and utilization of Haizhu Wetland Park, this paper systematically analyzes the internal causes of the imbalance of landscape protection and utilization, and reveals the coupling and balancing mechanism of the two, and explores the management of landscape protection and rational utilization of Haizhu Wetland Park. The sustainable development of Haizhu Wetland Park provides practical operational guidance and perfects the theoretical basis of sustainable development of wetland park landscape.
Key words: Landscape Sustainability, Landscape Pattern, Landscape Process, Landscape Design

Greenhouse Gas Emissions and Net Carbon Sink of Forestry in China

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Abstract: Forest management and resource utilization have been identified as critical factors influencing the carbon cycle of forest ecosystems. However, the greenhouse gas (GHG) budget of these factors remains not fully understood in China, and the forestry's net carbon exchange must be determined. We constructed a Carbon Accounting for Mitigation of Forestry (CAM–Forestry) methodology to evaluate the spatial-temporal patterns of the GHG emissions of afforestation; silviculture; harvesting and utilization as timber and bioenergy; the net carbon sink of China's forestry, and its driving factors during 2000-2014. The results indicated that GHG emissions from forest management and resource utilization was 17.7 Tg Ce yr–1 and offset 8.5% of forest biomass and products carbon sink and GHG mitigation from substituting fossil-fuel with bioenergy, resulting in a net carbon sink of 189.8 Tg Ce yr–1. Harvesting and resource utilization was a major contributor to national forestry GHG emissions, whereas the main driving factor of regional GHG emissions was varied. Afforestation dominated GHG emissions and was responsible for 56.0% and 78.4% of the carbon offsets in the southwest and northwest. Harvesting and resource utilization was the dominating factor of GHG emissions in the north, northeast, east, and south and contributed 52.5-86.8% to the carbon offsets. Our study provided a forest carbon accounting in China and indicated that simulations of forest management regimes, together with resource utilization, could provide new insights sustainable forest management to achieve climate change mitigation and have implications for forest management in other countries.

Key words: Greenhouse Gas Emission, Net Carbon Sink, Forest Management, Harvesting and Resource Utilization

Spatial Characteristics of Recreational Service Flow of Urban Park and Associated Physical and Non-Physical Factors

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Abstract: Park accessibility has been received growing attentions as well as equity and efficiency of park use, but research on spatial connections between urban parks and residence is still limited. In this paper, we examined spatial characteristics of recreational service delivering from urban park to residence and the associated influencing factors in Wuhan, PR China. Kernel density estimation method was used to analyze the spatial distribution of recreational service flows, and distance decay effects

of park access were examined. In order to understand the relationships between the service flow and its influencing factors, stepwise regression models were used to test the associations. Our results revealed that recreational service of urban park was delivered outward from different directions with distance decay effects in power function law curves. Frequency of park visitation decreased vastly until travel distance exceeded 7.5 km, while frequent visitors were within 5 km of the Euclidean distance. Furthermore, imbalance of service supply and demand between park and residence, transportation facilities, travel mode and residents' age were significantly related to the recreational service flow of urban park. These results suggest that quantifying spatial decay of recreational service might be more effective to identify the insufficient pattern of urban park, and managing the influencing factors could provide a useful path to optimize an equitable and efficient urban park system.

Key words: Recreational Service Flow, Urban Park, Distance Decay Effect, Influencing Factor

Interannual Variations in Growing-Season NDVI and Its Correlation with Climate Change in the Southwestern Karst Region of China

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Abstract: In this study, the updated NOAA Normalized Difference Vegetation Index (NDVI) dataset for growing season (April to October), which can better reflect the vegetation vigor, was used to investigate the variations in NDVI and its relationship with climatic factors. In order to preliminarily understand the climate impact on vegetation and provide theoretical basis for the response of ecosystem to climate change. Mann-Kendall and empirical mode decomposition (EEMD), were adopted to analyze the trend of the NDVI and the correlation between NDVI and climatic factors(temperature and precipitation) together at multiple time scales based on the Southwestern Karst Region of China , the results showed that:1) Average growing season NDVI significantly increased at a rate of 0.012/year from 1982-2015. The trend of change was phasic, and the increase is obvious after 2003. With the Mann-Kendall, both NDVI and climate have an abrupt change in 2001. The cumulative curve of precipitation and NDVI changed obvious before and after abrupt point, which indicated that the NDVI mutation was mainly affected by precipitation. 2) the change of NDVI can be completely decomposed four quasi-periodic changes on 2.48、5.8、11.2 and 25-yr time scales, and a long-term trend. The quasi-periodic changes of NDVI are significantly and positively related to changes in annual average temperature at 5.8-yr time scale. The trend of NDVI has a positive relation with temperature, but negative

relations with precipitation. 3) The significant positive correlation between temperature and NDVI is mainly distributed in the eastern region with large vegetation coverage and low terrain. The significant negative correlation is mainly distributed in the western region with higher terrain and low vegetation coverage. The correlation between precipitation and NDVI is not as good as that of temperature, the overall significance of the relevant areas are smaller, significant correlation areas are mainly concentrated in the Yunnan and Sichuan border with higher elevation. Vegetation variability is found to be driven predominantly by temperature. On the whole, the systematic research on the interannual variations of growing-season NDVI and its relationship with climate revealed the heterogeneity and variability in the complicated climate change in the Karst ecosystem for the study area. Hence, more attention should be paid to promoting Karst research in the future.

Key words: NDVI, Climate Change, Mann-Kendall, EEMD

Preliminary Estimate of Air Particulate Matter Removed by Tree Leaves in Beijing

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Abstract: Air particulate matter (PM) has been become a very serious air pollution in north China. Urban trees can provide multiple ecosystem services, including reducing air particulate pollution and improving air quality. PM retentions on leaves of 9 typical tree species were investigated in Beijing and PM removal from leaves by rainfall was measured. At last, annual mass of PM removal by trees in Beijing was preliminarily estimated. The main conclusions are as follows.

(1) The furrowed areas, leaf hairs, and stomata on leaf surfaces were feverous to capture PM. Number density measurement showed Juniperus formosana capture PM the most while Euonymus japonicus the least.

(2) PM retention on leaves could achieve saturation after a period of air exposure. The maximum masses of PM retention on leaves were 362μg/cm2 for Koelreuteria paniculata among broad leaf species, and 292μg/cm2 for Juniperus formosana among coniferous trees.

(3) PM can be recaptured by leaves after raining. Our estimation showed that during 2014, PM removal was 745.05μg/cm2 by evergreen species and 585.39μg/cm2 by deciduous trees. Total PM Removal by trees of 6 district of Beijing was 45,137 tons during 2014. This can increased 15 days when air quality is better than standard grade II.

Key words: Air Partilculate Matter, Urban Tree, Ecosystem Service, Beijing

Ecological Stoichiometric Characteristics of Leaves, Root, Litters and Soil in Response to the Plant Functional Traits in Desertified Region

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Abstract: Element cycling and energy flows are fundamental, interlinked principles explaining ecosystem processes. The element balance (C, N, P) in components, processes and interactions in ecosystem has been used to control ecosystem processes and define habitat and resources for other taxa; thus, they are a high priority for understanding the ecosystem at a site study trophic dynamics and the biogeochemical cycling. Based on the comprehensive studies in grassland, six plants were taken as the research object, Stipa bungeana, Agropyron mongolicum Keng, Glycyrrhiza uralensis Fisch., Cynanchum komarovii Al., Artemisia ordosica, and Sophora alopecuroides which was the dominate plant in the desertified region, Ningxia, Northern China. However, the distribution of C, N, P stoichiometry of leaves, root, litters and soil in this region has been largely unknown. This study investigated the stoichiometry of leaves, root, litters and soil, together with soil physicochemical properties and vegetation properties so that explore the plant functional traits and the impact factors of the elements (C,N,P) in desertified region. The results as follows: The content of C, N, P in plant and soil were lower compare with leaves and root, the content of C, N and P in leaves were higher than that of root. The content of N in Leguminous plants were significantly higher than Gramineous plants ($p < 0.05$), whereas the leaves of C:N and C:P in Gramineous plants were more higher which suggested that the supply of soil P element was relative adequate which can be lack of N element, and P element can be restrictive in Leguminous plants with the higher leaves of N:P. The content of C, N, P in leaves were below the world average level, which confirmed the lower N and P content in desertified region. The content of C in leaves, root, litters and soil had a significantly positive correlation with N and P ($p<0.01$). Moreover, the content of C, N and P in leaves, root, litters were significant correlation with the content C, N, P in surface soil layer (0-5 cm), and the correlation coefficient gradually weakened with the soil depth, which implied that the flows and cycling of C, N, P mainly depended on the surface soil layer. In addition, the correlation coefficient between ecological stoichiometric characteristics and the plant height ordered that Cr>Nr>Pr, and the correlation coefficient of soil and litters were higher than that of root and leaves, which showed that the plant height mainly depended on the ecological stoichiometric characteristics of soil and litters, especially the content of C. In total, this connection between ecological stoichiometric characteristics and plant functional traits is crucial for both understanding vegetation-soil-litters feedbacks, and for improving forecasts of the biogeochemical cycle.

Key words: Ecological Stoichiometry

Effect of the Beijing-Tianjin Sandstorm Source Control Project on Ecosystem Carbon Sink

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Abstract: The Beijing-Tianjin Sandstorm Source Control Project, launching in 2002, plays an important role in preventing land desertification around Beijing and Tianjin. Weichang County, a typical region of the Beijing-Tianjin sandstorm source, was selected as a study case to estimate the variation of ecosystem carbon sink after the Project operation. Net ecosystem productivity (NEP), a small difference between gross primary productivity (GPP) and ecosystem respiration (Re), was identified as the parameter representing the carbon sink. In this paper, the photosynthetic capacity model (PCM) and the coupling between GPP and Re were employed to estimate NEP in 2001, 2010 and 2015. Results showed that the total amount of NEP in Weichang was 120.00×104 t C^{a-1} in 2015, corresponding to a carbon sink of 127.60 g $C^{m-2\ a-1}$, which generally increased from north to south. From 2001 to 2015, NEP increased 58.67% with the increased area accounting for 96.57%. Among vegetation types, the NEP in grasslands were always highest, following by croplands, while deciduous coniferous forests had the lowest value either in 2001, 2010, or 2015.

Key words: Weichang County, Net Ecosystem Productivity, MODIS Data, The PCM

Effects of Elevated Temperature and Water Stress, on the Rice Brown Planthopper, Nilaparvata Lugens (Stål)

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Abstract: Background: Climate change is expected to bring about elevated temperatures and abnormal weather like drought and water stress that can affect rice pests. One of the most serious pests that might be affected is the brown planthopper (BPH), Nilaparvata lugens (Stål). Method: Although there is some information on the effects of single stresses on the BPH, little is known about the combined effects of water stress and temperatures. We investigated the combined effects of 5 temperature levels and 4 water-stress levels on the biological, physiological and biochemical changes in the BPH, and analyzed the differential gene and transcript expression of RNA-Seq experiments with Illumina technology de novo transcriptome

sequencing.Results: Water-stress and temperatures had no significant interaction effects on the BPH. Singly both factors had significant impacts on the longevity and oviposition of the brown planthopper. Longevity and oviposition at 38℃ were significantly lower than in other temperatures and between 22℃ and 26℃ there was no difference. Egg hatchability had no significant difference under the two stress conditions. Transcriptome Sequencing obtained 565 significant differentially expressed genes, include 348 up-regulation and 217 down-regulation. GO enrichment analyzed 278 significant transcriptions and there are 153 GO term up-regulated and 125 down-regulated. In addition, 350 associative pathways were involved in significant pathway enrichment. The study revealed that the significant differences in longevity and oviposition and the differential expressed genes under stress conditions were a kind of adaptive response of insect to adverse ecological conditions.
Key words: Climate Change, Temperatures, Water Stress, Brown Planthopper

Distribution Characteristics of Soil Labile Carbon in Subtropical Mountainous Meadow -- A Case Study of Wugong Mountain

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Abstract: Wugong Mountain because of the sharp rise in the number of tourists, and the "tent Festival" held in mountain meadow, serious interference, the occurrence of different degrees of degraded soil. Changes of soil active organic carbon in soil has higher sensitivity, therefore, it can be used as indicators of soil degradation degree. Distribution of active organic carbon in different regions of Wugong Mountain and under the different disturbance degrees are different, the conclusion are as follows:
(1) In Jinding area, carbon content, microbial biomass is the highest, the surface average valus are CK2039.71mg/kg, light disturbance is 1417.67mg/kg, and severe interference is 654.07 mg/kg. The subsurface are 1234.52mg/kg, 537.05 mg/kg, and 272.23 mg/kg. But compared with other activated carbon, microbial biomass carbon is the largest amount of carbon loss, the surface soil disturbance relative CK carbon loss rate was 30.50%, severe interference relative CK carbon loss rate was 72.06%, subsurface soil carbon loss rate is respectively 56.50%, 78.66%. While the soluble carbon loss rate is respectively 20.10%, 47.74% surface, sub surface is 39.91%, 59.54%; easily oxidized carbon loss rate is respectively 24.66%, 45.12% surface, subsurface is 31.26%, 46.28%. Interference is more serious area, activated carbon loss rate is higher.
(2) Activated carbon content in Jiulong Mountain area were not content the Jinding area high. The highest content is still for the microbial biomass carbon, its surface averaged values were 338.60mg/kg, 264.89 mg/kg, and 246.86 mg/kg, subsurface were

253.80 mg/kg, 185.59 mg/kg, 139.49 mg/kg. From the microbial biomass carbon content was the highest content of view, two regional difference. In the Jiulong Mountain area, the loss of carbon is the largest volume of soluble carbon, loss rate is respectively 23.67%, 87.05% sub surface layer; 16.84%, 96.13%. Thus, the degradation due to grazing meadow is more serious.

(3) both in the Jinding area and Jiulong Mountain area, the correlation between soil organic carbon and microbial biomass organic carbon, readily oxidizable carbon reached extremely significant level, and soluble carbon content are also significant correlation. The active organic carbon content of soil organic carbon level. Jinding area soil microbial biomass organic carbon and dissolved organic carbon, readily oxidizable carbon had significant correlation, and dissolved organic carbon and readily oxidizable carbon less correlation. So between organic carbon and active carbon are related to the changes of organic carbon, will directly affect the carbon content, and to change the relationship between soils carbon sink and source. To have a certain impact on atmospheric carbon dioxide concentration.

(4) the amount of different vegetation communities and microbial biomass carbon and soil organic carbon, readily oxidizable carbon were in significant correlation, and soluble carbon reached significant correlation; soluble carbon and carbon dioxide were significantly related, but have no correlation with microbial biomass carbon; microbial biomass carbon and readily oxidizable carbon no correlation. Factors of soil in different vegetation communities were many, including different area, different vegetation communities at different altitudes, influence factors, therefore, active carbon content will also have the very big difference.

Key words: Soil Labile Carbon, Soil Organic Carbon, Mountain Meadow

T1-08: Sustainable Ecosystem Srvices and Inovative Mnagement Srategies

Olfactory Responses of Stegobium Paniceum to Different Chinese Medicinal Material Volatiles Mixed with Feces Cues

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Abstract: Stegobium paniceum (L.) (Coleoptera: Anobiidae) is a major pest of stored products, causing great damage and huge losses to stored Chinese medicinal materials (CMM) in China. Effective control strategies are urgently needed. In this study, the olfactory behavioral responses of S. paniceum adults were examined to volatiles from three CMMs (Euphorbia kansui, Angelica sinensis, and Peucedanum praeruptorum) or those from the CMMs with S. paniceum feces in a Y-tube olfactometer, to explore the role of volatiles from CMMs and/or S. paniceum feces in host location and thereby to develop possible trap lures. The results showed that S. paniceum exhibited significant responses to odor of CMM or insect feces and that combinations of CMM and insect feces odors enhanced these responses. In tests with CMM volatiles versus insect feces, S. paniceum showed no significant preferences. However, S. paniceum displayed significant preferences for combinations of CMM and insect feces compared with individual CMM or insect feces alone. When S. paniceum was presented with different CMM versus each other, this species preferred E. kansui, then A. sinensis, and P. praeruptorum. In odor pairings of CMM volatiles mixed with insect feces, S. paniceum showed ranking preferences similar to that for CMM alone. Thus, volatiles could provide important information for understanding S. paniceum host location to stored CMM and how olfactory responses could be enhanced in the presence of S. paniceum feces.What's more, these results could aid in the development of effective trapping and monitoring strategies for the sustainable management of stored product pest.

Key words: Sustainable Pest Management, Drugstore Beetle, Behavioral Responses, Y-Tube Olfactometer

Oryza Sativa Cropping Impact on the Air Quality of a Natural Park Ecosystem

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Abstract: The aim of this paper is to analyze the impact of the traditional cropping of Oryza sativa on the atmospheric pollution of the National Park of Albufera (NPA) ecosystem. The PNA is located 8km from Valencia (Spain), in the east coast of the Iberian Peninsula. The park ecosystem has a surface of 210 Km^2. Oryza sativa crop represents 80% of this ecosystem area. The air quality monitoring network has an automatic station in the NPA, which registers several atmospheric pollutants and meteorology variables. Due to the European Union environmental regulations, the regional government forbids during several years the tradition Oryza sativa straw burning. This straw burning traditionally takes place from the end of September until October 29th. From 2014 the burning is allowed in order to prevent other ecological problems of the NPA. In this work the atmospheric pollution is studied to assess the impact of Oryza sativa cropping and straw burning, and the proximity (8 Km) of the urban area of Valencia (a one million inhabitant city with high traffic emissions). The monthly cycle and variability are analyzed. Several air quality indices are significantly higher during the fall months of straw burning, in comparison with the years when straw burning was forbidden. Daily observations of greenhouse gases exhibit more variability and peak values. Principal Components Analysis is applied to daily observations of five atmospheric pollutants, and six meteorology parameters. The data were measured during the fall months of two years with straw burning. Four factors are detected as important and explain 75% of the total observed variability. The first factor allows identifying four multivariate outlying observations in the values of carbon monoxide and nitrogen oxides variables, observed in 2003 during the Oryza sativa straw burning. The second factor explains high ozone values associated to high wind speeds, which facilitate the transport of atmospheric emissions from the urban area of Valencia. The third factor includes high temperature, relative humidity and solar radiation episodes, with very low wind speeds, that result in extreme values of several air pollutants. The fourth principal component represents the variability due to high precipitation episodes, which usually take place at the NPA after the straw burning period.

Key words: Natural Park Ecosystem, Oryza Sativa, Crop Straw Burning Impact, Atmspheric Pollution

Miaozihu Island and Qingbang Island Ecological System Carrying Capacity Evaluation

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Abstract: Relatrionship-entropy is a method to determine the index weights of the

bearing capacity between different island ecological systems. Island is a compound ecological system and it is still a relatively independent physiognomy cell. This paper discussed evaluaiton methods of the island ecological system carrying capacity. In this paper, 3 ecosystem carrying capacity indexes were determined: Island primary productivity, Water resources carrying capacity and Island habitat diversity. We can measure these 3 indicators by using the date of in situ investigation, statistics, remote sensing, etc.To determine 3 ecological carrying capacity index weight about Miaozihu island and Qingbang island by relatrionship-entropy method. Finally, the ecosystem carrying capacity values of two islands are calculated and compared.
Key words: Relatrionship-entropy, Island, Carrying Capacity

Evaluating Eco-capitals for Watershed Sustainability Using the Three-dimensional Ecological Footprint Model

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Abstract: Based on the three-dimensional ecological footprint model, the per-capita footprint depth, footprint and ecological footprint in 2000-2015 were calculated in the Jiulong River Basin, southeast China. The occupation of regional natural capital flows, natural capital stocks and the differences between different types of land were analyzed through capital flow occupancy rate, use ratio rate of stocks to flows and other indexes. The results show that: (1) In Jiulong River Basin, the per capita footprint depth increased from 2.34 to 4.33, the per capita footprint size increased from 0.463hm2 to 0.655hm2, the per capita ecological footprint was expanded from 1.08hm2 to 2.83hm2, which means the occupation level of regional natural capital flows gradually increased, natural capital stocks consumption were rapid increase, so that the pressure of ecosystem supply service increased. (2) There are significant differences in the use of natural capital in different land types, except for forest and grassland, the others are in the state of ecological deficit. Among them, the demand for fossil energy land is the fastest, which is the main reason for the accelerated increase of regional ecological footprint. (3) To promote the sustainable development, which needs to increase the natural capital flows limit and reduce the consumption of natural capital stocks. Therefore, it is necessary to advocate conservation-oriented consumption to residents, strength the protection of cultivated land resources, plan the construction land scale scientifically, and improve the energy efficiency.
Key words: Ecological Footprint, Three-dimensional Model, Natural Capital, Sustainability

Biodiversity in Corporate Social Responsibility Agenda: Analysis of Global Scenario vis-à-vis Indian Initiatives

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Abstract: The biodiversity loss is one of the pressing twenty-first century issues that calls for action. Biodiversity supports the world we live in and it's intrinsic value, focusing on the wealth of species and habitats, and is often communicated globally in the media and public policy. However, its value is still intangible for people who might adjust their activities to protect the environment. Therefore, to an increasing extent the extrinsic value is now communicated by focusing on the services ecosystems provide to human societies. Researches on the monetary valuation of ecosystem services received wide attention in late nineties (Figure 1). Ecosystems are defined as biotic and abiotic natural resources and their interactions whose functions, such as provision of food and water and regulation of climate control, result in various services and benefits for people. Until now, most of the communication about the extrinsic value of biodiversity in relation to ecosystem services focuses on the economic valuation of their ecological functions in terms of costs and benefits that may interest public policy makers. Although studies of The Economics of Ecosystems and Biodiversity have resulted in general reports and specific reports, among others for businesses, the underlying assumptions of rational economic agents, well-functioning markets, consistent preference etc. need attention, if the value is to be comprehensive, acceptable and feasible not only for behavioural scientists and public policy makers, but even more so for businesses and citizens. The behavioural underpinnings of rational choices and resource allocation are hardly acknowledged, nor is the co-evolutionary nature of people and ecosystems as many researchers opined. When corporate/business houses/companies usually began addressing environmental issues themselves, it was usually in terms of risks or costs, and their license to operate. This included a role in the protection of biodiversity in those cases. However, it is argued that they are becoming aware of the advantages sustainability has to offer. Several businesses are trying to move beyond traditional Corporate Social Responsibility (CSR) and environmental reporting to shape and transform the value chains and markets they operate in along with their company's internal organisation. Businesses are searching for ways to deal with such unpredictable changes, especially in sectors like food, energy and mobility where major societal changes are expected to occur in the coming decades. In this reasoning, it is often argued that businesses should be involved in the protection of biodiversity and ecosystem services. In this paper we explore the predevelopment phase of environmental sustainability transitions and shifts within businesses by analysing their perspective on the importance of biodiversity. Our focus will be on

environmental policy transitions and biodiversity conservation initiatives of the business houses as an entity of CSR amongst major players in the global context vis-à-vis India-based companies. In general, it is argued that various types of strategic initiatives can be witnessed in such shaping contexts, ranging from reactive to active. Therefore several CSR approaches will be outlined and will be related to the influence of their stakeholders. Finally, we discuss some possibilities to increase the involvement of companies to manage biodiversity and ecosystems.

Key words: Biodiversity, Corporate Social Responsibility, Ecosystem Services, Sustainability

Assessment of Erosion Control and Coastal Protection in Estuarine and Coastal Wetland

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Abstract: Estuarine and coastal wetland ecosystems, with a unique geographical location and complex ecological cycle, provide a lot of services that contribute to human well-being society. However, in recent years, the adverse effects of globe climate change, such as extreme weather events, sea level rise and the intensified human activities lead to a degradation in the services provided by estuarine and coastal wetlands, especially erosion control, coastal protection. The services degradation will be a threat to social-economic development. Therefore, valuing the wetlands services accurately and rapidly is necessary.

This paper took Shanghai estuarine and coastal wetland as a case study, based on RS and GIS spatial analysis technology, introduces the estimation of the method on the services of erosion control and coastal protection, puts forward the evaluation formula and evaluate these wetlands services. At first, we analysis physical and socioeconomic factors related to the service of coastal erosion on the estuarine and coastal wetlands, 12 related factors include coastal elevation, coastal slope, relative sea level change, longshore sediment transport rate, subsidence rate, mean range of tide, significant wave height, intertidal width, intertidal vegetation height, intertidal vegetation zone width, intertidal vegetation zone density and distance from sea edge. Analysis the relationship among various factors and put forward the evaluation formula. In study area, we use the buffer analysis of the shoreline to obtain evaluation unit, we divide the study area square grid 1km×1km, each evaluation unit is approximately 1km^2. Based on Landsat 8 satellite data in 2016 of Shanghai and spatial analysis technology of ENVI and ARC GIS, we obtained the spatial distribution of the values of erosion control. Similarly, we analysis the factors associated to to the service of coastal protection, we selected 6

related factors include coastal slope, mean range of tide, intertidal width, intertidal vegetation type, intertidal vegetation zone width, intertidal vegetation zone density, put forward the evaluation formula and valuing the service of coastal protection. Finally, we obtained the spatial distribution maps of erosion control and coastal protection and analyzed the results.

Key words: Estuarine and Coastal Wetland, Erosion Control, Coastal Protection, Remote Sensing

The State of the Art of the Biological Control of Ryegrass Pest in New Zealand Pastoral Ecosystems

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Abstract: The majority of New Zealand's intensively managed pastoral landscapes (c. 40% of the total land area) comprise introduced plant species, and while they can superficially appear similar to evolved grassland areas found elsewhere, in reality they are significantly different. Antipodean pastoral ecosystems comprise very low levels of both plant and arthropod biodiversity and although they may contain some adventive New Zealand-endemic invertebrates, these usually do not reach densities of pest-suppressing species such as parasitoids or generalist predators that are found in evolved ecosystems. This consequent lack of biotic resistance to invasive species, combined with unfilled niches explains why 90% of the country's pasture pests comprise exotic species. It is against this background that over the last 25 years in New Zealand, there has been a major biological control triumph in perennial ryegrass (Lolium perenne) pastoral ecosystems whereby the parasitic wasp Microctonus hyperodae Loan has made a significant contribution to controlling the Argentine stem weevil (ASW) Listronotus bonariensis (Kuschel), the country's worst ryegrass pest.This contribution discusses how there is now-emerging evidence of a breakdown in this biological control of the ASW, possibly as the result of rapid evolution of resistance by the pest to the parasitoid. This also seems connected to other drivers such as host-plant effects.For the purpose of this contribution, meta-analysis of parasitism data collected since the early 1990s has provided a strong basis against which to compare current laboratory and field parasitism rates at national and regional scales. Recently-collected laboratory data have shown that ASW parasitism rates by M. hyperodae are now about half of those measured in the 1990s. Similarly, national and regional field data have showed that overwintering levels of parasitism have progressively declined to similar levels over the last 25 years. In the 1990s there was good evidence for significant pest suppression, but this is no longer apparent. Based on

these recent results, the question then arises as to what the mechanism for such decline may be. Given both the ecological setting and biological characteristics of the weevil and the parasitoid, the now low levels of parasitism may reflect genetically-driven behaviourally-based resistance by the weevil to the wasp a result of ion pressure by the wasp. It is significant that on its release, the wasp also built up to very high densities because it too, as with the weevil, encountered few constraints to growth and was able to exert very high selection pressure on the weevil host. Thus, it may well be that the very thing that led to the success of M. hyperodae in suppressing L. bonariensis could now be the cause of its undoing. It seems that the empty habitat, devoid of biotic resistance and refugia has, after 25 years, has resulted in resistance to the parasitoid. Such resistance to classical biocontrol agents is rare and considered controversial by some scientists, but given the importance of biological control, the subject has now become the focus of intensive research in New Zealand.

Key words: Attack Rates, Grassland, Meta-Analysis, Natural Enemy

Estimate of Cultivated Land Resources Potential Based on Binary Logistic Regression Model in Hilly Area of Taihang Mountain

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Abstract: The research of mountain cultivated land resource potential is particularly important for the development and utilization of mountain arable resource in the future. We take Jingxing city as a case to estimate the potential of reserved cultivated land. 13 ecological factors which influenced potential of cultivated land resources in hilly areas were chose. They included 5 terrain factor and 8 climate factors or climate related factors. Key ecological factors were extracted by binary logistic regression analysis. Then logistic model was built based on key ecological factors. The map of potential of cultivated land resources in Jingxing city was obtained based on logistic model by GIS software. We analyzed potential of cultivated land resources based on the map. We extracted key ecological factors influencing cultivated land resources by binary logistic regression analyzing. The order of those factors contribution was obtained by analyzing model parameter (Wald 2). Regression coefficient (β) showed correlation relationship between key ecological factors and the potential of cultivated land resources. Odds ratio (OR) show that quantitative relationship between key ecological factors configuration changes and the potential changes of cultivated land resources. Result showed: 8 key ecological factors influenced cultivated land resources; the importance of terrain factors was more than climate factors; there were a negative correlation relationship between annual average temperature or coldness index and the potential of

cultivated land resources, others opposite. 60400ha land resources could be cultivated land resources in Jingxing city. Cultivated land reserved resources had 14800ha. The cultivated land reserved resources account 32.5% for existing cultivated land. So there is a lot of cultivated land reserved resources in Jingxing city. The result can provide theory basis for the development and utilization of cultivated land reserved resources in Jingxing city.

Key words: Cultivated Land, Hilly Region, Model

Based on the Improved Three-Dimensional Ecological Footprint Model China's Natural Capital Spatial Pattern of Dynamic Research

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Abstract: Natural capital accounting is an important measure for the sustainable development of quantitative basis. This paper, by using the improved three-dimensional ecological footprint model in mainland China 31 provinces (municipalities and autonomous regions) 2000, 2005, 2010 and 2014 natural capital per capita use of data and related analysis. Study found: (1) China's per capita three-dimensional footprint overall rise 0.052 hm2 breadth, depth of 3 d footprint per capita generally beyond the original length, and 19 areas beyond the original 10 times longer. (2) The footprint per capita widely cultivated land and grassland is an advantage to the constituents of the class, 3 d footprint depth depends on fossil energy consumption per capita. (3) Three-dimensional spatial distribution pattern of ecological footprint per capita showed: high value area scattered, part of the high value area and the high value area transformation;A lower end area covered, low-value area surrounded by including a zonal distribution.(4) China can be divided 3 natural capital use type, Ⅰ class area article focused on the east coast in zonal distribution; Ⅱ regional distribution range is the most widely;Ⅲ class area in qinghai province and the Tibet autonomous region.Conclusions of this study can provide a reference for changing current ecological deficit is normal phenomenon.

Key words: Natural Capital, Improved 3Decological Footprint Model, Spatial Pattern

Factors Influencing Economic Value of Ecosystem Services in a Natural Reserve in North China

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Abstract: Assessment of the economic value of ecosystem services is crucial for policy and decision making in ecosystem management. However, factors affecting fluctuations of the economic value of ecosystem services remains controversial. In this study, geographic information system, questionnaire survey and local meteorological factors were employed to evaluate the main ecosystem services (carbon fixation and oxygen release, soil conservation, entertainment culture, and nutrient accumulation) provided by the Kunyu Mountain Natural Reserve during 2001, 2007, and 2015, respectively. Our study found that carbon fixation and oxygen release, and nutrient accumulation registered a slight increase in 2007 and 2015 compared to 2001. Additionally, soil conservation increased significantly in 2007 but decreased in 2015 compared to 2001. Due to strict restriction of anthropogenic influence in the reserve, annual variation in meteorological factors was considered as the main factor affecting ecosystem services. In addition, comparison of ecosystem services value under different market prices verified that market price fluctuations have a significant effect on the ecosystem services value. Thus, the value of ecosystem services in natural reserves fluctuates with meteorological factors and unit price, while, in the long run, the value of ecosystem services in natural reserves would increase with the increase of willingness to pay.
Key words: Ecosystem Services, Meteorological Factor, Natural Reserve, Willingness to Pay

A Possible Linkage between Land-Use Intensity and Natural Disaster Risks: A Consideration for the Eco-DRR at Global Scale

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Abstract: Increasing frequency of extreme climate events, such as El Niño/Southern Oscillation (ENSO), is predicted under future climate change scenarios, which could trigger serious natural disasters to society. To face unpreceded natural disaster risks, it is necessary to clarify a possible relationship between human behaviours and vulnerability to natural disasters. Recently, the concept of ecosystem-based disaster risk reduction (Eco-DRR), which is an initiative to maximize or conserve ecosystem services contributing to disaster risk reduction, has been recognized worldwide as an adaptation strategy for climate change. Particularly, land-use change could impact ecosystem stability and thus degrade stable supplied of ecosystem services to human society. The relationship between land-use status and the function of Eco-DRR is now receiving a significant interest. The linkage between land-use intensity and disaster vulnerability during and after extreme climate events has been increasingly reported at

local or regional scale. However, there is little consensus concerning how land use intensity has affected the vulnerability of society to disasters at the global scale. In this study, we evaluated the influences of land-use intensity on natural disaster risks associated with El Niño events at the global scale.

We conducted superposed epoch analysis (SEA) to detect a significant temporal increment of natural disaster severity at current and next calendar year of five strongest El Niño years from 1980 to 2013. Only the countries teleconnected with ENSO were accounted for this analysis, and SEA was applied for each disaster type (e.g. drought, flood, and landslide) and each disaster statistic (e.g. the number of death, the number of affected people, economic damage). The results were compared between high and low land-use intensity countries. The significant increment of disaster damage was found in high land-use intensity countries, however the increment was also found in low land-use intensity countries depending on disaster types. Our results demonstrate the significant relationship between land-use intensity and the vulnerability of our society to natural disasters during the climate extremes, importantly suggesting that land-use intensification has made society further vulnerable to natural disasters by degrading ecosystem services in these regions teleconnected with ENSO events.

Key words: Climate Change, Ecosystem-based Adaptation, Ecosystem Stability, Superposed Epoch Analysis

The Role of Spatial Heterogeneity in Modulating Water-related Ecosystem Services in Yihe River Basin

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Abstract: Changes of some key drives, especially the modification of land use by humans can alter the provision of ecosystem services (ES). However, the role of spatial heterogeneity in modulating ES is rarely studied. There is topographic differentiation among the upper, middle and lower reaches of a river basin, which makes the heterogenic distribution of ES are obvious. In this study, we choose the Yihe River basin as our research area, to explore how the spatial heterogeneity modulates water-related ES (water conservation and water quality). We assessed the land use changes during 15-year period (2000-2015) in this area by using ArcGIS. We set sampling points in Yihe River and its branches, and examined the pH, temperature, turbidity, conductivity and dissolved oxygen (DO) of water in situ. We also collected water samples from these points, and examined the ammonia nitrogen, total phosphorus (TP) and chemical oxygen demand (COD) in the laboratory. The results reveal that from 2000 to 2015, the areas of farmland and building land in Yihe River basin are

increased, while in the upper researches, the area of forest has a slightly declining trend. The land use change caused water conservation in the upper reaches is decreased, and the water quality in the lower reaches is worse than before. It can be summarized that the spatial heterogeneity could modulate water conservation and water quality in Yihe River basin. In the future, more evidence will be needed to support the argument that spatial heterogeneity plays a significant role in modulating ES.
Key words: Spatial Heterogeneity, Ecosystem Services, Water, Yihe River Basin

Innovating Current Ecosystem Management Through the "Laws Divine and Human"（Dao De Jing/ Tao Te Ching）

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Abstract: In this paper, by analyzing the progress and development trend of different types of ecosystem management on earth (terrestrial ecosystems, marine ecosystems, wetland ecosystems, coastal ecosystems, etc.), and comparing the background of classical philosophy of Eastern and Western (Socrates, Cicero , Montesquieu, Confucius, Lao Zi etc.), the author thinks that understanding the philosophical thought of "Laws Divine and Human"（Dao De Jing/Tao Te Ching） will be more helpful to promote the innovation and development of the current ecosystem management. On this basis, the author also put forward the innovative management theory of "Envi-Atti Theory" And discusses its application prospect in the current ecosystem management issues.
Key words: Ecosystem Management, Laws Divine and Human, Envi-atti Theory, Innovation

Structure of Coastal Pine Forests at Two Regions with Different Social Conditions in Tokushima Prefecture, Shikoku, Japan

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Abstract: In many Japanese coastal regions, Piuns thunbergii Parl. (Japanese black pine) was planted to protect inhabitants and their agricultural fields from damages of wind, salt spray, and wind-blown sand. P. thunbergii is shadelerant, but highly tolerant to salt stress and infertile soil of the coastal sand dune. The coastal pine forests have been maintained by local people, cutting shrubs and scraping fallen leaves to use as fuel and organic fertilizer, and have represented a typical landscape called "white sand and

green pine trees". Thus the coastal pine forests have provided provisioning and cultural services as well as regulating services. However, after the 1950-60s in Japan, fossil fuels and chemical fertilizers came into use, and a large portion of the coastal pine forests were managerially abandoned. In addition, after the 1970s, spread of pine wilt disease has blighted many pine trees. In order to manage/conserve coastal pine forests to obtain ecological services continuously, current forest structure and its change should be evaluated in relation to social situations at the area. In this study, two coastal pine forests with contrastive structures, were compared and their sustainability was evaluated from ecological and social viewpoints. The pine forests are located at Kitanowaki and Ohzato region in Tokushima prefecture, Shikoku Island, Japan. We clarified land cover changes for 60 years by photo-interpretation, and difference of transition patterns between the two regions was discussed in relation to the land ownerships. Plot-based tree surveys were also conducted and ecological sustainability was assessed by predicting forest changes in the future. In Kitanowaki region, half of the coastal forest area is owned privately and the half is owned by local government. In the private area, most of pine forest had been replaced by broad-leaved forest due to pine wilt disease and forest succession. In governmental area, pine trees remained and dominated. However dense shrubs developed at forest floor and inhibited regeneration, because there is little incentive for local people to manage the pine forest. In Ohzato region, entire area of coastal forest was managed by local people, and the pine forest remained. Because local people continuously manage, such as clearing underbrush and planting pine saplings, for getting ecological services, regulating service in particular, from the pine forest. The situation suggests that the pine forest can be continuously maintained by the local people.Social characteristic of region has affected structure and changing pattern of coastal pine forests. Different strategies, therefore, must be developed along with social condition as well as ecological condition, to make/keep structure of coastal forest desirable for getting necessitated ecological services.This research was supported by the Environment Research and Technology Development Fund (4-1504) of the Ministry of the Environment, Japan

Key words: Coastal Forest, Piuns Thunbergii (Japanese Black Pine), Ecosystem Service, Sustainability

Priority Management of Migrant Waterbirds Habitat Suitability on Coastal Zone with Multi Temporal Data

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Abstract: The Changjiang estuary, a major habitat for waterbirds, plays a key

ecological role in the maintenance of global biodiversity, and allows the transfer of energy and genetic information between ecosystems, but suffers varies threats due to the human activities and natural processes during the past decade. Analysising the habitats suitability change trend and identifying conservation priority are considered to be critical to waterbirds protection and policy demand. This study proposed an integrated framework for habitat priority management. With the spatial fuzzy assessment model and Dinamica EGO model, we realize the mapping of migrant waterbirds habitat suitability change for last decade and the predictions of possible status in the next decade. Based on that, the priorities for future protection was definited, and further help the effectiveness of policy formulation. The integration of remote sensing data and ecological knowledge greatly assisted in analyzingthe migrant waterbirds habitat classes and characteristics that have previously been difficult to detect. And with the Object-Based Image Analysis method and synthetic aperture radar interferometry technology, the main input factors of the two models were obtained and quantified, including fifteen typical habitat structure factors and three main driving factors respectively. As the final priority level were ranked considering the existing zoning status of protected area and the habitat suitability difference between present and future. The result showed that in order to get the maximum management benefit, the existing protected area with a high priority level should enhance the original management performance and pay attention to the future protection, while the nor protected area with low priority can consider later. We present a frameworks of priority protection management on the coastal zone, and provide an applied case for the migrant waterbirds habitat with the key process including suitability assessment, spatial prediction and priority determination. It help to improve the efficiency of future protection policy making and our capability to anticipate future changes. And make the policy have the opportunity to coherent the nature conservation with social and economic development.

Key words: Priority Management, Migrant Waterbirds, Habitat Suitability, Coastal Zone

The Simply Analysis of Liabilities in Natural Resources Asset Balance-Sheet

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Abstract: The research on the definition and accounting of natural resources liabilities is one of the important and difficult problems of the compilation of natural resources asset balance-sheet, and at this stage, the relevant research is great shortage, which

seriously hinders the development of natural resources asset balance-sheet. Therefore, it is a great significance to definite and account the liabilities of natural resources. In this article, we firstly illumined the basic connotation of natural resources liabilities combined its economic essence, producing premise, approach and conditions. On this basis, we chose the forest resources, water resources, mineral resources and land resources as the research object and illumined the connotation of different resources' over-consumption from the quantitative change of renewable resources, non-renewable resources and the qualitative change of natural resources, and then provided the basic ideas of accounting different resources' liabilities from the natural limit of resources' attributes and national policy boundaries.

Key words: Natural Resources Asset Balance-sheet, Liabilities, Sustainable Development

Tradeoffs and Time Lag in Ecosystem Services during Degradation and Restoration Processes in a Freshwater Lake of Northern China

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Abstract: Understanding the relationship between ecosystem services is important to ensure the success of ecological restoration projects. This study assesses the tradeoffs and relationships between ecosystem services during the degradation and restoration phases of a freshwater lake. Changes in land cover and ecosystem service value (ESV) were studied with long time periods from 1984 to 2015 in Mata Lake which had undergone significant changes in land use. Variable land use dynamic index (LUDI) suggested that land cover change fluctuated frequently in the Mata Lake, specifically for water and lakeside wetland. The ESV change was more notable and temporally influential than land cover change, indicating a time lag between land cover change and ESV change. Results of Pearson's correlation analyses showed that tradeoffs in ecosystem services mainly occurred in provisioning and regulating services. We noted that temporary increase of single ecosystem services such as food production was detrimental to the long-term development of total ecosystem services. On the contrary, improvement of some regulation services at the cost of provisioning services contributed to the total ESV significantly. The biodiversity conservation was significantly related to other ecosystem services, while food production and raw materials were not. Hence, biodiversity conservation is holistic and affected by multiple circumstances, while food production and raw materials are relatively independent. Our research in Mata Lake has significant implications on future restoration and management projects for other lakes worldwide.

Key words: Ecological Restoration, Ecosystem Service Value, Land Cover Change, Land Use Dynamic Index

Applications of Floristic Quality Assessment in the Vegetation Integrity Assessment in Riparian Area of Hai Basin, China

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Abstract: Hai Basin is the largest river basin in north China and the most polluted basin in the country. Meanwhile, Hai Basin occupies important strategic position in national development of society and economy, in which Beijing-Tianjin-Hebei Metropolitan Region is the political and cultural center of China. As the work of pollution abatement has taken a certain effect, the key of environment treatment in Hai Basin transform to the restoration of ecological integrity gradually. Vegetation, which is the important component of the ecosystem, can well reflect the health of river ecosystem. Therefore, a plant-based method for ecological integrity is needed to evaluate the degree of degradation as well as the effects of restoration, so as to support guide for ecological restoration.

The Floristic Quality Assessment (FQA) is a tool to assess the quality of natural or remnant native plant communities, of which the coefficient of conservatism (C) is the core. The establishment of C values and the use of the floristic quality index (FQI) eliminate subjectivity and provide a standardized method to evaluate the floristic condition of a site, which allows for comparisons between different sites and monitoring of sites over time.

Approximately 517 plants were found in 402 sampling sites during the survey in the riparian area of whole Hai Basin in 2012, of which 90.7% are considered native and 9.3% are considered non-native. C value of every species was determined through Expert Scoring Method, and FQI of each sampling site was calculated. Of the 469 plants examined, approximately 48.03% of them(C value 0~1) were classified the ruderal category, whereas 41.97% (C value 2~10) were classified into category of ruderal affinity to natural areas and plants obligate to natural areas. The C value of species in riparian area of Hai Basin ranges from 0.44 to 3.88, and FQI ranges from 0.11 to 32.6, which indicate overall low quality of vegetation. Among the basin, vegetation quality of the upper reach of Luan River and Zhangwei River with FQI of sampling sites over 20is relatively high, the quality in plain area of Ziya River, Northern Three River and Yongding River nearby urban area of Beijing with FQI mostly less than 2 is the worst,. The study results can provide scientific and technological support for ecological environment management in Hai Basin.

Key words: Hai Basin, Vegetation Integrity Evaluation, Floristic Quality Index, Coefficient of Conservatism

Telecoupling in Ecosystem Services: A Case Study of Xishuangbanna

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Abstract: Nature provides human society with a vast diversity of benefits, because human well-being is totally dependent upon the continued flow of ecosystem services (ES) which provide a range of services that are of fundamental importance to human well-being, health, livelihoods, and survival. Many ES (including food, fuel, and clean water) are produced locally, but their benefits extend regionally, nationally, and even globally and the interactions among socio-economic benefits and ES are generally studied under local levels. Here we apply the emerging telecoupling framework which is socioeconomic and environmental interactions over distances to systematically analyze the causes, agents, effects, flows and systems of ES. We develop a conceptual model for applying the telecoupling framework which built on the basis of TEEB's pathway from ecosystem structure and processes to human well-being diagram. We attempt to address these sharply socio-economic benefits and ES interactions increase issues by first elaborating on the framework of telecoupling for different types of the ecosystem services. The telecoupling framework provides a broader analytical lens to integrate distant socioeconomic and environmental interactions affectiong sustainability across local to global levels, and these are lacking in the current research based on the fact that the increased interactions over long distances in the whole world.
Key words: Ecosystem Services, Telecoupling, Xishuangbanna, TEEB

Telecoupling in Spatiotemporal Variations of Ecosystem Service Based on RS: A Case Study of Xishuangbanna

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Abstract: Ecosystems provide a range of services that are of fundamental importance to human well-being, health, livelihoods, and survival which human and natural components interact. The telecoupling is socioeconomic and environmental interactions over distances. The concept of telecoupling is deeper than the local interactions and coupling. The research on telecoupling can make public understand how the things happened and developed, and also can make trasforming sustainalble

development practice a reality. There are great demand for evaluating impacts of human well-being on the ecosystem services, most researchers focus on the mechanism of ecosystems services(ecosystem structure, processes, functons, and services), evaluation and modeling, policy and decision-making, although distant factors sometimes have been mentioned, but also require a new research framework to fill knowledge gaps and advance sustainability science and applications. Similar to the umbrella concept of ecosystem services, which encompasses a variety of nature's benefits to humans and facilitates studies on relationships among different types of services, the framework of telecoupling can help promote systematic, multidisciplinary studies on different types of distant interactions and their interrelationships. Interactions among ecosystem services are generally studied under local location. Although such studies have generated important insights, there are limitations especially with increasing globalization and trade.Here we apply the emerging telecoupling framework to ecosystem services. The telecoupling framework provides a lens and method to evaluate human well-being and ecosystem interactions in linked systems across distances. It can alos help to analyze ecosystem services and human well-being's interrelaionships, provide a useful means to incorporate feedbacks as well as multiple systems(sending, receiving, and spillover systems).There are increasing telecouplings between socio-economic and ecosystem interactions over distance. To analyse these complex interactions, we apply the new telecoupling framework to the ecosystem services of Xishuangbanna which borders on Burma, Laos and Viet Nam.Ecosystem services, which include ecosystem supply services, ecological regulation services, and ecological culture services, are key contributions in human society. We chose three types of ecosystem services ground on realities of situation and data sources: provison services, ecological regulation services, and ecological culture services. The telecoupling framework presents opportunities for more understanding of ecosystem services.

Key words: Ecosystem Service, Telecoupling, Xishuangbanna, Spatiotemporal Variations

T1-09: Civilization and Ecology in the Anthropocene: Improving a Broken Relationship?

Multinational Collaborations in Ecology and Environmental Science within Asia: Current Status and Pathways Forward

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Abstract: Publications in the fields of ecology and environmental science have recently greatly increased in Asia over the past decades, often as part of international collaborations. Yet the general pattern of these collaborations is that they are a partnership of one Asian country and its American or European partners. For example, in a dataset of papers published in 2015, 22% contain authors from at least one Asian county, but only 2% had authors from more than one Asian country. We argue there is an opportunity to increase collaborations between Asian countries, as (a) most countries in Asia share a large percentage of their biodiversity, at least at the generic and familial levels; (b) Asian countries also share a range of threats that are especially extreme in the region. To illustrate the later point, we focus on a set of toxicological substances, as well as the rate of urbanization in Asia. Concentrating on the two largest Asian countries, China and India, we discuss the cultural and political barriers that can make collaboration difficult, as well as successful ventures that have bridged these gaps. Ultimately, collaborations between Asian countries can result in more widely sampled datasets that are more generalizable, different perspectives that can arise from different cultures and experiences, and the realization that many countries share the same environmental challenges.

Key words: Research Collaborations, Environmental Sciences, Asia, Conservation

First Steps towards Developing a Common Global Ecology Curriculum

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Abstract: There is an increasing awareness and concern with regards to human-induced global environmental change and biodiversity loss and their impacts on ecosystems and human well-being. This concern occurs not only among ecologists and

conservation scientists/practitioners but also within spheres of politicians and scholars from non-scientific fields worldwide. However, a great majority of the global population, both in industrialised and developing countries, do not integrate ecology and environmental issues as part of their everyday decision processes. We believe that this lack of integration comes from the little knowledge and observational skills of ecological processes and of Human-Nature interactions at an early age, and from the general tendency to put ecology as a side-topic in early stage of formal education (e.g., middle and high school).

The international Network of Next-Generation Ecologists (INNGE) organised and ran an online open forum (May 2016), with a diversity of keynote speakers, including a Professor in environmental education from Australia, a middle school science teacher from the USA and members of the Education and Careers committee of the British Ecological Society (BES). These speakers showed that many tools can be used to educate people in ecology at all ages and that observation and knowledge of the local environment is key to understanding and caring about ecological processes. In addition, ecological concepts and issues have no boundaries and an international curriculum could be a tool for a global ecological awareness at an early age.

Hence, we question whether building a curriculum that would be a basis to be adapted and taught in all countries is appropriate and feasible, and if so, how we could create it. Teachers must be involved to shape this curriculum. A first step would be to build a global survey with and for teachers, with the inputs of ecologists and education specialists, to identify the needs, the limitations and the knowledge that teachers require nationally and internationally in order to integrate ecology as a major science/environmental course ‘in schools from primary to secondary school students.

The BES, a partner of INNGE, has recently launched the BES Special Interest Group (SIG) for Teaching and Learning that will likely be of use to help collect best practices, identify networks and contributors, and to push action towards a global ecology curriculum.

Key words: Teaching, Schools, Education, Undergraduate, Global Survey, SIG for Teaching and Learning

Environmental Education in the Sacred Woodlands of Korhogo (Ivory Coast) and Adoption of Environmental Behavior by the Insider

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Abstract: In African traditional societies, the relationship with the Environment has constituted for a long time, a link of intimacy between the African and his

environmental space. This report has its peculiarity in that, the environment is an integral part of the social organization and cultural practices. Now the spiritual question within the African traditional society is strongly related to the elements of nature such as water, pebbles, and trees. As African traditional religion apprehends these elements as the place of habitation of deities and ancestors. This is why the Senoufo people practice in their wooded forests the initiatory rites called "Poro" which situates the social education of the young boy. Thus, in initiatory forests, these young people from 14 to 18 receive an environmental education aimed at health, agriculture and climate change concerns. However, at the exit of these initiatory sites, ecological behavioral differences are observed for some of them in the community. This paper will therefore analyze the determinants of environmental education given to insiders; but also, it will observe the aged environmental perceptions' who are in charge of the training of these young people in the forests. At the end, this production will answer the question "What are the logics underlying the adoption of the environmental behavior by insiders of the sacred woods of Korhogo in the Northern of Ivory Coast.

Key words: Sacred Woodlands, Environmental Education, Environmental Behavior, Insider

Evaluation of Urban Sustainable Development from the Perspective of Coupling and Coordination——A Case Study of Yangtze River Delta

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Abstract: Sustainable development is the core value guiding of future development of city and is also an important way to promote human civilization and realize social harmony. Urban sustainability assessment is precisely evaluation of urban sustainable development capacity, which focuses on ecological rationality of human activities and emphases coherence of economic development, social progress, environmental protection and resource-usage. So, this paper, with the concept of sustainable development as the support, gives development and coordination sustainable assessment connotation，then takes comprehensive sustainability assessment of the city's economic, social, environmental and resource systems from the year 2005 to 2014 in the Yangtze River Delta . Firstly, using the entropy method to compute the comprehensive evaluation values of the four systems, which are urban economy, society, environment and resources. Secondly, constructing spatial measurement model of sustainability degree, coordination degree and sustainable development degree of sustainability assessment and analyzing 41 cities through using diachronic evolution

and synchronic comparative analysis. Finally, having a spatial correlation analysis for the sustainable development degree of 41 cities, which uses exploratory spatial data analysis method.

（1）Overall, the level of comprehensive evaluation of economic, social, environmental and resource systems rise fluctuant in the Yangtze River Delta, and the inter-city differentiations are still obvious;

（2）Although the development of Shanghai is high, the rest of the cities are lower, leading to the overall coordination degree is higher and the degree of development is lower. Therefore, improving the comprehensive level of each system is a key to enhance sustainable development.

（3）It is divided into I-VIII classes of sustainable development degree from high to low. The first feature of sustainable development degrees is obvious, and most of cities concentrated in the III, IV, V and VI class. The cities with high degree of sustainable development are mainly located in Shanghai, southern Jiangsu and northeastern Zhejiang;

（4）The sustainable development degree shows spatial agglomeration, and exists two spatial polarization regions. Shanghai, southern Jiangsu and northern Zhejiang belong to the sustainable development high value gathering area, while Huainan and the northern Jiangsu belong to the sustainable development low value gathering area.

Key words: Coupling and Coordination, Sustainable Development, Evaluation, Yangtze River Delta

Synthesis Centers - Critical Research Infrastructure to Support Future Research

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Abstract: Synthesis centers offer a suite of amenities that make them conducive to creative discovery in unique ways. The combination of logistical support, post-doctoral or senior fellowships, complex data management, informatics and computing capability/expertise, and most of all, opportunity for group discussion and reflection lowers the ‘activation energy’ necessary to promote creativity and cross-fertilization of ideas. Synthesis centers are explicitly created and operated as community-oriented infrastructure, with scholarly directions driven by ever-changing interests and needs of an open and inclusive scientific community. The last decade has seen a rise in the number of synthesis centers globally, but also the end of core federal funding for several of them, challenging the sustainability of the infrastructure in support of this key research strategy. Here we present the history and rationale for synthesis centers,

and explore different challenges and opportunities to long-term sustainability.
The talk will reflect on the value of synthesis centres for the whole research community and give an outlook about opportunities and possibilities to develop new research agendas and networks in the future.
Key words: Synthesis Centers

How Did Rural Landscape Under Human Intervention Change in Japan? : A Case Study in Tsushima City, Nagasaki Prefecture

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Abstract: 【BACKGROUND】People have been utilizing and managing their surrounding natural environment to sustain their daily lives. The traditional Japanese rural landscape reflects the local people's lives and livelihoods in its long history and semi-natural environment forming semi-natural grasslands, secondary forests, paddy fields and so on. It is important not only for food production, but also for multiple ecosystem functions, such as groundwater recharge and habitat provision for various species. However, it is said that recent underuse of natural resources is causing negative effect to the local environment. Population outflow to the urban area started in the 1960s at Tsushima City, Nagasaki Prefecture. It is concerns that traditional landscape has been changed and the functions previously described have been deteriorated due to the less of human intervention. The purposes of this research are to 1) examine the actual conditions and transitions of natural resource use, 2) find out the change of land use from 1955 to 2015 and 3) identify the reasons of the changes in Tsushima City. 【STUDY AREA AND METHODS】This research was conducted in Shitaru, in Tsushima City, where the population in September 2015 was 64 people and the percentage of the population over 65 years old was 62.5%. Three methods were used in this research. The first one was aerial photograph analysis (in 1955, 1977, 1993 and 2015) to identify the changes of land use. The second method was field survey to clarify current land use in detail. The last one was interview with local residents to investigate the current situation of natural resource use and land use.【RESULT】About 60 plant species had been used in the 1950s and the half of them were not used in 2015. There were two reasons for the suspension of utilization. The first reason is deterioration of value resulted from changing lifestyle such as energy revolution and introduction of substitute products. The other one is shortage of the resource amount. Comparison on land use of 1955 to 2015 showed that functioning agricultural land decreased 79.3%, while 60% of upland fields has been still remaining for the purpose of self-consumption, 90% of the paddy fields was disappeared. In forest, shifting cultivation had been

conducted in the 1950s, but was lost before the 1990s.
Key words: Landscape, Natural Resource, Land Use, Underuse

Deep Learning and Deep Ecology: Complexity Science and Holism in the Context of Big Data

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Abstract: Starting from the two most popular issues in the sustainability, Eco-civilization and Artificial Intelligence (AI) and their intersection, the authors reviewed the classical theories and the advances trying to reveal the key intermediate links and the original thoughts. In the context of big data technology flourishing, deep ecology and deep learning were identified as the base for Eco-civilization and AI respectively. All these development could be backtracked from the complexity science and the holism theory. In this study, we employed the bibliometric method to quantify the pattern and trends in the relevant fields. At final, we prospected some innovative directions in various aspects of philosophy, engineering, and sciences.
Key words: Deep Learning, Deep Ecology, Complex Science, Bibliometrics

Countermeasures of Adaptive Environmental Management Based on Historical Review in Dianchi Lake Watershed

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Abstract: In Dianchi Lake watershed, the history of civilization development is a process that mankind adapts to the change of water environment and achieves water environment safety. It has gone through three periods: Primitive civilization period, peoples constantly migrated to cope with the lack of food and change in the place of residence, that had caused by the amount of water; the period of agricultural civilization, people constructed a lot of water storages and drainage to settle the problem of too much or too little water; The period of industrial civilization, comprehensive measures are applied to prevention and control pollution of water. The history of human response to water environmental problems in Dianchi Lake Basin tells us, it is necessary to use adaptive environmental management in water watershed environmental safety management. The methods of adaptive environmental management can solve effectively the uncertain factors of natural, social and economy,to avoid effectively water environmental safety risks. There are four major water environmental safety

problems in Dianchi Lake watershed, water supply is limited, water quality is deteriorative, watershed ecosystems is fragile, and economic, population and living standards are growing. So we should strengthen monitoring and forecasting to reduce the risk of uncertainty and understand risks, make a plan that can cope with risk of changes and uncertainty, and develop the information disclosure system, increase the degree of stakeholder engagement. So as to we can improve the adaptive management ability of water environment safety in Dianchi Lake watershed.

Key words: Safety of Water Environment, Dianchi Lake Watershed, Changing Environment, Adaptive Management

An Eco-geographic Approach to the Distribution of Pre-Industrial Civilizations

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Abstract: Examination of the distribution of pre-industrial old-world civilizations exhibits remarkable geographic regularities. First, along the latitudinal axis from the equator to the arctic, a descending trend of human ethno-cultural diversity is found to be in coincidence with a descending trend of biological diversity. Second, along the same latitudinal axis, the complexity of civilizations shows a humpback pattern with the peak at the intermediate latitude. Third, along the longitudinal axis of the Eurasian continent, the two extremes of the continent, i.e., Europe and East Asia, demonstrate symmetrical and independent developments of the most sophisticated and robust pre-industrial civilizations. It is postulated that civilizations are propagated by group learning, and that group learning is positively related to human population size, human interactions, and environmental challenges. Under such postulations the relationship of group learning with important environmental-geographical factors, including climate, terrains, watersheds, biodiversity/bio-productivity, and human parasites and diseases, are examined. A hypothesis of intermediate bio-productivity and a hypothesis of intermediate isolation are formulated to account for those geographic patterns of civilizations.

Key words: Eco-Geography, Civilization, Bio-producticity, Group Learning

Conservation Practices Are Pushing the Yangtze Finless Porpoise to an Even More Dangerous Situation in Poyang and Dongting Lakes

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Abstract: The critically endangered Yangtze finless porpoise (Neophocaena asiaeorientalis asiaeorientalis) is endemic to the middle and lower reaches of the Yangtze River and its two adjoining lakes (Poyang and Dongting Lakes). These two lakes are crucial habitats for the porpoise by preserving more than half of the total wild population. Lake management efforts including a seasonal fishing ban and law enforcement actions on illegal fishing were expected to benefit this species by protecting food resources and reducing bycatch. However, an increase of unusual deaths of the porpoise questioned the management effectiveness.

To investigate potential causes of this management failure, we analysed local ecological knowledge about fishery resources and fishing activities in the two lakes. We interviewed 313 informants and 323 informants among local fishing communities in the Poyang Lake region and the Dongting Lake region respectively. The results showed a rapid decline of fishery resources in both lakes. For Poyang Lake, the average proportions of fishing time in the daytime and nighttime were 50.4% (SD=24.2%) and 49.6% (SD=24.2%) respectively. For Dongting Lake, more than 80% of the informants expressed their willingness to fish at night. Although 78% of the informants denied using illegal fishing gears, 85% of them claimed to see illegal fishing activities of other fishermen.

The rapid decline of fishery resources has driven the fishermen to adopt more powerful illegal fishing gears. Fishermen's tendency to night fishing and the extensive use of illegal fishing gears resulted in more frequent accidental captures or collateral damages to the porpoise, since this species is a primarily nocturnal and crepuscular feeder. The prevalence of illegal fishing at night was speculated to be an outcome of biased management, since illegal fishing was limited by management patrols in the daytime, which led to compensatory unregulated fishing at night. The night fishing tradition possessed by local communities in Poyang and Dongting lakes guarantees the fishermen's capability of working in a more hazardous environment at night; however, unintentional damages on the porpoise could not be avoided in such poor visual conditions.

This research demonstrates a failure of conservation practice without thoroughly considering fishermen's activities under management and the animal behaviour and ecology. We strongly recommend to improve monitoring approaches on illegal fishing and to extend the fishing ban for the porpoise conservation.

Key words: Yangtze Finless Porpoises, Conservation Practice, Illegal Fishing, Local Ecological Knowledge

T1-10: Recent Progress and next Challenges toward Cross-Scale Understanding on Ecosystem Structure and Function by Remote Sensing

Digital Cameras as a Tool for Assessing Vegetation Phenology and Integration with Satellite Image Analysis

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Abstract: A fundamental challenge faced when using remote sensing techniques to monitor vegetation phenology is the trade-off required between the level of spatial detail and the revisit time provided by the sensor. One way to address this challenge is to integrate remotely sensed observations obtained at different spatial and temporal scales to provide information that contains both a high temporal density and fine spatial scale observations. However, first of all, the integration must be carried out for the methods which are proved their appropriateness in terms of biologically relevant phenological events, and by using valid vegetation index. In this paper, we compared measurements of vegetation phenology compiled from a network of ground-based cameras, which were established at Mongolian Oak forest in five sites (Mt. Nam, Mt. Mido, Mt. Cheonggye, Gwangneung and Mt. Jeombong), South Korea and satellite-derived measurements of vegetation conditions derived from a fused broad MODIS with visual assessments in the same sites. Based on the vegetation indices extracted from each measurement, we deduced phenophases transition dates, such as start dates of green-up by using MODIS satellite images and digital camera. The start of the growing season of Mongolian oak expressed in ExG, which were extracted from digital camera image, were agreed well with that of visual assessment. Enhanced vegetation index (EVI) among vegetation indices showed the highest correlation with ExG and visual assessment. Based on RMSE, the transition dates assessed by visual observation were agreed with the dates, which were estimated based on curvature K.

Key words: Phenology, Green-up, Digital camera, MODIS

Effects of Land Use Change on Ecosystem Service Value of the Small Sanjiang Plain since the Mid-1960s

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Abstract: Small Sanjiang Plain is the important food production base in China. But the unreasonable development and utilization of land lead to ecological damage that affects the goal of ecological environment protection. The land use change and its effects on ecosystem service value (ESV) in the rapidly developed region of the Small Sanjiang Plain since the mid-1960s are analyzed, and the relationship between ESV and land use structure is researched. The methods used in the paper are based on the ESV computing formula and ESV coefficients of the land ecosystems in China advanced by Xie Gaodi et al. In this study, we used the mid-1960s CORONA images from USGS and the 2015 Landsat images of the Small Sanjiang Plain. The results show that: Since the mid-1960s, the area of marsh and forests seriously reduced, while construction land and cultivated land increased. The decreased marsh mainly transformed to paddy land and dry land in Small Sanjiang Plain. The decrease of the ecosystem service value of the Small Sanjiang Plain was mainly responsible to the dramatic expansion of construction land and the reduction of forests and marsh since the mid-1960s.
Key words: Small Sanjiang Plain, Ecosystem Service Value, CORONA Images, Marsh

Watching Grass Grow: Successes and Limitations of Image-Based Methods for Monitoring Grassland Phenology

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Abstract: Seasonal changes in aboveground primary production (i.e. phenology) are influenced by environmental conditions with implications for land-atmosphere interactions, carbon cycling, and agricultural production. Monitoring phenology and quantifying seasonal patterns across spatially extensive grasslands and savannas require cost-effective, consistent, and accurate approaches for detecting changes in the growing season. Remotely sensed imagery offers capabilities to quantify growing season metrics via vegetation indices that have been linked to biomass and forage and net primary production. However, in many water-limited ecosystems contributions of exposed soil due to modest vegetation cover and susceptibility of vegetation to drought challenge these biophysical retrievals using moderate- and coarse-resolution satellite imagery. This challenge emphasizes the importance of verifying seasonal metrics derived from remotely sensed imagery (e.g., start, end, and length of growing season and timing of peak greenness) to identify limitations and uncertainty of said metrics used to forecast plant responses to climate and estimate biomass accrual and crop yields. We collected and evaluated data at multiple spatial and temporal scales from 2012 through 2016 to quantify the degree of correspondence between field and remotely sensed growing season metrics. This study was conducted at an ungrazed desert grassland site in southern New Mexico. Weekly field observations of plant phenology

and canopy greenness were compared with metrics derived from MODIS satellite imagery and near-surface digital cameras (hereafter "phenocams"). MODIS 250-m NDVI vegetation index data are acquired every 16 days while color images are acquired daily from phenocams mounted at a height of ca 6 meters providing data at finer spatial and temporal scales that those from satellite. In addition, phenocams offer the opportunity to identify individual plants in the image to extract species-specific patterns in greenness. Growing season metrics from both types of imagery were derived using Timesat software (v3.2).

Phenocam greenness curves for individual species indicated rapid canopy development for the widespread deciduous mesquite shrub (Prosopis glandulosa) over 14 to 16 d in the spring (April to May) whereas peaks in greenness for the dominant perennial black grama grass (Bouteloua eriopoda) occur with warm season rainfall in July. Weekly field estimates of canopy development were significantly correlated with greenness index values from phenocams for mesquite ($r = 0.735$) and black grama ($r = 0.609$). Start and end dates for growing season derived from MODIS NDVI corresponded well with phenocam greenness representing the landscape ($R2 = 0.691$) with better fit for end of season. These data demonstrate the utility of phenocams for reliably depicting species-specific patterns in phenology in this arid grassland although uncertainty with start of season for black grama was less than that for mesquite. The ability to distinguish contributions to landscape greenness between C3 shrubs and C4 grasses can dramatically enhance landscape monitoring efforts over spatially extensive grasslands and savannas where field monitoring is not feasible large areas. Future research will include additional grassland sites using image data from the Phenocam Network and online analytical tools that are in development to bolster opportunities to bridge satellite, camera, and field data to quantify and predict ecosystem productivity.

Key words: Remote Sensing, Phenology, Cross-scale, Desert Grassland

UAV-HiRAP: A Novel Method to Improve Landscape-Level Vegetation Classification and Coverage Fraction Estimation with Unmanned Aerial Vehicle Platform

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Abstract: Lightweight unmanned aerial vehicles (UAV) are revolutionizing spatial ecology and environment monitoring due to their ability to acquire high-resolution imagery and flexibility of flying time. Development of image-analyzing tools is currently challenging to extract efficiently and effectively vegetation structural and functional attributes at landscape-level in the local ecosystems with UAV platform.

In this study, we proposed a novel method with machine learning algorithm to classify vegetation and calculate the vegetation coverage fraction (VCF) on the high spatial-resolution orthomosaic generated from thousands of images acquired by UAV with structure-from-motion (SfM) computer vision technique. We validated this method with detailed ground measured datasets, including 3953 trees and 19677 shrubs in the 100 ha (1000 m×1000 m) long-term monitoring plot (115.95E，42.96N) in Elm (Ulmus pumila) Sparse FOrest Grassland Ecosystem (ESFOGE-Plot), which is located in Otindag Sandy land, Inner Mongolia, China. The new method was incorporated a user-friendly software "Unmanned Aerial Vehicles - High Resolution imagery Analysis Platform" (UAV-HiRAP), which integrated color space transformation function, classification and regression tree (CART) algorithm and parallel computing. Finally, we developed a model to optimize the workload of vegetation survey by Monte Carlo stochastic simulation based on the classified vegetation map.

Using this new method, bare sandy land, perennial plants and herbaceous plants were classified successfully on the high-resolution orthomosaic (10 cm/pixel) of ESFOGE-Plot. The VCF calculated from UAV imagery agreed well with the results estimated from the crown diameters of all individuals measured in the ground survey. The validated results showed that the coverage fractions of perennial plants calculated from UAV imagery and that estimated from ground survey have a stable linear relationship over different spatial scale (slope = 0.76, 0.77, 0.80, and 0.77, R2 = 0.62, 0.25, 0.12 and 0.20, at 100 m×100 m, 50 m×50 m, 25 m×25 m and 12.5 m×12.5 m plot-levels, respectively; $P < 0.001$). Furthermore, we found the relationship between investigated quadrats number n and side length l can be described as $n=727 / (l + 7)$ ($R2= 0.996$, $P<0.0001$) at desired confidence level of 95%. The number and area of Quadrats can be estimated from this function, which reduces workload in the field survey while preserving the accuracy and reliability required.

Our results suggest that UAV-HIRAP can be a powerful tool to classify vegetation and calculate VCF at the landscape-level with UAV platform, and demonstrate the potential of UAV to monitor vegetation in ecology and environment management.

Key words: Dryland Vegetation, Machine Learning, Sparse Forest Grassland, Orthoimages

Satellite Ecophysiology —the Remote Sensing from Single Leaf to Global Scales

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Abstract: Atmospheric CO_2 concentration has increased due to human activities, e.g.,

fossil funeral burning and land use change, and this increase is the main driving cause of climate change in global scale. Terrestrial ecosystem, which is large carbon sink, uptakes 31 % of anthropogenic CO_2 through photosynthesis by plants (Global Carbon Project 2016). However, since photosynthetic process is quite sensitive to environmental conditions, such as radiation, temperature, soil moisture, etc., CO_2 flux of terrestrial ecosystem shows remarkable temporal variations (IPCC 2013). Thus, to deal with the climate change issue effectively, it is necessary to monitor the spatial and temporal dynamics of ecosystem structure and characteristics that are responsible for photosynthetic CO_2 absorption. Satellite remote sensing is very useful tool to assess ecosystem characteristics from regional to global scales. However, since the data we could measure directly by satellite is very limited and there are scale gaps between satellite measurements and ecological phenomena including photosynthetic processes, to use the satellite data, it is important to analyze with underlying mechanisms.

Plant ecophysiology is key to interpreting remote sensing data to CO_2 uptake function of terrestrial ecosystem. The radiation reflected from the canopy surface, which is generally used for vegetation remote sensing is strongly affected by leaf optical properties, i.e., reflectance, transmittance and absorption of radiation (Field, Randerson & Malmström 1995; Ustin et al. 2004). The leaf optical properties characterize leaf biochemical components, such as chlorophylls, carotenoids, anthocyanin, nitrogen, cellulose, lignin and water, and anatomical structures (Ustin et al. 2004; Asner et al. 2009; Davis et al. 2011). The radiation absorption by leaves is directly linked to photosynthesis and leaf biochemical and morphological properties are also related to physiological processes. PRI (photochemical reflectance index) and SIF (solar-induced chlorophyll fluorescence), which are optical parameters to related to physiological mechanisms of plant to avoid photoinhibition are also useful to photosynthetic 'activity' and plant stress (Gammon et al. 1997; Garbulsky et al 2011; Frankenberg et al. 2011; Joiner et al. 2011). Thus, detailed assessment of relationship between remote sensing data and in-situ measured plant ecophysiological data would provide us the spatial distribution and temporal dynamics of potential and activity of carbon sequestration.

In this paper, I will introduce the efforts to interpret remote sensing data to ecosystem characteristic based on plant ecophysiological studies from single leaf to global scale and discuss future perspective.

Key words: Photosynthesis, Remote Sensing, Leaf Optical Properties

Sensitivity Analysis of the Canopy Scale 3D Sun-Induced Chlorophyll Florescence Model at Various Forest Structures

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Abstract: To date, the potential use of the satellite-based sun-induced fluorescence (SIF) has been widely recognized for global GPP estimation. Although the global models need to be simple enough to run globally, it is not well investigated how much detail we need to simulate the realistic canopy scale SIF. We have been developing leaf to plant canopy scale photosynthesis and SIF models as precise as possible. The developed model has been used to understand how the leaf-level SIF emission can be related to the canopy scale SIF, which enables to investigate the top of canopy SIF observed from ground-based and satellite-derived SIF measurements. In this study, we show the canopy scale SIF simulation under various forest structure conditions. From our results, we discuss how leaf angle, leaf area index, and clumping influence the canopy scale SIF.

Key words: Radiative Transfer, Fluorescence

Using Solar-Induced Chlorophyll Fluorescence to Estimate Gross Primary Productivity of a Temperate Forest

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Abstract: Recent studies indicated that solar-induced chlorophyll fluorescence (SIF) provides a more direct measure of photosynthesis of terrestrial ecosystems than widely-used vegetation indices including normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI). Here we use SIF data from the Observing Carbon Observatory 2 (OCO-2) to estimate GPP for a temperate forest. The ground-based GPP data are derived from a tall eddy covariance flux tower. OCO-2 SIF shows a strong relationship with tower GPP at both instantaneous and daily timescales. The relationship at the daily timescale is slightly stronger than that at the instantaneous timescale. SIF exhibits a stronger relationship with GPP than does NDVI or EVI. We then use SIF and tower GPP data to develop predictive models, and compare these models against traditionally used light use efficiency (LUE) and empirical models. Cross-validation is used to evaluate the performance of these approaches. Our results show that the performance of the SIF model is comparable to, or slightly better, that of the LUE model. The scale mismatch between the tower footprint and the OCO-2

footprint does not substantially influence the relationship between GPP and SIF. Our results demonstrate the potential of SIF observations from space borne platforms for estimating GPP for forests.

Key words: Solar-induced Chlorophyll Fluorescence, Gross Primary Productivity, Carbon Fluxes, Modeling

Accurate Detection of Spatio-Temporal Variability of Growing Season in Boreal and Temperate Forests by Analyzing in Situ- and Satellite-Observed Remote-Sensing Data

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Abstract: Accurate detection of the timing of start (SGS) and end of growing season (EGS) is required to evaluate the spatio-temporal variability of ecosystem functions and service in boreal and temperate ecosystems under climate change. Towards this aim, analysis of daily satellite-observed vegetation index is useful. However, the validation and test of satellite observation have not yet been sufficiently conducted by performing long-term continuous in situ observations. Here, (1) we have taken daily phenological images by using time-lapse digital cameras in boreal (in Alaska and Siberia) and temperate forests (in Japan); (2) we validated the timing of SGS and EGS detected by daily Terra and Aqua/MODIS-observed green-red vegetation index (GRVI); and (3) we evaluated the spatio-temporal variability of the timing of SGS and EGS with a 500m spatial resolution in Alaska, eastern Siberia, and Japan from 2003 to 2015. We found that (1) GRVI=0 showed the timing of leaf-flushing in over story vegetation and leaf-coloring in understory vegetation in a larch forest in eastern Siberia and that in understory vegetation in an open-canopy evergreen coniferous (black spruce) forest in Alaska; (2) in contrast, GRVI=0 showed the pre leaf-flushing and post leaf-fall periods in a closed-canopy deciduous broadleaf (oak and birch) forest in mountainous region, Japan; (3) however, the spatial characteristic of timing of SGS and EGS along vertical (elevational) or horizontal (latitudinal) gradients was well detected in Alaskan, eastern Siberian, and Japanese ecosystems; and (4) the year-to-year variability of timing of SGS and EGS showed geographical characteristics among three regions. Because the timing of SGS and EGS detected by daily satellite-observed GRVI is included the uncertainties caused by heterogeneity of plant species and complex topography in mountainous regions, it was shown as the period of keeping the photosynthetic capacity.

Key words: Satellite, Phenology, Ground-truth

Study on Coupling Relationship between Land Use Change and Population- a Case Study of Dehui City

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Abstract: Land use change is an ideal entry point for the study of human-environment coupling systems.Land use change is mostly caused by human through land use activities, while land use changes and population pressures can also cause changes in the ecological environment.Dehui City,which is chosen as study area, is located in the hinterland of the Songnen Plain.Most of the areas have been reclaimed as farmland, affected by human activities.It is a typical representative.Using the image of military satellite CORONA, the land use data of the 1960s were obtained by means of spatial matching and man-computer interactive interpretation。To explore the land use change process by the use of land use data in 1965,1996 from the first national land resources investigation,2010 and 2015 from the second national land resources investigation and change data.The number of farmland is increasing .By the end of 2015, the proportion of arable land reached 79.04%.In 50 past years ,the relationship between farmland and population is measured by the use of arable land and population density curve center of gravity.Calculate the value of ecosystem services in each period, perform the performance in the format of grid.Then the natural factors which affect the distribution of population incuding terrain ,land use and so on.The model of the spatialization of population is divided city and village .Finally, calculate coupling relationship between the ecosystem Service value and population.We can find that the ecological pressure is increasing in Dehui city.

Key words: Land Use, Ecosystem Services Value, The Spatialization of Population, Coulping Relationship

Monitoring Decadal Changes of Understory Vegetation in Boreal Forests Based on MODIS BRDF Products

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Abstract: Boreal forests play important roles in global carbon cycles by accounting for about 8% of carbon exchanges throughout the global terrestrial ecosystems. It has been widely known that the understory vegetation contributes largely to the carbon and energy balances of the boreal forest ecosystems. However, it is still unclear how the understory vegetation of boreal forests changed at continental scales over long periods under global climate changes. In this study, the decadal changes of the understory

vegetation in boreal forests (defined as latitude >50oN) were analyzed based on satellite observations during years 2001-2015. To do so, a semi-empirical algorithm was first enhanced to retrieve the time series of understory NDVI (NDVIu) from 2001 to 2015 using MODIS BRDF products. Algorithm validations were carried out at two forest sites in Alaska and Estonia, respectively, by comparing the retrieved NDVIu to the in situ measured values. Then, the monthly temperature and precipitation dataset covering the same areas and periods of the satellite data was collected from Climatic Research Unit, University of East Anglia to study the relationships between NDVIu and climatic factors. Validation results of NDVIu demonstrated satisfactory retrieval accuracies. Neither increasing nor decreasing trend was found for the growing season (GS, defined as May to October) NDVIu from the retrieved time-series of satellite dat. The interannual variation of GS NDVIu is significantly correlated with the corresponding GS temperature (R= 0.56, P= 0.03), but not with GS precipitation (R= 0.18, P= 0.50). Moreover, it was found that the correlation coefficient between temperature and GS NDVIu was remarkably higher than that between temperature and GS total NDVI of understory vegetation and overstory canopies (R= 0.30, P= 0.39). This indicates that the understory vegetation is more sensitive to temperature changes than overstory canopies, which may be a useful mechanism for understanding and modeling carbon exchanges in the boreal forests.

Key words: Understory Vegetation, Remote Sensing, Boreal Forests, Temperature

Estimation of above Ground Biomass and Carbon Using Airborne LiDAR Data in Temperate and Tropical Forest

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Abstract: Light Detection and Ranging (LiDAR) has been used for delineating crown area, detecting individual trees and measuring tree height by analysing 3-dimensional cloud pulse and multi-spectral imagery which is sensed simultaneously with LiDAR. This individual tree based on tree height and crown area can provide forest scientists and foresters with possibilities to estimate tree volume, biomass and carbon stock which are considered important for climate change but was partially possible with traditional remote sensing techniques.

However, there still remains much technical consideration on using LiDAR data. Besides considering LiDAR pulse density which can define analysis accuracy, we also need to use adequate analysis method.

In this presentation, we compared several methods such as Point Cloud-Based (PCB) and Canopy Height Model (CHM) for estimating Above Ground Biomass (AGB) and

carbon in temperate and tropical forest using LiDAR data. The PCB approaches that make use of the entire LiDAR point cloud, such as LiDAR height and intensity distributional metrics, have been used for estimating AGB using height and intensity percentiles, skewness, and kurtosis, etc. The CHM-based approach has the advantages of relative simplicity and of applicability to various image segmentation methods. However, details contained in the original dataset are lost in the process of resampling from 3-D point LiDAR data the 2-D grid. The methods therefore do not take advantage of LiDAR's primary virtue of 3-D point cloud data.

Recently, a 'height bins' approach has been implemented in a number of cases. This approach separates vertical space at various height intervals (e.g., 5 m intervals) and then examines the occurrence and total number of points within each height bin. The so-called "volumetric pixel (volume pixel or voxel)" emerged as a comprehensive approach to illustrate both vertical and horizontal slices of LiDAR point clouds. The voxel-based approach is expected to improve the understanding of complex forest structures such as the tropical forest and it contributes to the advancement of forest carbon quantification techniques.

Key words: LiDAR, Volumetric Pixel (voxel), Above Ground Biomass (AGB), Tropical Forest

Remote Sensing Assessment Model and Method of Ecological Security for Highly Developed Urban

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Abstract: 1. INTRODUCTION Ecological security refers to the health and integrity of ecosystems. Urban ecological security emphasizes the security function of ecosystems to urban survival and development. It is the foundation and core of national or regional ecological security. In recent years, the acceleration of urbanization has triggered a series of urban and urban environmental problems, the sustainable development of urban ecology has been mentioned to an unprecedented height. Remote sensing has obvious advantages in the information extraction of underlying surface. However, the underlying surface of cities, especially the highly developed cities, is highly complex and dynamic, and there are obvious shortcomings in the extraction of urban ecological security index parameters and dynamic changes combined with remote sensing technology. Therefore, this study presents a model and method of ecological security remote sensing evaluation based on the grid as an evaluation unit, which is oriented to highly developed cities and combined with remote sensing technology and methods.2. MATERIALS AND METHODSA Case Study of Highly Developed Beijing, combined

with the data of land use and night light, and based on the P-S-R index system to establish the ecological security index system and remote sensing assessment model and classification tree warning system of highly developed urban. Taking the grid of 1*1 km^2 as the evaluation unit, finally， the urban ecological security dynamic evaluation and early warning analysis were realized from the time and space scale.3. RESULTS AND DISCUSSION1) the comprehensive index of ecological security in Fig.1 showed that: the rapid population growth and the rapid expansion of urban land are closely related to urban ecological security. From 1995 to 2015, the trend of the comprehensive index of urban ecological security in Beijing was improvement after the first deterioration, which was consistent with the actual situation and reflected the reliability of the evaluation model.2) The results of early warning analysis in Fig. 2 showed that: the ecological security warning area of Beijing increased in 2010 compared with that of 2005; to 2015, the ecological security of Beijing has made considerable progress under relevant policies; The improvement of urban ecological security is a long and slow process, in the future sustainable development of the city still faces a difficult task. Fig.1 Spatial distribution of urban ecological security comprehensive indexFig.2 Spatial distribution of urban ecological security warning indicatorsFig.1 Spatial distribution of urban ecological security comprehensive indexFig.2 Spatial distribution of urban ecological security warning indicators.

Key words: Urban Ecological Security, Remote Sensing, Highly Developed, P-S-R Model

GLOBMAP LAI: A Long-Term Global Leaf Area Index (1981-2015) with Separation of Overstory and Understory for Needleleaf and Deciduous Broadleaf Forests

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Abstract: Leaf area index (LAI) is a critical parameter for modeling vegetation's water, carbon, and energy exchange with the atmosphere. Several global LAI datasets have been generated from satellite observations. However, they are limited in temporal coverage and representation of canopy structure. In this presentation, we generate a long-time series (1981-2015) of global LAI products with consideration of the clumping effects at the pixel level, and separately estimate global overstory and understory LAIs for neeleleaf and deciduous broadleaf forests by fusing AVHRR, MODIS and MISR data. A long-term consistent LAI was generated from AVHRR and MODIS data by establishing an AVHRR Simple Ratio (SR)-MODIS LAI relationship

pixel by pixel. Firstly, A MODIS LAI series was derived from MODIS data based on the GLOBCARBON LAI algorithm. Then, the pixel-based relationships between AVHRR SR and MODIS LAI were constructed using these two datasets for the overlapping period. This relationship was applied to historical AVHRR data to derive LAI back to 1981. Since the MODIS LAI is used to constrain AVHRR retrieval, it ensures that the LAI from these two sensors are consistent. Then, the global forest overstory and understory LAIs were estimated separately by fusing MISR and MODIS observations. Monthly forest understory LAI was retrieved from the forest understory reflectivity estimated using MISR data at a spatial resolution of 1 km. The forest overstory LAI was estimated from the MODIS land surface reflectance, after correcting for the background contribution using monthly mean forest understory reflectivities. Besides, the clumping effects was considered at the pixel level by employing a global clumping index map at 500m resolution derived from MODIS BRDF products. The comparison during the overlapped period show that the LAIs from the two different sensors are good consistency, with LAI differences are within over 99.0% vegetated pixels. A comparison of the AVHRR and MODIS LAI at 352 global BELMANIP sites also indicates a good agreement, with an RMSE value of 0.11 LAI. The largest extent of forest understory vegetation is present in the boreal forest zones at northern latitudes. The mean proportion of understory LAI to total LAI is greater than 30%. Significant seasonal variations occur for understory vegetation in these zones with LAI values up to 2-3 from June to August. Higher understory LAI values are found in needleleaf forests than in deciduous broadleaf forests due to the more clumped foliage and easier penetration of light to the forest floor in needleleaf forests. The results are also compared with other products and field measurements. This work provides a long-term LAI over 30 years for modeling the carbon and water cycles for global vegetated regions, and help us better understand the seasonal patterns of forest structure as well as evaluate the ecosystem functions.

Key words: Leaf Area Index, Understory, Global, Remote Sensing

Forest Canopy Structure Analyzed by UAV-SFM: Toward Understanding the Relationship between Forest Structure and Species Diversity

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Abstract: Tropical rain forests in Southeast Asia hold high biodiversity in the world although the forest cover has been decreasing rapidly in this region. Understanding the mechanisms of maintenance of high species diversity in the nature is essential for community ecology as well as biodiversity conservation. One of the important factors of species coexistence is a complex forest structure including canopy gaps and tree height. However, the effect on species coexistence is unknown due to technical difficulties in measuring the canopy structure. Recent advances in digital surface models (DSM) with high resolution enable us to characterize the three dimensional (3D) canopy structure in the tropical forest. Close range digital photogrammetry based on structure-from-motion (SfM) algorithms provide a high spatial resolution DSM and orthophoto mosaic.

The main objective of the study is to investigate how canopy structure affects species diversity locally. For this purpose, we firstly establish the method to develop 3D model of canopy structure of tropical rain forest using SfM algorithms. We also evaluated the metrics which represent the convexity of canopy surface. A drone was used to capture aerial photos that have been used to produce 3D model and DSM.

We conducted this study in 6-ha plot in Pasoh Forest Reserve, Malaysia. To take aerial photography, we operated drones from the open space near the station. The flight route was designed to achieve overlap rate of aerial photography was more than 80%, and we also include one flight route to cover 40 ground control points (GCPs) within or near the plot. Each GCP were surveyed a geographic coordinate and an elevation using global navigation satellite system. The flight was repeated three times with different camera angles. DSM (canopy height image) and an orthophoto (orthographic projection photograph) of forest canopy were constructed using a SfM software (PhotoScan, Agisoft). We also constructed digital elevation model (DEM) using all GCPs. The canopy height was estimated by the difference between DSM and DEM and evaluated the accuracy by comparing the estimates and the observed tree height measured by using a hypsometer Vertex.

In this talk, we will present the results of constructed 3D canopy structure of tropical forest by the UAV-SfM method. We will also show the accuracy of the constructed DSM and evaluate the robustness of the method. Then we discuss about gap, possible cause of the error, and the future direction to yield an accurate DSM and an orthophoto with high resolution toward understanding the relationship between forest structure and biodiversity.

Key words: Tropical Forest, UAV, Structure-from-motion, Digital Surface Model

The Potential of Solar-Induced Chlorophyll Fluorescence for Retrievals of Vegetation Photosynthetic Capacity

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Abstract: Remote sensing of sun-induced chlorophyll fluorescence (SIF) is a novel optical tool for assessment of terrestrial photosynthesis or gross primary production (GPP). Space retrievals of SIF have recently become available. Current widely used terrestrial biosphere models usually employed Farquhar's photosynthesis models, in which the maximum rate of carboxylation (Vcmax) and other biochemical parameters are key control parameter on leaf photosynthesis. Remote sensing can be used to produce a spatially-continuous and temporally-resolved view on photosynthetic efficiency, but traditional vegetation observations based on spectral reflectance lack a direct link to plant photochemical processes. Alternatively, recent space-borne measurements of SIF can offer an observational constraint on photosynthesis simulations.

In this presentation, we discuss whether SIF can be used to constrain terrestrial biosphere models through estimation of Vcmax. We use the Soil-Canopy Observation of Photosynthesis and Energy (SCOPE) balance model to simulate photosynthetic uptake and chlorophyll fluorescence of croplands in the US Corn Belt. First, we tested the Vcmax estimation at six crop flux sites in the Midwestern US using spaced-based SIF retrievals. SIF retrievals are from the European GOME-2 instrument onboard the MetOp-A platform. The seasonal Vcmax estimated from the SIF retrievals, rather than a fixed PFT-specific value, significantly improved the agreement of GPP and SIF modelling results with observed tower fluxes. On the other hand, the sensitivity of SIF to Vcmax are discussed for different versions of SCOPE model at different parameter space.

Further discussion is made for benchmarking the regional modelling of regional photosynthetic uptake of croplands in the US Corn Belt. To do this, we first retrieved a key parameter of photosynthesis model, the maximum rate of carboxylation (Vcmax), from field measurements of CO_2 and water flux during 2007-2012 at some crop eddy covariance flux sites in the Midwestern US. Then we empirically calibrated Vcmax with apparent fluorescence yield which is SIF divided by PAR. The resulting apparent fluorescence yield shows a stronger relationship with Vcmax during the growing season than widely-used vegetation index, EVI and NDVI. New seasonal and regional Vcmax maps were derived based on the calibration model for the cropland of the Corn Belt. The uncertainties of Vcmax were also estimated through Gaussian error propagation. With the newly derived Vcmax maps, we modelled regional cropland GPP

during the growing season for the Midwestern USA, with meteorological data from MERRA reanalysis data and satellite LAI. The results show the improvement in the seasonal and spatial patterns of cropland productivity in comparisons with both flux tower and agricultural inventory data.

Key words: Solar-Induced Fluorescence, Maximum Rate of Carboxylation (Vcmax), GPP, Carbon Cycle

T1-11: Alpine Ecosystems in the 21st Century and Beyond: Structure, Function and Ecosystem Services

Spatial Modelling of Biodiversity in Alpine Landscapes: From Species to Ecosystem Services

Antoine Guisan

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Abstract: Advancing our capacity to obtain and understand the spatial distributions of key biotic and abiotic environmental factors is a major challenge in predicting the response of alpine ecosystems and their services to climate change. Meeting this challenge requires integrating intensive biodiversity field surveys across large environmental gradients, high resolution numerical environmental data and advanced modelling methods, which is best achieved by focusing multidisciplinary research efforts in a same mountain area. Here, I present an overview of biodiversity modelling research performed during sixteen years in the Western Swiss Alps. Models were early developed there to predict the spatial distribution of species and communities of various groups of organisms (plants, insects, soil micro-organisms), and were later used to develop climate and landuse changes projections. Yet, their predictive power has remained so far limited by the recurrent absence of some key environmental data, such as soil or geomorphological maps, which can now be acquired by advanced remote sensing and modelling technologies. Meeting these challenges in order to improve forecast of alpine ecosystem services is the main aim of the new ongoing EcoGeoINTEGRALP project, from which I will present some preliminary results and future perspectives.

Key words: Species Niche and Distribution Models, Mountain Environments, Community Assembly, Future Projections

Mountains Are Forever

Laszlo Nagy, Eva Spehn

UNICAMP, Hungary

Abstract: At geological and evolutionary time scales climate and atmospheric change have been shaping and reshaping species pools and communities in high mountains. Land use has a more recent origin, however, its impacts on changing ecosystem structure and function have been marked and ever-increasing in most parts of the

world's high mountains. In many countries, notable changes in the type of land use have occurred during the last 50 years. The traditional predominant agricultural use has been, to various degrees, replaced or supplemented by infrastructure projects for water provision and priorities for soil protection are emerging. These, together with ever-increasing recreation-related activities pose new challenges and opportunities for conservation of biodiversity and the appreciation of ecosystem services. This talk gives an overview of how biodiversity and ecosystem service use may be harmonised by considering conservation priorities and opportunities for satisfying human needs.
Key words: Mountains

As Forest Go, Will Forest Bees?

Lindsie Marie McCabe, Neil S. Cobb

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Abstract: Can species move to higher elevations along an elevation gradient before current suitable habitat becomes unsuitable? I addressed this question using a group of 21 forest & woodland bees, and focus on experimentally assessing temperature as a key limiting factor. I predict that most bees will successfully move up in elevation, except for habitats above tree-line, which may require over 200 years before nesting substrates become available. We set up nest block along the C. Hart Merriam Elevation Gradient in Arizona, USA. I assessed temperature thresholds for the immature stages. I placed nest blocks at 4 life zone sites to accommodate all 21 Megachilidae species. Colonized nest blocks were transferred up one life zone, down one life zone, while keeping an equal number at the original life zone. Larval and pupal survivorship were measure to assess survivorship of these species adapting to warmer temperatures. We found 2 main results 1) at the pinyon-juniper life zone (~1800 meters) had no initial colonization, however when bees are placed there they will survive. 2) Bee species that were moved up in elevation to cooler temperatures experience more death in the larval stage than species that were moved down to warmer temperatures. Along elevation gradients, most bees are replaced by flies as the dominant pollinators at higher elevations, indicating bees are more sensitive to lower temperatures. Consensus opinion is that climate change will open these colder-higher habitats up to bees but also reduce habitat suitability for bees where they already occur along elevation gradient. The key to staying in the system is to survive in existing suitable habitats at least until higher elevation habitats become suitable.
Key words: Bees, Climate Change, Nest Blocks, Adaptation

Soil Carbon Stocks along an Altitudinal Gradient of Pinus Hartwegii Lindl., the Altitude Pine in Central Mexico

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1 Universidad Autonoma Del Estado De Mexico, Mexico; 2 Instituto de Ciencias Agropecuarias y Rurales; 3 El Colegio de Posgraduados

Abstract: Soil organic carbon (SOC) stocks in mountain ecosystems in highly heterogeneous because of differences in soil, climate, and vegetation with elevation. To evaluate SOC stock along altitudinal gradients represent an important opportunity to understand the impact of climatic change over the ecological processes such as the involved on C cycle. In this study, changes in SOC stocks and chemical composition of soil were evaluated along an elevation gradient of eight sampling points (3300, 3400, 3500, 3600, 3700, 3800, 3900, 4000 m a.s.l.) on Nevado de Toluca, Mountain Mexico. Ten trees of Pinus hartwegii Lindl., were selected at each altitudinal level, and two sampling soil collected with a polypropylene tube of 5 cm of diameters and 15 cm of depth. Soil was analyzed to different physiochemical (pH, humid content (%), soil bulk density, organic soil matter (%) and organic soil carbon (%)) properties and soil organic carbon (SOC) calculated to each altitudinal level. One-way ANOVA was used to evaluate differences among soil properties and SOC stock, using as main factor altitudinal level. Results showed that altitudinal affect each determined variable, however patters about decreasing or increasing across altitudinal gradient not were registered. Altitudinal level have an important factor that influence the SOC stock in the P. hartwegii high mountain recording significant differences between altitudes. Decreasing SOC stock have the following decreasing pattern uuu3700=143,34 (±13,19)>3500=131,20(±9.93)>3800=125,45(±7,94)>3300=120,68(±13,48)>3400=1 08,54(±9,92)>4000=108,01(±25,36)>3900=74,16(±17,83)>3600=70,29 (±18,69), beside not showed a. These results showed that mainy factors could be acting in a simultaneously manner to drive SOC stock in this ecosystems, however also showed the importance of high mountain soils in the C cycle and CO_2 mitigation.

Key words: C Pools, Climate Change, Altitudinal Migration, Andosols

The Impacts of Climate Change and Nitrogen Deposition on the Plant Diversity and Biomass of Alpine Ecosystems on Qinghai-Tibetan Plateau

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Abstract: Climate change and nitrogen deposition are greatly influencing the alpine

ecosystems on the Qinghai-Tibetan Plateau. In this study, we examined the impacts of climatic warming, nitrogen deposition and their interactions on the plant diversity and biomass of three types of alpine ecosystems, alpine meadow, alpine steppe and alpine desert across vast regions of Qinghai-Tibetan Plateau through controlled simulation experiments. The results indicated that the plant diversity and biomass were positively correlated to soil nitrogen in all three types of alpine ecosystems. The plant diversity and biomass were positively correlated to the temperature in alpine meadow and alpine steppe, while not correlated to the temperature in the alpine desert. Adaptive management strategies can be implemented for the alpine ecosystems to cope with climate change and nitrogen deposition.

Key words: Plant Diversity, Plant Biomass, Alpine Ecosystem, Climate Change

Abiotic and Biotic Factors Affecting the Soil Bacteria Community along the Qinghai-Tibet Railway

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Abstract: To understand the factors affecting alpine soil microbe diversity is important to predict the response of alpine soil ecosystems to global climate changes and the associated impacts on ecosystem services. Recent studies have showed that soil pH, nitrogen content of soil, soil texture, and plant species richness were major influential factors of soil microbe diversity in the Qinghai-Tibet plateau. However, the anthropogenic influence was rarely considered. The construction of Qinghai-Tibet railway since 2001 has brought significant changes to ecosystems in the Qinghai-Tibet plateau. In this study we wanted to find out how the construction affected the soil bacteria diversity along the railway. We took 570 soil samples along the railway and analyzed the diversity of soil bacteria communities using the 16S rRNA metabarcoding method. The dissimilarity of species composition among soil samples were analyzed using Shannon diversity index. The influences of biotic and abiotic factors on the dissimilarity were explored by using distance-based Redundancy analysis (dbRDA). The result show that plant diversity, the nitrogen content of plant aboveground, and phosphorus content of soil are the top three factors controlling the bacterial diversity. The magnitude of disturbance by railway construction and the distance to the railway also have impacts. Our results also indicate that the dominant influencing factors at large scales are different than those at small scales.

Key words: Soil Bacterial Community, Dbrda, Abiotic Factor, Biotic Factor, The Qinghai-Tibet Railway

Patterns of Soil Bacterial Richness and Composition Tied to Plant Richness, Soil Nitrogen, and Soil Acidity in Alpine Tundra

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Abstract: Patterns of soil bacterial richness using operational taxonomic units (OTUs) and the abundance of bacterial groups (Phylum or Class) were studied in relation to plant richness, forb and graminoid abundance, and soil characteristics in the alpine tundra at Niwot Ridge, Colorado USA. The study used a natural and manipulated soil moisture gradient in addition to plots amended with nitrogen (N). Bacterial richness was not correlated with concentrations of total soil carbon (C) or total soil N, but showed strong positive correlations with pH and corresponding positive correlations with metallic cation concentrations. Bacterial richness showed a strong (r= -0.86) negative correlation with soil acidity and declined about 30% over the pH gradient of 6.0-4.5. Plant richness showed a more modest relationship with acidity (r = -0.70) but declined 50% over the same gradient. Total soil bacterial OTU richness was only sensitive to soil acidity and not to N amendments to plots. However, the abundance of five major bacterial groups responded positively to N additions, four responded negatively, and three groups exhibited no statistically significant changes. Forb richness and cover correlated with bacterial richness, but causal relationships remain unresolved.

Key words: Soil Bacterial Richness and Composition, Plant Richness, Soil Nitrogen, Alpine Tundra

The Effect of Species Loss Order on the Dilution Effect in the Tibetan Alpine Meadows

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Abstract: With increasing attention being paid to the consequences of global biodiversity losses, several recent studies have demonstrated that realistic species losses can have larger impacts than random species losses on community productivity and resilience. However, little is known about the effects of the order in which species are lost on biodiversity-disease relationships. Using a novel removal experiment manipulating plot-level plant diversity, and multi-year nitrogen addition and artificial warming experiments, in natural assemblages of alpine meadow vegetation on the Qinghai-Tibetan Plateau, we explicitly compared the effect sizes of random versus

realistic species losses under fertilization and/or warming on plant foliar fungal diseases. We found that realistic species losses under fertilization had greater effects than random losses on fungal diseases, and that species identity outweighed nested structure itself in driving the diversity-disease relationship. The plant species most prone to foliar fungal diseases were also the least vulnerable to extinction under fertilization, demonstrating the importance of protecting low competence species to impede the spread of infectious disease. In contrast, there was no difference between random and realistic species loss scenarios on the diversity-disease relationship under experimental warming (or the combination of warming and fertilization), an important reminder that the functional consequences of species losses may vary under different drivers.

Key words: Alpine Meadows, Nonrandom Diversity Loss, Biodiversity-disease Relationships, Nitrogen Addition

Explaining the 4270 M Limit of an Evergreen Oak in Yunnan, China

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Abstract: In contrast to the reasonably well understood alpine treeline, the upper range limits of tree taxa that do not reach the alpine treeline are largely unexplained. In this study, we assessed the freezing resistance of buds and leaves from winter to summer in the sclerophyllous Qucercus pannosa (Fagaceae), a species that builds dense stands of 4-5 m tall individuals, 100 m below the climatic conifer treeline in the SE Himalayan (28°20’25’’N; 99°03’47’’E). In situ temperature measurements over three years revealed an absolute minimum canopy temperature of -17 ℃. Hindcasting longer term absolute minima via correlations with long-term weather service data indicate that these oaks operate with a safety margin of 5-6K, given they tolerate -24 ℃ freezing in mid-winter. The critical period is the early season with late freezing occurring till late May/early June. The evolutionary answer to this risk is a very late bud break, flowering and leaf production by end of June only (as recorded by phenocams mounted in the canopies), compensated for by a mean 176 day growing season early November (applying temperature thresholds as they were developed for treeline). Hence, by timing bud break in such a way, Q. pannosa prevents freezing damage at this exceptionally high location for an evergreen oak. Specific leaf area [SLA], foliar δ13C, non-structural carbohydrates [NSC] concentrations examined along a 1600 m elevational gradient revealed no carbon reserve depletion, a comparatively high photosynthetic CO_2 use efficiency and a high investment of C per unit leaf area at the upper limit of the species. We also show that these oaks enter the growing season with

fully intact (not embolized) xylem, presumably also related to the small trachea size and diffuse porouse xylem anatomy. Overall, our study underlines the overarching role of phenology controls for species range limits in harsh, high elevation environments.
Key words: Climate, Freezing Tolerance, Phenology, Wood Anatomy

Vegetation Analysis of the Qinghai - Tibet Highway Corridor Based on the Comparative Analysis of Normalized Difference Vegetation Index (NDVI)

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Abstract: Based on comparison of SPOT-VGT NDVI data from 2000 to 2007, we analyze the influence of Qinghai-Tibet road, Qinghai-Tibet Railway and 110KV power transmission construction on vegetation within a certain width of the corridor and in the adjacent undisturbed zone. The NDVI in the corridor is not significantly different from that in the undisturbed area, the average NDVI undisturbed area is significantly higher than the corridor zone, in south of the Tanggula section. The annual difference of NDVI of the corridor zone and uninterrupted area, are related to the changes of meteorological factors, which are positively correlated with the temperature and precipitation in the growing season. In the corridor along Golmud-Lhasa section of Qinghai-Tibet road, the construction will only affect the vegetation coverage in some local sections and in short-term. The main factor affecting the vegetation coverage is the change of meteorological factors.
Key words: Qinghai-tibetan Road, Vegetation Restoration, Vegetation Index, Road Corridor

Tracing the Response of Alpine Biota to Ongoing Climate Change across the Urals - A Unique 1500 Km Long Latitudinal Transect in Northern Eurasia

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Abstract: The Urals is a unique submeridional mountain range in Eurasia extending over 2000 km in north-south direction from the shores of Arctic Ocean to the Pre-Aral Sea sands and crossing several zonobiomes. Although being not very high the Urals have alpine life zone along the major part of its length and therefore is a kind of natural

laboratory for studying response of alpine biota to a variety of influences. The field sites of our study are distributed in Polar, Northern and Southern Urals and constitute 3 target regions of the Global Observation Research Initiative in Alpine Environments (GLORIA). This international long-term monitoring network focuses on tracing and understanding the response of alpine ecosystems to ongoing climate change. Each target region comprises a suite of four summits, representing an elevation gradient of alpine vegetation patterns. The vascular plant species occurrence was recorded first in Southern and Polar Urals in the year 2001 and in Northern Urals in 2003. Since then the surveys were repeated twice and herpetobiotic arthropods were added as additional target group.

For the period of observations a general decrease in the total cover of vascular plants and changes in percentage cover of the dominant species was recorded on the permanent plots, certain species of herbs decreased and certain shrub species increased. For arthropods the dominance structure at species and family levels demonstrated certain changes as well.

Throughout the Urals species numbers steadily increased and the total surplus of vascular plants was up to 13 species on separate summit for 14 years. The colonization of summits by vascular plant species from lower altitudes was recorded for 10 species in Southern Urals, for 2 species in Northern Urals and for 6 species in Polar Urals.

After 14 years the altitudinal index for vascular plants gave upward movement along entire mountain range but with regional differences. An average upslope movement was the largest in Polar Urals - 13.6 m, while it was 9.3 m in the Southern and 9.0 m in the Northern. Using data on altitudinal ranks and cover of each plant species within permanent plots a composite score in the following thermic vegetation indicator was calculated. Its differences between respective years were used to quantify transformations of plant communities. This thermophilization indicator for Polar Urals between 2001 and 2008 was very close to a European mean and after 14 years the extent of transformation of alpine communities in the Polar Urals was found equal to 9.3% of one vegetation belt. This is lower than in Northern (13%) and Southern Urals (17%).

The obtained data on climate-induced transformation of alpine biota within 14 years can be considered a rapid ecosystem response to ongoing climate change. The final stage of our explorations was supported by the Russian Foundation for Basic Research (project 15-05-05549 A).

Key words: Alpine Biota, Climate Change, The Urals

Is Seed Germination Affected by Microsite Characteristics After the Removal of Understory Vegetation?

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Abstract: Forest management practices, in forests near Mexico City, include removal of shrub and herbaceous vegetation in order to provide lighter and less competition to benefit mature forest trees´ seedlings establishment. These activities might change microsite soil characteristics: light, moisture and temperature that fulfill seed germination requirements, therefore affecting population recruitment. The aim of this research was to characterize suitable microsites for germination of five shrub species. We established transects (50 m each) in eight forest sites. In four of them, understory vegetation (UV) has been removed; two were in slopes facing north (N) and two more in south facing slopes (S). The other four sites have understory vegetation, two in north facing slopes and other two in south facing ones. In each transect three microsites (separated by 25 m) were located. Data loggers were set in each microsite in order to measure soil temperature and moisture. Also, hemispheric photographs were analyzed in order to calculate the global site factor (GSF) to characterize the light environment, and soil tests for nitrogen content and pH were carried out as well. Three samples of 50 seeds each were sown in each microsite; once the radicle emerged, seed samples were exhumed and germination percentages were calculated. ANoVA, Kruskal-Wallis and/or Mann-Whitney tests were carried out to assess differences in light, soil temperature, moisture, nitrogen content and pH, as well as in germination percentages between microsites with and without UV, and in different slope orientations. Significantly higher FSG values in microsites with UV (GSF=0.37±0.01 MJm^{-2y-1}) than in those without it (GSF=0.16±0.009 MJm^{-2y-1}) were found, because canopy gaps above them were bigger (U=1890, p=0.0005). Microsites in S slopes also showed higher values (GSF=0.33±0.01 MJm^{-2y-1}) than in the N (GSF=0.21±0.01 MJm^{-2y-1}), (U=4250, $p< 0.01$). A significant effect of microsite on light values was found (H=156.4, $p< 0.01$). No statistical differences were found in soil nitrogen and pH between microsites, although slightly higher values for both were found in microsites without UV. Soil moisture was significantly higher in microsites with UV (75.7%) than in microsites without it (52.3%) ($F_{1, 23} = 44.83$, $p< 0.001$). Soil temperature was slightly higher in microsites in S oriented slopes and in those without UV, but no significant differences were found. In general Cestrum thyrsoideum showed the highest germination percentages of all species (58%). All species germinated in slightly higher percentages in microsites with UV and in S oriented slopes (with the exception of Solanum

cervantesii which germinated more in N oriented slopes). Kruskal-Wallis (H) tests showed a significant effect of microsite on the germination percentages of four species (Ageratina glabrata H= 40.42, p= 0.01, Symphoricarpos mycrophylla H= 40.83, p=0.01, Solanum cervantesii H= 46.58, p< 0.01 and Ribes ciliatum H= 40.12, p= 0.01). S. mycrophylla showed significantly higher germination percentages in microsites with UV (U=46.15, p=0.03). Results showed that UV and slope orientation affect shrub species germination, these factors probably modify physical variables such as soil moisture and light, making some microsites safer for germination than others.

Key words: Germination, Microsite, Understory-vegetation, Red/Far Red-Ratio

T1-12 Interactions between Air Pollution and Ecosystems: Functioning and Services

Ozone Exposure and Flux-Based Response Relationships with Photosynthesis, Leaf Morphology and Biomass in Two Poplar Clones

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Abstract: To establish ozone exposure and flux-based response relationships with photosynthesis, leaf morphology and biomass, the poplar clone 546 (P. deltoides cv. '55/56' × P. deltoides cv. 'Imperial') and clone 107 (P. euramericana cv. '74/76') were conducted in fifteen open-top chambers (OTCs) covering five ozone concentrations. There were significant negative relationships with light-saturated photosynthesis rate, chlorophyll content, Leaf mass per area, actual photochemical efficiency of PSII in the light and root biomass but not for stomatal conductance (gs), and leaf and stem biomass. Results indicated that ozone had a greater impact on underground biomass of poplar than aboveground. The slopes of the regression function of the relationship were larger in clone 546 than clone 107, indicating that clone 546 was more sensitive to ozone than clone 107. However, there was no significant difference for the relationship between relative biomass and two O3 metrics for two clones. Both ozone concentration and stomatal flux and relative biomass relationships had quite similar coefficients of determination (R2). The critical levels of AOT40 (concentration accumulated over a threshold ozone concentration of 40 ppb) and POD7 (phytotoxic ozone dose above a flux threshold of 7 nmol O_3 $^{m-2}$ PLA $^{s-1}$) for a 5% reduction in total biomass for two poplar clones were 14.8 ppm. H and 9.8 mmol m-2, respectively. These results can provide parameters for ozone model and regional ozone risk assessment

Key words: Ozone, Does-response Relationships, Critical level, Poplar

Assessing Impacts of Nitrogen Deposition on Forest Ecosystems: Systematically Biased by Experimental Simulation?

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Abstract: Anthropogenic nitrogen (N) emissions have dramatically increased global N deposition since the industrial revolution. This anthropogenic enhancement of global N deposition has aroused great concerns on its ecological impacts, including loss of

species diversity and stimulation of forest carbon sequestration. Current knowledge on the effects of N deposition is mainly based on experimental simulations by applying N additions. However, systematically biases might be resulted from the failure to exactly simulate the way of N depositing ecosystems. For instance, high doses and extremely concentrated N solutions are commonly used in existing experiments, while the interactions between forest canopy and N deposition usually are neglected. By reviewing these shortcomings of existing experiments in forest ecosystems, I rethink the potential biases from the experimental design. The findings can help to improve our understanding of the ecological impacts of N deposition.

Key words: Nitrogen Deposition, Biodiversity Loss, Carbon Sequesration, Forest Ecosystem

Comparison of the Growth of Acer Saccharinum L. And Amorpha Fruticosa L., the Invasive Alien Species of Woody Plants, Due to Climate Change

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Abstract: In order to investigate the response of invasive species to climate change, we measured the growth of Acer Saccharinum L. and Amorpha fruticosa L., which are widely distributed in Korea, by warming and nitrogen treatment of soil. Atmospheric conditions were divided the outdoor environment (ambient CO_2 and ambient temperature), temperature elevation (ambient CO_2 and elevated temperature), and climate change treatment (elevated CO_2 and elevated temperature). Control pots without nitrogen fertilizer were made in each atmospheric condition. The Acer Saccharinum L. were treated with 2g (N1 treatment), 20g (N2 treatment) of nitrogen fertilizer and 1g (N1 treatment) and 5g (N2 treatment) of Amorpha fruticosa L. After the sowing and the weasel fighting in March 2014, they were transplanted to each environment in May 2015. After the adaptation to each environmental condition until October 2016, the length of the shoot of the two exotic species and the diameter of the stem were measured.As a result, the length of shoot was better in the climate change treatment and temperature treatment than in the control, and it grew well when treated with nitrogen. However, the diameter of shoot was the largest at N1 treatment in the climate change treatment and no difference in the nitrogen treatment at the control. The length of shoot of Amorpha fruticosa L. was good when treated with nitrogen in the climate change treatment, and showed no difference according to the nitrogen treatment

in the control. The diameters did not show any difference according to nitrogen treatment in the climate change treatment, but they were greatest at N1 in the control. The above results indicate that the increase of soil nitrogen increases the growth rate of the ground surface in the condition where the temperature increases and the temperature and CO_2 concentration increase together.

Acknowledgment: This work was supported by the Korea Foundation for the Advancement of Science & Creativity (KOFAC) grant funded by Ministry of Education (MOE).

Key words: Acer Saccharinum L., Amorpha fruticosa L., Climate Change, Nitrogen Treatment

Differential Responses of Peach (Prunus Persica) Seedlings to Elevated Ozone among 13 Cultivars Are Related with Leaf Mass per Area, Antioxidant Enzymes Activity Rather Than Stomatal Conductance

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Abstract: To evaluate the ozone sensitivity among peach cultivars widely planted in Beijing region and explore the possible eco-physiological response mechanisms, thirteen cultivars of peach seedlings were exposed to either charcoal-filtered air or elevated O3 (E-O3, ~120 ppb) for one growing season in open-top chambers. Leaf structure, stomatal structure, gas exchanges, pigments, antioxidants contents, antioxidant enzyme activity and lipid peroxidation were measured in three replicated chambers. Results showed that E-O3 had a significant effect on leaf thickness and stomatal aperture but not on stomatal area and density. E-O3 significantly accelerated leaf senescence, as indicated by increased lipid peroxidation and higher declines in light-saturated photosynthetic rate and pigments contents. The reduced ascorbate content (ASC) was decreased but antioxidant enzyme activity (CAT, APX and SOD) and total antioxidant capacity (TAC) were significantly increased by E-O3 among cultivars. The cultivars with visible symptoms also had more reductions in net photosynthetic rate and increases in malonaldehyde content than those without visible symptoms. The seedlings of white peach cultivars were more sensitive to O3 than those of nectarine cultivars among selected cultivars. Ozone sensitivity was strongly linked to leaf mass per area (LMA), antioxidant enzymes activity e.g. SOD, APX rather than stomatal parameters (stomatal area, density, aperture and gs) and ASC. Results could provide a theoretical basis for selecting and breeding the ozone-resistant cultivars of

peach trees grown in high O3-polluted regions.
Key words: Ozone, Prunus Persica, Leaf Mass per Area, Antioxidant Defense

Dimethylsulphoniopropionate Formation and Dimethyl Sulphide Emission in Higher Plants

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Abstract: Biogenic DMS (dimethyl sulphide) is a significant natural source of tropospheric sulphur. DMS is converted to sulphate aerosol, a cloud condensation nuclei precursor, having implications for planetary albedo and climate change. DMS is derived from the enzymatic cleavage of DMSP (dimethylsulphoniopropionate), an organic sulphur compound synthesised in the chloroplast from methionine imported from the cytosol. Methionine is involved in the maintenance of plant-environment homeostasis. DMSP and DMS are found mainly in marine phytoplankton (i.e., microalgae and macroalgae). DMS emission from higher plants has been reported in some halophytic plants. However, these emissions are minute compared to those emitted by marine phytoplankton. We recent developed a sensitive and accurate protocol for detecting and quantifying DMSP pool sizes, and potential DMS emissions, in cryoextracted leaves. These studies, performed on Solanum lycopersicum and Arundo donax, show that DMS is also potentially emitted from non-halophytic plants, especially when subject to drought stress. In Arundo, the emission of isoprene also rose under moderate drought, suggesting that synthesis of isoprene and DMSP were regulated as part of the methyl-erythriol and methionine (MET) pathways in the biochemical response to stress. Moreover, DMSP is likely a multifunctional molecule playing a number of roles in the response of higher plants to reduced water availability. The MET pathway plays a central role in the biochemical response to stress, and modification of the MET pathway may facilitate the development of enhanced tolerance in crops grown in drought prone marginal lands. Our findings are discussed in the context of potential functions of DMS emission in higher plants.
Key words: DMSP, DMS, Drought Stress, Biomass Crop

Effects of Foliar Trichomes of Tillandsia on the Retention and Resuspension of Atmospheric Particulates

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Abstract: Tillandsia velutina with typical foliar trichomes was selected as materials, and its trichomes were removed artificially to investigate the dust retention and resuspension under different wind strengths and different time. The results showed that leave dust retention with all the foliar trichomes was 22.19 ± 0.11 g/m2, which was significantly higher than those without foliar trichomes (11.95 ± 0.35 g / m2). More than 99.7% of the atmospheric particulates would be resuspended under the function of wind for those without foliar trichomes, while only 50.2% for those with foliar trichomes. Resuspension ratio increased significantly with the increase of wind speed or function time. Scanning electron microscopy (SEM) analysis showed that density of the foliar trichome had significant positive correlation with the particulates density. Therefore, effects of foliar trichomes of T. velutina on the retention and resuspension of atmospheric particulates was reflected not only in the total amount of atmospheric particulates, but also in the process of atmospheric particulate resuspension. Resuspension must be taken account in the future study in order to accurately assess the relationship between vegetation and atmospheric particulates deposition.
Key words: Air Pollution, Foliar Trichome, Resuspension

PM2.5 Dry Deposition Velocity on Plant Leaves: An Indirect Experimental Method

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Abstract: As the only alive infrastructure in urban area, green spaces and urban forestry had an important role of purifying atmospheric particulate matter and improving air quality. However, the determination of PM2.5 dry deposition velocity on plant leaves is very difficult. Verious methods bring uncertainties and thus reduce the reliability of results.

Therefore a brand new indirect method for determining the deposition velocity of PM2.5 on plant leaves was developed in this research. PM2.5 aerosols were put and well dispersed in an inclosed aerosol smoke chamber and two independent experiments were made: first, paticles collided in the chamber and settled down by themselves; second, aero particles settled down jointly by themselves and plant leaves. Real-time PM2.5 concentrations in the chamber were record by an aerosol spectrometer and described by exponential decay model. Differences between two modeled curves were analyzed, where the initial concentration, test duration and time interval, and other parameters was determined. Calculation formula was then deduced and PM2.5 dry deposition velocity was computed. Finally, leaves of 19 typical tree species in Shanghai were collected and tested by the indirect method, and the relationship between

botanical characteristics and deposition velocity was discussed briefly.

The results show that, compared with the traditional method such as wash-off or wind tunnel, the indirect method could significantly improve the accuracy and stability of the measurement, and also reduce the cost of the experiment. This study developed a unique way to determine PM2.5 dry deposition velocity on plant leaves, which could provide reliable methodology to compare the the ability of air quliaty improvement by different urban tree species.

Key words: PM2.5, Urban Trees, Dry Deposition Velocity, Indirect Method

Drought Alleviated the Adverse Impact of Elevated O3 on Urban Trees

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Abstract: Drought and tropospheric O3 are escalating climate change problems that can co-occur in the urban. The experiments by using open top chambers (OTCs) built in Shenyang city, the northeast of China, were conducted to study the changes in the eco-physiological parameters of several urban tree species exposed to drought (35% field capacity) and elevated O3 concentration (80ppb) and the combination of the two treatments. The results showed that elevated O3 decreased the photosynthetic rate (Pn), stomatal conductance (gs), transpiration rate (Tr), maximal fluorescence (Fm), maximum photochemical efficiency (Fv/Fm), stomatal size, and increased the activity of superoxide dismutase (SOD), the contents of malondialdehyde (MDA) in leaves of urban trees. Growth of Populus Alba decreased significantly under drought, but did not significant change under elevated O3. Compared with elevated O3 single, Pn, Tr, Fm, Fv/Fm, SOD in leaves of Lonicera maackii under the combination of O3 and drought had higher levels, which increased by 58.21%, 43.16%, 10.12%, 8.11%, 63.68%, 19.9%, respectively, while gs, Fo, MDA, Proof L. maackii decreased by 31.25%, 21.81%, 28.48%, 16.46%, respectively ($P<0.05$). Under drought and combination of the two stresses, abscisic acid (ABA) in leaves of trees increased significantly, compared with single O3 stress. These results showed that drought alleviated the oxidative stress and damage of elevated O3 to urban tree species, which might due to stomatal closure to limit the absorption of O3 in order to adapt the combined environmental risks (O3 pollution and drought) in an urban area.

Key words: Elevated O3, Drought, Urban Tree, Oxidative Stress

Ozone Fluxes and GHG Balance in a Spanish rice Paddy Field

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Abstract: Project GEISPAIN (CGL2014-52838-C_2-2-R, MINECO, Spain) has been launched with the general objective of quantifying the GHG balance of different relevant Spanish ecosystems. Measurements of O_3 fluxes with a fast O_3 analyzer (FOS, Sextant) in combination with eddy covariance technique were carried out in a rice paddy in Sueca (eastern Spain) during all the vegetative period of the crop. During rice cropping period, ozone fluxes were highly correlated with CO_2 fluxes and largely driven by stomatal conductance, while during non-cropping period, the fluxes were lower and driven by non-stomatal surface resistance. Complementarily, gas exchange leaf measurements under ambient conditions were carried out with a LICOR-6400 in order to parameterize the DO3SE model and to model stomatal O_3 fluxes in rice. The proposed parameterization for "Japonica" varieties exhibited about double maximum stomatal conductance values (gmax) than the Asian "Indica" varieties. We additionally measured carbon dioxide (CO_2) and methane (CH_4) fluxes with eddy covariance in order to obtain a full carbon balance. Methane (CH_4) and nitrous oxide (N_2O) fluxes were determined at different stages of rice cultivation using the static chambers technique to estimate greenhouse gas (GHG) budget. The ecosystem was a net carbon source during non-cropping period, reaching high respiratory rates (> 5 μmol $^{m-2\ s-1}$) during pre-seedling and post-harvest periods and nearly null CO_2 fluxes during autumn-winter flooding period. During rice cropping period (June-July), the ecosystem was a strong carbon sink with maximum CO_2 sequestration rates up to ca. 50 μmol $^{m-2\ s-1}$. Overall, the studied paddy rice field presented a net ecosystem productivity (NEP) of ca. 650 g C $^{m-2\ y-1}$ and a Net Ecosystem Carbon Balance (NECB = NEP – C harvested) of ca. 250 g C $^{m-2\ y-1}$. The rice paddy field behaved as a CH_4 source most of the year, with higher emissions rates during the rice cropping period. Positive N_2O emissions were only observed at the beginning of the vegetation growth phase and were related to pre-seedling fertilization.

Key words: Ozone Fluxes, GHG Budget, Methane, Nitrous Oxide

Elevated Ozone Exposure Inhibits Whole-Plant Hydraulic Conductance and Disturbs Water Loss Regulation of Six Temperate Tree Species in China

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Abstract: The coordination of plant hydraulic properties with gas exchange has been observed in numerous plant species in response to global change. Ground-level ozone (O_3) alters the processes of photosynthesis and transpiration in many plant species, but until recently its influences on plant hydraulic architecture have received little attention. To find a link between hydraulic acclimation and shifts in trees' resource allocation in the seedlings of temperate forest tree species in response to elevated O_3, the seedlings of six temperate tree species were exposed to and ambient air (CK) and elevated O_3 (eO_3, ambient air added 40 nl•l^{-1}) in six open-top chambers. Two year eO_3 exposure decreased the biomass accumulation in seedlings, but the biomass partitioning among aboveground parts (leaves, petioles and stems) remained unaffected. Accompanied by growth responses, eO_3 caused reduced whole-plant hydraulic conductance (Kplant) and plant water-use efficiency. A detailed analysis on hydraulic conductance of different components of the whole-plant water transport pathway revealed that changes in root and leaf hydraulic conductance, rather than that of the stem, were responsible for Kplant responses to eO3. Elevated O_3 also significantly reduced stomatal conductance (gs) and water potentials (ΨL) with higher minimum rate of epidermal water loss (gmin) compared with CK plants. The loss of whole-plant hydraulic conductance, together with substantial variation in net photosynthetic rate and allometric growth, suggested that elevated O_3 may influence water balance between transpiration demand and water transport, consequently affecting plant water use and drought tolerance. Changes in hydraulic architecture in the present study may represent an important underlying mechanism for the commonly observed changes in water-related tree performances in response to O_3 pollution.

Key words: Elevated Ozone, Epidermal Conductance, Hydraulic Conductance, Stomatal Conductance

Changes in Isoprene Emission from Single Leaves and Whole Plants of Two Hybrid Poplar Clones Exposed to an Ozone Concentration Gradient

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Abstract: Concentration- and flux-based O_3 dose-responses of isoprene emission from single leaves and whole plants of two hybrid poplar clones with different O_3 sensitivities were developed for the first time. Clone‘107’ (Populus. euramericana cv. ‘74/76’) and clone‘546’ (Populus. deltoides cv. ‘55/56’ × P. deltoides cv. ‘Imperial’) were exposed to five O_3 concentration gradients in open-top chambers for 97 days: charcoal-filtered ambient air (CF), non-filtered ambient air (NF), and NF with targeted O_3 addition of 20 ppb (NF+20), 40 ppb (NF+40) and 60 ppb (NF+60). At both leaf and plant level, isoprene emission was decreased by NF+40 and NF+60 treatments for both clones. Over the daylight hours of the growing season, both concentration-based (AOT40, Cumulative exposure to O_3 hourly concentrations exceeding 40 ppb) and flux-based (POD7, cumulative stomatal uptake of O_3 above a threshold of 7 nmol O_3 m^{-2s-1}) indices were highly correlated with decreased isoprene emission at leaf level for both clones. When the responses were up-scaled to the whole plant level, however, the O3 dose-response relationship in the O_3-sensitive clone ‘546’ was sharper than in the O3-tolerant clone ‘107’. Moreover, under the well watered condition, although AOT40- and POD7-based O_3 dose-response relationships performed equally well with respect to isoprene emission, POD7 with a critical level of 3.9 mmol m-2 was recommended to use for modeling at regional scale provided differences between O_3-sensitive and O_3-tolerant clones are considered. Our results suggest that O_3 pollution decreases isoprene emission of poplar plants, thus may lessen the air pollution in the long term.

Key words: Tropospheric Ozone, Isoprene Emission, AOT40, Phytototic Ozone Dose

Spatio-Temporal Pattern of Ozone Weekend Effect, Beijing

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Abstract: Urban human activity is the major force that changes the ambient air quality. Weekday and weekend's difference in human activities could interpret the changes of human activities' intensities on environment, especially the urban air quality. Our study thus took ozone (O3) as key pollutant which has a short lifetime that could directly correlate with nearby areas' human activities, and Beijing as study area due to its a typical mega city with intensive human activity and heavy air pollution in China, to evaluate the spatio-temporal pattern of O3 weekend effect (OWE). The study periods was 1 Jan.- 31 Dec., 2014.The O3 mean value in 8-hour daytime was used as the daily concentrations from twelve ambient air quality monitoring stations in Beijing. .The twelve monitoring stations were classified four different types: central urban points,

urban points, suburbs and natural points, by its nearby urbanization level, to understand different urbanization level's impact on OWE. And, days with wind speed > 4 m/s or precipitation events were removed to minimize the influence by unstable meteorological conditions. The OWE was then calculated with equation: OWE = [(Cweekend - Cweekday)/Cweekday] ×100%, where Cweekend and Cweekday are the mean daily O3 concentration in weekend (i.e., Saturday and Sunday), and weekdays (i.e., Monday to Friday), repectively. We finally compared OWE among the different sites, and their seasonal variability.We also analyzed the relationship between the OWE and proportion of artificial surface at each station's nearby areas, to indicate the urbanization's relationship with air pollution. We found: 1) Ambient ozone concentrations varied greatly among seasons. The daily ozone concentration was remarkably high in summer, with an average of 98.0ug/m3, but low in autumn and winter. 2) OWE varied greatly by locations, as well as by seasons. The OWE was larger when the locations are closer to the urban center. 3) Urbanization has remarkable influence on OWE as a clue found that OWE tend to decrease when the monitoring stations' nearby areas' artificial surface increased. This study provides an important insights on the spatial and temporal characteristics of weekend effects of ozone concentrations, and thus have important implications for ozone pollution control。

Key words: Ozone, Weekend Effect, Urban, Human Activity

Quantifying Particulate Matter Accumulated on Leaves by 17 Species of Urban Trees in Beijing, China

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Abstract: Airborne particulate matter (PM) has become a serious problem and harms human health around the world. Trees can effectively remove particles from the urban atmosphere and improve the air quality. In this study, a washing and weigh method was used to quantify accumulation of water-soluble ions and insoluble PM on the surfaces and within the wax of the leaves of 17 urban plant species (4 shrubs and 13 trees). The deposited PM was determined in three size-fraction (10-100 μm, 2.5-10 μm and 0.2-2.5μm). Significant differences in the accumulation of PM were detected between various species. The leaves of Platycladus orientalis and Pinus armandi were the most effective in capturing PM. On average across the species, 65.3% and 34.7% of PM deposited on the leaf surface and in the wax, respectively. The greatest PM accumulations by mass on leaves was in the largest PM size fraction, while accumulations of coarse and fine particle size fractions were smaller. Water-soluble

ions accumulated on leaf surfaces contributed 27.7% to the total PM on average. This study has demonstrated that leaves of woody plants accumulate PM differently so the most effective plant species should be selected in urban areas for attenuating ambient PM.

Key words: Particulate Matter, Urban trees, Leaf Deposition, Wax

Agricultural Land Use Affects N_2O Production Pathways in Subtropical Acidic Soils in China

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Abstract: Agricultural practices have a significant impact on soil properties and N transformation rates, which would probably result in the alteration of main N_2O production pathways compared to woodland soils. In this study, we collected natural woodland soils (WD) and three kinds of agricultural soils including upland agricultural soils (UA), tea plantation soils (TP) and bamboo plantation soils (BP) and carried out a paired 15N-tracing experiment in laboratory to investigate the effects of land use on N_2O production pathways and the main regulating factors in subtropical acidic soils in China. The results showed that land use changes had significantly affected N_2O production pathways. The heterotrophic nitrification was the dominant pathway of N_2O production in WD, which was responsible for 44.6% of N_2O production. However, the contribution of heterotrophic nitrification to N_2O was very low in all agriculture soils with average less than 2.7%, which was mainly due to the lower organic C content and soil C: N ratio compared to woodland soils. The contribution of autotrophic nitrification to N_2O production varied from 21.5% to 42.8% in all studied soils and significantly increased to 42.8% in UA, because of the increasing pH after woodland soils converted to agricultural soils. Denitrification played an important role in N_2O production, ranging from 34.0% to 72.8%, in all studied soils under aerobic conditions. Moreover, the contribution of denitrification increased after woodland soils converted to agricultural soils. The NO3- content as substrate of denitrification could be the main factor affecting the contribution of denitrification in different land use soils. Our results highlighted that the N_2O production pathways significantly varied among different land use soils and soil pH, quantity and quality of organic C, and NO3- content were the main regulating factors. These results were valuable for modeling and mitigation of N_2O production under different land use in subtropical acidic soils in China.

Key words: N_2O Production Pathway, Subtropical China, Land Use

The Impact of Environmental Regulations on TFP of the Electric Power Industry-Evidence from Thermal Power Companies

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Abstract: As a basic industry of the national economy, the power industry is greatly influenced by regulatory policies. This paper mainly analyze the impact of environmental regulation on TFP. For environmental regulations on the one hand restrict industrial pollution emission to protect the environment, but also increase the pollution control cost that firms need to pay for. We focus on research the bilateral impact on TFP. Depending on the existing research, this paper first describes the structure of power industry and the current pollution emissions of power industry, and a brief overview of existing environmental regulatory policies in China. Secondly, use non-parametric OP method to calculate the TFP of China's thermal power industry during 1998--2007, and analysis the impact of environmental regulatory on it. Through empirical analysis, we find that with the increasing of regulatory intensity, the impact of environmental regulation on thermal power enterprises TFP showed "inverted N", when Regulation strength is weak, firms lack of the motivate to innovate, pollution control cost increases will lead to TFP decline; but with the increasing intensity of regulation, firms will increase R&D, so TFP improved; then if regulations continue to increase intensity, till exceed the tolerance of the firm, TFP decline. View from the how long policy show its effect, its positive effect show till lag a period to, and it has long-term effect. At the same time, TFP is influenced by the size and location. To sum up, China should continue to strengthen reasonable environmental regulation on thermal power industry.

Key words: Power industry, Environmental Regulation, TFP, Air pollution

Simulation of Indirect Carbon Loss Caused by Fire Emissions of Ozone and Aerosols

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Abstract: Fire is an important perturbation to terrestrial carbon cycle. In addition to the direct carbon emissions, large fires can alter global carbon budget through biogeochemical processes related to fire-emitted ozone and aerosols. Surface ozone damages vegetation photosynthesis through stomatal uptake, while aerosols influence photosynthesis by increasing diffuse radiation and changing meteorology. Here, we use a fully coupled carbon-chemistry-climate model to assess the combined effects of fire

ozone and aerosols on global carbon fluxes. Annually, fires contribute surface ozone of 10-20 ppbv (30-50%) in central Africa, 1-10 ppbv (20-40%) in southern Amazon, and 5-10 ppbv (10-30%) in Southeast Asia. A similar pattern of perturbations in aerosol optical depth (AOD) by fires is predicted. Without ozone damages, fire aerosols enhance global gross primary productivity (GPP) by 1.1 Pg C $^{yr-1}$, net primary productivity (NPP) by 0.8 Pg C $^{y-1}$, and net ecosystem productivity (NEP) by 0.1 Pg C $^{yr-1}$. Such enhancement is a combined result from vast tropical cooling, enhanced diffuse radiation, and increased land precipitation. Including both ozone damages and aerosol effects, fire pollution instead reduces GPP by 0.3 Pg C $^{yr-1}$, NPP by 0.1 Pg C $^{yr-1}$, and NEP by 0.1 Pg C $^{yr-1}$, mainly because of the offsetting between the aerosol fertilization and ozone damages. Our simulations reveal a missing carbon source caused by fire-emitted ozone and aerosols.

Key words: Fire Emissions, Ozone, Aerosols, Carbon Cycle

T1-13: Ecological Protection Redlines and Protected Areas System

Ecological Effects of Greenbelt Designation in Korea

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Abstract: Greenbelts were designated by the central government in 1971 in 14 major cities to prevent indiscreet urban expansion in Korea. This study aims to clarify the ecological effects that greenbelt designation has brought for about 35 years. In order to arrive at the goal, first of all, we investigated landscape change based on satellite image interpretation. Secondly, we analyzed vegetation dynamics not only to track changes occurred during those days but also to predict changes to be occurred in the future. Thirdly, we examined the ecological roles of the greenbelt in terms of ecosystem service. Finally, we prepared sustainable management and improvement plans for the greenbelt areas based on the results obtained from this study. The greenbelt area remained forest cover without almost loss, whereas the areas inside and outside of the district has experienced big loss of forest cover. Consequently the greenbelt area maintained landscape connectivity, whereas landscape outside and inside of the zone was fragmented severely. Vegetation quality in the greenbelt area evaluated based on NDVI remained 80% to 95% level of that in outside of the greenbelt. In contrast, NDVI of inside of the greenbelt maintained 30% to 53% level of that. As the results of analysis on vegetation dynamics, succession of the needle-leaved forests, which had maintained due to human interferences, to the broad-leaved forests of the late successional stage is in progress actively. Ecosystem service functions of the greenbelt area were improved greatly due to this vegetation change. These results suggest that the greenbelt system has performed its primary roles well. However, the existing green space was not enough for functioning in a sink for various kinds of environmental stresses from the surrounding urban areas. We discuss how the negative effects from urbanization can be reduced through sustainable management and restoration to promote ecological functioning of the greenbelt in urban landscapes.

Key words: Greenbelt, Forest Cover, Landscape Quality, Urbanization

Security Pattern Construction Based on Ecological Protection Redlines in China

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Abstract: China is facing huge environmental problems with its current rapid rate of urbanization and industrialization, thus causing biodiversity loss, ecosystem service degradation on a major scale. Against this background, three previous examples (the nature reserve policy, the afforestation policy, and the zoning policy) are implemented in China. These all play important roles in protecting natural ecosystems, although they can sometimes cause new problems and lack rigorous targets for environmental outcomes. To overcome current management conflicts, China has proposed a new "ecological protection redlines" policy (EPR). EPR can be defined as the ecological baseline area needed to provide ecosystem services to guarantee and maintain ecological safety. This study analyzed the scope, objectives and technical methods of delineating EPR in China, and put forward the proposed scheme for the ecological security pattern based on EPR. We constructed three kinds of redlines in China, including key ecological function area redlines, ecological sensitive or fragile areas redlines, and forbidden development areas redlines. For the key ecological function area redlines, a total of 38 water conservation functional zones have been designated, covering a total area of 3.23 million km^2; 14 soil conservation zones have been designated, covering a total area of 881700 km^2; wind-prevention and sand-fixation zones across the country cover a total area of about 1.73 million km^2, accounting for 57.13% of the total land area of the whole country. With respect to the ecologically vulnerable redlines, 18 ecologically vulnerable zones has been designated across the country, covering 2.19 million km^2, accounting for 22.86% of the total land area of the whole country. Forbidden development areas redlines covered a total area of 3.29 million km^2, accounting for 34.3% of the total land area of the whole country. We also suggest to form a complete ecological security pattern including patterns of protecting ecological function, residential environment safety, and biodiversity maintenance. Further emphasis should be put in supporting management and control measures in order to promote ecological protection in China.

Key words: Ecological Protection Redlines, Security Pattern Construction, Ecological Protection, China

Effectiveness of Land Sparing Strategies in Preventing Land Conversion and Deforestation: A Case Study in Protected Areas of Xishuangbanna, Southern China

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Abstract: In order to satisfy the needs of increasing human population, the world's forested area is decreasing in a rapid rate even while the scientists are introducing new strategies and methods to protect the existing forest. This study was designed to evaluate the effectiveness of such a policy called "land sparing". Land sparing is reserving land for specific purposes as PAs for species conservation. Our study site Xishuangbanna is important because of its disproportionate high biodiversity and rapid rubber expansion. We measured the success of PAs in preventing expansion of rubber and other non-conservation land uses within their boundaries. We used matching methods to minimize the bias of PAs location and other factors influencing PAs establishment and to compare land use conversion rates within PAs zones and with outside PAs.By 2010, Xishuangbanna had designated an area of 3455.52 km^2 (~ 18%) as PAs, while rubber (22%) showed and expansion rate of 153.4 km^2 y^{-1} and approximately 16% of PAs were deforested by 2010 with an annual rate of 6.8 km^2yr^{-1} and if this rate continues assuming that the rate is constant, within next 40 years another 10% of PAs land will be deforested but because drivers of deforestation continuously change and accelerate rather than decelerate Xishuangbanna's PAs might lose more forest than we predicted in this analysis. Therefore it should be a timely concern to review or to strengthen current land sparing policies, rules and regulations.

Key words: Protected Areas, Deforestation, Rubber, Xishuangbanna

Lichens and Forest Macrofungi in Mamparang Mountain Range, Northern Luzon: Emerging Species and Parameters for Environmental Monitoring and Assessment

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Abstract: Biodiversity resources along the Sierra Madre Mountain in Philippines are among the richest ecosystem in Northeastern Luzon where Mount Palali-Mamparang in Nueva Vizcaya and Quirino nestled. The mid-mountian forest in this area is predominated with dipterocarps and associated oaks with other myrtaceous trees. The ecosystem serves as habitat and niche to diverse group of macrofungi on forest floor being substrates and lichen hosted by trunks. Population of both organisms were behaving variably in response to natural phenomenon and anthropogenic activities which are essential in regular monitoring and assessment of the environmental condition of the ecosystem. This is the main goal of this paper to develop strategy in M and E for any developmental or industrial activities such as mining through behavioral characterization of living organisms exhibited by lichens and macrofungi. Both wet and dry season lichen assessment consistently having less favorable conditions for epiphytic lichen development in terms of frequency. The factor contributing to the low diversity of lichens was the inexistence of aged host trees in the sampling site and the corresponding favorable microhabitat conditions. Bark analysis was conducted as pH of the bark is recognized as sensitive index responding to relatively small changes in the habitat acidification. Fifty species of standing trees in the sampled sites have slightly acidic to acidic bark pH; thus, acidophilic species of lichens are expected to occur. This chemistry of substrate serves as one of the factors that significantly influences lichen abundance and distribution in the context of Philippine Dipterocarp forest within a mining site. The terrestrial macrofungi comprised of 37 species, 34 genera and 33 families under 16 orders, 8 classes and 2 phyla. The presence of ectomycorrhizal species like Russula, Amanita, and Cantharellus are noteworthy because these kinds are normally associated with roots of dipterocarps and other non-dipterocarps for mutual exchange of carbon from plants and sharing of essential nutrients absorbed by hyphae of fungi. Fungal production across sampling sites ranged from 14.2 - 708.3 g.m2, which was generally lower in habitats categorized as high impact and less in disturbed vegetation. Production of forest litter was 4.99 kg.m2 which was apparently favored by macrofungi being 82% greater than areas with lower fungal production. In general, little seasonal variations were observed in fungal and litter production, suggesting possible stable nutrient dynamics in the mountain ecosystem.The result of a two-year collaboration with a mining firm would suggest that these organisms could provide vital scientific evidence to detect microclimate condition as impacted by anthropogenic and natural factors.

Key words: Lichens and Macrofungi, Mamparang Mountain Range, Environmental Monitoring and Assessment

Spatial Variability of Meadow Soil Nutrients on Wugong Mountain Based on GIS and Geostatistic

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Abstract: In order to research the spatial variation of meadow soil nutrient in wugong mountain located at Pingxiang of Jiangxi province, this paper selected core scenic area of regional block mountain meadow from wugong mountain jinding to the scenic spot named diao ma zhuang as the research object, collect two layers of meadow soil within depth of 0-20cm and 20-40 cm at wugong mountain jinding scenic and using the ASI soil nutrient status measurement system analysis, and use the conventional statistics and geostatistics to analyse and reveal the spatial variation of soil nutrient, and use the ordinary kriging interpolation to make map based on GIS,through the analyse of distribution and spatial heterogeneity of soil nutrients, reveal the experimental zone meadow soil nutrient spatial variation law of wugong mountain,to make a comprehensive understanding of the test area meadow soil nutrient status, can not only for scientific fertilization, partition of mountain meadow nutrient management to provide important basis, also helpfully to reveal the variation of soil nutrients in degraded meadow ecosystem, provided ecological restoration theory guide for soil nutrients in the meadow, To guide the restoration technology of the subtropical degraded alpine meadow vegetation and enhance scientific theory reference for subtropical mountain meadow nutrient management.The main analysis conclusion is as follows:(1) on the whole, experimental zone meadow soil in general are acidic and belong to the second classes of organic soil, the various nutrient distribution in meadow soil happened to be a mostly unstable situation, the descriptive statistical analysis of meadow soil nutrient is insufficient to specify the region meadow nutrient status; (2)using ordinary kriging interpolation to make map, choosing the best interpolation model for processing, to map a spatial variety of soil nutrients in the middle of the jinding and Diao Ma Zhuang area and v-shaped valley distribution of space variation, found the present nutrient spatial distribution in the jinding, hanging Ma Zhuang and v-shaped valley have regional difference, between four and in the north and south of jinding things in the direction of slope also has difference distribution, a variety of nutrients in the jinding tourist areas and normal meadow area also have bigger difference, appeared in the jinding and v-shaped valley content is high, high, comprehensive analysis, known mainly for altitude, landform, the cause of the differences between tourism activities and other factors.(3)the upper and lower the soil in wugong mountain experimental meadow area, each other of the most soil nutrients have a positive or negative correlation with a significant or extremely significant degree beside available iron and available boron ,it show that the relationship between

the nutrients is not existed independently, but have a relationship of the mutual influence and restriction, a large amount of nutrients and trace nutrients, is closely related between the nutrient management relations is conducive to each other, this conclusion can be used in transformation of soil physical and chemical properties with some corresponding scientific measures.

Key words: GIS, Spatial Variation, Statistics, Wugong Mountain

Efficacy of Conservation Strategies for Endangered Oriental White Storks (Ciconia Boyciana) Under Climate Change in Northeast China

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Abstract: Climate change can lead to habitat loss and degradation, and consequently endangers species in a specific region. Besides addressing the priority areas of species distribution, an urgent consideration is to identify suitable conservation options and map areas according to their effectiveness when planning to conserve a rare species under climate change. Here, we conducted a study to develop potential conservation strategies and assess their effectiveness under different climate scenarios in Sanjiang ("Three rivers" in English) Plain (Amur, Ussuri and the Songhua Rivers) of Northeast China. We used the species distribution software MaxEnt to model current and future habitat distributions of endangered oriental white storks (Ciconia boyciana). Based on field surveys, experts' knowledge and literature findings, we developed the methods to identify conservation strategies. By including additional species presence sites derived from conservation strategies (a presumption of the further analyses) MaxEnt, we predicted the future habitat distribution under the implementation of different conservation strategies. To estimate the effect of conservation strategies,we compared the differences in the extent of suitable habitat with and without conservation strategies under two different predicted climate change scenarios. The results showed that the suitable habitat of the oriental white stork in the study region dramatically declined by over 80% in the absence of conservation strategies under both scenarios. Predicted suitable habitats with conservation strategies had broader distribution ranges than those without. The strategy of reclaiming cropland back to wetland offers the most impressive effectiveness with a tenfold increase in suitable habitat, followed by the strategy of establishment of nature reserves with six fold and the strategy of artificial bird nest with two fold increase. Our approaches emphasize the effect of integration of knowledge of experts in conjunction with MaxEnt when mapping and assessing the effect of the conservation strategies.

Key words: Endangered Species, Habitat Distribution, Maximum Entropy (MaxEnt),

Climate Change

Volatile Chemicals Emitted by Halymorpha Halys (Stål) (Hemiptera: Pentatomidae): Weapon for Defence or Cue to the Parasitoid

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Abstract: Halyomorpha halys, originated from East Asia, has become an important worldwide agricultural pest since its accident introduction North America in the mid-1990. Trissolcus japonicus is a predominant egg parasitoid of this pest in its native range. Here, we analysed the volatile chemicals released by H. halys and assessed their functions and effects to T. japonicus. Seven volatile compounds were analysed with GC-MS. Electrophysiological analysis with GC-EAD revealed the presence of two bioactive volatile compounds from H. halys adults. Further behavior bioassays with Y-tube olfactometer showed completely different responses of T. japonicus to these volatile compounds. Furthermore, host searching time of female T. japonicus was significantly reduced and prolonged when H. halys egg mass was treated with either the volatile compound alone or the mixture of two compounds. These results were discussed in the context of host insect-parasitoid interactions through infochemicals.Keyword Halyomorpha halys, Trissolcus japonicus, Egg parasitoids, Kairomones, Alarm pheromone, N-tridecane, E-2-Decenal

Key words: Halyomorpha Halys, Trissolcus Japonicus, Egg Parasitoids, Kairomones

Institutional Construction of Ecological Protection Redlines in China

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Abstract: The expansion of artificial constructs with the rapid economic development and ecological vulnerability in China has led to ecological and environmental emergencies. Though efforts toward the establishment and protection of ecology in China have been done a lot, the overall trend of the deterioration of resources and ecological environments has therefore not yet been fundamentally reversed. The measures taken have improved the degraded resources and environment to some extent

but have not satisfied the pressing global demands of resource and environmental protection with the crises of ecosystem degeneration and decreasing biodiversity. Nationwide programs therefore have been implemented to "draw ecological protection redlines" to strengthen ecological protection. The redlines would be delimited and under rigid protection in the areas of key ecological function for national and regional ecological security, ecologically sensitive areas, and various established legally protected ecological areas. It has become a new strategy of ecological protection with Chinese characteristics to delimit and strictly observe redlines, which will play a more important role in ecological protection in the future.
Key words: Ecological Protection Redlines, Institutional Construction, China

A Review on Eco-environmental Quality Assessment

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Abstract: Eco-environment is the abbreviation for ecological environment, it is the functional integration of various ecological factors and ecological relationships which form the basis for the living organisms to survive, to develop to reproduce and to evolve, generally refers to water environment, land, climate, environment and biological environment. Eco-environment plays an indirect but vital role in the survival and development of human society. A sustainable development of society and economy must be based on the stability of eco-environment. However human society development in the 21st century has made the destruction and pollution of the eco-environment reach an unprecedented stage, like forest destruction, fresh water resources shortage, air quality deterioration, the loss of land resources，those become important bottleneck restricting the development of human society. How to ensure a sustainable development which keeps a good balance between the development of human society and eco-environment protection has become one of the most important issues all over the world. Many countries around the world have implemented lots of major ecological construction projects in order to improve the eco-environmental quality, such as forestry engineering in the United States, green dam engineering of the five countries in North Africa and Three North Shelterbelt Program in China. These projects have achieved positive results for environmental protection and ecological construction. But it should be noted that the trend of eco-environmental deterioration has not been fundamentally curbed because the extensive growth mode of industry has not been changed radically. Especially in some developing countries, with the rapid economic development, eco-environmental protection is facing severe challenges. Thus, how to enhance the quality of eco-environment as an important strategic task for today and tomorrow becomes urgent in front of the human society.

Much progress has been made in the content, methodology and index system of eco-environmental quality assessment. Ferguson B.K. proposed the concept of ecological health in 1998. He thought that the purpose of the eco-environmental quality assessment is to achieve ecological health. At the end of 1980s, the Organization for Economic Cooperation and Development proposed the pressure-state-response model for assessing the ecological environment problems in sub Saharan Africa, which provided a basis for the eco-environmental quality assessment. In addition, some research also involved the ecological risk assessment, ecological fragility evaluation, the ecosystem health evaluation and the ecological footprint. But the eco-environment system is complex and dynamic, and all the impact factors determined the difficulty of the evaluation, so there is still a lack of accepted theoretical framework, methodology and index system, especially a quantitative evaluation method of universal applicability. This paper reviews the content, methodology and index system of eco-environmental quality assessment, aims at posing the insufficient in the current study and providing some suggestions about the research directions in the future.

Key words: Eco-environmental Quality Assessment, Index System, Evaluation Methodology

Fish Egg Dynamics in the "Man-Made Flood Pulse" in the Middle Yangtze River down the Three Gorges Reservoir, China

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Abstract: The dam is the most obvious and most direct change to the river. Control the flow of rivers, which is usually an ecological bottleneck that brings critical stress and opportunity to a large number of aquatic organisms. The Yangtze River is the most important river in China. The Three Gorges Reservoir greatly changed the flow regime of the Yangtze River, resulting in effects on fish populations, particularly those of the four major Chinese carp (FMCC): black carp, grass carp, silver carp, and bighead carp. Spawning has dramatically decreased since the Three Gorges Reservoir was established in 2003.Flow re-operation were executed from 2011 to 2015 for seven times, This study investigated the impacts of re-operation on FMCC, and validated the environmental factors that promote spawning of the FMCC. A significant difference in FMCC egg density was observed among seven re-operation floods, The FMCC egg mean density ranged from 0.29 to 201 ind. ·1000 m-3 among the seven re-operation floods from 2011to 2015. About eight spawning grounds for FMCC were extrapolated and mainly distributed between reach sections of 30 to 150km up from the Shashi transect, this result was basically consistent with historical data.The egg community

was significantly correlated with water transparency, change in daily water discharge, and change in daily water level. The better regulation schedule we suggest was the mean daily discharge increase was approximately great than 1800 to 2000 m^3 s^{-1} d^{-1}but less than 3050 m^3 s^{-1} d^{-1}, duration time of water level arising was 5 days or more, the interval time between two re-operation floods were 8 to 11days.

Key words: Three Gorges Reservoir, Four Major Chinese Carp, Re-operation, Flow Regime

Ecological Protection Redlines Identification: A Case Study Analysis

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Abstract: The expansion of artificial constructs with the rapid economic development in China has led to ecological and environmental emergencies. The extent of the decline in natural resources and environmental conditions has recently been recognised. Identifying “ecological protection redlines”, i.e. ecological limits, to guarantee ecological baselines for natural resources and ecosystem service functions would therefore help to coordinate economic development and to protect ecological resources in the coming years. EPRs are being established and taken seriously with the current situation that the government requires. It is required that the demarcation of the border and calibration of the regions should be completed and an ecological protection "red line" system will be basically established by the end of 2020. Some provinces and cities have finished the delimitation of EPRs, while most areas are ongoing. Here provides a reference of Zibo which is a typical and important city in Shandong province for the delimitation of EPRs, as an example to illustrate the principles and methodology of ecological protection redlines. The ecological protection redlines area for Zibo encompassed an area of 1132.26 km^2, accounting for 18.98% of the total area of Zibo, were mainly distributed in the southern regions of the municipality, and consisted of extremely important areas of ecosystem service functions, including water conservation, both soil and water conservation, windbreaks and sand fixation, and the conservation of biodiversity. In the decade of 2000-2010, ecological assets of the EPRs area decreased by 2.31 million Yuan with a rate of 3.60%. Strict measures of management and control as well as improvement should be implemented to protect the long-term effectiveness of ecological protection redlines.

Key words: Ecological Protection Redlines, Identification, Zibo

The Study on Temporal and Spatial Evolution Characteristics of Regional Ecological Land Based on Type Differentiation

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Abstract: The purpose of this study is to define the connotation of ecological land reasonably and to grasp the temporal and spatial evolution characteristics of ecological land in Jiangsu Province on the basis of type differentiation. Research methods: literature analysis, mathematical model, empirical research method. The results show that: (1) the qualitative analysis shows that according to the connotation and attribute of ecological land, ecological land is divided service ecological land, functional ecological land and reserve ecological land. (2) The empirical results show that during the period of 1996-2015, the area of ecological land in Jiangsu province is reduced by 26000 hectares per year. The total reduced area of service ecological land, functional ecological land and reserve ecological land is 350000 hectares, 150000 hectares and 20000 hectares. The center of gravity model shows that the ecological land center of Jiangsu Province changed obviously, the transfer distance is 42.56 km, and the direction is from southeast to northwest. The transfer distance and direction of the service ecological land is 37.01 km, that of functional ecological land is 62.16 km and reserve ecological land is 17.35 km. The conclusions are that: To take the road of sustainable development, it is necessary to keep the balance of ecology during the development of city, especially to coordinate the protection of ecological land and the development of urban construction land. To protect our ecological security, we need to protect and develop reserve ecological land in order to raise the quantity and quality of ecological land, establish and improve the standard of connotation and classification of ecological land as soon as possible, accelerate the pace of demarcating urban expansion boundary and ecological land redline.

Key words: Ecological Land, Land Type, Temporal and Spatial Evolution, Jiangsu Province

Ecological Redlines and Conservational Effectiveness of Ecosystem Services in China

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Abstract: An ecological conservation redline paradigm has evolved at the central government level in China as a new attempt for better protection of biodiversity and ecosystem services across the country to materialize the new national strategy of

developing an ecological civilization. We first analyzed the ecological conservation redline paradigm under the ecological civilization strategic development in China and the context of international conservation science. Then we formulated a biophysical composite indicator approach for ecosystem service provisioning oriented priority setting for the planning of candidates of ecological conservation redline areas. Based on this indicator based approach, we mapped the key ecosystem service provisioning areas accounting for about 41.9% of China's land mass as candidates for delineating ecological conservation redline areas at the national scale. We overlaid these areas with the maps of national nature reserves to quantify the status of strict conservation of the key ecosystem service provisioning areas. We found that only 6.7% of these areas were represented by the national nature reserves. Considerable gaps were identified between conservation representativeness demands and supplies with significant spatial heterogeneity at the regional and provincial scales. Within the current policy transition towards an "ecological civilization" in China and based on the above gap analysis, this paper contributes to the policy-oriented optimization of national nature reserve network and the demarcation of "ecological redline areas" from the perspectives of improving the representativeness and conservation of highly functioning land units for ecosystem service generation. Moreover, the method developed for ecosystem service assessment in this paper can be conveniently adapted to other large scale conservation researches because of low data requirement and high use efficiency comparing to complex models. To advance the redline paradigm as a practical resource and environmental management tool, we finally proposed recommendations including (1) strengthening the executive capacity of redline management by rule of law, (2) developing closer collaborations among different governmental sectors, (3) creating multi-source economic incentives through payment schemes for environmental services, and (4) promoting public participation.

Key words: Systematic Conservation Planning, Ecosystem Service Mapping, Conservation Representativeness, Remote Sensing

T1-14: Hindu Kush Himalaya Ecosystems: Resilience, Adaptation and Services

Building Ecological and Community Resilience in the Hindu Kush Himalaya

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Abstract: Ecological and community resilience concept considers building or reverting back after shocks and moving forward to adapt in the changing conditions. This approach combines economic, social, and environmental dimensions of sustainable development with climate change adaptation, resilience, and preparedness for future risks towards an integrated development in the Hindu Kush Himalaya. This approach combines both ecological and community based resilience where people and nature connections are understood better and maintained.

In the Hindu Kush Himalaya using the resilience concept International Centre for Integrated Mountain Development (ICIMOD) is working on Resilient Mountain Solutions in achieving adaptation goals and trans boundary landscape management cooperation. The approach constitutes mountain specificity of fragility, inaccessibility, marginality, diversity and niche. It covers the climate resilience, socio-economic resilience and future resilience.

This paper presents drivers of change faced by the people and ecosystems in the Hindu Kush Himalaya. The theoretical concepts of resilience, context and practical experiences in ecosystem management, agriculture and community adaptation are used for identifying resilient outcomes and developing solution packages. Examples of ICIMOD's experiences in responding to resilient outcomes and solutions for both ecosystem and community based adaptation will be shared.

Key words: Building Ecological

Is the Growth of Birch at the Upper Timberline in the Himalayas Limited by Moisture or by Temperature?

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Abstract: Birch (Betula) trees and forests are found across much of the temperate and boreal zones of the Northern Hemisphere. Yet, despite being an ecologically-significant

genus, it is much less-well studied compared to common genera like Pinus, Picea, Juniperus, Quercus, and Fagus. In the Himalayas, Himalayan birch (Betula utilis) is a widespread, important broadleaf timberline species that survives in mountain rain shadows via access to water from snowmelt. Because precipitation in the Nepalese Himalayas decreases with increasing elevation, we hypothesized that the growth of birch at the upper timberlines between 3,900 and 4,150 m a.s.l. is primarily limited by moisture availability rather than by low temperature. To verify this assumption, a total of 292 increment cores were extracted from 211 birch trees at nine timberline sites. The synchronous occurrence of narrow rings and high inter-series correlations within and among sites evidenced a reliable cross-dating and a common climatic signal in the tree-ring widths variations. From March-May, all nine tree-ring width site chronologies showed a strongly positive response to total precipitation and a less strongly negative response to temperature. During the instrumental meteorological record (after 1960), years with a high percentage of missing rings coincided with pre-monsoon drought events. Periods of below-average growth are in phase with well-known drought events all over monsoon Asia, showing additional evidence that Himalayan birch growth at the upper timberlines is persistently limited by moisture availability. Our study describes the rare case of a drought-induced altitudinal timberline that is composed by a broadleaf tree species.

Key words: Treeline, Tree Ring, Pre-monsoon Precipitation, Global Warming

Effects of Soil Warming, Rainfall Reduction and Changing Water Table Level on CH_4, CO_2 Emission and Pore Water DOC Concentration of Zoige Peatland in China

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Abstract: The Zoige Plateau features approximately 4605 km^2 of peatlands, making it the largest peatland area in China. This area stored 2.9 Pg peat during the Holocene, yet little is known about carbon (CH_4, CO_2) emissions and pore water DOC concentration from this region. We designed a mesocosm experiment to measure CH_4, CO_2 emissions and DOC concentration during the growing seasons under different scenarios involving soil warming, 20% reduction in rainfall and changeing water table level. This research aimed to understand how climate change affect CH_4 and CO_2 emissions and whether the trends of changes in CH_4 and CO_2 emission are consistent with those of DOC concentration. Our results showed soil warming treatment increased average CH_4 emissions by 28%, while rainfall reduction increased it by 30%; however, neither increase was statistically significant. In contrast, the combined effect of soil warming

and rainfall reduction significantly decreased CH_4 emissions by an average of 58%. Extending this result across the entire peatland area in the Zoige Plateau translates approximately 5.3 Gg of CH_4 uptake per year. For CO_2 emission, we found temperature at 5 cm depth have positive linear relationship with CO_2 emission. The combined effect of soil warming and rainfall reduction increased CO_2 emission by 96.8%. Extending this result to the entire peatland area in Zoige Plateau translates into 0.45 Tg CO_2 emission per year over a growing season. These results suggest that a drier and warmer Zoige Plateau will become a CH_4 sink and an increasing CO_2 source. We also found a positive relationship between water table level and CH_4 emissions. Average CH_4 emissions decreased by approximately 82% as water drawdown varied from 0 to -50 cm. However, there is no significant relationship between water table and CO_2 emission and DOC concentration. When we simultaneously examined the effect of all three factors of water table level, soil warming and rainfall reduction on CH_4 emissions, we found soil warming and rainfall effect on CH_4 emissions varied with water table levels. However, none of the three factors significantly affected CH_4 emissions at a water table depth of 30 cm below peat depth. We also found the contribution rate of DOC concentration to CO_2 emission was increased by 12.1% in the surface layer and decreased by 13.8% in the subsurface layer with combined treatment of soil warming and rainfall reduction, which indicated that the warmer and dryer environmental conditions stimulate surface peat decomposition process and the subsurface peat layer is insensitive to climate change.

Key words: Qinghai-Tibetan Plateau, Peatlands, Climate Change, DOC

Fungal Community Changes and Assembly Processes along Retreating Glacier Soils

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Abstract: Primary soil microbial community assembly is essential for pedogenesis and development of organic legacies. Retreating glacier front provides an ideal chronosequence model system for studying primary succession and the establishment and early assembly mechanisms of biological communities. Here, we investigated fungal succession and community assembly by high-throughput sequencing along a well-established glacier forefront chronosequence spanning 2-188 years of deglaciation. Fungal diversity and community were significant different across the glacier foreland. The response of diversity to distance varied in different fungal phyla. Basidiomycota diversity significantly decreased with the distance, while the pattern of Rozellomycota diversity was unimodal. Yeast was dominated in all samples and its abundance

increased with successional stages, but those of Leotiomycetes decreased. Based on null deviation analyses, fungal community composition is initially governed by deterministic, as succession proceeded, the assembly process was dynamic. These results suggested time-dependent shift in the stochastic/deterministic balance during fungal primary succession.

Key words: Qinghai-Tibetan Plateau

Grassland Degradation and Restoration in Tibet Plateau

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Abstract: Grassland degradation and the corresponding ecosystem function loss in Tibet Plateau has become a severe problem in recent years, destroying the sustainable development of local animal husbandry and even threatening national ecological safety. However, little is known about the mechanisms below grassland degradation in Tibet Plateau and the succession pattern of its restoration. Here, we present field studies to investigate ecosystem changes under different intensities of degradation in Tibet Plateau. Shifts in plants, soil properties, microorganisms and fauna are monitored to figure out key factors determining the progress and extent of degradation. Moreover, a restoration experiment is manipulated in a highly degraded grassland in Naqu, Northern Tibet by using strategies of precluding animal grazing, increasing soil organic matter and improving soil structure, altering soil nutrient cycling by inhibiting nitrification, and increasing plant diversity. During the restoration process, ecosystem succession pattern is determined through capturing changes in plants, soil, microorganisms and fauna. These ongoing studies are expected to enhance our understanding of degraded grassland restoration in Tibet Plateau, and help to find optimal strategies for sustainable grassland management under grazing and climate change.

Key words: Restoration

Warming and Grazing Accelerate Plant Organic N Uptake in Alpine Meadow

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Abstract: Background and aims the availability of nitrogen in forms accessible to

plants is one of the primary factors that limits productivity and plant species coexistence in terrestrial ecosystems. Although some studies have tested the temperature response of plant N uptake in controlled greenhouse experiments, we know little about how plant N uptake responds to warming in natural grassland ecosystems, even the warming accompany by grazing.

Methods we conducted short-term 15N tracer experiments during the peak growing season in an alpine grassland on the Tibetan Plateau to investigate the effects of warming and grazing on the uptake of NO_3^--N, NH_4^+-N, and glycine-N by plants. Four dominant plant species (Kobresia humilis, Potentilla anseria, Elymus nutans, Poa annua) were for the study. As these species represented more than 50% of total vegetation cover, the plant uptake of 15N in our experiments approximated the uptake of the total plant community.

Results Across species, warming significantly decreased plant uptake rates of NH_4^+-N and total inorganic N (NH_4^+-N and NO3--N) by up to 80%, while warming significantly increased uptake rates of glycine-N by 152.17%, 600%, 81.81%, 43.92% in K. humilis, P. anserine, and E. nutans. There were no significant effect of warming or warming × plant species on total plant N uptake rate.

Conclusion These findings indicate that increased plant glycine-N uptake under warming is a key factor to sure plant total N uptake and drive plant species composition.

Key words: Warming, Grazing, N Utility

Response of Spatial-temporal Changes of Vegetation Coverage to Soil Moisture in Tibetan Plateau

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Abstract: As one of the essential parameters in terrestrial ecosystem, vegetation plays a vital role in material cycling, Earth's energy budget and climate change. Moreover, vegetation has been recognized as the most significant and sensitive indicator of climate change. Soil moisture, as a key natural factor, can provide material basis for terrestrial plants and has a significant impact on the growth of vegetation by controlling the exchange of water and heat energy between the land surface and the atmosphere. This study aims to analyze the variation characteristics of vegetation coverage, and explore the relationship between soil moisture and the changes of vegetation coverage in order to improve our understanding of the response and adaptation mechanisms of

the terrestrial ecosystems to soil moisture. Firstly, spatial-temporal characteristics of vegetation coverage variation were explored using normalized difference vegetation index (NDVI) data from 1981 to 2016 in Tibetan Plateau. Subsequently, the land surface water index (LSWI) that calculated by the near infrared and shortwave infrared measurements, was used as the indictor to infer soil moisture conditions over the study area. With both the NDVI and LSWI datasets, the relationship between NDVI and LSWI was further investigated. Results revealed a significant increment of the mean annual NDVI from 1981 to 2016, indicating an overall improvement of vegetation coverage in Tibetan Plateau. Moreover, a general "decline-rise-unchanged" variation of NDVI occurred from southeast to northwest. It was found that the vegetation coverage changes were positively correlated to the variation of soil moisture over the same period.
Key words: Normalized Difference Vegetation Index (NDVI), Vegetation Changes, Soil Moisture, Tibetan Plateau

More Resilience for Better Adaptation – Sustainable Management of Ecosystems in the HKH Region

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Abstract: The Hindu Kush Himalayan region houses diverse ecosystems which harbour a myriad of habitats and remarkable biodiversity. The provisioning, regulating, supporting, and cultural services provided by these ecosystems are enjoyed by the mountain populations of the region, by the people living in the areas downstream, and by people everywhere as part of humanity's global patrimony. In recent years, environmental changes wrought by anthropogenic pressures have led to disruption of the region's mountain ecosystems. Action at the local, regional, and global levels is required to ensure that ecosystem services are maintained and that the people of the region have the tools they need for mitigation, adaptation, and enhanced resilience. In this presentation, authors will share the experience and lessons of ICIMOD on developing strategies for sustaining ecosystem services and ecological restoration, promoting regional cooperation on transboundary landscapes and ecosystem based adaptation, and facilitating participatory natural resource management for the maintenance of biodiversity in the Hindu Kush Himalayan (HKH) region.
Key words: Resilience, Adaptation, Sustainable Management

Integrated Management Strategies for Adaptation to Climate Change Impacts on Alpine Grassland Ecosystems in Northern Tibet, China

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Abstract: Northern Tibet is the head-stream region for the Yangtze, Nu (Salween River), Lancang (Mekong River), and numerous other inflowing rivers and high mountain lakes. Sustaining the environmental conditions in the region is of vital importance for Tibet and the whole of China. Being a fragile ecosystem, the alpine grassland ecosystem in Northern Tibet is extremely sensitive to climate change and human activity. In recent years, severe alpine grassland degradation with diverse annual fluctuations has been detected in Northern Tibet. Observed rising trends of temperature and precipitation are likely to continue in the future, which potentially predicts that the climate in Northern Tibet becomes warmer and dryer. In order to adapt to such possible future climate changes, we developed integrated management strategies to control the grassland degradation and promote the sustainable use of alpine grassland resources. These strategies will lessen the adverse impacts of climate change on the alpine grassland ecosystem in Northern Tibet.

Key words: Climate Change, Adaptation, Integrated Ecosystem Management, Alpine Grassland

Increase in Ammonia-Oxidizing Microbe Abundance during Degradation of Alpine Meadows May Lead to Greater Soil Nitrogen Loss

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Abstract: The alpine meadows on the Tibetan Plateau have experienced severe degradation in recent decades. Although a few studies have explored the effects of alpine meadow degradation on soil properties, there is still a paucity of knowledge on the responses of nitrogen cycling microbes (NCMs) to degradations and their links to the changes in soil properties. Here, we systematically determined the effects of patch degradation on soil properties (i.e. total carbon, total nitrogen, ammonium nitrogen, nitrate nitrogen, available phosphorus, dissolved organic carbon, moisture, δ15N, δ13C, and pH) and NCMs (based on nifH, amoA, narG, nirK and nirS genes and their transcripts), across three degraded Tibetan alpine meadows. The results showed that compared to the original grassed patches, contents of most soil nutrients (e.g. carbon, nitrogen, and phosphorus) were significantly lower in the degraded patches, across the

three study sites. Patch degradation also tended to increase soil δ15N values and nitrate nitrogen contents. Among the aforementioned NCMs, soil diazotrophs and denitrifiers only showed weak responses to the patch degradation, while ammonia-oxidizing microbes showed the highest consistency and sensitivity in response to patch degradation, across the study sites. The copies of amoA gene and archaeal amoA mRNA increased significantly under patch degradation, which were positively correlated with soil δ15N values and nitrate nitrogen contents, but negatively correlated with soil total and inorganic nitrogen contents. These results suggest that the increased abundance of ammonia-oxidizing microbes may be an important driver of soil nitrogen loss under patch degradation of alpine meadows.

Key words: Nitrogen Cycling Microbes, Alpine Meadow Degradation, Metagene Expression, Soil Biogeochemistry

Ecological Gradient Analyses of the Balakot Forests District Swat in the Hindu Khush Range of Mountains

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Abstract: In the Swat District the Balakot Forests is the part of Hindukush range of mountain that is one of the remote area where vegetation of different areas have not been studied correlated to environmental variables. The recent research were carried out to study the different effects of environmental variables specially altitude on plant species association and variation among plant communities of Balakot Forests. The present exploration recognized the various environmental ingredients and recommendation for accurate measures. The quantitative line transect method were used during 2014-15. The size of transect was 50 meter which were further divided 10 meter respectively. The Stands were planned along 15 altitude on different aspects (South, North, East and West), Total 27 transects were studied in all stands in different station. Phytosociological attribute were observed i-e Frequency, Frequency and Cover for all species in the region. The initial results documented a120 plant species. The presence and absence or one zero data of all plant species were treated through PCORD version 5 to make cluster of all stations. The Canonical Correspondence Analysis was used to know about the various environmental ingredients. It was concluded that among all environmental ingredients altitude, soil texture and aspect were the strongest vaiables that greatly affected the vegetation of the Balakot Forest in term of plant distribution and its associations. It is recommended that to protect and use wisely all the flora and particularly the rare species of the region.

Key words: Balakot Forests, Ordination, Classification, Environmental Gradient

Rewetting Decreases Carbon Emissions from the Zoige Alpine Peatland on the Tibetan Plateau

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Abstract: Peatlands play an important role in the global carbon cycle and potentially have a significant impact on regional climate change. Restoring and rewetting the degraded peatlands is an urgent task. However, effects of rewetting on the carbon emissions of peatlands remain poorly understood. In this study, the process of rewetting a piece of degraded peatland was simulated experimentally and its results were compared with those of natural rewetting by monitoring CO_2 and CH_4 fluxes and a few environmental factors before and after rewetting. We tested the effects of rewetting on the carbon emissions from Zoige alpine peatland. The natural rewetting results showed that rewetting decreased ecosystem respiration (ER) by about 60%. Further, rewetting increased CH_4 emissions by 127%, decreased total carbon emissions (TCE) from 270 mg CO_2 m^{-2} h^{-1} to 157 mg CO_2 m^{-2} h^{-1}, and decreased TCE from the entire ecosystem by 42%. The results of controlled experiment showed that ER decreased gradually as the degree of rewetting was increased, and CH_4 fluxes and changes in water level were significantly and positively correlated: CH_4 fluxes increased from 0.3 mg CH_4 m^{-2} h^{-1} (water level –20 cm) to 2.17 mg CH_4 m^{-2} h^{-1} (water level 20 cm). After rewetting, the TCE of the whole ecosystem significantly decreased. Regional observations showed that CO_2 fluxes were significantly and negatively correlated to the water level; CH_4 fluxes and the corresponding CO_2 equivalent were significantly and positively correlated to the water level, while TCE were significantly and negatively correlated to the water level. Our finding indicates that rewetting can decrease carbon emissions and thus help in mitigating the adverse effects of climate change in alpine peatland.

Key words: Carbon Budget, Greenhouse Gas Emission, Peatland, Rewetting

Nutritional-balanced Production of the Tibetan Alpine Pastoral Animal Husbandry Industry: Theory, Technology and Practice

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Abstract: Pastoral livestock production on Qinghai-Tibet Plateau is characterized by a disequilibrium system between livestock seasonal nutrient requirements and herbage production in both quality and quantity, which forces herdsmen to keep larger numbers

and longer term raise of livestock, both leading to grassland overgrazing. To solute those problems, an integrated grazing-feedlot livestock system is promoted to improve the efficiency of livestock production and at the same time to conserve natural grassland for a sustainable Tibetan Plateau. In such a system, Tibetan sheep and yaks mainly graze on the natural grassland area during the short warm season and turn to the mixed crop/pastoral area for the cold season. Forage, agriculture byproducts of the mixed cropland/pastoral zone and cropland area also provide important supplement forage for livestock. The use of large-scale artificial grasslands in the crop/pastoral zone reduces the grazing pressure on natural grasslands by providing an alternative supply of livestock feed. Implementation of this new approach has demonstrated that the combination of livestock, forage and agricultural by-products from the three zones brings benefits beyond the sum of the value of the individual resources. Practice on ecological protection and Construction Project of the Three River Source Region shows that the new approach is a strategic way to decrease overgrazing caused by livestock production. It also improves the efficiency of livestock production and increases the income of herdsmen.

Key words: Nutritional-balanced

The Effects of Extreme Drought on Ecosystem Carbon Fluxes in Zioge Alpine Peatland

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Abstract: Evidence suggests that the expected increase in frequency and magnitude of extreme weather events during climate change will alter plant productivity and consequent carbon cycling. Zioge alpine peatland is one of the most sensitive areas to global climate change. In recent years, the climate in this region is becoming warm and dry. Drought events can significantly change temperature and hydrological conditions and influence the structures and functions of peatland ecosystem, which result in the variation in carbon fluxes including carbon dioxide (CO_2) and methane (CH_4). Here, an alpine peatland was exposed to a simulated single drought (32 days without the effective rainfall) during peak growth of the growing season in 2016. Effects on gross primary productivity (GPP), ecosystem respiration (Re), net ecosystem carbon dioxide exchange (NEE) and CH_4 fluxes were recorded from prior to the experiment until one month after the drought. During the experimental period, extreme drought significantly reduced NEE, Re and GPP by 20.4%, 13.5% and 11.3%, respectively. This resulted in decrease of carbon sequestration capacity during the whole growing season. GPP was more sensitive to extreme drought events compared to Re. After the experiment, the

CO_2 fluxes can be recovered rapidly as the ecosystem received the ecological effective rainfall. However, Extreme drought events have no significant effect on CH_4 fluxes in Zioge peatland. Extreme drought altered the relationships between temperature, soil water content and CO_2 fluxes. Specifically, extreme drought events weakened the correlations between NEE, Re, GPP and air temperature, but enhanced the correlations between NEE, Re, GPP and soil water content, respectively. As the soil water content was relatively high, a significant positive correlation between NEE, Re, GPP and temperature, but no significant correlation between NEE, Re, GPP and soil water content, respectively. Importantly, extreme drought events reduced the sensitivity of NEE, Re and GPP on the air temperature. As soil water content was relatively low, there was no significant correlation between NEE, Re, GPP and temperature, but significantly correlation between NEE, Re, GPP and soil water content. During the growing season, CO_2 fluxes was dominant to CH_4 fluxes which was only accounted for a small parts of greenhouse gases. Therefore, extreme drought was an important factor affecting the carbon cycling, and enhanced the global warming potential mainly by increasing the net ecosystem carbon dioxide exchange of Zioge peatland.

Key words: Extreme Drought, Peatland, Carbon Fluxes, Methane

Across-Scale Responses of Vegetation Phenology to Global Changes

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Abstract: Phenology is a sensitive and critical feature of vegetation, and it reflects the effects of climate variability and change on vegetation growth. Monitoring the vegetation phenology is a necessary step in quantifying the effects of climate change on terrestrial ecosystems. The Tibetan Plateau, the largest plateau in the world, has formed a unique climate system. Climate warming magnitude has been greater on the plateau than the other surrounding areas. By integrating manipulative experiments at a plot scale and remote sensing monitoring at a regional scale, this study systematically addressed how vegetation phenology responds to each global change associated factor and the underlying mechanism. At a plot scale, nitrogen addition advanced vegetation green-up; fast warming delayed vegetation green-up and shortened growing season length; enriched CO_2 concentration alleviated the negative effects caused by warming on vegetation phenology. Due to the thicker litter layer and improved soil moisture conditions, grazing exclusion advanced vegetation green-up. At a regional scale, vegetation greening up has apparently advanced in response to climate warming in the past decades. The cross-scale response patterns revealed that effects of climate warming on vegetation phenology vary with the warming magnitude. A moderate warming advanced vegetation greening up, while fast warming delayed vegetation

green-up due to the worsened moisture conditions caused by higher evaporations. Other global change related factors, such as nitrogen addition, CO_2 enrichments and grazing also changed vegetation phenology through modulating the moisture and heat conditions.

Key words: Across-scale Responses

Monitoring and Modeling the "Water- Cryosphere- Atmosphere- Biology" Multi-sphere Interactions over the Third Pole region

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Abstract: The Tibetan Plateau is an important water source in Asia. As the "Third Pole" of the Earth, the Tibetan Plateau has significant dynamic and thermal effects on East Asian climate patterns, the Asian monsoon process and atmospheric circulation in the Northern Hemisphere. However, little systematic knowledge is available regarding the changing climate system of the Tibetan Plateau and the mechanisms underlying its impact on third pole region (Tibetan Plateau and the nearby surrounding region). This study was based on "water-cryosphere-atmosphere-biology" multi-sphere interactions, primarily considering global climate change in relation to the Tibetan Plateau –third pole climate system and its mechanisms. This study also analyzed the Tibetan Plateau to clarify global climate change by considering multi-sphere energy and water processes. Additionally, the impacts of climate change in the third pole and the associated impact mechanisms were revealed, and changes in water cycle processes and water conversion mechanisms were studied. The changes in surface thermal anomalies, vegetation, local circulation and the atmospheric heat source on the Tibetan Plateau were studied, specifically, their effects on the East Asian monsoon and energy balance mechanisms. Additionally, the relationships between heating mechanisms and monsoon changes were explored.

Key words: Monitoring, Modeling, Multi-sphere Interactions, Third Pole

The Impact of Permafrost on Ecosystem Resilience of Alpine Grassland and Implementation in the Source Regions of Yangtze and Yellow Rivers

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Abstract: Due to the special geographical environment, permafrost is widely distributed in the source regions of Yangtze and Yellow Rivers. The water heat

exchange between the permafrost and the climate system maintains the function of alpine grassland ecosystem. Under the context of human activities and climate warming, the change in permafrost has affected the alpine grassland ecosystem. The temporal quantitative study on the dynamic response and its process is extremely rare, in which the relationship of permafrost variation and alpine grassland ecosystem resilience is investigated using the permafrost as an important driving factor. In order to describe the ecosystem resilience of alpine grassland in a more objective manner, the factor of frozen soil has to be considered. In this paper, using the structural dynamics method, we established the structural dynamics model of ecosystem resilience for alpine grassland from the aspects of grassland quality, grassland intervention, grassland potential and grassland pressure dimension, analyzed the variation in the grassland ecosystem resilience of permafrost regions and its sensitivity to the change of permafrost, and also quantified the contribution rate of permafrost active layer change to the ecosystem resilience of alpine grassland. The results indicated that (1) the ecosystem resilience of grassland in permafrost regions showed an increasing trend, especially after 1997, which is the integrated results of precipitation, air temperature in grassland growing season (April to September), NPP and ecological protection projects; (2) the sensitivity of ecosystem resilience of grassland to the variation in permafrost active layer was complicated, experiencing the course of sensitivity, high sensitivity and low sensitivity. Geographically, the sensitivity of northern, and western regions were overall higher than that of southern, and eastern regions, The shape of the high sensitive zone gradually changed from island to band shape, and from island to plane shape; (3) grassland ecosystem resilience was reduced as the increase in the thickness of permafrost active layer. The contribution rate of permafrost to the grassland ecosystem resilience was -4.3%, that is, a 0.04 unit reduction in the grassland ecosystem resilience is caused by every 1 unit increase in the thickness of permafrost active layer; (4) despite an increase in precipitation is clearly beneficial to the improvement of alpine grassland ecosystem resilience, the degradation of permafrost and the intensification of human activities obviously reduce the ecosystem resilience, thus, there are urgent calls for adaptation through a number of measures, such as to improve grassland quality, and mitigate grassland stressor in the face of climate change impacts.

Key words: Ecosystem Resilience, Permafrost region, Thickness of Permafrost Active Layer, Structural Dynamics

T1-15: The Role of Soils and Urbanization in Forest Ecosystem Services and Biodiversity

Comparison of the Microclimate Regulation Functions of Urban Forests in Harbin and Changchun, Two Provincial Capital Cities in NE China

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Abstract: Field observation on urban forests shading, cooling and humidifying effects and its influencing factors, is a foundation to build an efficient urban greening infrastructure with better environmental effects, while a systematic large-scale study is limited. In this paper, a total of 183 plots distributed in whole Harbin urban regions were selected, and 4 different forest types (affiliated forests, AF(51); roadside forests, RF(51); landscape forests, LF(36) and ecological welfare forests, EF(45)) were classified. In the same way, a total of 158 plots in Changchun city were investigated, which were AF (27), RF (26), LF (68) and EF (38). Tree growth-related parameters and environmental factors (inside and outside the forest) were measured simultaneously. The aims of this study were to provide scientific basis for the evaluation and management of urban forest ecological service functions of microclimate regulations, which will provide the data basis for the management of urban trees and the optimization of urban forests structure. The results showed that urban trees were usually young and small in Harbin and Changchun City, and height of most trees was < 10 m. However, trees height in Harbin was 0.57 m higher than that in Changchun on average, and the canopy size was significantly larger than that of Changchun 24.79 m2, and the DBH perimeter was about 12 cm larger. The external climate of Changchun was hotter than Harbin. Light radiation in Changchun City was 24 kLux higher than that in Harbin, and air temperature was 1.5 oC higher. Together with these tree size and outside forest climatic differences in two cities, we found urban-tree-related microclimate differences, such as higher shading degree in Harbin, while larger horizontal cooling effect and humidifying effect in Changchun (Table 1). Moreover, tree size differences and outside-forest climatic differences between 2 cities were possibly responsible for these microclimate regulating differences. The results of this study provide a data basis for the enhancement of microclimatic regulation of trees in urban afforestation.

Key words: Urban Forests, Microclimatic Regulation Functions, Environmental

factors, Tree Growth-related Parameters

The Difference of Mineral Soil Carbon Sink between Broadleaved Plantations and Coniferous Plantations in 4 Soil Types in Northeastern China

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Abstract: Effect of forest type-differences on mineral soil C sequestration and soil nutrient content in different soil types and its relations with root and litter compositional are crucial for afforestation practices and forest management. In this paper, two forest types (coniferous VS broadleaved) in 4 different soil types, including Alfisols, Cambosols, Mollisol and Solonetz, were investigated in northeastern China. Thirty parameters including mineral soil organic carbon (SOC), total N (TN), total P (TP), soil nutrient ratios (C/N, C/P, N/P), litter and root chemical compositional parameters of C, N, P, C/N, C/P, N/P, total phenols, hemicellulose, cellulose, holocellulose, ash and lignin, were measured. Our results showed that broadleaved plantations had higher ($p < 0.05$) SOC, TN and soil N/P (19.2g kg^{-1}, 1.1g kg^{-1}, 4.9) than coniferous plantations (16.0 g kg^{-1}, 0.8 g kg^{-1}, 3.7) for all 4 soil types with various levels. However, for TP, soil C/N and C/P, there was neither marked difference of between two forest types, nor general pattern among 4 soil types. Litter C, C/P, total phenols, cellulose and lignin in coniferous plantation were much higher ($p < 0.05$) than those in broadleaf ones by 1.1- to 1.7-fold, except a contrary tendency in hemicellulose. Organic C, total phenols, cellulose, holocellulose and lignin in coniferous roots were 1.1- to 1.3-fold higher than those in broadleaved root on average. It indicates that more recalcitrant C is in coniferous litter and root than that in broadleaved ones. Correlation analysis showed that the relation between soil properties and root chemical composition parameters was much stronger than the relation between soil properties and litter chemical composition parameters. It revealed that less amount of recalcitrant compounds in roots and faster turnover of organic materials accompany with higher mineral SOC and N sequestration in broadleaved plantation compared to conifer ones. Historical data and future climate changes showed the predominance of broadleaf instead of conifers in NE China, and these trends could result in more SOC and N sequestration may be also with increases in N/P in different soils. Our findings highlight forest type-differences could strongly associate with mineral soil C and N dynamics, and widespread afforestation of broadleaf trees are possibly improving mineral soil C sink.

Key words: Forest Types, Soil Stoichiometric Ratios, Chemical Recalcitrance,

Afforestation Practices

Survival, Growth, and Nutrient Changes in Transplanted Ornamental Tree Seedlings Cultured Under Longer Photoperiod

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Abstract: Larger ornamental seedlings are generally required to plant in urban planting, but it is unclear whether photoperiod-induced larger seedlings can also perform better in urban soils. In the present study, two slowly growing tree species, Buddhist pine (Podocarpus macrophyllus) (PM) and Northeast yew (Taxus cuspidata) (TC), were cultured as seedlings under contrasting photoperiods in 2014 and transplanted to pots with urban soils from April to October in 2015. First-year photoperiod did not affect survival of transplanted PM seedlings, but longer photoperiod increased survival rate of transplanted TC seedlings. Longer photoperiod increased growth of height ($F=21.03$; $P< 0.0001$), shoot biomass ($F=57.43$; $P<0.0001$) and root biomass ($F=7.19$; $P=0.0018$), which, however, did not affect growth of collar-diameter and biomass and resulted in the decline of height growth by 87.8%. After transplant, shoot N concentration generally declined but longer photoperiod remitted N dilution by 54% and 122% in PM and TC seedlings, respectively ($F=351.17$; $P<0.0001$). Shoot P concentration in transplanted seedlings did not respond to photoperiod treatment, which ranged between 6 and 11 mg g^{-1} and averaged to be 8.727 mg g^{-1}. In conclusion, first-year longer-photoperiod can continuously promote shoot growth in transplanted seedlings by improving shoot N utilization, but this influence is species-specific.

Key words: Urban Forest

Analysis on the Growth and Health of Street Trees Based on the Baidu Street View in Harbin City

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Abstract: Spatial distribution rules of the growth and health of the urban street trees is a must for urban trees management and optimizing the urban greening structure, however, quick and efficient survey from internet-based Street View pictures is still

limited and need a case study at a specific city. In this study, Baidu street view pictures were used to quickly and efficiently investigate 879 plots and 26140 trees in Harbin City, and the tree size (tree height, under branch height, canopy size and DBH), vertical structure (arbor, shrub and herb layer distribution) and health level of each plot were measured. We want to analyze the spatial distribution of the tree size, the vertical structure and health level in different districts and different ring roads, and their association relations for providing basic data for urban greening infrastructure improvement. The results showed that the most street trees in Harbin City were small in tree size. Tree height mainly distributed in 3 ~ 9m, and average under branch height was at 4m, while canopy size was usually < 5m and DBH was mainly in the range from 10 cm to 30cm (Fig. 1). Assuming the co-existence of arbor, shrub and grass is the best structure for urban forests, about 35% of the surveyed plots was in this good vertical structure, while over 60% street trees was also not good in Harbin city. The stents-supported trees and dieback trees in Harbin were less than 20%, while plots with over 10% died trees accounted for 8% and abnormal leaf color proportion (non-greenness) was relatively high (plots 100% abnormal tree leaf color were 25% in percentage). Comparison of different administrative districts, the street trees were relative smaller in the Daoli and the Daowai districts, and the vertical structure was the worst in Xiangfang District, and the health level in the Daoli District was the lowest. In the urban-rural gradients related to ring road development, outer ringroad regions (3th and 4th ringroad region) had much smaller trees, non-multiple-layer vertical structure and bad health level compared with inner ringroad regions, i.e. urban street trees growth better than suburb district. Pearson correlations analysis showed that, with the increases of the tree size, the proportion of the stents-supported tree, the abnormal leaf color proportion and the death proportion decreased in general, while the proportion of the dieback percentage increased. Our data suggested that, Baidu-street view pictures is a fast and efficient way to survey forests, and in the future, the protection of the big trees and the tending of the young trees in some administrative districts (such as the Daoli district) should be strengthened. The above results laid the basic data for the construction of Harbin street trees and the promotion of ecological service functions.

Key words: Street Trees, Tree Size, Health Level, Vertical Structure

Surface Soil Carbon Stabilization and Microbial PLFA Composition in Temperate and Sub-Tropical Oriental Oak Stands of East China

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Abstract: Forest ecosystems contain large amounts of soil organic carbon (SOC) that

may be sensitive to climatic change. However, we still lack a clear understanding of how forest SOC will respond in a warming future. We examined the influence of climate on the quantity and quality of SOC for organic and surface mineral horizons in seven oriental oak (Quercus variabilis) forest sites in East China, three in the warm temperate climatic zone and four sub-tropical. The temperate zone sites contained higher amounts of SOC in forest floor horizon (0.96 vs. 0.42 kg m-2 in sub-tropical zone), but similar amounts of SOC in the 0-10 cm mineral horizon (2.97 vs. 3.22 kg m-2). We used a combination of nuclear magnetic resonance (NMR) spectroscopy and elemental and isotopic composition to characterize SOC chemistry. The SOC in the sub-tropical zone appeared to be relatively more stabilized based on significantly higher alkyl/O-alkyl (A/O) ratio and alkyl/methoxyl (A/M) ratio at the 0-10 cm depths; also, using phospholipid fatty acid (PLFA) technique, we found that both microbial biomass and fungal-to-bacterial ratio at the 0-10 cm depth decreased with increasing MAT and MAP along this latitude; the links between surface SOC stabilization and microbial PLFA composition need further investigation. Soil OC exhibited increases in δ13C, δ15N and decreases in C/N with depth for all the seven sites, indicating an increase in its degree of decomposition. Our analysis suggests that warming climate could result in loss of less stabilized SOC from surface soils in temperate zone forests.
Key words: Soil Organic Carbon, Environment Change, Oriental Oak, Stabilization

Relation between Urban Greenness and Air Quality Indexes in China's 27 Provincial Capital Cities

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Abstract: Urban greenness has long been recognized as an important role in cleaning air pollutions. However, their associations in China, the fast urbanization country with heavy air pollution, is lack of a precise definition. In this research, Baidu Street- view pictures were used to calculate the urban greenness, and air quality were quantified in China's 27 provincial capital cities in 2016 from 207 air quality monitoring stations. We found Hefei and Chengdu city had the peak greenness at 10.9% and 10.1%, while Kunming city and Lhasa city had the lowest urban greenness. AQI as a comprehensive air quality index, peak annual and monthly lowest city were found in Haikou, and daily lowest city was found in Nanning, while the peak AQI was found in Zhengzhou for annual average (AQI=117.34), Beijing for summer monthly average (AQI=85.80) and Jinan for daily average(AQI=116.70). Pearson correlations showed that no consistent patterns were found between urban greenness and various air quality indices. For

example, significant positive correlation between urban greenness and AQI were found in the monthly average value (July and August) in Shanghai ($r=0.790$, $p< 0.05$), Kunming ($r=0.919$, $p< 0.05$), and the daily average value in Zhengzhou ($r=0.714$, $p< 0.05$), Guangzhou ($r=0.622$, $p< 0.05$), while no significant relations were found in all other cities. No significant relations between urban greenness and PM2.5 were observed in annual, monthly and daily averages, while significant negative relations were found in PM10 at Shenyang and Hebei in annual and monthly averages. Both the annual, monthly and daily NO averages had signification positive correlation with urban greenness in Guangzhou. The relations between O3 and urban greenness differed in different cities. No signification correlation between monthly SO_2 and urban greenness has been found in all cities in annual, monthly and daily average. Our findings showed that urban greenness and air quality significantly differed in different cities, however, urban greenness showed weak relations with air quality in most of the cities. Thus, although urban afforestation and greening is important for urban pollution removal, our finding highlighted that urban greenness alone has weak contribution for the improvement of urban air quality.

Key words: Urban Greenness, Baidu Street View, AQI

The Associations of Arbuscular Mycorrhiza and Host Plant Were Shaped by Drought Conditions

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Abstract: The arid valley of Minjiang River area, where is one of the most difficult vegetation restoration areas in Southwest China. A serious shortage of available water is that most limited factors for the growth of plants in this region, as well as phosphorous deficiency limited the vegetation restoration. Bauhinia faberi var. microphylla is a native perennial shrub of arid valleys, which is predominant on eroded slopes and plays a vital role in retaining ecological stability in this region. And Glomus mosseae, is a dominated arbuscular mycorrhizal fungi (AMF) species, distributed in B. faberi rhizospheric soil. We designed a full factorial and completely random pot experiment, which including inoculated seedlings with G. mosseae, rhizospheric soil inoculums and non-inoculated seedlings in a greenhouse to investigate the relationship between plant and AMF diversity under three drought stress conditions. The results showed inoculated with AM fungi could significantly promote the growth of seedlings, which infection ratio was 71.43%-97.34% and seedlings have higher maximum photosynthetic rate, water use efficiency, biomass allocation, nutrient (N, P, K) uptakes compared to non-mycorrhizal seedlings. Seedlings inoculated with G. mosseae have

better growth performance compared to seedlings inoculated with rhizospheric soil under medium and light drought stress condition. Although OTU richness, Shannon diversity index, Simpson diversity index and Pielou evenness index of AMF of seedlings that inoculated with rhizospheric soil had no significant difference (P> 0.05) under three drought stress conditions, however, it is interesting that AMF diversity was maximum under lowest water condition (40% field capacity). It demonstrates host plant symbiotic AMF depending environmental conditions and host plant favorites symbiotic more AMF species under harsh drought condition.
Key words: AMF, Biodiversity, Drought, Bauhinia Faberi Var. Microphylla

Urban-Rural Difference of Soil Properties and Tree Species Composition and Their Coupling Relationship in Harbin City, Northeastern China

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Abstract: Urbanization has been greatly accelerated by the economic growth in China, while its possible effects on soil properties, tree species composition and their associations are not well defined yet. Hence, we analyzed urban-rural gradients (landscape level: urban-farmland-forest-natural reserves; city level: ring road and urban build-up history) data in Harbin city, China, to investigate the changes in the soil properties and trees species functional groups during urbanization. Results showed that there was a great variation in the soil quality along the gradient. From rural to urban zones soil pH, soil organic matter (SOM), total P, available P and electrical conductivity (EC) significant increased (p< 0.05), whereas total N decreased (p< 0.05). Harbin soil average bulk density (1.38 g/ cm3), SOM (34.65 g/kg), available P (19.82 mg/kg) and EC (104.26 μs/cm) was 1.28-fold, 2.66-fold, 2.26-fold and 2.41-fold of nature reserve, respectively. PH, Total P and available P significant increased with in city. No matter in landscape level or city level, along urban-rural gradient, available N, total P and available P variation degree decreased, however, SOM and pH variation degree increased. Tree species diversity and composition changed during urbanization, one possible cause was soil properties changes. We found that Pielou index was significantly negative with bulk density, pH, SOM, available P, EC, but positive with bulk density standard deviation (p< 0.05). There was no significant relationship between Shannon-Winer, Margalef index and soil properties (p> 0.05). Overall, total species and native species decreased with BD and C/N increased, however, increased

with total P increases. Our findings would contribute to the uncovering complex associations between the underground soil properties and tree species alternations during fast-urbanization processes.

Key words: Urbanization, Soil Properties, Tree Functional Group

Spatial Variations of Urban Forest Health in Shenyang, Northeastern China

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Abstract: Few doubt the importance of urban forest or that they are intrinsically linked to resident health and well-being, and limited message is available on how urbanization impacting on urban forest heath and its spatial distribution in a specific city, although it is vital important for accurate urban managements for maximizing urban forest ecological services. By using Baidu street view pictures, in this study, 6 evaluation indexes of canopy with withered tips (CWT) percentage, leaf color abnormal percentage, unhealthy tree percentage etc. were visually determined in Shenyang City, with total 1326 plots were evenly (650m*650m net sampling) and 38244 trees were counted. The results showed that Shenyang urban forest ecosystem was not in a very good health status (Table 1) and the proportion of unhealthy trees (UT), leaf color abnormal(LCA), CWT, trees with stents supporting (TWS) was 40%, 35%, 6%, 17%, respectively. In different administrative districts, the proportion of TWS was the highest in Dongling (30%), nearly 50-fold that in Huanggutun (0.6%). The CWT percent in Shenbei new district was higher than 13.1%, however, other area lower than 9.0%. Unhealthy trees peaked in Dadong (58.0%), which was significantly higher than other areas (< 48.8%) ($P<0.05$). In addition to Huanggutun and Sujiatun, we failed to find significant differences in LCA percent in other different districts. In urban-rural gradients related ringroad development, the urban forest health in different ring-roads also had significantly differences. From 1st ring-road to 4th ring-road, the TWS percent sharply increased ($p< 0.05$). The highest CWT percent in 4th ring-road was 1.47-fold higher than 1st ring-road, 2.21-fold higher than 2nd ring-road, and 2.14-fold higher than 3rd ring road regions. The mean UT percent of different ring-roads was between 38.7% and 49.2%. No significant difference was observed in LCA percent among different ring-roads, and the value was 32.0%~38.6%. Our findings in this paper could provide data for urban forest managers, and is also useful for urban forest health monitoring in NE China.

Key words: Urban Forest Health, Baidu Street View, Visual Health Identification,

Urbanization

Impacts of Urbanization on Glomalin Related Soil Protein in Northeast China

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Abstract: Glomalin related soil protein (GRSP) is a hydrophobic glycoprotein which contains metalions (Fe3+) from arbuscular mycorrhizal fungi, that is significant for soil organic carbon (SOC) persistence and sequestration, owing to its large contribution to SOC pool. GRSP (easily extractable GRSP, EE-GRSP, recently produced GRSP fraction; total GRSP, T-GRSP, accumulated GRSP fraction) in plantation forest, primary forest, secondary forest and tropical rain forest ecosystems have been reported in many studies. However, rare study reported GRSP in urban forest ecosystem, although urbanization may affect GRSP due to the increasing urban land use rapidly. To clarify the effects of urbanization on GRSP-related parameters (T-GRSP, EE-GRSP, EE-GRSP/T-GRSP, EE-GRSP/SOC, T-GRSP/SOC) variations, 306 soil samples were collected and analyzed under two urban-rural gradients, defined according to human disturbance time and ring road development in Changchun city, Northeast China. In the ring road gradient, T-GRSP content of the fifth ring road reached 7.01 g/kg, which was 11.09–23.85% higher than T-GRSP in the other 4 ring roads, indicating rural region could largely accumulate T-GRSP. Moreover, EE-GRSP/T-GRSP of the fifth ring road (0.085) was lower than the other 4 ring roads (0.100–0.113), suggested that the rural region could rapidly change the recently produced protein (EE-GRSP) to the accumulated protein (T-GRSP). Obviously, EE-GRSP/SOC and T-GRSP/SOC showed markedly linear decrease with the ring road gradient ($R2 = 0.78, 0.89$; $p < 0.05$), and similar trend was found in the human disturbance time from 1900 to 2014. The results clearly indicate that urbanization can dramatically reduce the contribution of GRSP to SOC pool, although GRSP is an important component of soil organic matter and binding agents. Pearson correlation analysis and stepwise regression analysis showed that the urbanization-induced GRSP-related parameters changes were mainly affected by soil electric conductivity changes ($p < 0.05$), rather than forest types, tree growth and compositional changes ($p > 0.05$). Our findings highlighted that urbanization decreased by GRSP content, and reduced the contribution of GRSP to SOC sequestration.

Key words: Urbanization, Glomalin Related Soil Protein, Soil Organic Carbon, Electric Conductivity

Soil Nitrogen Availability Affects Belowground Carbon Allocation and Soil Respiration in Hardwood Forests of New Hampshire, USA

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Abstract: Plant nutrient acquisition in forests requires respiration by roots and mycorrhizae. Belowground carbon allocation and soil respiration should thus reflect plant effort allocated to nutrient uptake, for example in conditions of different nutrient availabilities controlled by site quality or stand history. Soil respiration, belowground C allocation, and fine root biomass were measured in three sites differing in nutrient availability in the northern hardwood forests of the White Mountains of New Hampshire, USA. Annual soil respiration and belowground C allocation measured in two stands at each site were lowest at Jeffers Brook, the site with highest nutrient availability, and higher at Hubbard Brook and Bartlett Experimental Forests. Soil respiration was significantly higher in successional (< 40-year-old) than mature (>90-year-old) stands, despite higher fine root (<1 mm) biomass in old stands. Across all 13 stands monitored in our three sites, soil respiration during the growing season was low where net nitrogen mineralization and net nitrification were high, and across the six intensively studied stands, annual belowground C allocation (estimated as soil respiration minus litterfall) decreased with increasing nitrification. Available P was not related to soil respiration. Plots in all 13 stands were then treated with low levels of N (30 kg/ha/yr), P (10 kg/ha/yr) or N+P. Significantly lower soil respiration was observed in nutrient addition plots at four of the most infertile stands. Most of the variation in the response of soil respiration to fertilization was explained by the N status of the stands, with the greatest reduction of soil respiration to N addition in the stands with lowest pre-treatment soil N mineralization and litterfall N flux. The relationships among N availability, belowground C allocation, and soil respiration support the claim that forests allocate more C belowground in ecosystems with low availability of a limiting nutrient.

Key words: Forest Soil Respiration, Root Biomass, Nitrogen Mineralization, Total Belowground Carbon Allocation

Stoichiometry of Deciduous Tree Seedlings Grown in Different Soils Exposed to Free-Air Ozone for Two Growing Seasons

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Abstract: To maintain urban mixed broad-leaved forests, the effects of elevated O3 in different soil conditions on foliar stoichiometry in elements were investigated in 3 native tree species with free-air enrichment systems in northern Japan over two growing seasons. Essential elements (Ca, Fe, K, Mg, Mn, N, Ni, P) and two unessential elements (Al, Ni) were analyzed in leaf samples obtained from 6 different treatments of O3 and soils at 5 sampling times though 2 growing seasons. In this study, interrelations among the foliar elements within each species were investigated and negative correlations between foliar N and the metal elements were observed in birch (Betula platyphylla var. japonica). From the differences of foliar contents as well as their re-translocation rate, beech (Fagus crenata) with determinate shoot growth pattern had rather a low capacity of foliar contents on O3 stress meanwhile oak (Quercus mongolica var. crispula) was possibly susceptible to O3 on dynamics of immobile elements. Re-translocation rate of Fe, K and P had distinct impacts with soil nutrient conditions. Principal component analysis revealed that Mn and K can become indices in assessing the O3 and soil effects in both short- and long-term monitoring of the growth of these tree species. Our findings are essential in further comprehension to nutrient conservation mechanism in multi-use of broad-leaved forests establsihed in different edaphic conditions.
Key words: Stoichiometry, Foliar Nutrients, Free-air Ozone, Volcanic Ash Soil

Variation of Glomalin Related Soil Protein in Urban-Rural Gradients at Harbin City, Northeast China

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Abstract: Glomalin Related Soil Protein (GRSP) is one kind of glycoprotein containing Fe3+ from arbuscular mycorrhizal fungi, and it has the potential to increase soil carbon, nitrogen storage and regulate soil physics. Currently, fewer studies have focused on the urbanization induced variation of GRSP and possible underlying reason related with plant species, land uses and soil properties. In this paper, total 257 soil samples from surface soil under urban forests and trees were sampled in whole city, and GRSP (total amount, TG and easily-extracted, EG), soil bulk density, soil organic carbon, pH and EC were determined, together with classifications of urban-rural gradients (ringroad and urban history), tree species identification (in family), forest types according to landuse (AF, affiliated forest; RF, roadside forest; EF: ecological welfare forest and LF, landscape forest, Farmland) and tree size (height, diameter at breast height [DBH], canopy size and underbranch height). Our result showed that, in

the ring road urban-rural gradient, TG and EG were peaked in the 5th ring road (P< 0.05). EG/SOC was consistent with TG/SOC, the value of 5th ring road were significant higher than other ring roads. Linear decreases in TG, EG, EG/SOC and TG/SOC were observed from 5th ring road to 1string road (P< 0.05). In the urban history urban-rural gradient, TG, EG, EG/SOC, TG/SOC of non-urban regions were the highest (P< 0.05). For EG/TG, no significant differences were found both in the ring road urban-rural gradient and in the urban history urban-rural gradient. In addition, soil properties (pH, electric conductivity, soil bulk density), tree sizes (tree height, DBH, canopy, under branch height), tree compositions and forest types also showed significant changes in both urban-rural gradients, and their variations were possibly responsible for the GRSP variations, as manifested by Pearson correlation and stepwise regression analysis. Of them, pH, soil bulk density, percentage of LF and RF were negatively correlated with the TG variations (P < 0.05), while percentage of Poaceae, Farmland, and EF, tree height and DBH were positively correlated with the TG and EG variations (P < 0.05). Our data provided an example of urban soil GRSP variation for improving soil-based urban vegetation ecological services for resident life, and the findings highlight that urbanization-induced GRSP changes and contribution to SOC carbon sequestration should be considered in soil improvements in urbanized regions.
Key words: GRSP, Urban-rural Gradient, Origin Analysis,

Urban Greenness Comparison of 31 Provincial Capital Cities in China and Their Geographic-Social Variation Patterns Based on Internet-Street-View Picture Analysis

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Abstract: Urban vegetation greenness is the basis for ecological services, and inter-city ranking comparison and underlying mechanism clarification may favor the city green infrastructure development and management. Through 748296 internet street-view picture analysis of all 31 province capital cities of whole China, we found that urban greenness of Hefei, Chengdu and Chongqing had the best urban greenness, while Shijiazhuang and Lhasa had the poorest greenness on average. Intra-city variations in greenness was lowest in Lhasa and Urumuchi, while largest intra-city variations were found in Nanjing and Beijing. These urban greenness pattern on average was mainly controlled by climatic condition, rather than economic development. However, the possible highest greenness of a city was determined by both climatic conditions and social development, i.e., lower sunshine hours, higher mean annual precipitation (MAP) and air humidity (RH), together with higher income and GDP usually accompanied

with the highest peak greenness. However, we failed to find that higher social development accompanying deduction in intra-city greenness variations, indicating a risk that economic development in China has possibly resulted in even larger unequality of greenness distribution in urban region. In future, urban green infrastructure development should take full consideration of this risk for a more equality distribution of greenness in whole urban region for a better civil well-being.

Key words: Urban Greenness, Urban Forest, Climatic Differences, Unenveness of Urban Greenness

Semi Variogram Analysis on the Spatial Heterogeneity of Urban Tree Characteristics in Harbin City

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Abstract: Abstract: Determination of the optimum sampling intervals and reasonable sampling numbers is important for making an efficient survey method for urban forests and tree growths, and semi-variogram analysis on field survey data has shown a mathematical method for providing these sampling protocol. Based on the large dataset of tree sizes(canopy size[CS] ,under the branch height[UBH], tree height [TH] and diameter at breast height[DBH]) derived from street view picture measurement in Harbin city, this paper want to find out the spatial variability, reasonable sampling interval and minimum sample numbers in making urban tree survey in Harbin city. Owing to the fact of Nugget value and base value of the ratio (C0 /C0+C) reflecting the spatial heterogeneity of the random part of the total spatial heterogeneity degree, we found that random part of the spatial heterogeneity for CS, UBH, TH, DBH contributed 26.56%, 8.16%, 8.14%, 12.80% of total heterogeneity, respectively. The anisotropy analysis showed that CS, UBH, TH, DBH in Harbin city showed non-significant differences at 0 °, 45 °, 135 °, and 180 °directions. The semi-variogram range values for CS, UBH, TH, DBH were 2340 m, 1320 m, 1470 m, 1890 m (Fig. 1), respectively, and the sampling interval should be within these range values for identifying the spatial heterogeneity. Considering the whole city area, thus the minimum sampling number was 156 samples for the CS, 440 samples for the UBH, 360 samples for the TH and 224 samples for the DBH. Our findings highlight the importance of understanding urban forest spatial heterogeneity and also guide the sampling protocol for urban forest studies in future in a more efficiently and rapidly way. Keywords: canopy; height under branch; tree height, diameter at breast height; semi variance analysis; spatial heterogeneity

Key words: Semi Variance Analysis, Spatial Heterogeneity, Canopy, Tree Height

Mapping street trees and their ecosystem services using Google Street View

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Abstract: The streets carry most of human activities in cities. It is important to map the urban landscape along streets in urban studies. Google Street View (GSV), which captures the profile view of streetscapes and has similar view angles with people on the ground, is probably the ultimate representation of the real world. It could be a very promising data source for street-level urban landscape mapping. However, few studies using the street-level images for cartographic purposes. In this study, we introduced two projects using GSV data to map the visibility of street greenery and shade provision of street trees within street canyons in Boston, Massachusetts, United States. The green view index, which literally represents the visibility of street greenery on the ground, was used to map the spatial distribution of street greenery based on static images captured at different horizontal and vertical angles. GSV panoramas together with LiDAR data were used to map the shade provision provided by street trees within street canyons in Boston. Results show that the GSV data would be a very useful data for urban landscape mapping in future urban studies.

Key words: Urban Environment, Google Street View, Street Greenery

The Influences of Fire to Forest Carbon, Plant Diversity, and Community Structure in Daxing'an Mountain Region of Northeastern China

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Abstract: The influences of fire to forest carbon, plant diversity, and community structure in Daxing'an Mountain Region of northeastern China Yang yanga , Zhong zhaolianga, Zhang jianyua, Du hongjua, Ji qianruc, Wang wenjieab*a Kay Laboratory of Forest Plant Ecology, Northeast Forestry University, Harbin 150040, P.R.Chinab Urban forest and wetland research group, Northeast Institute of geography and Agroecology, Chinese Academy of Science, Changchun 130102, P.R.Chinac City institute of Dalian University of Technology, Dalian 116600, P.R. China*: wjwang225@hotmail.comThe Daxing’an mountain is a frequent area for forest fire in

China, and forest fire plays a significant role in the stability of forest biodiversity, ecosystem reconstruction in this area. This study based on the survey in 5 national nature reserves at the Daxing'an mountain region of northeastern China, for exploring the effect of forest fire (<10 years after fire, 10-20 years, 30 years, 85 years) on forest carbon capture, biodiversity and community structure index. We found that significant effect of fire time on shrub coverage, breast height diameter, arbor and shrub biodiversity index, litter, shrub biomass and total carbon ($p < 0.05$). The grass coverage and biomass carbon were decreased with the increase of time after fire ($p < 0.05$). Meanwhile, with increases of time after forest fire, sharp increase in breast height diameter and shrub biomass carbon were found, and 85 years after forest fire had the maximum values at 14.3 m and 0.59 t hm-2, which were 14-fold, 5.4-fold higher than those in 10 years after forest fire, respectively. Shrub, total biomass and total carbon significantly increased with the time after forest fire ($p < 0.05$), while opposite tendencies were found in grass biomass carbon ($p > 0.05$). However, no evident effects were found in carbon storage, shrub ground diameter and grass height ($p > 0.05$). [Figure 1] No nomological changes were found in diversity indexes, and middle peaks at 30 years after forest fire were found trees and shrubs biodiversity. Our results highlight that long term (e.g. 85-yr) conservation of natural forest after forest fire could nomologically increase biomass carbon, but differed in different layers. However, such conservations cannot co-enhance the plant species diversity. Our data will benefit for the evaluation of forest function in the post-burning area of Daxing'an Mountain, the southern region of boreal forest in China.

Key words: Forest Fire, Forest Carbon, Biodiversity Index, Community Structure

Effects of China National Nature Protection Programe on Carbon Sequestration, Diversity Conservation, Structural Alternation and Their Associations in Northeastern China

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Abstract: The national nature reserve is an important platform for ecological civilization construction, evaluation of forest carbon sequestration, biodiversity conservation from natural forests protection programme. In recent years, more attention paid to the research of forest structure and carbon capture in nature reserve, but the difference of forest carbon accumulation, community index and their correlation in different functional areas of the reserves were rarely reported. The natural protection intensity is grouped as different functional area of the national nature reserve, i.e., the strongest conservation is in the core region, followed by experimental region and buffer

region, and the lowest conservation intensity is outside national nature reserve. This study based on 5 national nature reserves at the Daxing'an mountain region in northeastern China, to explore the effects of natural forest protection on forest carbon capture, biological diversity and community structure index, and their associations. We found that protection intensity sharply increased total biomass carbon, while no such tendencies were found soil carbon. Experimental area had the maximum values of soil moisture and soil N, which were 0.67%, 0.55 kg m-2, and 2.8-fold, 1.6-fold higher than those in the core area, respectively. Tree height, diameter at breast height and under branch height significantly decreased ($p < 0.05$), while grass height and coverage significantly increased ($p < 0.05$) with protection intensity decreased. The difference of shrub height and coverage was not obvious ($p > 0.05$), respectively between 0.73-0.64 m and 21.2-17.2%. Protection intensities did not evidently affect diversity indices of Simpson, Shannon-wiener and richness ($p > 0.05$). The correlation analysis showed that soil moisture, nitrogen, C: N, shrub coverage, grass height and grass coverage had positive ($p < 0.01$) associations with soil carbon and grass biomass carbon accumulation. Herb diversity indices had significant correlations ($p < 0.01$) with total carbon, arbor and shrub biomass carbon. Our findings highlight that the natural protection programme implemented in China could strongly affect biomass carbon sequestration through arbor, shrub and herb layer structural alternation, while underground carbon capture and plant diversity showed moderate influences from the conservation programme. The data in this paper could support the long-term evaluation of the national natural protection programme with reference to the forest natural reserves, widely distributed in the national forests in NE China.

Key words: Functional Areas of National Nature Reserve, Forest Carbon, Soil Properties, Community Structure Index

Spatiotemporal Pattern of Urban Forest Structural Attributes in Response to Rapid Urbanization and Urban Greening

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Abstract: Rapid urbanization and urban greening has caused the great changes of urban forest in China. Understanding spatiotemporal dynamics of urban forest structure under rapid urbanization and urban greening is important for urban forest planning and management. Therefore, we evaluated and explored the potential of estimating urban forest structural attributes by using Landsat TM imagery. For this case, we first collected three scenes of TM images acquired in 1997, 2004 and 2010 and conducted a field survey to collect urban forest structural data (including crown closure (CC), tree

height (H), leaf area index (LAI), basal area (BA), stem density (SD) and diameter at breast height (DBH), etc.). We then calculated and normalized NDVI maps from the multitemporal TM images. Finally, spatiotemporal urban forest structural maps were created using NDVI-based urban forest structure predictive models. The results show that NDVI could still be used as predictor for some urban forest structural attributes (i.e., CC, LAI and BA), but not for some other attributes (i.e., H, SD and DBH) that can be well predicted in natural forests. Both rapid urbanization and urban greening contribute to the changing process of urban forest structure. Urban vegetated pixel decreased gradually from 1997 to 2010 due to the intensive urbanization. The results also show that urban forest structural attributes (i.e., CC, LAI and BA) in the whole study area decreased sharply from 1997 to 2004 and increased slightly from 2004 to 2010 becaused of many urban greening policies. The CC, LAI and BA class distributions were all skewed toward low values in 1997 and 2004. Moreover, LAI, CC and BA of urban forest all present a decreasing trend from suburban areas to urban central areas. We demonstrated the usefulness of TM remotes sening in understading spatiotemporal change pattern of urban forest structure under rapid urbanization and urban greening.

Key words: Spatiotemporal Analysis, Urban Forest Structure, Landsat TM Imagery, NDVI

THEME 2

Global Climate Change and Ecosystem Adaptation

T2-01: Global Climate Change and Ecosystem Adaptation

Effects of Doubled CO_2 Concentration on Contents of Active Ingredients in Lycium Barbarum Fruit

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Abstract: Atmospheric CO_2 concentration has increased steadily with increasing industrialization and urbanization in China and has reached approximately 370 μmol·mol–1. It is estimated that atmospheric CO_2 will increase to 470–570 μmol·mol–1 by 2050 and will exceed 700 μmol·mol–1 by the end of this century (IPCC 2007). Carbon dioxide is the substrate for photosynthesis, and atmospheric CO_2 is a limiting factor for C_3 photosynthesis, affecting plant physiological and biochemical processes. Global climate change resulting from increased atmospheric CO_2 and characterized by an intensified greenhouse effect has indirect and direct effects on photosynthesis and crop growth. High atmospheric CO_2 concentrations can strongly influence crop yield and quality. Lycium barbarum L. is a solanaceous deciduous shrubbery, originating from Ningxia Province, and distributed in arid and semi-arid regions of China. The fruit of L. barbarum (Goji berry) is a well-known traditional Chinese medicine as well as a valuable nourishing tonic, which is widely used in Asian countries. Increasing number of studies have confirmed that the fruit has vital biological activities, such as antitumor activity, antiaging effects, anti-glaucoma effects, immunomodulation, neuroprotection, promotion of endurance, increased metabolism, improved control of glucose and other diabetic symptoms, etc. These activities are due to the presence of active ingredients in the fruit, among which flavonoids, carotenoids, polysaccharides, and taurine have been reported to be closely associated with its health-enhancing effect. Hence, the content of these active ingredients affects the fruit quality. In order to study the effects of elevated carbon dioxide (CO_2) concentration on the contents of biologically active compounds in Lycium barbarum fruit, seedlings of L. barbarum were exposed to either ambient CO_2 (350 ± 20 μmol·mol^{-1}) or elevated CO_2 (700 ± 20 μmol·mol^{-1}) in open-top chambers for three growing seasons, and polysaccharide, carotenoid, falconoid, taurine, and total sugar contents were assessed. Under elevated CO_2, carotenoid and flavonoid contents decreased by 16.48% and 12.82%, respectively; taurine and polysaccharides decreased by 15.27% and 7.9%, respectively; and sucrose and starch decreased by 14.14% and 23.64%, respectively. Our findings indicate that elevated atmospheric CO_2 may affect the nutritional quality of L. barbarum fruit.

Key words: Lycium Barbarum, Elevated CO_2 Concentration, Fruit Quality,

Polysaccharide Contents

Ecophysiological Responses of Camellia Japonica (Naidong) to Different Water and Light Conditions

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Abstract: Camellia japonica (Naidong) living in Qingdao, China, is a special ecotype of Camellia japonica and was research materials in present study. The Camellia japonica (Naidong) saplings were subjected to two light regimes L1, L2 (65%, 15% of full sunlight), and three water supply regimes W1, W2, W3 [75%, 50%, 25% of field capacity (FC)]. The ecophysiological and morphological responses of Camellia japonica (Naidong) were studied. The results showed that height (H), basal diameter (BD) and crown area (CA) of Camellia japonica (Naidong) were increased with the treatment time under L1 and L2, the morphological index was higher with the L1 treatment as compared to the L2, and the relative growth rate of each index increased rapidly. But with the extending of stress time, the relative growth rate increased slowly; SLA and LWC under L2 was significantly higher than L1. With the decreasing of water regimes, the Photosynthetic Rate (A), Ranspiration Rate (E), Stomatal Conductance (Gs) and Water Use Efficiency (WUE) decreased, Intercellular CO_2 Concentration (Ci) increased gradually, and Vapour Pressure Deficit (VPD) increased firstly and then decreased. The value of Maximal Fluorescence in the dark (Fm) Variable Fluorescence (Fv) and Maximal Quantum Yield (Fv/Fm) under the L1 conditions were higher than L2 conditions, and the Initial Fluorescence in the dark (F0) showed the opposite trend. With the decreasing of moisture gradient, the F0 increased gradually under L1, while showed the opposite trend under L2. Significant differences were found in photosynthetic pigment contents of leaves among various light and water treatments. Under high irradiation, chlorophyll a, chlorophyll b and total chlorophyll were higher than low irradiation, and the Chla/Chlb value showed the opposite trend. The contents of Superoxide Dismutase (SOD), Peroxidase (POD), Catalase (CAT), Malondialdehyde (MDA) and Proline (Pro) were significantly difference at every level of light and water treatment. And the contents of POD, SOD increased firstly and decreased later with the water gradient decreasing. The content of CAT decreased with the decreasing of water content under L2 conditions, and the contents of MDA and Pro increased gradually with the water gradient decreasing. Drought or shade has some restrictive effect to the growth of Camellia japonica (Naidong), certain moisture and light were favorable for plant growing. Camellia japonica (Naidong) could tolerate a certain degree of drought resistance and adapt the larger amplitude of light intensity. At

the same time, it can change the enzyme activity and osmotic adjustment substances to against damage.

Key words: Camellia Japonica (Naidong), Shading, Drought, Ecophysiology

Water Use Strategies among Different Functional Types Plant in a Monsoon Evergreen Broad-Leaved Forest at Dinghu Mountain of China

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Abstract: The monsoon evergreen broad-leaved forest in Mt. Dinghu National Nature Reserve, a typical zonal vegetation in the south subtropical zone of China provides a unique and important opportunity for climate change studies. Therefore, researches on the main source of plant water and the water use strategies of different functional types plant of different intensity precipitation provide evidence for the response mechanism of vegetation structure of monsoon evergreen broad-leaved forest in South China to the precipitation pattern change. In this study, the δD of dominant plant water and the potential water sources including precipitation, soil water, stream water and groundwater were analyzed to determine the source of plant water and the water use strategies of different functional types plant of the monsoon evergreen broad-leaved forest in MT. Dinghu National Nature Reserve, using hydrogen stable isotope technique. The water use efficiency was calculated by two element linear mixed model. The rainfall use efficiency of Castanopsis chinensis was 12.3% - 28.1%, the rainfall use efficiency of Schima superba was 47.0% - 62.3%, the rainfall use efficiency of Psychotria asiatica was 23.1% - 40.3%, and the rainfall use efficiency of Blechnum orientale was 31.2% - 47.4% under the small rainfall event of ≤10 mm. The rainfall use efficiency of C. chinensis was 5.9% - 24.5%, the rainfall use efficiency of S. superba was 32.9% - 58.7%, the rainfall use efficiency of P. asiatica was 16.7% - 35.2%, and the rainfall use efficiency of B. orientale was 19.2% - 46.6% under the moderate rainfall event of (10 - 20 mm). The rainfall use efficiency of B. orientale was the highest (39.7% - 92.2%) and the rainfall use efficiency of S. superba was the lowest (11.3% - 35.2%) under the heavy rainfall of >;20 mm during the same day either in the wet season or in the dry season. The results showed that: (1) Precipitation and groundwater were the sources of the plant water in a monsoon evergreen broad-leaved forest in MT. Dinghu National Nature Reserve. (2) In heavy rain, the water content of each soil layer in the wet season forest was higher than that in the dry season under the same precipitation intensity. (3) Plant utilization under the small rainfall and the moderate rainfall was, in a decreasing order, S. superba, B. orientale, P. asiatica, C. chinensis; plant utilization

under the heavy rainfall was, in a decreasing order, B. orientale, P. asiatica, C. chinensis, S. superba. The tree layer S. superba had different water use strategies under different intensity precipitation, the plant utilization under the small and the moderate rainfall was the highest, and the plant utilization under the heavy rainfall was the lowest. (4) The water use strategies of different functional types of monsoon evergreen broad-leaved forest were closely related to their root distribution.
Key words: Hydrogen Stable Isotope, Forest of Dinghu Mountain, Functional Type Plant, Water Use Strategies

Preliminary Assessment of Biodiversity/Ecosystems Vulnerability by Climate Change and Suggestion a System of Mitigation Measures for Them, Case Study: Hanoi City, Vietnam

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Abstract: In the paper, the authors applied the following items in order to assess the vulnerability of ecosystems / biodiversity of Hanoi city caused by climate change and to suggest a system of mitigation measures for them: The concepts on vulnerability, resilience, exposure, sensitivity, adaptation, mitigation according to guidelines of IPCC (2007). The impacts of climate change on ecosystems/biodiversity according to the results of researches of CBD experts (2009). Analysis the impacts of the factors of climate change on ecosystems/biodiversity according to the principles of ecological sciences. The characteristics of all 13 main ecosystems/biodiversity of Hanoi city are research results of the authors and our colleagues. Preliminary assessment of ecosystems/biodiversity vulnerability by climate change of the 13 above main ecosystems/biodiversity of Hanoi city are: Group of ecosystems/biodiversity with high vulnerability: urban ecosystems, rural ecosystems, agricultural ecosystems, grassland ecosystems, and land ecosystems yards outside the dyke. Group of ecosystems/biodiversity with middle vulnerability: nature lake ecosystems, dam ecosystems, wetland ecosystems, stream ecosystems, big river ecosystems. Group of ecosystems/biodiversity with low vulnerability: cave ecosystems, forest ecosystems. A system of 7 mitigation measures must be applied, such as: to increase the sustainability of biodiversity/ecosystems, to reduce current pressure on biodiversity/ecosystems, to enhance community awareness, to actively implement REDD program.
Key words: Ecosystems Vulnerability, Climate Change, Mitigation Measures, Hanoi, Vietnam

Climate Change and Korean Red Pine Dieback

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Abstract: Korean Red Pine (Pinus densiflora) has been protected and used as the most ecologically and socio-culturally important tree species in Korea. However, as dieback of Korean red pines has occurred in the protected area of the forest genetic resources. The aims of this study is to identify causes for the dieback of pine trees by investigating topographical characteristics of pine tree dieback and its correlation to meteorological factors. We extracted the dead trees from the time series aerial images and analyzed geomorphological characteristics of dead trees concentration area. As a result, 1,956 dead pine trees were extracted in the study region of 2,600 ha. Dieback of pine trees was found mostly in the areas with high altitude, high solar radiation, low topographic wetness index, south and south-west slopes, ridgelines, and high wind exposure compared to other living pine forest area. These areas are classified as high temperature and high drought stress regions due to micro-climatic characteristics affected by topographic factors. As high temperature and drought stress are generally increasing with climate change, we can evaluated that a risk of pine tree dieback is also increasing.
Key words: Pinus Densiflora, Dieback, Topographic Characteristics, Climate Change

Dynamic of CO_2 Fluxes and Productivity in Tropical Ecosystems: A Case Study of Sudanian Forests and Savannas in Benin (West Africa)

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Abstract: Continuous CO_2 fluxes were measured over three contrasting ecosystems with an eddy-covariance system from 2005 to 2009 in Benin. The fluxes data were completed by an inventory of dominating species around towers and the meteorological measurements. Fluxes were analyzed following the standard procedure and two main seasons imposed by the West African Monsoon cycle. Water availability was the main factor driving the dynamics of the ecosystems and carbon fluxes. During the day conditions, fluxes were mainly controlled by the radiation and were always higher for forest than savanna. The relationships were close between the CO_2 uptake and canopy conductance.

The ecosystem respiration was controlled by soil water availability. After a significant dry period, the respiration increased immediately in response to first significant rains. No clear dependency of the ecosystem respiration on temperature was observed.

The courses of WUE suggest a VPD influence, notably a partial stomatal closure impact besides radiation control. However, the sensitivity to the water usage did not vary for the forest. In contrast, it decreased for the savanna about 46 % from dry to wet seasons.

The forest and savanna acted as carbon sinks with 640 $\pm$ 50 and 232 $\pm$ 27 g C $^{m-2\ yr-1}$, respectively. Finally, this study suggests that the ecosystem respiration control the inter-annual variability of the carbon sequestration.

Key words: Eddy-covariance, Carbon Fluxes, Water Usage, Forest, Savanna, Benin, West Africa

Susceptibility of Different Mangrove Forests to Sea-level Rise at a Lagoon in China

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Abstract: Sea-level rise threatens the long-term sustainability of mangrove ecosystems and a key determinant of mangrove vulnerability is whether its surface elevation can keep up with rising sea level. Here the data set derived from 27 rod surface elevation table-marker horizon (SET-MH) stations at Dongzhaigang Bay, Hainan, China were analyzed to test whether the soil surface elevation changes varied with different mangrove settings and whether the soil surface elevation changes is keeping up with local rates of sea level rise (3.66 mm•y^{-1}). Mangrove surface elevation changes varied from -5.7 to 35.3 mm•y^{-1} (average of 11.5 mm•y^{-1}) across 27 SET-MH stations differing significantly by 9 mangrove settings (-1.9 to 21.4 mm•y^{-1}) and 3 sites (2.9 to 16.3 mm•y^{-1}). All mangrove settings experienced positive surface elevation changes, but seaward margin at Houpai site. Obvious difference was displayed between not only different vegetation types but also the same species types (Rhizophora stylosa) across the bay. In addition, surface elevation gains were sensitive to position in the intertidal zone (lower when higher in the intertidal). For 82 percent of SET-MH stations, the soil surface elevation gains exceeded the rate of local sea-level rise. Mangrove forests tend to keep up with local sea-level rise on the whole and not be subjected to adverse impacts from sea-level rise. However, Rhizophora stylosa forest and seaward margin at Houpai site are at high risk of being replaced by open water due to low surface elevation gains.

Key words: Mangroves, Sea-level Rise, Surface Elevation Change, Vegetation Type

Effects of Nitrogen and Phosphorus Addition on Aboveground and Belowground Biomass in a Meadow Steppe of Northeast China

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Abstract: Since the industrial revolution, because of human activities including fossil-fuel emissions, fertilizer consumption and livestock emissions, total inorganic atmospheric nitrogen (N) deposition significantly enhanced. In China, from 1980 to 2010 atmospheric nitrogen deposition increased at an annual rate of 0.41 kg N ha^{-1}. Moreover, N fertilization has been used as a management tool to enhance grassland primary productivity. The projected enhancement in N deposition is likely to shift limiting nutrient for biomass production from nitrogen to other macronutrients, such phosphorus (P). To test the effects of nitrogen addition on grassland biomass production, we conducted a N and P addition experiment in a meadow steppe in northeast China. We predicted that nitrogen addition would increase aboveground and belowground biomass, and would cause grassland phosphorus deficiency. Moreover, P addition would interact with N addition, especially at high N addition rates, to further increase biomass production. In 2015, 8 blocks (each has an area of 35m×70m) similar in vegetation composition was established. Within each block, 18 plots (each has an area of 10m×10m) were laid out and each plot was randomly assigned one of the N (0, 2.5, 5, 10, 20 and 40 g N m^{-2} yr^{-1}) and P (0, 5 and 10, g P m^{-2} yr^{-1}) addition treatment in combination. N and P treatment was implied since May 2015. Aboveground vegetation were sampled in early August of 2016 by clipping all plants at the soil surface using a 0.5m×0.5m quadrat randomly placed in the plot. Moreover, belowground biomass were taken from the surface to a depth of 10cm using a 8.4 cm diameter soil auger. The biomass were oven-dried at 65 ℃ for 48 h and weighed. In general, N addition increased aboveground and belowground biomass; but decreased root: shoot ratio. Nitrogen use efficiency gradually decreased with the increasing of N addition rate. P addition alone had no significant impacts on both aboveground and belowground biomass. However, there were interactions between P addition and N addition, especially at high nitrogen addition rates (20 and 40 g N m^{-2} yr^{-1}). The results indicated when N addition exceeded a certain rate (10 g N m^{-2} yr^{-1}) biomass production in the studied grassland was constraint by P insufficient. Overall, biomass production in the studied meadow steppe is likely to be benefited by the projected increase in N deposition. P addition is need at high N deposition or N fertilization rates in order to use N more efficiently. These results have a guiding significance for the sustainable development of the meadow steppe ecosystem.

Key words: Nitrogen Addition, Phosphorus Addition, Biomass, Meadow Steppe

Built-up Resilience to Climate Change in Peatlands

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Abstract: Peatlands have stored 600–700 gigatonnes of carbon over millennia. Many studies suggested that climate change, like drought and warming, may decrease C sequestration and increase C loss in peatlands, thus resulting in a positive feedback on climate change. However, peatlands broadly distributed from boreal to tropical regions have experienced complex climate conditions and, however, have consistently accumulated carbon historically, which is contrary to the short-term observations. In our study, we first synthesized published studies which showed that peatlands may have adaptive mechanisms other than anoxia to preserve carbon under drought. Second, we conducted a series of field and lab experiments in shrub peatlands to document how previously unrecognized mechanisms regulate the buildup of anti-microbial phenolics, which protects stored carbon directly by reducing phenol oxidase activity during short-term drought, and indirectly through a shift from low-phenolics Sphagnum/herbs to high-phenolics shrubs after long-term moderate drought. Third, we showed a symbiosis of slow-growing fungi along with high-phenolic plant shift decreased the temperature sensitivity of decomposition and stabilized the stored peat. We suggest that shrub expansion induced by climate change in boreal peatlands may be a long-term self-adaptive mechanism not only increasing carbon sequestration, but also potentially protecting soil carbon. Therefore, the projected "positive feedback loop" between carbon emission and climate change in peatlands may not occur in future. Peatlands are a strong self-stabilizing long-lived ecosystem in which the symbiotically adaption of plant-microbe triggered by persistent climate change likely can acclimate to the stressors and maintain their carbon sequestration function and processes.

Key words: Carbon Sequestration, Peatland, Climate Change, Adaptation

Isolation and Identification of Aeromonas Media Inhibiting N_2O Emission from Soil and Mitigation Mechanism Analysis

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Abstract: Larger amount of greenhouse gases emitted from agricultural soil have been one key factor causing global climate change because GHG CO_2、N_2O was originated from the degradation and transformation of great deal of wilted braches and plants in

the soil via microorganisms year by year. One of Solutions to global climate change is reduction of agricultural soil greenhouse gases emissions. An actinomycete Aeromonas media was isolated and identified from soil. This antinomyce could inhibit the N_2O emission from soil. The strain was cultured in Gause I medium where the colony in the culture was grey, tight mycelium, branched mycelium with spore microscopically. It's suitable growth temperature was 10-40℃, pH7-8, impact culture Gause I and PDA. Bottle incubator was conducted in a lab experiment in this investigation. Different dosage of pure culture broth was added in the soil for one month experiment. Resoults showed that a decrease of over 50% of N_2O from soil treated with Aeromonas media was found compared to control (without addition of microbial broth). N_2O was decreased by 20-55% from soil treatment of different crop stalks (wheat, rice and garlic) with a significant mitigation of greenhouse gas. Quantitative fluorescent PCR analysis indicated that the number of soil Nitrobacter, Nitrospira, Nitrococcus and cellulose-degrading bacteria was declined by 40-60%. GC-MS analysis demonstrated that some active compounds were found. These active substrate could decrease the N_2O emission from soil implying a sound application future for agricultural GHG mitigation.

Key words: Aeromonas media, N_2O , Inhibition, Greenhouse gas mitigation, Mechanism

The Dominant Species Stipa Grandis Was Depressed by Nitrogen Deposition

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Abstract: Nitrogen deposition has become greater due to human activities recent years, which has serious effects on terrestrial ecosystems. Nitrogen induced consequences upon grassland ecosystems have been intensively studied, mainly concentrated on species loss and biodiversity decrease and changes of community composition and ecosystem stability. For better understanding the influences of nitrogen deposition on communities and ecosystems, the functional group or family level responses of plants to nitrogen addition were investigated. However, responses at the genus or species level are less studied relatively. Study at the genus or species level is necessary because different genera or species may respond discrepantly to nitrogen enrichment, which can increase the knowledge in changes of community structure and diversity under nitrogen deposition.

The temperate steppe in Inner Mongolia of China, which is important ecological barrier, resource pool and pastoral farming foundation, is sensitive to climate change,

especially to nitrogen deposition. Previous researchers have investigated physiological, and nitrogen uptake and resorption responses of Stipa grandis to nitrogen addition as dominant species in Inner Mongolia grassland. Responses to nitrogen inputs of Agropyron cristatum and Cleistogenes squarrosa were also studied as subdominant grass and important C4 grass in communities, respectively. In this study, we aim to investigate the whole plant (including root) eco-physiological responses of the three species S. grandis, A. cristatum and C. squarrosa without inter-specific competition to nitrogen and water addition.

The soil substrate was 1:1:1 volume ratio of soil: sand: perlite mixture. Germinated seeds were sown in pots. Five seedlings were kept in each pot after the plants emerged. Four treatments combining nitrogen and water addition were set: High nitrogen high water (HNHW), High nitrogen low water (HNLW), Low nitrogen high water (LNHW) and low nitrogen low water (LNLW). No nitrogen added for low nitrogen treatments and 1.3g NH_4NO_3 were added per pot before sowing for high nitrogen treatments, which was equivalent to 16 g N^{m-2}. Low water and high water treatments were achieved by maintaining 25% and 35% of moisture content through adding water regularly and measuring weight of the pots.

Results showed that the biomass and biomass allocation of the three species responded differently to nitrogen. Nitrogen addition increased total biomass and each part biomass of Agropyron cristatum and Cleistogenes squarrosa (except root biomass of A. cristatum in HNLW treatment), but significantly decreased biomass parameters of Stipa grandis ($P < 0.05$). All the growth eco-physiological parameters showed consistent response to nitrogen and water for the same species. High nitrogen significantly decreased the growth of S. grandis ($P < 0.05$), while increased those values of A. cristatum and C. squarrosa. S. grandis was not sensitive to water availability, but high water availability increased growth of the other two species. Our results indicate that nitrogen deposition will decrease the dominance of Stipa grandis.

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Key words: Nitrogen Addition, Drought, Eco-physiological, Grassland

Relative Importance of Climate Changes at Different Time Scales on Net Primary Productivity --- A Case Study of the Karst Area of Northwest Guangxi, China

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Abstract: Climate changes are considered to significantly impact net primary productivity (NPP). However, there are few studies on how climate changes at multiple time scales impact NPP. With MODIS NPP product and station-based observations of solar duration, annual average temperature and annual precipitation, impacts of climate changes at different time scales on annual NPP, have been studied with EEMD (Ensemble Empirical Mode Decomposition) method in the karst area of northwest Guangxi, China, during 2000-2013. Moreover, with partial least squares regression (PLSR) model, the relative importance of climatic variables for annual NPP has been explored. The results show that1) only at quasi 3-year time scale, do solar duration and temperature have significantly positive relations with NPP. 2) Annual precipitation has no significant relation to NPP by direct comparison, but significantly positive relation at 5-year time scale, which is because 5-year time scale is not the dominant scale of precipitation; 3) the changes of NPP may be dominated by inter-annual variabilities.4) Multiple time scale analysis will improve the performance of PLSR model for estimating NPP. The Variable Importance in Projection (VIP) scores of solar duration and temperature at quasi 3-year time scale, and precipitation at quasi 5-year time scale are greater than 0.8, indicating important for NPP during 2000-2013. However, solar duration and temperature at quasi 3-year time scale are much more important. Our results underscore the importance of multiple time scale analysis for revealing the relations of NPP to changing climate.
Key words: Multiple Time Scales, Net Primary Productivity, Ensemble Empirical Mode Decomposition (EEMD) Model, Climate Changes

Responses of Soil Respiration to Nitrogen Deposition on the Sanjiang Plain Wetland in the Northeast of China

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Abstract: Response of soil respiration to simulated nitrogen (N) deposition in a temperate marsh in northeastern China was studied from June 2009 to September 2011. Our results showed that soil respiration presented a significant exponential decay relationship with soil water content. Soil respiration rates increased after N addition in the first year. In the following 2 years, however, the response of soil CO_2 flux to different N addition was not different from the control plot. Low N treatment continued to enhanced soil respiration rate by 9%, whereas high N treatment decreased by 7% than the control. Our results indicate that response of soil respiration to N addition depending on N deposition magnitude in the temperate wetland.
Key words: Soil Respiration, N Deposition, C Sequestration, Sanjiang Plain Wetland

China Subtropical Pine Ecosystem Is an Energy-Limited System Rather Than an Environmental-Factors Limited System

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Abstract: Subtropical forest ecosystems in China play a vital role in sequestering global carbon, even in old forests, therefore it is critical to conduct a precise investigation of intra-annual wood formation in these ecosystems to clarify the mechanisms behind. We established two field experiments in China subtropical ecosystems to weekly monitor intra-annual xylem formation process of Masson pine (Pinus massoniana Lamb.) from January to December in 2015 using the recently developed micro-sampling approach. The effects of climate on wood formation were also assessed using linear or mixed models. We discovered that 1) there is a semi-dormancy state in January in these subtropical ecosystems compared to the dormancy state in temperate and cold ecosystems and fully active state in some tropics commonly observed, 2) Trees grow better in dry season than wet season, indicating that China subtropical ecosystem is more an energy-limited system rather than an environmental-factors limited system due to less climate effects on wood formation revealed during the growing season; and 3) Trees in China subtropics might be less controlled by biological clock given that abiotic factors such as day length, temperature, precipitation in subtropics appear to play a less important role in regulating plant growth. Our findings are novel and may implicate that forests in subtropics might be able to benefit from increased rainfree days to promote xylem growth, thereby leading to better forest growth and improved carbon sequestration potentials under continued climate warming.

Key words: Subtropical Forest, Climate Change, Xylem Formation, Semi-dormancy

The Effect of pH on Daphnia Pulex, Daphnia Pulicaria and Daphnia Pulex-Pulicaria

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Abstract: Increasing attention has been focused on the effect of pH in fresh water as a limiting factor in the distribution and diversity of species. Acute toxicity testing using freshwater Daphnia is a popular bioassay used internationally for toxicity screening of chemicals and for monitoring of effluents and contaminated waters. The aim of this study is to evaluate the influence of pH in a 48h period on Daphnia pulex, Daphnia pulicaria and Daphnia pulex-pulicaria by measuring the LC50 of Daphnia exposed to a

gradient of pH. The LC50 value of D. pulex is 4.86, LC50 of D. pulicaria is 4.9 and the LC50 of D. pulex-pulicaria is 4.92. Results show that the three species can tolerate acid at the same level.

Key words: Daphnia, Ph, LC50, Global Acidification

Light Stress and Nitrogen Deposition on the Physiological and Ecological Characteristics of Camellia Japonica (Naidong)

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Abstract: Global climate change, including the change of illumination and nitrogen deposition, etc., are growing, this paper studies different illumination and nitrogen deposition on Camellia japonica (Naidong) of the morphological index, chlorophyll content and chlorophyll fluorescence characteristic, the influence of the gas exchange characteristics and physiological ecology characteristics. Will help to understand and predict the impact of climate change on winter resistance camellia, to better adapt to the environment and provide a theoretical basis for protection. The research results show that the plant height (H), base diameter (BD), the crown (CA), specific leaf area (SLA) and water content (LWC) is not affected by nitrogen and nitrogen and light interaction effects, under the light and the interaction of the nitrogen morphological indicators of winter camellia resistance with the increase of number of days on the rise, the same with fewer illumination, under the condition of nitrogen morphological indicators of winter camellia resistance drops, also showed the low light to its growth has certain inhibitory effect, but the L1 morphological indexes were higher than in L2. Part of the gas exchange parameters affected by illumination, nitrogen deposition, and the interaction was significant. Winter resistance of camellia vapor pressure deficit (VPD) by nitrogen deposition, illumination and the effects of the interaction of the two significant, net photosynthetic rate(A), transpiration rate (E) significant difference under nitrogen deposition and lighting effects, but no significant difference under the two interaction, water use efficiency (WUE) in significant difference under the influence of nitrogen deposition, no significant difference under the light and the interaction between the two. L2 winter resistance under low illumination camellia chlorophyll than L1 illumination condition, but Chla/Chlb above L2, chlorophyll, the only significant difference under the light conditions, under nitrogen deposition and the interaction between the differences was not significant. L2 winter camellia resistance under variable fluorescence (Fv), maximum fluorescence (Fm), PS Ⅱ photochemical efficiency (Fv/Fm) and PS Ⅱ potential active (Fv/F0) values are higher than that of L1, and initial fluorescence (F0) value, on the other hand, all the chlorophyll fluorescence

parameters of the plants were very significant differences only under the effect of light, and under the light and the interaction between the two was not significant.

Key words: Camellia Japonica (Naidong), Light, Nitrogen Deposition, Physiological Ecology Response

Rainfall Changes and Nitrogen Deposition Alter Leymus Chinensis Biomass Allocation in Songnen Grassland

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Abstract: In semi-arid steppes, water and nutrient are important limiting factors. As we all know changes in rainfall pattern and nitrogen deposition are two important components of global change, which will affect the soil moisture and fertility then alter the plant survival strategies. However, there are few researches reporting the effects of changes in precipitation and N deposition on plant biomass allocation or allometry in semi-arid steppes. In this study, we tested the hypothesis that rainfall changes and N deposition alter the plant biomass of leaves and stems, and then enrich the model of above-ground biomass allocation.

The experiment was a completely randomized block factorial experiment with two factors: altered rainfall (-30%, 0, +30%) by rainout shelter and N addition at the saturation rate of approximately 10 g $^{m-2\ yr-1}$ by applying NH_4NO_3 .There were 6 treatments in Songnen grassland in northern China.N addition increased the above-ground biomass significantly irrespective of rainfall changes. Grass invested relative more biomass to stem under decreased precipitation and N addition while invested relative more biomass to leaves under increased precipitation and N addition through analyzes by allometry method.

In conclusion, our study showed that nitrogen deposition can increase grass aboveground biomass. Grass reduce the risk of water stress through decreasing the allocation of biomass to leaves when water is limited; however, grass increase the allocation of biomass to leaves to get more area of intercepting light under increased water condition. This conclusion announces that the grass survival strategies under future climate change scenarios and provide theoretical support for agricultural production.

Key words: Rainfall Changes, Nitrogen Deposition, Biomass Allocation, Allometry

Zonal Vegetation Distribution and Water Niches of Dominant Shrubs in the Coastal Chenier Island of the Yellow River Delta

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Abstract: The seawater intrusion induced by rising sea levels under global climate change has been projected to have profound effects on species composition, growth rates and vegetation distribution on the coastal ecosystems. The vegetation patterns in the coastal chenier island of the Yellow River Delta were studied by the field surveys, quadrat approaches, and multivariate statistical analyses. The stable isotopic compositions in precipitation, soil water, groundwater and plant stem were observed to assess the water use strategy of the dominant shrubs (Tarmarix chinensis, Ziziphus jujube) in this area. A total of 35 taxa of vascular plants were documented, representing 15 families and 33 genera (of which most were mono-specific). There was a correlation between the micro-topography and soil physical and chemical properties (including the soil moisture, SOC, TN, TP, and TK levels) which would be vital factors affecting plant growth and vegetation distribution. The detrended correspondence analysis showed that the taxa and vegetation distribution had a significant correlation with micro-topography. The T. chinensis was mostly distributed near the high tide line, while the Z. jujube was dominated on the dune crest. Therefore, a typical zonal distribution of the vegetation was found from the high tide line to the inland. The water use strategy of the dominant shrubs showed significant temporal and micro-topographical variations. For dune crest, 68.3% of the water used by T. chinensis was come from upper soil water (20–100 cm), and only 21.2% was come from groundwater during a rainy summer (2013). However, T. chinensis absorbed 72.6%–95.4% of the water it used from the deeper soil water (60–100 cm) and groundwater during a drought summer (2014). While, near the high tide line, T. chinensis absorbed most of the water it used from the upper soil water (0–40 cm) during both summer to avoid the salt stress caused by sea water and shallow groundwater. Z. jujube got 40%–75% water from 60–100 cm soil layer in 2013, while absorbed water from all soil layers of 0–100 cm in 2014. The water niches of the dominant shrubs were estimated by the Levins index and Shannon-Wiener index. The water niche breadth of Z. jujube on the dune crest was narrower in the rainy summer than that in the drought summer, and T. chinensis had a contrary result. However, T. chinensis near the tide line demonstrated a narrower water niche breadth in the rainy summer than that in the drought summer. The Levins niche overlap between T. chinensis and Z. jujube was higher in the rainy summer (0.723) than that in the drought summer (0.184). The water niches revealed the adaptive strategies to different water conditions and interspecific

symbiosis mechanisms of the dominant shrubs in this area.
Key words: Coastal Ecosystems, Stable Isotope, Water Niche, Water Niche

Seasonal Variation in Ecosystem Energy and Water Vapor Exchange over a Typical Plantation Affected by Periodic Drought

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Abstract: Investigating the dynamics of energy and water vapor exchange in plantation ecosystems is important to improve scientific understanding of land surface processes in boreal forest regions. In this study, the seasonal and interannual variability in surface energy exchange and evapotranspiration (ET) of a typical plantation in northeast China, were investigated using multi-year (2012-2015) eddy covariance measurements. During the study period, the years 2012 and 2014 was considered to be a normal year according to different precipitation, and the year 2013, 2015 were dry year and wet year, respectively. Results showed that the energy balance closures were reasonable, varied annually between 0.48 to 0.57. The season changes in net radiation (Rn), latent heat flux (LE), and sensible heat flux (H) during the four years were similar. A reverse seasonal change was found in partitioning energy flux in H and LE. On the annual basis, H was the dominant consumer of Rn and exceeded LE during most of the year. LE exceeded H only in mid-growing season when frequent rainfall and high vegetation coverage. Daily maximum ET was 4.8, 4.5, 4.1 and 3.3 mm day^{-1} during the four years, respectively. The seasonal variation of ET was strongly related to water availability and bulk surface conductance. The direct enhancement of ET by high VPD was found in dry year, but was buffered by a concurrent suppression of gs in other three years. Annual ET varied from 290 to 371 mm with the highest value during the dry year. The high ET activity during the dry year were major supply deep soil water storages and high atmospheric evaporative demand. These findings suggest that the possible reduction in precipitation under future climate change scenarios with invariable or even enhanced ET will decrease the replenishment of groundwater and might increase in a possibly warmer and drier summer climate in the near future for Northeast China regions.
Key words: Energy Exchange, Evapotranspiration, Plantation, Eddy Covariance

Storm Events Restructured Microbial Community and Their Biogeochemical Potentials at Headwater Streams

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Abstract: Climate change is altering intensity, frequency, and duration of hurricanes and tropical storms nationwide. Since 1980s, increased heavy downpours (up to 71%) have been observed for the Northeast and Mid-Atlantic region of the United States. Large storm events have the potential to deliver significant upland and distal materials to headwaters. More importantly, "seeding and mixing" from terrestrial sources may result in "new" microbial consortia that facilitates nutrient transformation and export to receiving waters. Thus, there is an urgent need to investigate how storm events affect the microbial community structures and their potential functions.

From Aug. 26 to Sep. 8 2011, within days of each other, Hurricane Irene and Tropical Storm Lee passed through southeastern Pennsylvania and resulted in increased discharge in White Clay Creek. Bacterial population composition during the events was assessed by high-throughput sequencing of the 16S rRNA genes from collected water samples. Detailed bacterial community structure based on analysis of 3.3 million sequences indicated that a significant increase of bacterial diversity in samples during peak discharge of the storm. Successional changes of bacterial community before, during and after the events were observed: Betaproteobacteria, Actinobacteria, and Spirochaetes decreased in relative abundance, while the relative abundance of members of Acidobacteria, Alphaproteobacteria, Nitrospirae, Planctomycetes, and Verrucomicrobia increased during peak discharge, suggesting impacts from terrestrial inputs. At the same time, isotope hydrograph separation also indicated watershed runoff comprised the majority of water in the stream during peak flow. Cyanobacteria bloomed after the storm events, indicating that photosynthesis was one of the primary recovering processes. Real-time PCR (qPCR) analyses on functional genes (e.g., nitrification amoA, and denitrification nirS/nirK) suggested that storm events also changed the functional perspectives of the microbial communities, and therefore altered the subsequent biogeochemical transformation processes at headwater streams.

Key words: Storm Events, Microbial Community, Biogeochemical Potentials, Headwaters

Past and Future Influence of Climate Change on Spatially Heterogeneous Vegetation Activity in China

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Abstract: Climate change is a major driver of vegetation activity, and thus their complex relationships become a frontier and difficulty in global change research. In this paper, the spatial distribution and dynamic variation of climate change impacts on vegetation activity from 1980s to 2050 in China were investigated by the Geographically Weighted Regression (GWR) model, based on the combined datasets of satellite vegetation index, climate observation and projection, and future vegetation productivity simulation. Our results noted that the significant positive precipitation-vegetation relationship was and will be almost distributed in the north of China, except the northeast and northwest China with significant but varying influence of temperature rising, while the regions with temperature dominated vegetation activity mainly located in the southern part of China. There will be different climatic dominators for vegetation activity in some regions such as northwest China, and even opposite correlation in the northeast China, and further the responding patterns of vegetation activity to precipitation variation will be moving southward in the future three decades. It is indicated that although high warming rate will restrain the vegetation activity, precipitation variability can mediate the hydrothermal conditions for vegetation activity, for example the enhanced vegetation activity in the Tibetan Plateau and the weakened vegetation activity in the East and Middle China in the future. Furthermore, coupling the responding patterns and the dynamic variation, it can be found that during the period from 2021 to 2050, vegetation in most of north China may adapt to an arid environment, while in many southern parts it will be repressed due to water shortage. However, the continuous and dynamic responding process of vegetation activity to climate change will be determined by the spatial heterogeneity in climate change and vegetation cover.

Key words: Vegetation Activity, Climate Change Impacts, Temporal Variation, Spatial Heterogeneity

The Potential of Sun-Induced Fluorescence for Monitoring Heat Stress on Wheat in the Indo-Gangetic Plains, India

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Abstract: In the past few decades, the global mean annual temperature have been increasing, and this is also true for global main agricultural regions. Along with increasing mean temperature, there has been an increase in the occurrence of warm temperature extremes. In 2016, wheat was the second largest cereal after maize in the word, the production of wheat was 749 million tonnes, with more than rice. Yet, like other cereal crops, the production and productivity of wheat are vulnerable to a

changing climate. Therefore, it is important to monitor the response of wheat to the temperature increase and assess the impacts of heat stress on wheat at a broad scale. The repeat coverage of remote sensing enables monitoring of crop growth condition at a fine spatial and temporal resolution across a large spatial extent. Reflectance-based vegetation indices have been widely used to monitor drought/heat stress on the vegetation. However, these indices have been shown a time-lag response to the stress. The recent available spaceborne sun-induced fluorescence (SIF) has been proved to be a more direct and efficiency tool to accurately describe the photosynthesis process. The Indo-Gangetic Plains (IGP) in India is an ideal test bed for this purpose as wheat is usually well-irrigated. The IGP is a 255 million hectare fertile plain bounding on the north by the Himalayas typically with double cropping: irrigated spring wheat in the winter season and followed by irrigated/rainfed rice in the summer. The IGP produces more than 60% of the calorie intake of the areas involved. In spite of favorable conditions in Rabi season, in 2010 an abrupt rise in temperature during grain filling stage adversely affected the productivity of wheat.This case serves as a good opportunity for us to study the potential of SIF to reveal the impacts of high temperature on wheat at a broad scale. The satellite measurements of SIF, GIMMS NDVI, air temperature and precipitation reanalysis data from CRU-NCEP, with a temporal resolution from 16-day to monthly, are used in this study, and SYNMAP land cover data and digital map of irrigation areas are employed to select the valid wheat pixels. During the early stage of this heat stress event in early March of 2010, SIF showed a significantly reduction, while the NDVI showed no changes and cannot rapidly capture the heat stress conditions until at the late March. Meanwhile, the magnitude in reduction of SIF due to the heat stress, relative to multiyear mean from 2007 to 2014, was higher than that from NDVI. In April when the air temperature anomaly reached largest, the magnitude in reduction of SIF was 32.2%, which was much higher than that from NDVI of 7.3%. This demonstrates that satellite measurements of SIF are more sensitive to heat stress on wheat than NDVI, and shows earlier response to stress. A comparison with inventory-based crop yield data further demonstrated that spaceborne SIF measurements could better capture the decline in wheat crop yield of 2010 due to heat stress than NDVI. We expect that SIF measurements has the potential to timely monitor the heat stress on crops.

Key words: Chlorophyll Fluorescence, Crop Yield, NDVI, Heat Stress

Influence of Climatic Variables on Season Based Agricultural System in Satkhira District, Bangladesh

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Abstract: Southern part of Bangladesh is naturally susceptible to disaster where climate change posing versatile effects on agriculture. The study was conducted to investigate the influence of climatic variability (temperature, rainfall and relative humidity) on cropping pattern of major food crops (aus rice, amon rice, boro rice and potato) at Shyamnagar and Tala upazila of Satkhira district. Thirty years data (1984-2014) on climatic parameters were used in the study. To test the significance of the pair of parameters p-value has been measured. The study identified a statistically insignificant decreasing trend of annual average temperature and average rainfall whereas average relative humidity has a statistically significant relations ($p<0.05$) with year. Correlation between average relative humidity and potato production showed only significant ($p<0.05$) relation whereas all other correlation between production and climatic variables were statistically insignificant. Pearson's correlations among the different parameters were done to identify the relationship among soil quality parameters. The electrical conductivity (EC) value showed that yields of many crops can be restricted in dry season due to salinity. Average values of K, Ca, Mg, S and Zn were found higher than standard values in both seasons, which may be due to excessive use of fertilizers in the agricultural land of study area. Average value of P at Shyamnagar upazila was 7.53 µg/g soil and 3.95 µg/g soil, respectively in dry and wet season and at Tala upazila it was 7.56 µg/ g soil and 6 µg/ g soil, respectively in dry and wet season. In dry and wet season, the measured average value of B at Shyamnagar upazila was 0.529 µg/g soil and 0.53µg/g soil, respectively whereas at Tala upazila it was 1.45 µg/g soil and 0.63 µg/g soil. It also revealed from the study that during the wet season chemical properties (pH, OM, EC) of soil were more suitable than the dry season. It may be concluded from the study that climatic variables has influence on season based agricultural crop production in the study area.
Key words: Agriculture, Climate Change, Temperature, Rain Fall

Studies on Forest Ecosystem Physiology: 1. Marginal Water Use Efficiency

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Abstract: Marginal water use efficiency plays a critical role in stomatal behavior and plant carbon-water coupling relationships. In this paper, we studied the diurnal and seasonal dynamics of ecosystem marginal water use efficiency (λ) of a tropical seasonal evergreen forest, and compared the simulations of three stomatal optimization models – the Lloyd-Farquhar model, Katul model, and Medlyn model. Our objectives were to

explore the dynamics of λ across time scale, and address how λ varied with soil water content at diurnal and seasonal scale. At diurnal scale, we found a U-shape pattern of λ values. λ was higher in the early morning and latter afternoon compared to the lower while nearly constant λ values in the rest of the day. It is probably because early morning λ retain low value under dry conditions (low soil water content). At seasonal scale, λ was higher in the rainy season than dry season, as model simulations showed that λ increases with soil water content at seasonal scale. All three models showed similar diurnal and seasonal patterns of λ, although they differed in their simulated values.

Key words: Canopy Conductance, Stomatal Optimization, Soil Moisture, Photosynthesis Model

Effects of Elevated Atmospheric CO_2 on Dissolution of Geological Fluorapatite in Water and Soil

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Abstract: Most of phosphorus (P) is present as insoluble phosphorus-bearing minerals or organic forms in soil. Geological fluorapatite (FAp) is the dominant mineral-weathering source of P. In this study, FAp was added in water and soil under elevated CO_2 to investigate the pathway of P release. Two types of soils (acid soil from subtropical region and saline-alkali soil from Tibet Plateau) with similar total P were studied. In the solution, increased CO_2 in air enhances the dissolution of FAp, i.e., from 0.04 to 1.18 ppm for P and from 2.48 to 13.61 ppm for Ca. In addition, release of Ca and P from FAp reached the maximum (2.14 ppm for P and 13.84 ppm for Ca) under the combination of elevated CO_2 and NaCl due to the increasing ion exchange. Consistent with the results from solution, CO_2 elevation improves P release more significantly in the saline-alkali soil than in the acid soil. Therefore, saline-alkali soil in Tibet Plateau would be an important reservoir of available P under the global CO_2 rise. This study sheds the light on understanding the geological cycle of phosphorus.

Key words: CO_2, Phosphorus, Soil, Dissolution

The Spatial Differentiation of Household Carbon Emissions in Xiamen

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Abstract: With the acceleration of urbanization process in China, the urban population has increased dramatically. Carbon emissions from household consumption account for more than 40% of the total carbon emissions from China's primary energy use,which is an inconvenient part.Characteristics of household carbon emissions clarify the intensity of carbon emissions from various residential area and the level of carbon emissions in different geographic locations.It will also provide a scientific basis and theoretical foundation for low-carbon cities and the sustainable development of cities. We chose Xiamen, a rapidly urbanizing city in the southeast of Fujian Province in China, as the case study area.Based on sampling survey method and quantification evaluation methods of carbon emissions,we ascertained carbon emissions per capita of various residential area in 2009.Combined with RS and GIS , according to seven types of residential area and six districts in Xiamen, we calculated total carbon emissions of residential areas and analyzed their spatial distribution characteristics.The results showed that carbon emissions per capita of seven types residential area could be listed in decreasing order as: Super high-rise residential area >; High-rise residential area >; Middle high-rise residential area >; Multilevel residential area >; Historical district >; Village in the edge of the city .There were strong positive correlations between carbon emission per capita and residential building layers.Carbon emissions of Super high-rise residential and Village in the edge of the city accounted for 24% ,respectively.Their proportions were the largest and they were the focus of emission reduction .Housing building materials consumption, electricity and household sewage treatment were main emission reduction factors. Household carbon emissions per capita of Xiamen was 321.78KgC/month.Spatially,high carbon emissions region was mainly located in more developed Siming and Huli District ,accounting for 72% of the total household carbon emissions in Xiamen. They were important emission reduction areas. Electricity, food consumption and housing consumption of building materials, transportation were main emission reduction factors.

Key words: Household, Carbon Emissions, Spatial, Differentiation

Global Warming, Grain Production and Its Efficiency: A Case Study in Major Grain Production Region

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Abstract: Historical records and multiple researches suggested that there was a close connection between carbon dioxide and surface temperature. Climate change and its impacts on agriculture, especially grain production, is one of main challenges for food security and sustainable development. From the perspective of natural flow, climate

change directly acts on plant growing through affecting water circulation, such as drought and flood. Although the covariation of surface temperature and concentration of CO_2 will to some extent benefit photosynthesis of crop, grain production may fluctuate according to the situation of grain market which also affected by its erratic provisioning. Then we detect how climate change affects grain production and its production efficiency by using input distance function and technical inefficiency model. Firstly, we find that there is a significant relationship between surface temperature and grain production, although this impact is marginal which coefficient is 0.0037 in input distance function model. And secondly we find that surface temperature affect grain production not only through its photosynthesis, but also influence its production efficiency in major grain production areas. Thirdly, there is a large difference between counties or even provinces in grain production efficiency in case study area according to the grain production efficiency distribution map.

Key words: Global Warming, Agroecosystem, Grain Production, Grain Production Efficiency

Effects of Spring and Summer Drought on Carbon Flux in a Semiarid Shrub-Land Ecosystem Dominated by Artemisia Ordosica, Northwest China

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Abstract: The effectiveness of timing of droughts is a key scientific debate. Whether spring or summer drought is more critical to carbon uptake has been controversial.Here, the effect of spring and summer drought on C dynamics were evaluated using 2yr (2014-2015, with spring drought in 2014 and summer drought in 2015) of eddy covariance and microclimate data from a shrub-land ecosystem dominated by Artemisia ordosica in Northwest China. The ecosystem released 29 ±4 g C m-2 in 2014 and sequestered 35 ± 7 g C m-2 in 2015 across growing season. This was caused by greater suppression of GEP (gross ecosystem productivity, 29% = 73 g) than of Re (ecosystem respiration, 3% = 9 g) by spring drought. The more suppressed GEP was traced to lower canopy conductance (gc), maximum apparent photosynthetic capacity (Pmax) and apparent quantum yield (a). What's more, Pmax and gc increased linearly with increasing soil water content (SWC) with shallow slopes in 2015. Zero-mean normalization of GEP also showed much lower values in 2014. All of these might imply the ecosystem C uptake was more affected by spring drought than summer drought. Besides, GEP was affected more by deep soil moisture (i.e. 30 cm depth), but Re more by shallow soil moisture (i.e. 10 cm depth). Our results highlight the

vulnerability of shrub-land ecosystem C uptake to predicted increase in drought, maybe more to drought in spring and call for considering the severity of drought in terms of sensitivities of GEP and Re.

Key words: Drought, Carbon Flux, Semi-arid Shrub-land

The Effect of Land Management, Landholder, and Accessibility on the Fire Occurrence in Various Land Covers in a Tropical Peatland

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Abstract: Peatland in Southeast Asia has an important role in global environments namely as a carbon sink, biodiversity, climate regulation, water supply, and other ecosystem services. Recurrent fires in the peatland in this region, especially in Indonesia, has changed peatland from carbon sink to source and causing serious environmental and economic problems. To know the factors affecting fire in peatland, we compared the fire occurrence in 2014 between different land cover types, land management systems, landholder, and proximity to road and canals in 2014 in Riau Province, Indonesia. Remote sensing data and field data were collected and analyzed through GIS. Shrubland was the most fire-prone land cover type while rubber plantation and mangrove forest were those with least fire. Shrubland showed high fire occurrence regardless of land management and concession types. Forests which are allowed to be utilized was fire-prone than conserved forests. Oil palm plantation by the illegal companies had more fires than those by legal companies and smallholders. Coconut and sago plantations by company had more fires than those under smallholder. Forest near to road and canal were prone to fire than forest apart, while shrubland was fire-prone regardless of the distance from canals and roads. The high percentage of burned area in shrubland shows that land cover was a major factor that determines fire in peatland, followed by land management, land-holder, and proximity to the canal and roads. Current findings show the importance of the law enforcement and land management systems, the management schemes by different landholders, and the spatial arrangement of land cover, roads, and canal for the integrated peatland management and the restoration of shrubland peat swamp forest and other fire-resistant land covers with sustainable production

Key words: Peatland, Land Cover, Fire, Plantation

Responses of Soil Microbial Community to Intensified Rainfall after Spring Drought in a Subtropical Forest

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Abstract: The spring drought and wet-season heavy rainfall were projected to be common in the future. How it potentially influence soil microbial communities remains unclear, especially in the subtropical forests with seasonal dry-wet cycles. We conducted a manipulative precipitation experiment in a subtropical forest to determine the effects of spring drought and subsequent large rainfalls on the composition and function of soil microbial communities. Results showed that neither the 67% of throughfall exclusion in the spring nor the water addition during the wet season had significant effects on soil water content. However, the water addition during the wet season decreased the fungal: bacterial biomass ratio characterized by phospholipid fatty acids ($p < 0.05$). Derived from amplicon sequencing, water addition increased the relative abundances of a rare bacterial phylum Gemmatimonadetes and a fungal phylum Basidiomycota which consisted of 31% of the total fungal abundance, while decreased the relative abundance of Ascomycota which accounted for 49% of the total fungal abundance ($p < 0.05$). However, most enzyme activities did not respond to the precipitation change. Our results indicated that the intensified rainfall after spring drought have impacts on some specific taxa. The inconsistent changes of composition and function of microbial community might due to the functional redundancy. In order to have a better understanding of the composition and function of microbial community, the expression of enzyme-encoding gene and the presence of mRNA should be considered in the future.

Key words: Seasonal Precipitation Changes, Soil Microorganism, Amplicon Sequencing, Enzyme Activities

The Role of Extracellular Enzymes Differs in Priming of Soil Organic Matter Decomposition Depending on Temperatures

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Abstract: Temperature and labile organic inputs are two important factors affecting decomposition of soil organic matter (SOM). However, the interactions between temperature and organic inputs affecting SOM decomposition through extracellular enzymes over a temporal scale remains unclear. We incubated a temperate forest soil

for 3 months to quantify SOM decomposition and its priming by 14C labelled glucose at five temperatures (from 3 to 31 ℃ with 7 ℃ intervals). Activities of eight enzymes were measured four times during the incubation. Increasing temperature accelerated SOM decomposition with Q10 between 2.0 and 4.5. Labile substrate input significantly decreased temperature sensitivity of SOM decomposition. Response of priming to temperature was modified by extracellular enzyme activity and species temporally, e.g. activity of leucine-aminopeptidase increased priming over rising temperature in the first 3 days. Subsequently, the domain enzymes changed from N-acquiring (chitinase) to C-acquiring enzymes (β-glucosidase and galactosidase), companying with priming at lower temperatures gradually exceeding those at high and middle temperatures at a given time. Finally, priming at high temperature was greater than at low and middle temperatures, with xylanase activity dominated in this later stage. We conclude that the temporal scale of enzyme activities should be integrated in models of soil-carbon response to warming for better understanding the mechanisms responsible for SOM decomposition and stabilization depending on temperature.

Key words: SOM Decomposition, 14C Labeling Technique, Temperature Sensitivity, Extracellular Enzyme

Snow Damage Strongly Reduces the Strength of the Carbon Sink in a Subtropical Evergreen Forest

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Abstract: A primary subtropical evergreen broadleaved forest in Southwest China experienced a particularly extreme snow event during January 2015. We analyzed five years of continuous measurements of CO_2 exchange across the biosphere/atmosphere interface in the forest using an eddy covariance technique. We quantified how exposure to an anomalously heavy snow affected ecosystem processes that determine gross primary productivity (GPP) and ecosystem respiration (Reco), and thus annual net C sequestration. The forest canopy was damaged strongly by the heavy snow and the leaf area index (LAI) decreased significantly from January to July 2015. GPP, net ecosystem exchange (NEE), and Reco all sharply decreased in 2015 after the heavy snow. On average, a strong decrease of 544 g C m 2 year 1 in annual NEE in 2015 was associated with a decrease of 829 g C m 2 year 1 in annual GPP and a decrease of 285 g C m 2 year 1 in annual Reco. Therefore, GPP in 2015 decreased by 41 % and Reco decreased by 22 %. Overall, annual net carbon uptake in 2015 was reduced by 76 %. The 2015 event enabled the quantification of the impact of specific climate anomalies on the carbon balance.

Key words: Snow Damage, Extreme Event, Subtropical Forest, Carbon Balance

The Effects of Ozone on Phenolics and Enzymes in Soybean Leveas

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Abstract: For studying the effects of ozone on secondary metabolites and enzymes in crops, using OTCs (Open Top Chambers), the atmospheric ozone concentration as the control, the 110 nL/L O3 concentration was set as treatment, the effects of elevated O3 on phenolics and oxidases in soybean leaves was investigated, during branching, flowering and podding stage. Including the following aspects: total polyphenols, ferulic acid, P - coumaric acid and flavonoids (flavonoids, rutin, quercetin and morin), as well as the activities of phenylalanine ammonia-lyase (PAL), polyphenol oxidase (PPO) and lipoxygenase (LOX). Results showed that with the whole of soybean growth period, compared with CK, in different growth period the total polyphenols, ferulic acid and P - coumaric acid were higher, and reached a significant level ($P < 0.05$); flavonoids are all showed a trend which increased at first and then decreased, in the branching period all were significantly ($P < 0.05$) decreased, but in the flowering period (except rutin) and podding stage were significantly ($P < 0.05$) increased; and compared with the CK, the activities of three enzymes of PAL, PPO and LOX increased significantly ($P < 0.05$). Results indicated that under ozone stress PAL and PPO activitics were higher than CK, and then improved the contents of phenolics in soybean leaves, by the rise of polyphenols and flavonoids the antioxidant of soybean leaves was increased, but the rise of monphenol (ferulic acid) content showed soybean leaves were damaged by elevated ozone.

Key words: Soybean Leaves, Ozone, Phenolics, Flavonoids

Threats to the Biodiversity in the Western Ghats Mountain Forests from Changing Environment and Climate: Challenges in Adaptation

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Abstract: Climate change together with large-scale encroachment threatens the biodiversity of the Western Ghats Mountain forest of Peninsular India. The Ghats that extends around 1600 Km along the west coast is one of the recognized global biodiversity hot spots. Forests cover nearly 50,000 Km^2 of the mountain. About 27% of all species of higher plants in India is found here, half of them being endemic to the

region. The forests include moist deciduous and montane rain forests. Climate extremes, unsustainable use of resources and unwise government policies pose serious threat to the existence of many rare and costly medicinal plants, herbs and precious trees. Encroachment and introduction of plantation crops in the last century lead to the depletion of vast area of natural forests. Poachers have widely destroyed the precious trees such as sandal, rosewood and teak. They have killed thousands of animals, especially elephants. Farming of prohibited plants is going on deep inside the forest. Major hydropower projects submerged large areas of forests. Recent economic development and promotion of hill tourism spoils the virgin forests and grasslands. Rainfall in the region is becoming more seasonal and intense, resulting in the erosion of the already degraded soil. Because of long dry season and falling groundwater storage, seasonal plants become extinct. Forest fire becomes common. Strong winds associated with thunderstorms and tropical cyclones uproot big trees. Shift in regional climate may affect the biodiversity significantly. Many species, especially the bats are unable to adapt to the changing landscape and climate. New types of pests have already been reported. Ministry of environment and forests has established many protected areas to restrict human access, several wildlife sanctuaries to protect specific endangered species and many Reserve Forests. Rules and regulations often become farce because of weak administrative mechanism, corruption and vested political interference. The forests cover parts of six independent states with diverse social, political and economic condition, making governance difficult. There exist several social issues such as the disputes over the rights of indigenous people and claims over resources by different states. The ongoing national river linking project may adversely affect the forests. Sustainable management and utilization of forest products may boost the current economic development and help alleviating poverty of the tribal people. It is vital in maintaining securities in food, water and energy, as the rivers of Peninsular India originate in this mountain. Worldwide recognition of Ayurveda, the Indian system of herbal medicine, and new findings on the commercial use of certain plants raises a good hope. There are large areas of restorable degraded forests and afforestable wastelands. Community forest projects with people's participation could improve livelihood conditions of the poor. The ongoing mega schemes such as the 'green India mission' could be better implemented with their help. Present paper assesses the impact of climate change and environmental degradation on the forest and critically reviews the current policies and strategies for management and adaptation to suggest guidelines for an appropriate forest policy.

Key words: Biodiversity, Western Ghats, Climate and Environment, Adaptation

Effects of Microcystis Aeruginosa on the Life History Traits and SOD Activity of Daphnia Similoides

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Abstract: With global warming and water eutrophication, cyanobacteria blooms frequently occurred. The interaction between M. aeruginosa and Daphnia has become the focus of relative research. In this paper, six clones of D. similoides from Lake Junshan were employed, and three treatment groups (M0: 100% Scenedesmus obliquus; M20: 80% S. obliquus + 20% M. aeruginosa; M40: 60% S. obliquus + 40% M. aeruginosa) were designed to study the effects of M. aeruginosa on the life history and SOD activity of D. similoides. The results showed that the body length, the number of eggs at first brood, per female offspring number at the first reproduction and per female cumulative offspring numbers of six D. similoides clones were significantly negative correlated with the concentration of Microcystis ($P<0.01$), while it was significantly positive relationships between time to maturation and Microcystis concentrations among three clones ($P<0.05$). There was a very significant positive correlation ($P<0.01$) between Microcystis concentration and SOD activity of D. similoides (M0: 349.99 ±184.05U/g FW, M20: 693.93 ±144.43 U/g FW, M40: 1401.73 ±380.03 U/g FW), and some differences were also found among different clones. The SOD activities of D. similoides originated from the offspring of two clones were measured at three treatments (M0, M20, M40). Compared with their parent, the SOD activities of D. similoides originated from the offspring in M20 treatment of the mother decreased in M0 and M20 treatments while it increased in M40 treatment. However, the SOD activities of D. similoides originated from the offspring in M40 treatment of the mother increased in three treatments. Our results suggested that the influence of M. aeruginosa on the life history traits and SOD activity of D. similoides was obvious, and it was also decided by the genotype (or genetic differences) of D. similoides.

Key words: Daphnia Similoides, Microcystis Aeruginosa, SOD, Life History Traits

A Synthesis Analysis of Carbon Storage in the Grasslands of China

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Abstract: As one of the most widespread vegetation types in the world, grassland ecosystem plays an important role in the global carbon cycle. China has very abundant resource of meadows and profound carbon sink. Grassland ecosystem holds a central position in the process of carbon cycling in terrestrial ecosystems in China,and even

global. The carbon storage of grassland were estimated different in the studies, due to the differences in estimation methods and resources. This study makes a synthetic analysis on distribute pattern of carbon stock and carbon sink in Chinese grassland ecosystem by literatures. Our estimate indicates that the total carbon storage in grassland ecosystem in China were 14.5 PgC- 64.46 PgC, the difference of results could be as large as 4 times. Most of the carbon stored in the soil. In China, the grassland carbon reserves are mainly distributed in alpine meadow, alpine steppe, temperate grassland and lowland meadow. They are concentrated in the northern and western China, covering 47.04 % of the grassland area. However, these four grassland types made up 69.14% of all the carbon stored in grassland in China. The average area of grassland varied largely from different resources and grassland classification systems with the range from 274.45-355.04×10^4 km^2, the maximum average came from data of grassland inventory and the minimum average came from remote sensing data. Statistically, the average of grassland area in china was 324.47±57.03×10^4 km^2. Root-shoot ratio, as the most common way of estimate below-ground biomass, could also lead to large differences in estimation of below-ground biomass. The value of root-shoot ratio was range from 0.38-52.3. The carbon storage was also different depending on estimation methods, the maximum value was estimated by average carbon density in global, but the minimum was estimated by models. It is concluded that the total carbon storage in grassland ecosystem in China was 41.67PgC.
Key words: Grassland Ecosystem, Carbon Storage, Synthesis Analysis, Distribution Pattern

GHGs Emissions from Tropical Rainforest and Rubber Plantation

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Abstract: To understand the effects of landuse on GHGs emissions and local climate change in the tropics, we measured N_2O, CO_2, CH_4 fluxes from a primary tropical rainforest (TRF) and a mature rubber plantation (RP) at Xishuangbanna, southwest China since 2003. The results have shown: 1) Rubber plantation N_2O was bimodel, one peak after dry season fertilizer, another after rainy season fertilizer, while tropical rainforest N_2O was one peak in the rainy season. Otherwise, CH_4 and CO_2 emission were in the similar seasonal dynamic with one peak in the middle of rainy season for RP and TRF. 2) due to the fertilizer influence, the positive correlation between soil temperature/soil moisture and N_2O, CO_2, CH_4 was more significantly in tropical rainforest than rubber plantation respectively litter input changed the dominated controller of N_2O emission in TRF: litter carbon input and soil DOC content for control treatment and, soil temperature and soil NO3- -N for litter removal treatment. 3) The

N_2O, CH_4 and CO_2 emissions from rubber plantation (0.067±0.067 mg N_2O $^{m-2\ hr-1}$, -0.022±0.055 mg CH_4 $^{m-2\ hr-1}$, 352.0 ±91.3 mg CO_2 $^{m-2\ hr-1}$) and tropical rainforest (0.014±0.012 mg N_2O $^{m-2\ hr-1}$, - 0.65±0.61 mg CH_4 $^{m-2\ hr-1}$, 356.4±114.1 mg CO_2 $^{m-2\ hr-1}$) indicated that, because of fertilizer and landuse changing, rubber plantation increased local N_2O and CH_4 emission, but there were not significant influence on soil CO_2 emission. 4) 100-year carbon dioxide equivalence of soil N_2O, CH_4 and NEE global warming potential (GWP) from RP and TSF was 25264.4 Kg CO_2 $^{ha-1\ yr-1}$, and 5906.1 Kg CO_2 $^{ha-1\ yr-1}$ respectively, indicated that there is more positive feedback to local climate change than tropical rainforest, but considering the complete life cycle of the rubber plantation, starting from deforestation of the previous tropical forest, the results of plantations serving as positive feedback may not supported by our study.

Key words: Ghgs, Landuse Change, GWP, Tropical

Ecological Implication of Different Plant Responses to Leakage of High Soil CO_2 Concentrations from Carbon Capture and Storage Sites

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Abstract: The impact assessment of potential CO_2 leakage from carbon capture and storage (CCS) site has been substantially conducted and the negative effects of high soil CO_2 concentration on plants germination and growth were widely reported. However, different sensitivities of plants to high soil CO_2 concentrations have not been systematically summarized and at present, there is no standard for ecosystem management in the region of CCS sites. To understand how different plant species react to high soil CO_2 concentrations, three separate experiments conducted in a greenhouse were compared. Two herbaceous plants (cabbage: Brassica rapa var. glabra and radish: Raphanus sativus) and one woody shrub (grape: Vitis coignetiae) were selected and they were exposed to high soil CO_2 for 12, 28 and 32 days, respectively. All the plants were grown in a specially designed chamber from the bottom of which the CO_2 gas (99.99%) was continuously injected. The soil CO_2 concentrations were maintained at 66.8%, 45.6% and 41.3% at 5 cm depth in cabbage, radish and grape, respectively. During injection, the responses of different plants varied significantly. Chlorophyll contents of cabbage and radish were increased at the beginning and then decreased after 7-8 days of injection, while those of grape were maintained at normal level and then decreased after 8 days of injection. Increased chlorophyll contents of cabbage and radish implied that fast growing plants operated compensational mechanisms to overcome high soil CO_2 stress. Despite of the compensational reaction, visible changes

of cabbage and radish were more evident. Leaves of cabbage and radish were wilted and turned yellow after 7-10 days of injection. In contrary, leaves of grape did not appear visible change until 18 days of injection although the inhibition of root water absorption by grape was detected early (after 5 days of injection). After injection, cabbage and radish showed leaf color change but they looked survived. However, in case of grape, leaves turned completely red and appeared very dry, indicating they were dying. The results indicated fast growing plants like cabbage and radish were more resilient to high soil CO_2 stress than a woody plant of grape. Planting this kind of fast growing species around CCS site might have larger ecological benefit than tree species, because their compensational reactions might be more effective to survive under high CO_2 stress from potential CCS leakage.

Key words: Carbon Capture and Storage, High Soil CO_2, CO_2 Stress, Plant Response

De Novo Transcriptome Analysis of Mangrove Kandelia Obovata Reveal Potential Molecular Mechanisms on Coastal Environment Adaptation

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Abstract: Kandelia obovata, a species of Rhizophoraceae, is one of the most cold-tolerant mangroves. Living in the intertidal environment, it forms a series of adaptive traits including viviparity. To understand the molecular mechanisms of these ecological adaptations, transcriptomes from eight organs of K. obovata were sequenced by Illumina Hiseq 2500 platform. After de novo assembly, we obtained a total of 76,280 unigenes, with N50 value 1433bp. Gene Ontology classification result revealed that most of the unigenes were assigned to cell part in cellular component category, assigned to protein binding in molecular function category. In biological process category, multicellular organismal development and response to stress were the most enriched. Further detailed classification of response to stress showed that a large number of unigenes were annotated to response to salt stress, cold, water deprivation and bacterial defense. KEGG pathway analysis shown that most of unigenes participate in ribosome, biosynthesis of amino acids, carbon metabolism and RNA transports, these pathways also highly representation in plants which have the same living environment with K. obovata, implied that pathways may associated with plant response to adverse conditions.

Further analysis of genes associated with the characteristics of mangrove plants we analyzed specific expression genes in different organs, secondary metabolites and plant hormone signal transduction pathways were enriched in almost each organ. Two

unigenes annotated in jasmoic aicd and salicylic acid pathways, participated in seed germination and development in Arabidopsis, were enriched in fruit. It suggested that they may play an important role in mangrove special reproduction manner -- vivipary. Cytokinin and auxin pathways were enrichment in leaf and stamen, correlated with response to stress and stamen development, respectively. ABC transporters were enriched in root, which may help K. obovata response to heavy metal stress commonly found in its growth environment. Furthermore, we identified 51 transcription factor families, including bHLH, NAC, MYB_related families occupy a large proportion, function of which may be important to coastal environment adaptation. These results shed lights on molecular ecological understanding of this special group of coastally adapted habitats.

Key words: Mangrove, Kandelia Obovata, Transcriptome, Adaptability

Higher Phenotypic Plasticity Does Not Confer Higher Salt Resistance to Robinia Pseudoacacia Compared with Amorpha Fruticosa

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Abstract: A greenhouse experiment was conducted in which two leguminous species commonly used in the Yellow River Delta for vegetation restoration, Robinia pseudoacacia and Amorpha fruticosa, were subjected to the five salt treatments: 0, 50, 100, 150 and 200 mmol L^{-1}. We aimed at investigating which of the two species would be better suited for growth in a saline environment, and whether the acclimation capacity to salinity resulted from an inherently higher phenotypic plasticity of the species. The results showed that salinity affected most growth parameters and biomass parameters but had no effects on most leaf traits and physiological parameters of the two species. Height, relative growth rate of crown area, root biomass and leaf mass ratio of R. pseudoacacia were reduced by higher salinity while A. fruticosa was not affected. Chlorophyll a to chlorophyll b ratio and total antioxidative capacity of A. fruticosa increased with higher salinity while those of R. pseudoacacia remained unchanged. Root mass ratio and vitamin C concentration of both species were not affected by salinity, whereas vitamin C concentration of A. fruticosa overall was higher than that of R. pseudoacacia. Methane dicarboxylic aldehyde concentration of R. pseudoacacia increased with the increase of salinity while that of A. fruticosa was not affected. Root to shoot ratio of A. fruticosa was higher than of R. pseudoacacia at most salt treatments. Of all leaf traits, only leaf area differed among the different salinities. Robinia pseudoacacia generally exhibited a greater plasticity than A. Fruticosa in

response to salinity, but A. fruticosa was more resistant to the higher salinities, compared to R. pseudoacacia, and is thus a better candidate for vegetation restoration in saline areas.

Key words: Salt Stress, Black Locust, Indigo Bush, Yellow River Delta

Response of Calcareous Foraminifera to Ocean Acidification, Preliminary Laboratory Experiments and Improvements

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Abstract: Ocean acidification is one of the major environmental problems caused by CO_2 emissions. Since the Industrial Revolution, the ocean has absorbed about one third of the total CO_2 emitted by humans. Ocean acidification may cause biodiversity loss, alter ecosystems and impact food security, yet uncertainty of ecological responses to ocean acidification remains considerable. Foraminifera are one of the most abundant groups of marine calcifiers, estimated to precipitate ca.50% of biogenic calcium carbonate in the open oceans. Previous work on ocean acidification and foraminifera were mostly short-term single species laboratory experiments. In this study, we collected several foraminiferal species (Ammonia beccarii. Elphidiella kiangsuensis. Cribronon vitreum.) from a near shore intertidal zone, located at Zhoushan Islands, China. And artificial sea water was prepared to study the differential response of the foraminifera to ocean acidity change. The pH range of our study was set between 7.20 and 8.20 and the concentration step was 0.2. At the same time each day, we observed morphological changes under microscope. All experimental species began to dissolute after about a week (with the test a sensible soft touch) and the lower the pH, the faster the corrosion rate. Different foraminiferal species with various shell hardness may cause the dissolution rate variation, and detailed test structures using a scanning electron microscope may give more reliable explain. The degree of dissolution depend both on pH and species type, and our experiments show that foraminifera can be used as the indicator species of ocean acidification in Zhoushan sea area ,Zhejiang Province.

Key words: Foraminifera, Ocean Acidification, Ecological Response, Zhoushan, Zhejiang Province

Transcriptome Characterization Reveals Potential Pathways of Viviparous Embryo Development in Mangrove Kandelia obovata

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Abstract: Vivipary in plants refers to the phenomenon that sexually produced offspring germinate on the maternal plants with short or no dormancy. This is a distinct way of reproduction different from orthodox seed germination. It has been reported in many species, but mostly manifested itself in many mangrove plants, where vivipary is a genetically controlled process. Mangroves are woody plants that are dominant in the tropical or subtropical intertidal zones with ecological and economic significance. Vivipary in mangroves has long been recognized as an adaptive trait to cope with the complex coastal environment. However, the underlying molecular mechanism of such a genetic control remains mysterious. Here, using Kandelia obovata, a widespread viviparous mangrove species in China, we performed comparative transcriptome analysis of different embryo tissues in key stages to explore its genetic control. To this end, RNA-seq libraries of 7 embryonic tissues, including cotyledon, axis, shoot apical meristem and hypocotyl before or after germination, were constructed and sequenced by Illumina HiSeq 2500 platform. A total of 221,538,050 high-quality paired-end reads was de novo assembled 50,526 unigenes with an average length of 869 bp and a N50 of 1421 bp. Of them, 25,452 unigenes were functionally classified to known Gene Ontology terms, 6687 unigenes assigned to 362 pathways in Kyoto Encyclopedia of Genes and Genomes (KEGG) databases. A set of differentially expressed genes was generated when comparing different tissues or different stages of development. Using these data, we identified unigenes that may play key roles in viviparous development, including genes participated in hormone metabolic pathways, and genes responsible to environmental stimuli like heat, UV-light, salt stress, and hypoxia. The latter group may help the embryo to survive in harsh coastal situations. Interestingly, some photosynthesis related genes are active in embryo, which could provide nutrients in these stages. In addition, a large number of candidate genes, but with unknown functions, were predicted. In conclusion, our data provides insights into the possible molecular mechanism controlling viviparous embryo development, germination, and adaptive strategy to survive under tropical/subtropical coastal environment.
Key words: Viviparous Development, Adaptation, Molecular Mechanism

Typical Mountain Forest Ecosystem——Lacustrine Sediments Records of Holocene Vegetation Evolution Signals in Fanjingshan

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Abstract: Fanjingshan is located in the northeast of Guizhou Province with the integrity of ecosystem structure and function. It is a typical subtropical mountain forest ecosystem and the vegetation composition affected by the global climate

change. Under the background of climate change, it is significant for the formulation of region environmental policy to use the surrogate indicators to reconstruct the palaeoecology in this area. However, there is no report about the high resolution and quantitative research on the mountain ecology in Fanjingshan. Pollen can represent the vegetation at that time intuitively but it is lack of quantitative. Lignin can reflect the change of vegetation roughly, and it can be used for quantitative track the different changes of vegetation in the production of organic carbon. From August to October in 2015, we did pollen analysis from samples of peat cores in Jiulongchi wetland of Fanjingshan Changes are revealed from meadow and broad and deciduous leaved forest-evergreen deciduous broad-leaved mixed forest-deciduous broad-leaved forest and meadow. The responsible climate changes are interpreted as follows: warm cool and dry-warm and moist-warm cool and dry. The characteristics of the ecological environment in early, middle and late Holocene were completely recorded in Fanjingshan, and the climate optimum period of Holocene was in the middle Holocene. Among them, Fagus pollens were relatively high during this period in a steady state, although the content of Tsuga chinensis pollens were low, while the pollens always existed in this period, moreover, Abies pollens were found before 9,000 years. This paper explored the evolution of ancient ecology and environment in Fanjingshan from the world natural heritage of Outstanding Universal Value perspective, through the analysis of pollen of lacustrine sediments, combined with radioactive 14C dating, reconstructed the changes of vegetation and the characteristics of ancient climate since the Holocene period, speculated the evolution of ecological environment, and find the response to climate changes of organic carbon by lacustrine sediments quantitatively. The Quaternary spore pollen recorded the change of Holocene vegetation and climate in the nominated property. This paper provided a theoretical background and important support for the Outstanding Universal Value of the world heritage in Fanjingshan.

Key words: Fanjingshan, Holocene, Environment Evolution, Lacustrine Sediments

Terrestrial Net Ecosystem Primary Based on Remote Sensing and Ecosystem Process Model in Three-River Headwaters, Qinghai

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Abstract: Three-River Headwaters (TRH) of the Yangtze River, the Yellow River and the Lancang River is located in the Qinghai-Tibet Plateau and is sensitive and fragile to global climate change. Therefore, the region was considered as a natural lab to explore the changes of carbon absorption and release under global climate changes in future. In

this study, the GLOPEM-CEVSA, a model coupled remote sensing based production efficiency model with ecosystem process model, was applied to estimate the terrestrial net ecosystem primary of the TRH region in 1982-2005. The input data included the meteorological data interpolated from station observations (temperature, precipitation, wind speed, relative humidity and sunlit hour) and the Fraction of Absorbed Photosynthetically Active radiation from satellite remote sensing. The outputs were compared with the results from other model and the observation on eddy covariance towers. The comparison showed the model of this study has a good seasonal consistency with CEVSA in simulating the ecosystems gross primary productivity, net primary productivity, autotrophic respiration and heterotrophic respiration in the throughput tower of Haibei station in Qinghai. Further, the temporal and spatial change pattern and interannual trend of heterotrophic respiration and net ecosystem primary of Qinghai were analyzed. Then we found that the interannual variability of net ecosystem primary in Qinghai is mainly affected by net primary productivity. The interannual variation of heterotrophic respiration in ecosystems is small; net primary productivity fluctuates and net ecosystem productivity also shows a trend of increasing trend. That is, the Qinghai area ecosystem develops from a larger carbon source to a smaller carbon source direction. The influence of climate changes was analyzed further. Since, this paper provided a methodological reference for estimating carton budget based on satellite remote sensing on regional scale.

Key words: Qing-Tibet Plateau, Remote Sensing Model, Carbon Budget

The Tolerance of Tropical and Subtropical Plants to Extreme Chilly Events Is Related to Their Native Distribution

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Abstract: Previous studies have demonstrated that plants are moving poleward and upward in response to climate change. However, such movements are lag behind warming for many reasons, including extreme cold events that prevent plant movement. In this study, we measured potential maximum photochemistry efficiency of PSII (Fv/Fm) in 101 tropical and subtropical angiosperm species after 3 subsequent chilly events with subzero temperature (each lasting several days up to a week) to assess their cold tolerance in a southern subtropical city, Nanning, China. We found that 73.26% of the species suffered cold stress with Fv/Fm reduced to < 0.8, while 16.83% species suffered severe damage to photosynthetic apparatus with Fv/Fm < 0.6, which were exclusively tropical plants. A significant negative correlation between Fv/Fm and mean annual temperature of native distribution of a species was found.

Our results suggest that the poleward movements of some tropical plants would be slowed-down by such extreme cold events. The quick measurement of Fv/Fm is useful to assess cold tolerance of plants, and the present results can be used for the species in horticultural management and urban landscape design.

Key words: Cold Tolerance, Global Change, Distribution, Chlorophyll Fluorescence

Response of ChlF Energy Partitioning of Xerophytic Plants to Rainfall Pulse in Semi-Arid Area of Nothwest China

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Abstract: Moinitoring response of plants to stress in situ using chlorophyll fluorescence (ChlF) technique has been of growing interest. How plants can cope with and acclimate in arid and semiarid regions to the projected climate warming associated with increasing climatic variability and weather extremes is a growing concern. Excitation energy partitioning based on ChlF was used in our study in semi-arid area of northwest China. Three strong precipitation events and two short-term drought in 2012-2013 were chosen to analyse response of xerophytic plants to extreme weather enents. Both drought and heavy precipitation have different impacts on the two studied xerophytic plants. S. psammophila is more sensitive with SWC70cm while A.ordosica is sensitive with SWC30cm. In the first rain pulse, ΦPSII (Photochemistry consumption of absorbed light in PSII) of S.psammophila decline dramaticly along with decreased ΦNPQ (regulated non-photochemical energy loss in PSII), NPQ(non-photochemical quenching) and raised ΦNO(non-regulated non-photochemical energy loss in PSII) when SWC70cm reached 16%, which last for 5days, and the duration is different in the third rain pulse that the SWC70cm reached 14%, the recovery time is 2days; phenological stage plays an important role in A.ordosica's response to rain pulse, photosynthetic physiological activity were inhibited in the third rain pulse with a maximum SWC30cm of 16% and had a long recovery couldn't recovery in 5days. Diverse sensitive duration of the two species were concluded in our research, A.ordosica is more vulnerable to drought stress in August, while S. psammophila is more vulnerable in June. Finally, different acclimation mechanisms in the two species coping rain pulse and drought were discussed.

Key words: Semi-arid Area, Rain Pulse, Chlorophyll Fluorescence, Energy Partitioning

Abundance-Weighted Trait Variation along Large-Scale Abiotic Gradients: A Comparison of Wetland and Terrestrial Habitats

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Abstract: Trait variation along gradients can be used to investigate ecological processes, e.g. species strategies, community assembly and ecosystem functioning. However, trait variation has always been quantified without considering species relative abundance. Besides, the relative extent of trait variation in wetland and terrestrial habitats has little been investigated. Here, we tested how abundance-weighted trait variation in wetlands differed that in terrestrial habitats within and among sites along large-scale abiotic gradients. Plant height and 12 leaf traits related to important ecological strategies were quantified within dominant species in wetland and terrestrial ecosystems from 27 sites across China. We found that community weighted mean (CWM) of height, leaf area, specific leaf area and leaf P in both wetland and terrestrial ecosystems increased significantly with increasing mean annual temperature (MAT). For all 13 traits, the abundance-weighted trait variation within sites is larger than among sites for both wetland and terrestrial ecosystems, although there is small difference between these two sites. Moreover, for height, leaf chlorophyll content, leaf thickness, leaf area, specific leaf area, leaf C and leaf P, trait variation within sites in wetlands is larger than that in terrestrial habitats. Except for height, leaf area and leaf N, trait variation among sites in wetlands was smaller than that in terrestrial habitats. Our results suggest that abundance-weighted trait variation at local scale may play the same important role as that at regional scale irrespective of ecosystems types. The relative extent of within-site trait variation in wetland and terrestrial habitats depended on traits, and among-site trait variation in wetlands smaller than that in terrestrial habitats is consistent with the azonality of wetland vegetation.

Key words: Trait Variation, Wetlands, Abiotic Gradients, Spatial Scales

Global Forest Bird Extinction Risks Driven by Climate Change

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Abstract: Species extinction rate at present is estimated as 100–1,000 times higher than those recorded in the pre-industrial eras and the extinction risk is expected to increase with the ongoing climate change. Climate-change mitigation policies will influence land-use decisions, which could have significant impacts on habitat for a substantial number of species. Birds are the most widely studied organisms on the earth and represent an important indicator for the effects of climate change on biodiversity. Here we demonstrate how extinction rates of forest birds are synergistically affected by land-use and climate change at the global scale.

A total of 1,307 forest bird species (including 194 migratory species) that met our following criteria were analyzed: (1) those were categorized as forest inhabitation in the IUCN Red List, and (2) both population size information and distribution map were available in the BirdLife International database. First, we constructed forest habitat areas for these bird species by superimposing species distribution maps (BirdLife International) on a global forest cover map in 2000. Then we calculated forest habitat loss rates by using the 2000 forest habitat areas and future land-use prediction map in 2100. Finally, we calculated the "quasi-extinction" probabilities, which are the probabilities that population sizes become lower than an extinction threshold (n = 50 or 500) after habitat loss based on initial population sizes and forest habitat loss rates. We mainly focused on the extinction threshold of 50, given an increased likelihood of bird species extinction.

We estimated that country endemic species (n = 839) had a 5.2% significantly greater extinction rate relative to non-endemic species (n = 468) by 2100, indicating that distribution area of the endemic species and their population sizes appeared to be relatively small. Regions also differed significantly in extinction rate. North America (11.1%; n = 63) was characterized by the highest rates of species extinction possibly due to decline in boreal forest extents. Species extinction rates for birds in Caribbean islands (7.2%; n = 72) were also significantly higher than overall average value (4.3%; n = 1307), because most of distribution area and population size of species in this region were relatively small. In contrast, bird species for West and Central Asia (n = 63), North Africa (n = 37), and Europe (n = 52) were characterized by the lowest rates of species extinction (0%). Species extinction rates for birds in East Asia (0.2%; n = 105) and Sub-Saharan Africa (1.5%; n = 184) were also significantly lower than the global average. We found that the number of extinction bird species by 2100 was the largest in South America (n = 10) and South and Southeast Asia (n = 10), and these trends were almost consistent with previous studies.

Key words: Forest Birds, Climate Change, Species-area Relationship, Land-use Change

Surface Conductance for Evapotranspiration of Tropical Forests: Calculations, Variations, and Controls

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Abstract: Tropical forests evaporate huge amounts of water in the atmosphere annually. Surface conductance (gs) is a poorly understood term that plays a central role in regulating this evapotranspiration. We studied the calculations, variations, and controls of gs based on eddy flux measurements from 10 tropical forests that covered a wide range of water gradient across continents. We found that boundary layer conductance (gb) is comparable with aerodynamic conductance for momentum (gaM) and thus, it should not be ignored in estimations of total aerodynamic conductance for water vapor (gaV). Based on the findings, we have made some recommendations for gaM estimation both with and without measurements of turbulence. Furthermore, energy imbalance was found to have profound effect on gs estimation. The seasonal variation of gs is slight in humid sites but strong in sites with a dry season. A value of 24.8 ±13.8 mm $^{s-1}$ was suggested for maximum surface conductance (gsmax) for tropical forests. Both water vapor deficit (D) and radiation (Q) play an important role in controlling gs. The model driven by both D and Q could capture the diurnal variations of gs well and it showed potential for future use in large-scale models. We believe the findings of this study could contribute substantially to improved understanding of tropical forest gs.
Key words: Boundary Layer Conductance, Penman–monteith Equation, Maximum Surface Conductance, Energy Imbalance Correction

Elevated Temperature Reduces Settlement and Survivorship of the Moon Jellyfish Aurelia Sp.1 Planulae

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Abstract: The recruitment of planula larvae to benthic polyp population is important for population size of the Aurelia sp.1 medusae, and this may be affected under projected changes in climate conditions. In laboratory study, we determined the effects of elevated temperature and reduced salinity on the behavior, survival and settlement of Aurelia sp.1 planula larvae. Three temperature levels (21, 24 and 27 ℃) and two salinity levels (31 psu and 22 psu) were used. The interactive effect of temperature and salinity are statistically significant only on the planula larvae size, but not on the swimming behavior, survival and settlement of Aurelia sp.1 planula larvae. The

survival of Aurelia sp.1 planula larvae was not influenced by the reduced salinity (22 psu). However, reduced salinity has significant negatively effect on the swimming behavior and settlement of Aurelia sp.1 planula larvae. Aurelia sp.1 planulae moved fast and preferred to settle at the ambient salinity (33 psu). The settlement rate of Aurelia sp.1 planulae was high at the current ambient temperature (24 ℃) in summer. Aurelia sp.1 planula larvae became significantly smaller under the combination of elevated temperature (27 ℃) and reduce salinity (22 psu). Elevated temperature (+3 ℃) increased the morality rate of Aurelia sp.1 planula larvae that was statistically significant by day 7 under the reduced salinity condition. Meanwhile, elevated temperature reduced the settlement rate of Aurelia sp.1 planula larvae that was statistically significant during the first 3 days under the reduced salinity conditions. Our present study provides information on the response of Aurelia sp.1 planulae to the temperature and salinity, which are helpful to understand how environmental factors will influence the recruitment dynamics of Aurelia sp.1 planula larvae. Moreover, in terms of Aurelia sp.1 planula larvae, future oceanic warming may have negative effect on the recruitment dynamic of Aurelia sp.1 and don't contribute to the jellyfish blooms.
Key words: Jellyfish Blooms, Global Warming, Hyposaline Conditions, Larvae Behavior

Soil Fungal Community Structure and Diversity in Response to Nitrogen Addition and Increased Precipitation in a Stipa Baicalensis Meadow Steppe

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Abstract: Atmospheric nitrogen deposition and changes in precipitation regimes cause great influences on the structure and function of grassland ecosystem. There are widespread concern and deep study focusing on the effects of nitrogen deposition and increased precipitation on the plant community structure and plant diversity of grassland ecosystem. However, we lack knowledge on the microbial communities in grassland soil, especially, the mechanism and varying patterns of fungal community structure and diversity. The purpose of this study was to evaluate the effects of nitrogen addition and increased precipitation on soil fungal community structure and diversity. A situ experiment with nitrogen addition (50 kg N hm^{-2} yr^{-1}) and increased precipitation (+14%) and their interactive treatments was conducted on a Stipa baicalensis meadow steppe in Inner Mongolia Autonomous Region, China. Each treatment has 4 replicated plots, and the size of each plot is 2 m × 2 m. Since 2010, nitrogen was applied in the form of NH_4NO_3 in June annually, and the treatment of increased precipitation was

implemented using rainfall intercepting tank. Soil samples were collected in May, July, August and September in 2015, respectively. The root samples were taken at a depth of 0-15 cm below ground level. 18S rRNA of soil fungal community for high throughput sequencing and real-time PCR were used to detect soil fungal community structure and diversity. The results showed that there were 32 phyla, 55 classes, 90 orders, 115 families and 154 species on S. baicalensis meadow steppe, and the dominant fungal communities were Ascomycota community and Basidiomycota community. The effects of nitrogen addition, increased precipitation and their interactive treatments on soil fungal community structure, diversity and were not significant. However, the Ace index, Chao index, Shannon index of soil fungi and bacteria/fungi ratio were significantly different ($P < 0.05$) in the different periods including May, July, August and September during the growing season. Nitrogen addition significantly reduced the soil fungal biomass C, N ($P < 0.05$), however, the inhibitory effect of nitrogen addition on soil fungal biomass was partly relieved by increased precipitation. Fungal gene copy number was not significantly different at different sample times. The effects of nitrogen addition and increased precipitation on soil fungal community structure and diversity are weaker than the season factor in S. baicalensis meadow steppe. The main factor in regulating the soil fungal community structure and diversity is the variation in seasonal precipitation regime. Our findings demonstrate that the effects of nitrogen deposition and increased precipitation on soil fungal community is a slow process, and it is important to extend the temporal scale in global change manipulative experiment.

Key words: Global Change, Nitrogen Deposition, Precipitation Regimes, Soil Microbes

Characteristics of Nitrogen Mineralization in Degraded Meadow Soils in Wugong Mountain

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Abstract: Wugong Mountain meadow was typical and special in the vegetation vertical zone in the south of China with its characteristics of wide area and low level of distribution. But as tourists soared in recent years, tourists trample and waste emissions caused a large area of meadow degenerated in Wugong Mountain.This paper took Wugong mountain degraded meadow soil which caused by the tourists trampled as the research object, analyzed the effects of simulated warming on Wugong mountain meadow soil nitrogen mineralization. The aim was to take nitrogen as the breakthrough point, revealed the response of meadow soil in Wugong Mountain to global warming.

At the altitude of 1900m selected sample plots：not degradation (CK,vegetation coverage>;90%)、lightly degradation (LD,60%<vegetation coverage<75%)、medium degradation (MD,30%<vegetation coverage<45%) and heavily degradation (HD,vegetation coverage<10%) meadow area, and along the slope the ridge line at the altitude of 1600m,1700m and 1800m, selected the sample plots of not degradation and heavily degradation meadow area. The soil samples were collected by undisturbed soil column method, and study on nitrogen mineralization of meadow soil. The results showed that: At the same temperature, the rate of net nitrogen mineralization increased with the aggravation of degradation. Under the condition of the same elevation and degradation degree, the soil net nitrogen mineralization rate was significantly increased from 15℃to 25℃(P<0.05),and slightly reduced from 25℃to35℃,Overall performance as 25℃>;35℃>;15℃. Thus，it cloud be predicted that the peak value of soil net mineralization in Wugong Mountain meadow might appear between 25℃~30℃. Therefore under the trend of global change, the increase of temperature will also accelerate the occurrence of soil nitrogen mineralization, promote the release of inorganic nitrogen, and accelerate the loss of soil nitrogen, affect the absorption of nitrogen in plants, and thus hinder the normal growth and development of plants, which accelerated meadow degradation, a vicious spiral.

Key words: Wugong Mountain, Meadow Degradation, Soil Nitrogen Mineralization, Simulated Warming

T2-02: Adaptation of Native Broadleaved Forests Under a Scenario of Global Change: Threats and Opportunities for Sustainable Rural Development

The Trait Variation in Temperate Canopy Tree Species and Their Responses to Climate Change from NE China

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Abstract: In temperate ecosystems, the frost events are an important environmental stress that can influence detrimentally tree physiology, growth and survival. The precise evaluation of temperate canopy tree species responses to climatic factors (temperature) and environmental stress across different spatial and temporal scales will contribute to a better mechanistic understanding of how climate change will affect forest ecosystems and their feedback to climate change. we have investigated the structural and functional traits of leaves and stems of 10 deciduous broadleaved tree species in combination with climatic factors (temperature, precipitation) along different altitude gradients (550 - 2000m) across three forest vegetation belts (Montane mixed-forest belt below 1100m, Upper-montane coniferous forest belt from 1100 to 1700 m, Subalpine dwarf-forest be1t from 1700 to 2000 m) from Changbai Mountain (at 42 ℃00′N and 128°10′E) of NE China to test how hydraulic traits of these canopy tree species vary along elevational gradients and are response to climate change. We found significant variation in leaf and wood traits (e.g. Leaf dry mass per unit leaf area, LMA and wood density) along different elevations. There existed also the strong coordination of morphological and physiological traits among these tree species. Moreover, contrasting functional traits and phenotypic flexibility from these canopy tree species showed alternative adaptation strategies across different altitudes (temperature and precipitation gradients), suggesting that there were differences in sensitivity to climate change of these temperate tree species. Our findings will provide more mechanistic groundwork for the precise global modeling and predictions of forest ecosystems responses to climate change.

Key words: Elevation, Climate Change, Functional Traits, Scale

The Impacts of Robinia Pseudoacacia on Functional Structure of Plant Community in Different Vegetation Zones of Yanhe River Catchment

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Abstract: We pairs of samples of Robinia pseudoacacia communities and native plant community of the different vegetation zones in Yanhe River catchment,the functional structure of the community as the research object, the functional characteristics(specific leaf area, leaf tissue density, leaf carbon content, leaf nitrogen content, leaf phosphorus content) of the dominant species in the community were determined.We Calculated the index of the community functional structure (community-weighted mean of each functional trait; functional diversity: functional abundance, functional uniformity, functional dispersion and dispersion).The changes of functional structure of Robinia pseudoacacia communities in different vegetation zones were revealed, and the comparison between the Robinia pseudoacacia and the native plant communities in the same vegetation zone was carried out to analyze the effect of the introduction of Robinia pseudoacacia on the functional structure.The results showed that: (1) The specific leaf area and leaf tissue density of Robinia pseudoacacia community were significantly different ($P<0.05$), while the contents of leaf carbon, leaf nitrogen and leaf phosphorus were slightly different. (2) The FEic index and FDis index and RaoQ index were significantly different between different vegetation zones ($P<0.05$), but the difference of functional segregation was not significant ($P<0.05$) in different vegetation zones. In general, the forest zones> forest-steppe zones> steppe zones. (3) Relative to native plant communities, leaf carbon content, leaf nitrogen content and specific leaf area of Robinia pseudoacacia communities were significantly higher than those of the native plant community ($P <0.05$), and leaf tissue density of the Robinia pseudoacacia community was significantly lower than the native plant community in the steppe zone and forest steppe zone ($P <0.05$). (4) Relative to native plant communities, the functional richness of the Robinia pseudoacacia community was lower than that of the native plant community, and the FDiv index of functional segregation degree and FEve index of functional uniformity were not significant. In the steppe zone, The FDis index and RaoQ index of Robinia pseudoacacia community were significantly lower than those of native plant communities, and there was no significant difference in forest-steppe zone, but higher than that of native plant communities in forest zone.

Key words: Robinia pseudoacacia, Native Plant Community, Yanhe River Catchment, Functional Structure

Ecological Risk Assessment in Arid Inland River Basin in Xinjiang

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Abstract: Due to the vulnerability and complexity of ecosystem in arid area, ecological problems are becoming more and more serious in arid inland river basin. So the research mainly study ecological risk assessment in arid inland river basin, which is one of the most representative mountain-oasis-desert ecosystems in arid region of China, based on the theory of modern geography and ecology, by means of quantitative research, analysis technology and method as the means such as principle companent analysis, fuzzy mathematics, AHP method and GIS spatial analysis techniques. We, firstly, analyze deeply the interaction mechanism and the relationship among each ecosystem from the watershed ecosystem perspective, and then studied the content and features of ecological risk assessment about typical watershed, level division and assessment unit determination. Secondly, according to the basic elements (risk sources, habitat and effect) affected on the ecological risk assessment, base on an overall consideration of many risk sources, risk factors, multi-endpoint and ecological receptors coexistence, we had constructed an technology system which includes the hazard indicators of risk sources, the vulnerability indicators of habitats as well as the potential loss of risk receptors. The main parts of system included comprehensive model building, index system. Finally, we use the ArcGIS technology and assessment model to evaluate the time-spatial evolution character of risk assessment in arid inland river basin. Based on the results, the most important regions of eco-environmental protection in the study area were determined, and the management countermeasures of eco-environmental protection and strategies were put forward. It is significant to make a reasonable assessment of ecological risk to establish the ecological risk alarm mechanisms, minimize the risk of ecological environment and maintain the ecological function in arid inland river basin.

Key words: Ecological Risk, Inland River Basin, Arid Area, Xinjiang,

Socio-Economic and Technical Determinants for the Adaptation of Native Hardwood Forests of Temperate Zones under a Scenario of Global Change

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Abstract: It is expected that climate change due to increased greenhouse effect strongly affects human activities and the natural environment. The primary sectors such

as agriculture and forestry will be more susceptible than the secondary and tertiary sectors.

Forests in general and particularly native hardwood forests are being especially sensitive to climate change and climate variability, both in the northern regions like southern Europe. In the Mediterranean region, forests may be affected mainly by increased droughts and forest fires. In northern Europe, is expected to increase in rainfall is large enough to offset the increased evapotranspiration. On the other hand, increased precipitation, cloudiness and rain days and the reduced duration of snow cover and soil frost may negatively have an effect on forestry and timber logging determining lower profitability of forest production and a decrease in socio-cultural possibilities. Adaptation management strategies should be introduced, as effective tools, to try reducing the negative impacts of climate change on forestry sector.

Our work focuses on the review of the impact of climate variability and climate change on forests and forestry in Europe. In particular, we show the ecosystems responses, as well as key management strategies adopted to avoid or at least reduce the impact of this process.

The results show that the consequences of global change in Europe will probably increase forest productivity due to increased CO_2 concentration, plant efficiency and also because warming will produce more favorable conditions for production in northern Europe. In the southern areas, however, the benefits of climate change will be limited, while the drawbacks will be predominant. The efficiency of water use caused by increased CO_2 will only partially offset the negative effects of water scarcity. In addition, adverse effects will occur in southern areas due to the increase in extreme weather events (e.g. heat waves and wind speed). These negative impacts could be addressed by supporting the development of specific adaptive forest management measures (water conservation practices, microclimate modification, and sustainable forest management).

Key words: Natural Forests, Greenhouse Effect, European Regions, Sustainable Forest Management

Changes in the Land-Use and Natural Forest Regeneration in the Native Forests of Northwest Mountains of the Iberian Peninsula

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Abstract: A lot of forests that populated our planet, especially native forests in many places on Earth were transformed in croplands, felled mainly for naval, metallurgy and railways industries, suffered large forest fires, and finally were replaced by

fast-growing species, above all coniferous and eucalyptus. All of these activities have led to an important reduction in the occupied area by them. Nowadays they are covering small sites generally abrupt, occupying the places where the territory characteristic makes another land-use impossible. They are also in the plains, near to the villages usually, but natural regeneration is limited by human activity. The landscape is highly modified, with a slow but continuous transformation. Here, the conservation of biodiversity is very important, but there is a great risk of losing it. One positive aspect is that the area covered by these forests, in general, has recently increased and there is greater awareness raising for their conservation; for example, in the European case, numerous of these forest ecosystems have been recognized as habitats of interest for the European Union as part of Natura Network 2000, which could assure the adaptation to new climatic conditions, and therefore their future conservation. For this, it is essential to ensure the natural regeneration of these ecosystems. Changes in land-use have also produced major changes in ecosystem services that these forests provide us, as well as in the current difficulties for get an adequate natural regeneration. Ecosystems in general and natural forests in particular, generate different ecosystem services (e.g. food production, water regulation and control erosion, socio-cultural values) and insurance values. The latter is the value of ensuring that no regime changes occur with irreversible negative consequences for human welfare. Our goal is to estimate the value of the various services and benefits that ecosystems and biodiversity generate and analyze different assessment approaches. The results obtained in the evaluation process will depend largely on the socio-cultural and economic factors, which limits, in any case overlap with aspects of ecological systems. For proper evaluation it is essential that there is adequate coordination between all stakeholders. Despite the difficulties of transferring various valuation approaches and results to other regions, the transfer of benefits can be a practical, quick and inexpensive way to get an estimate of the value of local ecosystems. The results vary with the characteristics of the ecosystem and the beneficiaries of the services it provides.

Key words: Natural Forests, Ecosystem Services, Valuation Approaches, Insurance Values

Numerical Simulation of the Feedback of Land-Cover Change on Regional Climate in the Loess Plateau

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Abstract: Land-cover change is driven by the natural climate change and human activities, meanwhile, the land-cover change has impact on regional climate. The

land-cover change processes affect the climate through exchanges of materials (e.g., water) and energy across the land-atmosphere interface, and the processes play an important role in regional ecological construction. In this paper, we conducted two numerical simulations（1980-2014、2005-2014）using Regional Climate model (RegCM) version 4.5, which are driven by ERA-Interim reanalysis data produced by the European Centre for Medium-Range Weather Forecasts(ECMWF). A set of land-cover data with high spatial resolution and timeliness had been built based on the 1:250000 land use data, and the map of vegetation and soil. Then the changes in temperature and precipitation due to the actual land-cover changes was simulated with the land surface process model Biosphere-Atmosphere Transfer Scheme (BATS) in the Loess Plateau. The feedback of land-cover change and the surface energy budget were analyzed on regional climate. The implications from the study are as follows: (1) RegCM4.5 can reproduce the observed annual cycle of mean temperature and precipitation well, as well as the feedback of water-heat conditions under the land-cover change on the Loess Plateau (Fig.1). (2) The feedback is different under different types of land-cover change as Fig.2 showed, desertification can lead to increase of temperatures and decrease of precipitation, which would hinder the natural vegetation recovery. This is mainly due to the desertification can lead to increase of the surface albedo, and the decrease of the net absorption of radiation, effective heat flux and the net absorption of shortwave radiation. Meanwhile, the green leaves look a lot darker than a bare soil surface. And bare soil surface to absorb fewer calories. (3) Reclamation will lead to increase of temperatures and precipitation in summer, which may cause more drought and flood events. Due to the increase of surface roughness, and the changes of the wind stress drag coefficient. Further the surface will create more turbulence, and the atmosphere will increase more convective activities. This will bring more rainfall. (4) Grassland amplification will lead to decrease of temperatures and precipitation in spring and summer and increase of temperatures and precipitation in autumn and winter. Grassland amplification will lead to decrease of the surface albedo, and the increase of the net absorption of shortwave radiation. With increase of grass land, lead to the increase of soil water content, surface roughness, leaf area index and evapotranspiration, this leads to marked increase in surface latent heat flux. The conclusion can deepen the understanding of the effects of ecological environment change in loess plateau, and the process of reciprocal effects between land-use and climate change. The conclusion provided a reference for regional ecological construction policy.

Key words: Regcm4.5, Land-Cover Change, Climate Feedback, The Loess Plateau

Temporal Acclimation and Adaptation in Needle Photosynthesis and Respiration of Larix Gmelinii: A 30-Year Common Garden Experiment

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Abstract: Dahurian Larch (Larix gmelinii) is the dominant tree in the boreal forests of Eurasia, and it is essential to research the eco-physiological response of this species to climate change. We study the seasonal variations of needle photosynthesis and respiration of larch trees originating from six provenances grown for 30 years in a common garden and determine whether these variations were driven by genetic adaptation or by phenotypic acclimation. Our results showed that the area-based maximum net photosynthetic rates (Pmax-a) and dark respiratory rate (Rd) at 25 ℃ all had significant provenances difference at each growing season stage. The provenances came from high growing season mean temperature (Ts) habitats had the lower/higher Pmax-a /Rd in the early growing season than other provenances, and showed the opposite trends in the peak growing season. The provenance difference of Pmax-a measured at peak growing season stage can represent the whole year difference, however, the provenance difference of Rd can't. Pmax-a and Rd were inconsistent with the leaf phenology, but co-varied with N and environmental factors of seed-source original sites, providing evidence for the adaptation under the genetic control. The temporal patterns of Pmax-a/Rd and their correlations with seasonal temperature and precipitation of the common garden were indicative of a consistent environmental acclimation response, but the magnitude and direction of acclimation was dependent on temporal scale and provenance. The provenances from cold habitats had the significant high/low initial values of Pmax-a/Ra with the increasing of temperature and precipitation. Our results suggested that we should consider the temporal scale of observation and the provenances differentiation when we discussed the effects of climate change on photosynthesis and respiration of forest tree in the regions with obvious seasonal variations.

Key words: Acclimation, Adaptation, Photosynthesis, Respiration

Carbon Sequestration Potential of Pinus Roxbrughii in Garhwal Himalaya

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Abstract: The aim of the present study was to assess the carbon stock potential of Chir

pine (Pinus roxburghii) in Garhwal Himalaya. Chir pine is a very prominent forest cover in Uttarakhand Himalaya. Out of total 24,414.80 km^2 area under forests; it occupies 3,943.83 km^2 which is 16.15 % of total forest area of the state. Chir pine is the most important tree species used for afforestation pro¬grammes in Himalayan regions. In Nepal, Ministry of Forest and Soil Con-servation has also focused on Chir pine as commercially planted species and the most appropriate for greenhouse gas emission reduction because of greater carbon storing and sequestering capacity.

In the present study, fourteen forest stands, in four different altitudes i.e., <1000m (Khola, Rudraprayag, Khairakhal), 1001-1400m Kandikhal, Mayali, Badiyargarh, Daddi) 1401-1800 (Pokhal, Agrora, Lansedown, Gumkhal) and > 1801m (Ranichauri, Dandichilli, New Tehri) Garhwal Himalayan from its lower altitude to upper altitude to assess carbon stock potential. The maximum density (575.00±90.14 ind. ha^{-1}) of Chir pine trees was in New Tehri <1801 m and minimum (135.00±5.00 ind. ha^{-1}) in Daddi between 1001-1400 m. The tree height ranged from 12.67±2.29 m (New Tehri) to 25.29±3.41 m in Agrora. However diameter ranged from 19.00±1.63 cm to 56.16±5.45 cm in Kandikhal and New Tehri respectively. The maximum value of basal cover was 41.36±7.94 m2 ha-1 in Kandikhal (1001-1400 m) and minimum (11.12±3.13 m2 ha^{-1}) in Gumkhal (1401-1800 m). Similarly volume ranged from 93.98±35.43 m3 ha^{-1} to 407.07±88.15 m^3 ha^{-1}. The highest aboveground carbon stock (96.00±18.36 t ha^{-1}) was in Kandikhal with the values of 89.93±19.47, 5.17±1.04 and 0.90±0.14 t ha^{-1} for bole, branch and foliage respectively. The lowest aboveground tree carbon stock was in Gumkhal (26.68±9.48 t ha^{-1}) with the values of 20.72±7.84, 4.50±1.58 and 1.47±0.11 t ha^{-1} for bole, branch and foliage respectively. The belowground tree carbon (root carbon) was again highest in Kandikhal (28.58±4.81 t ha^{-1}) (1001-1400 m) and the lowest belowground tree carbon was observed in Gumkhal (9.19±2.87 t ha^{-1}) between 1401-1800 m. Overall, litter production was found high in summer season followed by rainy and winter seasons. The study concluded that tree density has not shown any trend with altitude, however, density has shown positive relationship with tree volume, tree carbon and litter carbon as density change the parameter also changed.

Key words: Tree Carbon, Chir Pine, Altitudes, Garhwal Himalaya

Effects of Different Substrate Quality on Leaf Weight Loss and Nutrient Variation of Tailed Leaves in Mixed Decomposition Process

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Abstract: In order to compare the difference of quality loss and nutrient release between leaves of Eucalyptus grandis in different mixed decomposition processes, it

was clarified that the difference of leaf weight of leaves of Eucalyptus grandis was different. The Using the decomposition bag method, the leaves of the mixed decomposition were Acacia, pepper, complex feather leaf Koelreuteria, alder, camphor, magnolia, and mixed with the juvenile eucalyptus leaves by 1: 1, respectively. The contents of C, N and P in the leaves of Eucalyptus urophylla during the three - month, six - month and 8 - month decomposition were determined. The changes of C, N and C /N, C/P and the loss of leaf weight of Eucalyptus urophylla leaves. The results showed that the loss of leaf litter of Eucalyptus urophylla was lower in the early stage of decomposition than in the later stage of decomposition, but there was no significant difference in the quality loss of leaves of Eucalyptus urophylla in different treatment groups. The leaf litter of different mixed species had different effects on the nutrient release of leaves of Eucalyptus urophylla. The low quality litter leaves had an inhibitory effect on the nutrient release from leaves of Eucalyptus urophylla, while high quality litter leaves had a mixed effect on the release of nutrient elements from leaves of Eucalyptus urophylla, which had a promoting effect, a suppressive effect or no effect.
Key words: Eucalyptus Urophylla, Mixed Decomposition, Quality Loss, Nutrient Release

Analysis and Prediction about Land Use Change in Area along the Belt and Road Initiative Based on CA-Markov Model

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Abstract: The meaning of the Belt and Road Initiative is the Silk Road Economic Belt and the 21st Century Maritime Silk Road, which is a new international regional economic cooperation mode proposed by China to promote the development of Chinese economic globalization and create a platform for economic and trade exchanges to get the mutually beneficial with the areas along the Belt and Road Initiative. Land use is one of the key elements for regional development, so the study of land use changes in area has important significance for the construction of the new platform and the new mode. Five provinces in Northwest China belong to the area along the Belt and Road Initiative, and Shaanxi Province is the starting point of the Silk Road, which has a unique geographical and ecological environment. Based on the 1980 and 2005 land cover data of Shaanxi Province in Northwest China, this article analyzes land use change in 25 years of the area along the Belt and Road Initiative, the result shows that the area of cultivated land, forest land and unused land is decreased, and the area of grassland, water area and construction land is increase in 25 years. Forecasting land use situation in 2030 by using CA-Markov model combined with the transfer

probability matrix of land use area, the result shows that the accuracy of simulated data in 2005 is meeting the demand，and the trend of land use change from 2005 to 2030 is consistent with trend of land use change from 1980 to 2005.

Key words: The Belt and Road Initiative, Shaanxi Province, Land Use Change, CA-Markov

Effects of Enhanced UV-B Radiation and Nitrogen Deposition on ChlorophyII Fluorescence Parameters of Invasive Plant Triadica Sebifera

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Abstract: Exotic plant invasions are important components of global change. Photosynthetic abilities are vital to growth, establishment and even expansions of invasive plants. Global change factors enhanced UV-B radiation and nitrogen (N) deposition could both impact plant invasion successes by regulating photosynthetic abilities. Triadica sebifera is native to China but has been reported to be aggressively invasive in the US. However, the effects of enhanced UV-B radiation and N deposition on the invasion success of Triadica sebifera have not been examined and understood. Here, a study with simulated UV-B radiation and N deposition with or without active soil biota communities were conducted to examine their effects on the growth and chlorophyII fluorescence parameters (maximum quantum yield of photosystemII (Fv/Fm), effective quantum yield of photosystemII (Y(II)), photosynthetic rate in light-limited region of rapid light curve (α), maximum relative electron transport rate (ETRmax), minimum saturating irradiance (Ik)) and relative chlorophyII content (SPAD) of invasive plant Triadica sebifera with different populations. The results showed that both chlorophyII fluorescence parameters and plant height growth were significantly influenced by UV-B radiation, N deposition and soil sterilization treatments. Triadica sebifera seedlings from the invasive origin were higher in Y(II) and height growth but also more sensitive to enhanced UV-B radiation in SPAD. In addition, SPAD of the native Triadica sebifera seedlings were higher than the invasive ones while however soil sterilization treatments removed these differences. Thereby, the invasive Triadica sebifera might have evolved to be more efficient in photosynthesis and hence plant growth rate, which enable the invasive plants to be higher in UV-B radiation-tolerance during range expansion.

Key words: Chlorophyii Fluorescence Parameters, Nitrogen Deposition, Invasion, Triadica Sebifera,

Modeling the Effects of Climate Change on Carbon Dynamics and Forest Composition in a Mid-Subtropical Mixed Forest

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Abstract: Future climate change is expected to bring multiple uncertainties for forestry productivity, potential carbon storage, forest composition, and biodiversity. In China, forests that once suffered widespread deforestation were banned logging in the past few decades, and are currently suffering rapid regeneration and expansion. However, the expected migration, that species ever shrank and confined to microrefugia will expand and colonize new areas beyond 'safe islands', may be hampered by the future climate change. Understanding the effects of climate change on forest carbon sequestration, forest composition, and species migration is urgently needed, which may help formulate climate-suitable planning as a strategy for maintaining forest productivity and functional diversity. We used a forest landscape model (LANDIS-II) to project the long-term effects of business-as-usual (BAU) management and climate change (IPCC representative concentration pathways (RCPs) scenarios) on forest carbon dynamics, forest composition, and species distribution in a mid-subtropical mixed forest in China. The whole forested landscape was divided in six ecoregions, mainly depending on altitude, climate, and soil properties. We analyzed the effects of two future climate scenarios (RCP4.5 and RCP8.5) against the current climate scenario on distinct ecoregions, especially higher mountainous terrain ecoregions as microrefugia for maintaining biodiversity. Results reveal that climate change, especially severe climate change (RCP8.5), will have negative effects on forest carbon sequestration (both soils and vegetation) in a long-term succession in our study area. For series ecoregions from low elevations to higher elevations, climate change contribute to gradually changes from negative to positive effects on vegetation carbon accumulation, especially under RCP8.5 climate scenario; however, severe climate change will limit soil carbon sequestration potential in all ecoregions. Forest composition in lower mountains is strongly affected by climate change, whereas climate change seems to have minor effects on forest composition in higher mountains. Endangered species, including Davidia involucrata and Magnolia officinalis, are almost lost under RCP8.5 climate scenario. Microrefugia show relatively strong resistance to climate change, but do not support as much species diversity as we expected. The unexpected results highlight the importance of forest management in face of climate change. Furthermore, our predicting results promote further understanding of climate change effects on mixed forests, in turn, offering useful information for developing climate-suitable planning in local management.

Key words: Climate Change, Forest Landscape Model, Carbon Sequestration, Forest

Composition

Beta Diversity of Vaccinium Uliginosum Communities at Different Spatial Scales: Influences of Forest Type and Latitude

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Abstract: Understanding the drivers of species beta diversity at different scales can help reveal the maintenance of species diversity. To investigate the influences of forest type and latitude on beta diversity at different scales, we quantified the species composition of Vaccinium uliginosum communities under broadleaf and needleleaf forests at two latitudes at quadrat (2m×2m) and plot (10m×10m) scales in Daxing'anling, NE China. At quadrat scale, species richness of V. uliginosum communities was higher in broadleaf forests than in needleleaf forests at both latitudes. The differences in species beta diversity (1-Sorenson's similarity) in two forest types depended on the latitude: beta diversity in broadleaf forests was higher than that in needleleaf forests at higher latitude, while at lower latitude beta diversity in needleleaf forests was higher. At plot scale, species richness and beta diversity of V. uliginosum communities decreased from broadleaf forests to needleleaf forests at higher latitude, and they didn't show significant differences between forest types at lower latitude. These results showed that the influences of forest type and latitude on species alpha and beta diversity were different across two spatial scales, suggesting that mechanisms driving species diversity may be different at different scales.

Key words: Beta Diversity, Understory Vegetation, Forest Type, Spatial Scales

Photosynthetic Acclimation of an Evergreen Broadleaved Shrub (Ammopiptanthus Mongolicus) to Seasonal Climate Extremes in a Cold Desert Ecosystem

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Abstract: Woody evergreen plants inhabiting cold desert ecosystems must cope with

chronically dry conditions and large seasonal temperature variations. To understand the photosynthetic strategies enabling survival of evergreens in cold desert ecosystems, we monitored seasonal changes in foliar gas exchange and traits of Ammopiptanthus mongolicus, an evergreen broad-leaved shrub native to the cold desert of northwestern China. We found that the photosynthesis of A. mongolicus proceeded slowly in fall and winter and rapidly in spring and summer. As photosynthesis decreased in winter, A. mongolicus showed a decrease in maximum RuBisCo carboxylation rates (Vcmax), maximum RuBP regeneration rates (Jmax), and photosynthetic nitrogen use efficiency (PNUEmax). The pre-dawn quantum efficiency of photosystem II (Fv/Fm) decreased in winter leaves, along with the decrease of Vcmax and Jmax. In summer leaves, however, we observed decreased chlorophyll contents and unchanged Vcmax and Jmax. These results suggested that A. mongolicus maximize its C assimilation rates during spring and summer and downregulate its photosynthetic capacity during winter in order to growth efficiently. To avoiding photo-oxidative damage under stressful conditions, A. mongolicus increases the consumption of incoming light energy by activating sustained energy thermal dissipation in cold winter, and decreases the input of light energy by reducing the size of the light-harvesting antenna in hot summer. Our study demonstrates the possible growth and photoprotection strategies by which A. mongolicus could success in cold desert environments.

Key words: Evergreen, Photosynthetic Capacity, Thermal Dissipation, Nitrogen Allocation

T2-03: Synthesizing Macrosystem Ecology across the Long Term Ecological Research Network

Understanding Phylogenetic, Spatial and Intraspecific Variation in Wood Densities of Tree: A Global Synthesis

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Abstract: It is estimated that over 20 million hectares of forests are lost annually (Hansen et al. 2013). With such high deforestation rates, it is imperative to understand the ecosystem value of the remaining forests. Besides providing several ecosystem services, forests are a critical repository for carbon, storing as much as _% of total stocks. Above-ground live trees comprise a significant component of carbon stocks, with equal or more carbon than below-ground stocks (Curtis, Pregitzer and Euskirchen 2004). Tree wood density is a trait that is significantly correlated with carbon stocks, is associated with site level factors such as the disturbance regime, climate and soil fertility, as well as is an indicator of the life history strategy of trees (Muller-Landau 2004). However, wood density values of all the species in a region of interest are not readily available and genera level approximations are often used since wood density is considered to be a trait that is phylogenetically conserved (Chave et al. 2006). While this information is available more recently due to global trait databases being made available (Reyes et al. 1992, Zanne et al. 2009, CTFS), there exists both phylogenetic and spatial variation (Chave et al. 2006, Flores & Coomes 2011). To investigate intraspecific variation, we analyzed the variation between individuals of species and between species within genera. To investigate spatial variation, we undertook this analysis at three scales: global, continental and regional scales. We also tested if low sample size results in less robust approximation of species level wood density values at the local level.

Key words: Wood Density, Carbon Estimation, Meta-analysis

Biogeographic Mechanisms for the Global Patterns of Terrestrial Carbon Fluxes

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Abstract: Although climate is known to influence the geographic patterns of carbon

fluxes, the underlying control mechanisms are not well understood yet. Here, by synthesizing the observed carbon fluxes at the global scale, we propose a new biogeographic mechanism for the climate control. The mechanism includes three interlinked controls: (1) "climate-constrained community photosynthetic capacity", in which spatial patterns of temperature and precipitation control the patterns of growing season length and mean carbon uptake and thus the annual primary production; (2) "climate-constrained dual substrates respiration", in which spatial patterns of newly production and stored organic matters control the annual ecosystem respiration; (3) "climate and disturbance-constrained ecosystem carbon allocation", in which spatial patterns of production and disturbances influence carbon use efficiency thus control the annual net production. Our results clarify the biogeographic processes of how climate patterns control the global distribution of carbon fluxes and provide a new theoretical basis for building global carbon pattern assessments with clear biogeographic mechanisms.

Key words: Carbon Flux, Biogeographic Mechanism

Coordinated Distributed Experiments 2.0: A Standardized Research Methodology for a Global Ecological Experiment Network

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Abstract: Controlled experiments provide the best research methodology for ecology and environmental science. However, ecological methodologies are rarely consistent between studies and there are challenges of cost and human resource when attempting to deploy similar methodologies across multiple sites, large scales and over long time periods. A consistent, standardized set of measurement variables is therefore a necessary addition to global ecological and environmental science. There are an increasing number of studies beginning in the 1980's that employ innovative methodologies for multiple study sites, which have been referred to as coordinated distributed experiments (CDE) and distributed collaborative experiments (DCE). But, these approaches are study-specific and do not satisfy the need for a standardized global dataset that could be applied to multiple issues, either presently known, or emerging in the future. Perhaps closer to this objective is citizen science, the biological record centre (BRC) as an example, which focuses on field observation by volunteers. A synthesis of current global experimental network methodologies (e.g., CDEs and DCEs), with its rigid protocols and accurate data collection, in combination with something similar to citizen science, with the model of long term, collegial partnerships, is the next generation of global field experiments in ecology and environmental

sciences; namely, coordinated distributed experiments 2.0 (CDE 2.0). Here we present a framework for CDE 2.0, including a list of candidate measurement variables for the testing of current and future environmental issues and ecological hypotheses.

Key words: Field Experiment, Coordinated Distributed Experiments (CDEs), Distributed Collaborative Experiments (DCEs), Citizen Science

Threshold Responses of Soil Organic Carbon Content and Composition to Multi-Level Nitrogen Addition in a Temperate Needle-Broadleaved Forest

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Abstract: Responses of soil organic carbon (SOC) cycling and C budget in forest ecosystems to elevated nitrogen (N) deposition are divergent. Little is known about the N critical loads for the increase-decrease alternation of SOC storage in the old-growth temperate forest of Northeast China. The objective of this study was to investigate the nonlinear responses of SOC content and composition to multiple rates of N addition, as well as the microbial mechanisms responsible for SOC alternation under N enrichment. Nine rates of urea addition (0, 10, 20, 40, 60, 80, 100, 120, 140 kg N $ha^{-1}yr^{-1}$) experiment with 4 replicates for each treatment were conducted. Soil samples in the 0-10 cm mineral layer were taken after three years of N fertilization. Soil aggregate size distribution and SOC physical fractionation were performed to examine SOC dynamics. Phospholipid fatty acid (PLFA) technique was used to measure the abundance and structure of microbial community. Three years of N addition led to significant increases in the contents of soil coarse and fine particulate organic C fractions (coarsePOC and finePOC) only. The responses of SOC, total N, and each labile OC fraction to the rates of N addition followed Gaussian equations, with the N critical loads being estimated to be between 80 and 100 kg N ha^{-1} yr^{-1}. The change in SOC content (ΔSOC) was positively correlated with the changes in aggregate associated OC ($r2 > 0.80$) and POC contents ($r2 > 0.50$). Nitrogen addition tended to elevate the abundances of fungal, gram positive (G+) bacterial, anaerobic bacterial PLFAs, as well as the percentages of macro- and microaggregates, which favored the accumulation and stability of SOC. Our results suggest that short-term exogenous N inputs to the temperate mixed forest should have limited contribution to C sequestration in mineral soils. Considering the potential mechanisms for physical protection of SOC in aggregates, N inputs less than the N critical loads could increase soil C storage in northeast China's forest over the long term.

Key words: Atmospheric N Deposition, Aggregate Size Distribution, Microbial

Community Abundance, Nonlinear Responses

Soil and Vegetation Carbon Turnover Times from Tropical to Boreal Forests

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Abstract: Terrestrial ecosystem is now functioning as a net carbon (C) sink for atmospheric C dixoide (CO_2), however, whether this C sink can persist with climate change is still uncertain. Such uncertainty comes largely from C turnover time in an ecosystem, which is a critical parameter for modeling C cycle and evaluating C sink potential. Our current understanding of how long C can be stored in soils and vegetation and what control their spatial variations at large scale is still very limited. We used C stocks and C influx from 1087 plots in soils and 2753 plots in vegetation and investigated the spatial patterns as well controlling factors of C turnover times across a forest transect in eastern China. Our results showed a clear latitudinal pattern of C turnover times, with the shortest turnover times in the low-latitude zones and the longest values in the high-latitude zones. Mean annual temperature (MAT) and mean annual precipitation (MAP) were the most important controlling factors on the soil C turnover times while forest age accounted for the most majority of variations in the vegetation C turnover times. Forest origin (planted forest, natural forest) was also responsible for the variations of vegetation C turnover times while forest type and soil properties were not the dominant controlling factors. Our study highlights different dominant controlling factors on the soil and vegetation C turnover times and different mechanisms underlying above- and below-ground C turnover. The findings are essential to better understand and reduce the large uncertainty in predictive models of coupled C–climate system.

Key words: Carbon Turnover time, Climate, Foret Age, Structure Equation Model

Linking Global Patterns in Nitrogen Resorption with Litter Decomposition

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Abstract: Nitrogen (N) supply for new plant growth mainly derives from two biological transformation processes: N resorption within plants and mineralization via

microbial decomposition. Understanding the interactions of the two processes is critical to assess the response of ecosystem nutrient cycle to environmental change, but largely ignored by previous studies. Our global synthesis showed that N resorption negatively correlated with litter residence time and N mineralization rate. Plant N acquisition strategy shifts from more favorable to N resorption at high latitudes to N mineralization at low latitudes, which we expect is a probable result of plants to optimum C cost for N acquisition. N cycle in high latitude biomes is thus slower and more conservative than that in low latitude biomes, and supports slow growing plants and microbial community with high fungi: bacteria ratio. We highlight the importance to consider the geographic pattern and the dynamical interaction between N resorption and N mineralization, which should be incorporated earth system models to improve the simulation of nutrient constrains on ecosystem productivity.

Key words: Nitrogen Resorption, Litter Decomposition, Nitrogen Mineralization, Fungal: Bacteria Ratio,

Primary Production, Carbon Distribution and Carbon Budget of Subalpine Forest in Mt. Halla.

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Abstract: Net primary production (NPP) and carbon budget were studied in the A. koreana forest, T. cuspidata forest and J. chinensis var. sargentii forest of subalpine zone at Mt. Halla from 2014 to 2016. Standing biomass of the A. koreana forest was respectively, 112.12, 112.6, 118.49 ton ha^{-1} and the average of three years was 114.42 ton ha^{-1}. Standing biomass of the T. cuspidata forest was respectively, 34.32, 35.07, 37.73 ton ha^{-1} and the average of three years was 35.71 ton ha^{-1}. Standing biomass of the J. chinensis var. sargentii forest was respectively, 7.41, 8.06, 9.77 ton ha^{-1} and the average of three years was 8.41 ton ha^{-1}. Standing biomass of the tree forest increased annually. NPP of the A. koreana forest was respectively, 5.35, 8.44 ton C ha^{-1}, and the average was 6.9 ton C ha^{-1}. NPP of the T. cuspidata forest was respectively, 2.92, 3.83 ton C ha^{-1}, and the average was 3.38 ton C ha^{-1}. NPP of the J. chinensis var. sargentii forest was 1.26, 2.12 ton C ha^{-1}, and the average was 1.69 ton C ha^{-1}. In the each three forests, the NPP in 2015 year was higher than the NPP in 2014. Distribution of organic carbon in plant in A. koreana forest was respectively, 50.48, 50.67, 53.33 ton C ha^{-1}, and average of three years was 51.49 ton C ha^{-1}. Accumulation of organic carbon was respectively, 2.41, 3.81 ton C ha^{-1}, and average was 3.11 ton C ha^{-1}. Distribution of organic carbon in plant in T. cuspidata forest was respectively, 15.44, 15.78, 16.98 ton C ha^{-1}, and average of three years was 16.07 ton C ha^{-1}. Accumulation of organic

carbon was respectively, 1.31, 1.73 ton C ha-1, and average was 1.52 ton C ha-1. Distribution of organic carbon in plant in J. chinensis var. sargentii forest was respectively, 3.22, 3.62, 4.4 ton C ha-1, and average of three years was 3.75 ton C ha-1. Accumulation of organic carbon was respectively, 0.55, 0.96 ton C ha-1, and average was 0.76 ton C ha-1.Organic carbon in plant of A. koreana forest was the highest among the three forests. Then Organic carbon in plant of J. chinensis var. sargentii was the lowest. In the each three forests, the accumulation of organic carbon in 2015 year was higher than the accumulation of organic carbon in 2014 year. The average of Amount of litter production and organic carbon of A. koreana forest was 4.41 ton ha-1 and 1.99 ton C ha^{-1}, respectively. The average of Amount of litter production and organic carbon of T. cuspidata forest was 3.76 ton ha^{-1} and 1.69 ton C ha^{-1}, respectively. The average of Amount of litter production and organic carbon of J. chinensis var. sargentii forest was 1.86 ton ha^{-1} and 0.84 ton C ha^{-1}, respectively. Amount of litter production and organic carbon of the tree forest increased annually. The average amount of litter on the forest floor and organic carbon of A. koreana forest was 3.74 ton ha^{-1} and 1.68 ton C ha^{-1}, respectively. The average amount of litter on the forest floor and organic carbon of T. cuspidata forest was 1.82 ton ha^{-1} and 0.82 ton C ha^{-1}, respectively. The average amount of litter on the forest floor and organic carbon of J. chinensis var. sargentii forest was 2.08 ton ha^{-1} and 0.94 ton C ha^{-1}, respectively. The average of soil organic carbon in each forest was 42.84 ton C ha^{-1} in the A. koreana forest, 138.35 ton C ha^{-1} in the T. cuspidata forest and 175.04 ton C ha^{-1} in the J. chinensis var. sargentii forest, respectively. Soil respiration in the A. koreana forest, T. cuspidata forest and J. chinensis var. sargentii forest was respecitvely, 24.49, 18.88, 14.47 ton CO_2 $ha^{-1}yr^{-1}$ for three years and organic carbon spilled the atmosphere was respectively, 6.68, 5.14, 3.95 ton C $ha^{-1}yr^{-1}$. Consequently, the aveage of net ecosystem production (NEP) in the A. koreana forest, T. cuspidata forest and J. chinensis var. sargentii forest was respectively, -0.38, -1.14, -1.31 ton C $ha^{-1}yr^{-1}$ for two years (2014 to 2015).

Key words: Allometry, Subalpine, Volcanic Island, Soil Respiration

Responses of Soil and Air Temperature to Solar Radiation and Their Diurnal Cycles

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Abstract: The energy and water cycle of soil-air system is an important part of the ecological process, influenced by solar radiation, such cycle has the character of diurnal fluctuations. Observing and analyzing the key variables of the cycle is helpful to grasp

the dynamic pattern of them. This study collected 4-minute step of solar radiation, air temperature, precipitation, soil temperature, soil moisture content of the ecological environment through field observation using multiple sensors. Soil temperature and moisture of the surface layer, meteorological variables and their response to solar radiation were analyzed. The results showed that solar radiation directly affected the temperature-rising process of soil and air and daily temperature range. If solar radiation increases 100W/m2, air temperature and soil temperature increased by an average of 1.22℃ and 0.74℃, respectively. Air temperature responded more dramatic and rapid to solar radiation than the surface soil, with the rate of change about 1.6 times of soil temperature. An increase of 1kWh/m2/d solar radiation would increase about 1.70℃ air temperature range and 0.92℃ soil temperature range of the day. In days without precipitation, soil water content decreased nonlinearly with daily microcirculation, soil moisture with the lowest value appeared at about 18:00, then after about 3 hours' recharge, it would reach steady after 21:00. The observation and analysis results would be helpful to deepen our understanding of the soil-air energy and water cycle, and provide the basis for the development of process based eco-hydrological models.

Key words: Solar Radiation, Soil Water Content, Soil Temperature, Diurnal Cycle

Study on the Mechanism of Ecosystem Development in the Agro-Pastoral Ecotone of Northern China

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Abstract: Ecosystem ecology has become the focus field of ecology research to study life processes and phenomena since Sir Arthur Tansley proposed the concept of ecosystem. Driven by both natural factors and anthropogenic impacts, ecosystem is always in constant change in the real world especially those ecosystems with human disturbance. Geographically, there is a 400mm rainfall contour through Greater Khingan Range - Zhangjiakou - Lanzhou - Lhasa - eastern Himalayas from China's northeast to southwest, which is the boundary between forest and grassland, agricultural civilization and nomadic civilization, and also farming and animal husbandry. The zonal (native) natural grassland continues to develop new ecosystems near this rainfall contour, mosaic distribution of natural grassland, artificial grassland, grain crops and economic crops. What is the mechanism of the zonal ecosystem development? The emergy of metabolism and soil stoichiometric characteristics in different ecosystems were studied in Guyuan County, Zhangjiakou City, Hebei Province. The ecosystems studied included natural grassland, artificial grassland, field

crops and commercial crops. These four ecosystems were further subdivided into a total of ten ecosystems. Natural grassland was divided into free-grazing and mowed ecosystems; artificial grassland consisted of oat, Chinese leymus and corn silage; field crops included naked oats, flax and wheat; and commercial crops consisted of cabbage and potatoes. The results showed that the emergy input of different ecosystems demonstrate pronounced differences under the same environmental conditions. Natural resource emergy (e.g. climate, soil etc) input was the basic energy for ten ecosystems, and purchased emergy (e.g. groundwater, fertilizer etc) input was the direct cause of the evolution of the zonal ecosystem. The zonal ecosystem develops into non-zonal ecosystems under the action of specific natural resources and different purchased energy inputs, which likes the chemical reaction, no spontaneous reaction from the initial low-energy state to the final high-energy state, heated (energy input) or light (such as photosynthesis) excitation is required. Furthermore, this phenomenon is also similar to the atomic structure in physics, the zonal ecosystem (natural grassland) is the nucleus, the non-zonal ecosystems (e.g. potatoes) like the extra-nuclear electron. The higher purchased emergy, the greater difference in emergy constitution (the ratio of natural emergy and purchased emergy), the farther away from the non-zonal ecosystems to the zonal ecosystem (Figure 1). Overall, this mechanism of ecosystem development is what we call "Ecosystem Core" hypothesis, it can also be used for the research of other ecosystem development (e.g. an extensive farmland to an intensive farmland, a forest to a farmland etc). In addition, soil stoichiometric characteristics of carbon, nitrogen and phosphorus changed with the stable development of non-zonal ecosystems (Table 1), which may bring about the mosaic distribution of soil types and soil nutrient, further affect the structure and function of ecosystem. These findings will help us to understand and explain the existing ecological problems such as landscape fragmentation, ecosystem management, ecosystem restoration and can also be used as a reference for the research of other ecological micro or macro levels.

Key words: Ecosystem, Emergy, Agro-pastoral Ecotone, Development

Responses of Carbon Hydrolase Kinetics to Nitrogen and Phosphorus Additions in Temperate and Subtropical Forest Soils in Eastern China

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Abstract: Soil enzyme kinetic parameters are linked to microbial nutrient demand,

microbial metabolism, and biogeochemical models. Increased nitrogen (N) deposition may not affect microbial functioning in N-rich subtropical forests but may promote carbon (C) mineralizing functions in N relative poor temperate forests. While phosphorus (P) additions may promote carbon (C) mineralizing functions in P-poor subtropical forests but may not affect microbial functioning in P-rich temperate forests. However, the responses of carbon (C)-mineralizing enzyme affinities to their substrates and catalytic efficiencies for N and P additions are poorly defined in temperate and subtropical forest soils. Thirty-two 20 m × 20 m plots were established in temperate and subtropical forests in the Changbai and Dinghu Mountain, respectively. Four treatments, i.e. a control, N, P, and combined N and P, with four replicates were randomly distributed through each forest site. We investigated the effects of long-term N and P additions on the β-1,4-glucosidase (βG) and β-1,4-N-acetylglucosaminidase (NAG) potential activities (Vmax) , their half-saturation constant (Km) and catalytic efficiency (Vmax/Km).We found that, without N and P additions, the Vmax for βG and NAG were tremendously higher in the Changbai than in the Dinghu forest soils. On the contrary, the affinities to their substrates were stronger in the Dinghu than in the Changbai forest soils. The catalytic efficiency for βG was higher in the Changbai than in the Dinghu forest soils, in the contrast, the catalytic efficiency for NAG was lower in the Changbai than in the Dinghu forest soils.In agreement with our hypothesis in the Changbai forest soils, N and NP additions caused the Vmax and Km for βG and NAG to increase, and increased the catalytic efficiencies. Though P additions caused no effect on the kinetic parameters for βG, P additions increased the Vmax, Km and catalytic efficiency for NAG in the Changbai forest soils.But partly in agreement with our hypothesis in the Dinghu forest soils, the N, P and NP additions had no effects on the kinetic parameters for βG. Not in agreement with our hypothesis, N additions decreased the Vmax and Km and increased the catalytic efficiency for NAG, but P additions had no effect on the kinetic parameters for NAG in the Dinghu forest soils.Our results suggest that microorganisms allocate more C-related hydrolases in temperate than in subtropical forest soils to promote soil C dynamics and sinks. Future increasing N deposition combined with P additions would increase βG catalytic efficiency in temperate forest soils. While in the subtropical forest soils, βG and NAG kinetic parameters and the catalytic efficiency were inert to P additions, but NAG affinity to the substrate and catalytic efficiency were increased by N additions.

Key words: Kinetic Parameters, β-1, 4-glucosidase, β-1, 4-N-acetylglucosaminidase, Forest Soils

Global-scale Responses of Plant Biomass to Global Warming: From Leaf Traits to Biodiversity

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Abstract: Predicting biomass responses to global warming is of fundamental importance to clarify the debate on the positive feedback between climate warming and terrestrial carbon cycle. Unfortunately, current state-of-the-art models suffer great uncertainty in simulating and predicting the biomass responses to global warming. To identify the proper mechanisms underlying responses of carbon processes to temperature and reduce the uncertainty in model outputs, it is necessary to incorporate the information provided by the global change experiments at different scales from leaf to individual to ecosystem levels. However, as the spatial scales are usually mismatched between ecosystem models and global warming experiments, an investigation on the scaling rules of ecophysiological responses to global warming among different levels may be helpful to evaluate and improve model performance. Therefore, in this study, using a series of statistic techniques, we investigate the potential scaling relationships of warming effects among different levels from leaf to ecosystem based on 481 published papers. Our results showed that the biomass responses to warming at the species level were well predicted by responses of leaf area. Meanwhile, two factors that had been previously overlooked (i.e., phylogenetic information and intraspecific variation) are proved to be the most important regulators for the variation of biomass responses to global warming at the species level. When the species-level responses were scaled up to ecosystem-level, the species dominance was more important. At the ecosystem level, biodiversity played a critical role compared to thermal niche and warming magnitude. In communities with low biodiversity, biomass responses to warming are mainly regulated by diversity responses and community synchrony, while for communities with high biodiversity, biomass responses are much more stable and no significant driver is found. These results highlighted the importance of leaf area, phylogenetic information, intraspecific variation and biodiversity to the plant biomass responses to warming across scales, and suggested that these aspects should be incorporated land surface models in order to predict ecosystem functioning under global warming more accurately and precisely.

Key words: Warming, Leaf Traits, Biomass, Biodiversity

Vegetation and Soil Environmental Conditions Impact Nitrogen-Cycling Microbial Abundance along Soil Depths in Temperate and Subtropical Forest Soils in China

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Abstract: Soil nitrogen (N) cycle, as a network of interlinked process, is primary driven by various microbial communities. However, even with extensive research efforts, the differences and influencing factors of N-cycling microbial abundances between temperate and subtropical forest soils is still poorly understood. Moreover, the current studies generally focus on the surface soils, neglecting the fact that forest soils are often several meters deep. Our study was performed in a native conifer mixed broad-leaved temperate forest and an ever-green broad-leaved subtropical forest with soil depths ranging from 0 to 80 cm in eastern China. We aimed to evaluate the changes and influencing factors of N-cycling microbial abundances along soil depths in these two contrasting forests. We used real-time quantitative PCR to measure the abundances of nitrogen functional genes (NFGs): chiA for organic N decomposition, nifH for N fixation, amoA for archaeal and bacterial ammonia oxidation (AOA and AOB, respectively), nirK and nirS for nitrite reduction. The results showed that due to the sharp declines of soil carbon and N substrates concentrations, all the absolute abundances of NFGs decreased, which indicated that N transformation primarily occurred in the surface soil. Both AOA and AOB were more abundant in the subtropical forest than the temperate forest which were consistent with the higher soil NH_4+-N concentrations in the former. The chiA, nifH and nirK were more abundant in the upper soils in the temperate forest than in the subtropical forest, while the subsoils were opposite with 40-60 cm depth layer as the boundary. This was caused by the different soil environmental conditions along soil vertical profiles between these two forests that the soil carbon, N and phosphorus concentrations were dramatically higher in the surface than those in subsoils in the temperate forest, while theses soil properties dropped moderately in the subtropical forest. The relative abundance, namely the normalization of each NFG to the total NFGs abundance measured in our study showed that microbes invested more energy in the two resource-costing processes (N fixation and organic N decomposition) to supply N in surface soils where soil total carbon and nitrogen ratios are relatively high. Also these N supplements could be balanced by gaseous N losses caused by nitrite reduction which was reflected in the high nirK relative abundance in the topsoils. In the contrast, microbes increased their energetic investments in ammonia oxidation to acquire more energy in subsoils (40-60 cm depth layer in particular). The relative abundance of nirK, chiA and nifH in the subtropical

forest were positive correlated with soil SOC, phosphorus concentrations and carbon and N ratios, while only nirK gene relative abundance showed the same pattern in the temperate forest, indicating that N-cycling microbes were more sensitive to soil environment in the former than the latter. Our study provided insight of how soil environmental conditions impact N cycle through mediating N-cycling microbial abundance along the vertical gradients of soil profiles. Also we showed evidence of N-cycling microbes balancing their energetic investments between upper and subsoils in a molecular scale.

Key words: Temperate Forest, Subtropical Forest, Depth Profile, Nitrogen Functional Genes Abundance

T2-04: Modeling Species Distributions and Functional Responses under Global Change

Influence of Climate Impact on Habitat of the Endangered Korean Long-Tailed Goral (Naemorhedus Caudatus)

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Abstract: We examined the applicability of a local climate simulation technique to habitat analysis for an endangered species, the Korean long-tailed goral (Naemorhedus caudatus), with a small isolated population. During winter 2005 and summer 2006, we recorded the coordinates of fecal deposits within the current goral habitat and used them to extract computer-simulated climate factors (i.e., mean temperature, relative humidity, wind direction and wind speed) from Weather Research and Forecasting (WRF), a regional or local scale numerical climate model. The datasets of the IPCC climate scenarios were downscaled to fit a small local scale area, the Seoraksan National Park, and the simulation results were compared with the data from actual climate observation stations to measure the model sensitivity. The results were significantly correlated in statistical sense, indicating that the simulation was applicable to forecast future local climate conditions and to analyze future goral habitat. The climate scenarios forecast a mean temperature difference of 2.33, 4.03, and 4.15 ℃ between the 2000s and the 2090s, respectively. Based on the simulation for summer (June) and winter season (December), the change in mean temperature showed a possibility of dramatic decline and disappearance of the current goral habitat by the 2090s. These results suggest that the goral population could potentially be affected by climate change, more specifically, by global warming.

Key words: Habitat, Climate Change, Endangered Korean Long-tailed Goral, Numerical Model

On How Big Data and E-Research Infrastructure Can Help Advance Our Understanding of Climate Change Impacts on Species and Ecosystems: The Biodiversity & Climate Change Virtual Laboratory

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Abstract: Data-intensive ecological analyses can now be undertaken that draw upon cloud-based high performance computing and massive biological and environmental data sets from multiple sources including field observations, laboratory-based isotopic and molecular data, remotely sensed data, and modelled outputs. These analytical capacities allow ecological phenomena to be examined across scales from literally the micro- to the global-scale. This enhanced analytical capacity has arrived at a fortuitous time as we struggle to understand the complex impacts of climate change on organisms (e.g. body size and shape), populations (distributions) and communities (productivity), among other thing. If we are, however, to capitalize on the potential benefits of new analytical capacities to address these emerging problems, a number of pre-requisites must be met including the availability of the necessary: (1) e-research infrastructure, (2) data management systems and (3) modelling platforms. In Australia, the National e-infrastructure system provides researchers to a network of high performance computers and mass data storage systems including the National Computational Infrastructure (NCI), the Atlas of Living Australia (ALA) which provides online access to biological collections, the Terrestrial Environmental Research Network (TERN) providing online access to environmental data, and the Biodiversity and Climate Change Virtual Laboratory (BCCVL) which presents users with unprecedented capacity to model species distributions and trait responses to current and future climate. However, our ability to explain what is already known and predict future biological responses at multiple levels of organization, depends on our ability to make use of new and novel empirical analyses in ways that help advance ecological theory through, among other things, testing hypotheses. Here I illustrate these points using a species distribution model developed from the aforementioned e-systems, for Nothofagus Comminghamii a Gondwanic southern temperate rainforest canopy tree species, to examine the potential impacts of future climate, changed fire regimes, and other threats. The results illustrate the benefits of integrating multiple data streams, the power of statistical modelling based on large data sets, and the ways in which these methods can help shed light on our ecological understanding of plant-environment-human interactions.

Key words: Big Data, Modelling Platform, Species Distribution Models, E-research Infrastructure

A Rapid Assessment on the Impacts Induced by Climate Change on Birds' Conservation Priority in China

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Abstract: The effect of climate change on biodiversity has become a hot issue, but the research on the topic needs to be strengthened in China. This abstract demonstrates the distribution change of 40 birds based on birdwatching data and consequent species turnover in China under the Intergovernmental Panel on Climate Change Special Report on Emission Scenario (IPCC SRES) A1B scenario by 2050. The current and projected distributions of birds were modeled using Maxent software, and the current conservation priorities of birds in China were modeled using Zonation Model from 1051 species of 1427 birds in China. Among the randomly 40 species for climate change projection study, 24 species were predicted to extend northwards and upwards. 11 species were predicted to reduce their distribution drastically. 5 species' distributions were predicted to be stable. Highest species turnover was predicted to take place in Southwest Mountainous Subregion, Western Mountainous Subregion, Qinghai-Zangnan Subregion, the Tianshan and Greater Khingan Mountain Range. Highest species turnover rate relative to current species richness was predicted to occur in western Qinghai-Tibet Plateau, the Kunlun, Tianshan, and Greater Khingan Mountain Range. Compared to the current conservation priorities, the Southwest Mountainous Subregion and the Western Mountainous Subregion need to be more focused. While high species richness in more than half of areas in Southwest Mountainous Subregion could retain, large tracts of higher species richness would emerge in South China. The changing species richness pattern asks for dynamic understanding and management.

Key words: Birds' Distribution, Maxent Model, Climate Change, China

How Does Contemporary Climate versus Climate Change Velocity Affect Endemic Plant Species Richness in China?

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Abstract: Abstract Climate change is considered a top threat to biodiversity, but the relative roles of contemporary climate versus the rate of climate change in determining spatial patterns of biodiversity are far from clear. China has a very diverse flora and harbors a high percentage of endemic species, but the mechanisms underlying spatial patterns of plant endemism are poorly understood. This study explores the geographical patterns of a representative sample of 555 endemic seed plant species at the scale of 0.5 degree latitude × 0.5 degree longitude. Ordinary least squares and spatial autoregressive models were compared to assess the relationship between richness of endemics and the rate of climate change in the past century, as well as a group of contemporary climate variables. In China, a high level of endemism was associated

with high elevation and low rate of climate change. However, contemporary climate had a stronger impact than climate change velocity in the past century on endemic species richness patterns. Specifically, mean annual precipitation and annual range of temperature were important contemporary climatic factors. The rate of change of annual mean temperature, but not that of annual precipitation, also significantly contributed to the spatial pattern of plant endemic species richness. We found no significant relationship between topographic variation and endemic species richness, while temperature variability at multiple time scales was strongly correlated with the species richness pattern. Future work should consider the direction of climate change and incorporate higher-resolution data.

Key words: Species Richness, Endemic Plant, Climate Change, Topography,

Modelling Climate-Induced Range Shift of Native Tree Species in the UK

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Abstract: Climate change and land use configuration are both strong drivers of landscape transformation and likely to interact to shape the future landscapes and their permeability to species' movements and migration. These two aspect are predicted to be the leading causes of species extinctions in the 21st century and to have major impacts on species distributions and, as a consequence, on ecosystem services and human well-being. Climate change is likely to cause a shift in the area representing the 'climatic niche' of many species or, in some cases, even a drastic restriction of habitat that may lead to species reduction or extinction. The ability of species to respond and adapt to changes along established temperature gradients depends on the landscape mosaic and configuration as well as on the rate of the direct climatic change and on the specific and intraspecific genetic variability. However, predicting to what extent ranges will actually shift is not straightforward. Any realised shift in practice will depend on the differences in the climatic conditions but also on how resistant the landscape is to migration and how plastic are species in response to bioclimatic differences and habitat fragmentation.

To evaluate the link between bioclimatic aspects and landscape configuration and the influence on species distribution, we mapped the niche distribution of 25 UK-native tree species across Europe with spatial integration of abiotic and biotic information, such as land use, climate, soil, vegetation.

Information about species presence were derived from ca 3000 plots from the European

ICP Forest Level 1 Biodiversity dataset, with information at plot level in 20 different European countries. We integrated the European level data with information at national level from the UK. Climate and bioclimate variables were derived from WorldClim data integrated with data for UK (Metoffice). The Species' niches distributions were modelled with the Random Forest algorithm. The model was built at European scale, while predictions of future distributions were produced only for the UK. To add realism, we applied a model to simulate gradual range shift through the landscape under climate change scenarios to investigate how dispersal limitation can modify projections of future tree distributions.

Intermediate results show that while climatic niche shift will occur for several species, slow migration through the landscape could hamper the establishment of equilibrium with climate.

To be successful, present woodland expansion policy needs to take account changes in future requirements of forest species and landscape permeability to movement.

Key words: Climate Change, Ecological Niche Model, Landscape Adaptation, Range Shift

Habitat Fragmentation Restricts Gene Flow and Adaptation near the Edge of Species Distribution in an Endangered Salamander

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Abstract: It is important to clarify the mechanism for determining the species distributions for predicting the impacts of climate change on the distributions. Theoretical studies predicted that if the distribution edge is highly fragmented, the low rate of gene flow may prevent adaptation and range expansion. However, there have been few empirical studies due to the difficulties in identifying the distribution edge. Tokyo salamander, Hynobius tokyoensis, is endemic to eastern Japan, and this species is listed in red lists of IUCN as vulnerable (VU). At present, we have detailed data on the distribution of this species mainly from the intensive citizens' surveys. In the present study, we tried to clarify the mechanism for determining the distribution limit of the Tokyo salamander. We analyzed the environmental factors affecting the distribution using a Maxent model, which is one method of ecological niche models (ENM), and examined the geographical variation of the genetic diversity, population size, and adaptive traits of local populations all over the species distribution. In the genetic diversity analysis, five microsatellite locus were used and the some genetic diversity indicators, such as heterozygosity were calculated. In the adaptive traits survey, the body size, clutch size, and hatchability were examined for each population. The result

of ENM showed that temperature is the strongest factor limiting the distribution among environmental factors analyzed, and that the suitable habitat decreased near the distribution margin. Thus, we found the habitat of distribution edge was highly fragmented. The genetic diversity analysis showed that the genetic diversity increased near the center of the distribution, and decreased at the distribution edge. It was also found that the population size decreased and some adaptive traits became non-adaptive at the distribution edge. The relationships among habitat suitability, population size, genetic diversity, and some adaptive traits were analyzed in detail, and the results suggested that the habitat fragmentation at the distribution margin prevents the gene flow and adaptation, and therefore restricts range expansion.

Key words: Distribution Limit, Population Size, Genetic Diversity, Adaptive Trait

Testing Niche Conservatism and Biogeographic Equilibrium for Plant Species with Long Invasion History: The Peruvian Peppertree in Mexico

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Abstract: It is assumed that invasive plants retain their niche when they arrive to new geographical areas. Thus, during the invasion process, only those sites colonize environmental conditions similar to those prevailing in their native distribution range. This process will continue until they reach the biogeographic equilibrium, what happens when they occupy all available sites for establishment in the invaded area. The Andean region of Peru and Bolivia has a remarkable climate convergence with central Mexico, dominated semiarid climates. Thus, these regions are an interesting system to test theories niche conservation and biogeographical equilibrium for study of invasive species. This study tested both theories using as a model the Peruvian peppertree, a species native to the Andes in South America that has invaded central Mexico. To do this, we first compare the environmental conditions of sites that have reported the presence of Peruvian peppertree their ranges between native in South America and invaded in Mexico. We also use climatic niche models to estimate the geographical distribution of this species in South America and Mexico. Both models were projected on Mexico to estimate its potential geographic distribution in this country. Our results indicate that climate niche of Peruvian peppertree is strongly conserved in Mexico, that is occupying a niche subset climate in South America and has left out a substantial fraction of this climatic niche. Comparisons of distribution models project that invaded the region both as native, share similar climatic areas. Thus, we conclude that climate niche in Mexico is conserved and also this species is found in biogeographical

equilibrium.
Key words: Biological Invasions, MaxEnt, Schinus Molle, Climatic Niche

From South America to the World, the Invasion of the Monk Parakeet (Myiopsitta Monachus)

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Abstract: A recent and alarming case of biological invasion is the Monk parakeet (Myopsitta monachus), due to the severe ecological and socioeconomic impacts has caused. This parrot has had a high pet trade, and from leaks or intentional releases have been successfully established in several regions of the world. In Mexico, the existing information about this parrot is scarce, and from his first record in 1986 to date has been reported in 25 states and in several sites the Metropolitan Area of Mexico City, and many of them establishing communal nests and reproductive individuals. However, it seems likely to continue colonizing Monk parakeet favorable areas in Mexico, as has happened in other regions of the world, as long as there is no control their sale and continue to increase the release of captive specimens. Therefore, it is urgent that measures are taken to control its spread and establish decision defining the principles and methodologies to monitor the impacts of this specie in Mexico.
Key words: Biological Invasions, Exoyic Species, Mexico, Trade Pet

Identifying in Situ Climate Refugia for Threatened Plants and Animals

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Abstract: Rearrangement of climate zones and the emergence of novel climate profiles during this century will have substantial ramifications for biodiversity, hence identification of refugia for species from climate change is increasingly considered important for conservation. However, conservation decision-making may be impeded due to variation in the distribution and longevity of putative refugia that may arise from the use of alternative yet plausible climate scenarios. Based on > 500 threatened plant and animal species within the south-eastern Australian state of New South Wales, we provide a case study identifying in situ refugia across the spectrum of plausible future climates. We define in situ refugia as areas that currently contain populations of the target species, and are projected to remain climatically suitable in the future. Refugia

were identified across scenarios describing futures that are, relative to 1990–2009, warmer and wetter, warmer/drier, hotter/wetter, and hotter with little precipitation change. Despite substantial variation in the spatial extent and longevity of climate refugia across species, ecoregions and climate scenarios, we identified clear patterns. By 2070, refugia for species in desert and xeric shrublands; mediterranean forests, woodlands and shrublands; and temperate and tropical grasslands are likely to be less extensive under a hotter/wetter future. Conversely, wetter conditions may lead to broader refugia for species in temperate broadleaf forests. Importantly, we identified areas of congruence where a refugium for a threatened species is likely to exist across all climate scenarios analysed. These regions therefore appear robust to uncertainty about climate change, presenting high value targets for conservation attention. We developed a web-based visualisation and decision-support tool to provide valuable information for stakeholders and decision-makers, enabling them to identify and visualise the spatial arrangement of refugia. This reveals management options in the context of climate uncertainty and facilitates informed prioritisation of conservation resources.

Key words: Climate Change, Conservation, Species Distribution Models, Decision-Support Tools

Explaining the Species Richness Pattern and the Response to Climate Change for Woody Species in Southwestern China

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Abstract: Southwestern China is a region with highest plant species diversity of China; it is also one of the 34 diversity hotspots of the world. Over 22,000 seed plants have been recorded and ~7000 species of them are woody plants (trees, shrubs & woody lianas). The climate gradient and topography driven diversification are both thought to be the major drivers of species richness in this region; meanwhile, the original habitats of those plants are under considerable conservation pressures due to climate change. However, across the broad geographical regions the relative importance of climate and topography complexity has been poorly investigated; meanwhile, little was known about how climate change will affect the forests in this region. Here, based on the geographical distribution pattern of woody species, the relative importance of climate and evolutionary factors in forming species richness pattern was measured using a structural equation model (SEM). The climatic gradients include annual mean precipitation and annual mean temperature. The evolutionary factors (topography driven diversification) were inferred from phylogeny-based measures of mean root

distance, phylogenetic species variability, and net relatedness index. Furthermore, by combining 12 climate change scenarios in 2070s, the future species 'source' and 'sink' were identified (no dispersal and unlimited dispersal) and the environmental variables that responsible for species 'source' and 'sink' were identified. These results are especially useful in effectively conserving the species diversity and developing conservation strategies to mitigate the effects of climate change at local scale.

Key words: Species Richness, Climate Gradient, Topography Related Diversification, Climate Change

Stronger Recovery Ability from Defoliation in an Alien Species Robinia Pseudoacacia Compared with a Phylogenetic Related Native Species Sophora Japonica in Well-Watered Conditions

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Abstract: Climate change may result in the increase of both pest insect damage and the frequency of drought. Therefore, there is a need to better understand the combined effects of defoliation and drought on tree growth, and physiological processes to predict the effect on forest ecosystem productivity in response to climate change. Artificial defoliation was often used to simulate the pest insect damage. In this study, we conducted a manipulative experiment in a greenhouse, where 1-year-old seedlings of both R. pseudoacacia and S. japonica were exposed to three soil moisture conditions (75%, 55%, 35% of saturated soil moisture content) and three defoliation regimes, i.e. control, removing upper canopy leaves (approximately 48% of total leaf area) and all leaves (100% defoliation). We found that at 2 weeks after the defoliation, photosynthetic capacity of the two species was significantly increased under different defoliation treatments, which indicated that plants have already started to compensate growth by increasing photosynthetic capacity. At the end of the experiment, photosynthetic capacity and chlorophyll content of the two species under defoliated treatment had no significant difference between all treatments, which suggested that the physiological parameters of both species recover to controls. In addition, most parameter of growth, biomass accumulation and non-structural carbohydrate of both species under 50% defoliation treatments were recovered. However, these parameters of 100% defoliated trees were lower than that of undefoliated trees, which means seedlings of both species are difficult to recover when the leaves suffer from serious damage. Meanwhile, our results showed additive effects of defoliation and water stress on most of parameters. In addition, most measured parameter of R. pseudoacacia had significant higher than that of S. japonica under any soil water conditions. Meanwhile,

100% defoliated R. pseudoacacia can enable compensate to controls under favorable conditions, but S. japonica did not. From the aspect of recovery capability, R. pseudoacacia may have a better ability than S. japonica in favorable conditions.
Key words: Drought, Defoliated, Recover, Physiological

Mapping Changes in Continental Extent Endemism under Climate Change Using the Biodiversity and Climate Change Virtual Laboratory and Biodiverse

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Abstract: The degree of range restriction, or endemism, of a set of species is a key factor in our understanding of biodiversity. Knowledge of which species are range restricted, and where they are potentially concentrated, enables a clearer understanding of the drivers of endemism, potentially improves our understanding of evolutionary histories, and enables managers to more efficiently allocate scarce conservation resources. A key issue in our understanding of the patterns of endemism is that we do not have detailed sample data for all species. Species distribution models (SDMs) are therefore the only means we have of identifying a more complete geographic distribution for many species. SDMs are also the only means of understanding how species ranges might change under future climate projections.
In this talk I will demonstrate the use of the multi-species modelling capabilities of the Biodiversity and Climate Change Virtual Laboratory (BCCVL) to predict the geographic ranges of a suite of taxa across the continental extent of Australia, using time periods until 2080. The modelled species distributions will then be analysed using the Biodiverse functionality, both that implemented within the BCCVL and in the Biodiverse toolkit itself.
Key words: Endemism, Climate Change, Biodiversity, Geospatial

How Might Climate Change Affect the Distribution of Nepalese Tigers and Snow Leopards?

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Abstract: Future climate change is likely to affect distributions of both the Tiger (Panthera Tigris) and Snow Leopard (Panthera uncia) populations in Nepal, given their

high altitude habitat and the growing impacts on alpine habitats worldwide. Rigorous information on the impact of climate change on the future distribution of these species will assist in the formulation of conservation policies that minimize the consequences of adverse range changes, and maximize potential benefits. We used the Biodiversity and Climate Change Virtual Laboratory (www.bccvl.org.au) to do several species distribution modelling experiments for both current and future climate states. Predictor climatic variables were observed station data from Nepal for monthly minimum and maximum temperature for (1971-2013), rainfall (1967-2012), and relative humidity (1976-2013). These data have been gridded and downscaled to have a spatial resolution of 0.01 degree (around 1km). Occurrence records were obtained using state of the art molecular techniques to identify Tiger and Snow Leopard distributions from scats collected throughout Nepal, by the Center for Molecular Dynamics and Genesis Consultancy. Our aim was to see what impact changes in these climatic variables may have on the future distribution of Tigers and Snow Leopards in the intermediate (2050) and long term future (2085). We used four different species distribution modelling algorithms to investigate this impact: a Generalised Linear Model, a Classification Tree, an Artificial Neural Network, and MaxEnt. We chose to model future distributions with the IPSL-CM5A-LR General Circulation Model (used in CMIP5), based on Lutz et al.'s (2016) documentation of this particular model's high skill score for precipitation and mean air temperature for the relevant regions in Nepal which encompass the current and possibly expanded future distribution of Tigers and Snow Leopards. The climate scenario chosen was RCP 8.5. Preliminary results indicate that the distribution of Tigers may expand greatly. Some algorithms indicate this expansion would be to the south and west of Nepal and beyond, other algorithms show range expansion to a lesser extent, and more eastern parts of Nepal and beyond. There was no consensus among algorithms as to the direction of range expansion or extent, however all algorithms indicate limited northwards expansion of Tiger range, which could have the effect of pushing the range of snow leopards into higher elevations. The distribution of Snow leopards may expand at least along the Indian-Nepal-Bhutan and Tibetan boundary – all algorithms show such a range expansion. Some algorithms show the Snow leopard range expanding north far into Tibet/Northern India, and another also shows southwards expansion. These results emphasize the importance of using an ensemble approach to species distribution modeling, to delineate the uncertainty in future species distribution changes. Our preliminary findings suggest that based on changes in key climatic drivers and the current distribution within Nepal, if there were no detrimental changes to Nepalese and broader regional ecosystems or conservation policies, both Tiger and Snow leopard populations could increase in range by 2050 due to climate change alone.

Key words: Tiger, Snow Leopard, Species Distribution Modelling, Climate Change

Effects of Climate Change on Distribution Patterns of Chinese Giant Salamander (Andrias Davidianus) in China

Ying Li[1], Tian Zhao[2], Jianping Jiang[2]
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Abstract: Understanding the effects of climate change on biological groups are critical to effectively protecting species and biological diversity. Most previous studies mainly focused on the effects of climate change on plants, mammals, fish, birds and reptiles. Given the special life history traits, how amphibian species can response to cilimate change are attracting increasing attention from ecologists in recent days. The aim of the present study is to assess the responses of Chinese amphibian species to climate change by using Chinese giant salamander (Andrias davidianus) as the model species. We predict that the distribution patterns of Chinese giant salamander can be strongly affected by climate change. To test this prediction, we first assessed the climate change vulnerability of 104 Chinese amphibian species based on questionnaires. We then quantified the climate niche shift of Chinese giant salamander in 2050 and 2070, and calculated the contribution of each climate factor to species distribution. Finally, protection strategies were provided based on ecology and conservation biology theories. Our results indicate that the studied 104 Chinese amphibian species can be strongly affected by climate change, including 47.12% high vulnerability, 36.53% medium vulnerability and 16.35% low vulnerability species, respectively. The suitable distribution regions of Chinese giant salamander located in Qinling-Daba Mountains, Nanling Mountains, the middle and lower reaches of the Yangtze River Plain, and Wuyi Mountain, etc. However, habitat area of these places will be decreased, while some regions of Qinghai Province and Neimenggu Province can provide suitable climate conditions for Chinese giant salamander populations in the future. It can be recognized that the suitable habitats of this species will present a northward trend, and Qinling-Daba Mountains could be the bridge that connect the northern and southern habitats. Moreover, our results showed that Annual Mean Temperature, Max Temperature of Warmest Month, Precipitation of Wettest Quarter, Min Temperature of Coldest Month, and Precipitation of Driest Quarter are the first five climate factors that affect the distribution of Chinese giant salamander populations. While Mean Temperature of Wettest Quarter, Precipitation of Wettest Month, Mean Temperature of Warmest Quarter, Precipitation Seasonality, and Annual Precipitation are the last five climate factors that contribute little to the distribution of Chinese giant salamander populations. Further, 26% climate niche of this species will be modified by the end of 2050, and this precentage will be increased to 34% in 2070. Our findings highlighted the need of adjusting existed nature reserves and creating new nature reserves in the potential habitats.

Key words: Climate Change, Chinese Giant Salamander, Climate Niche, Distribution

Patterns

Modelling the Spatial Distribution of Plateau Pika (Ochotona Curzoniae) in Qinghai Lake Watershed, Northeast Qinghai-Tibet Plateau Using BIOMOD

Yujun Ma, Yinan Wu, Wenling Liu

Beijing Normal University, China

Abstract: With the development of statistical models and spatial information data, species distribution model has become an important tool to study the species distribution at large-scale in the context of global change. Plateau pika (Ochotona curzoniae) is a keystone species in the Qinghai-Tibet Plateau, and has both detrimental and beneficial impacts on the terrestrial ecosystem. Previous studies on the plateau pika mainly focus on its active habits and the influence of population density on soil properties, plant communities, and so on. However, the distribution pattern of plateau pika at regional scale, and how this pattern will change under the influence of climate change and human activity remains unclear. This research aimed to model the spatial distribution of plateau pika in the Qinghai Lake watershed using seven models from BIOMOD package with occurrence data and environmental variables. The results showed that the Boost Regression Tree model (GBM) and Maximum Entropy model (MAXENT) make the best predictions, while the results of Generalized Linear Model (GLM) are poor. The plateau pika mainly distributed in the west and north bank of Qinghai Lake, around Tianjun county and in the upstream of the Buha River. The most important environmental factors affecting the distribution of plateau pika were the distance to road, the distance to the settlement, the air temperature of the warmest month, the NDVI standard deviation, and the precipitation of the coldest and driest quarter. The optimized result shows that integration can improve the accuracy and performance of the model effectively.

Key words: Species Distribution Model, BIOMOD, Plateau Pika, Qinghai Lake Watershed

Disentangling Critical Drivers of Stem CO_2 Efflux from Pinus Elliottii Trees in Subtropical China

Jie Tu[1], Xiaohua Wei[2], Houbao Fan[3], Jianping Wu[3], Qingbao Pei[3]

1 Nanchang Institute of Technology, China; 2 Earth and Environmental Science Department, University of British Columbia (Okanagan), China 3 Institute of Ecology and Environmental Science, China

Abstract: Stem CO_2 efflux (Es) plays a critical role in forest carbon budgets and net ecosystem CO_2 exchanges, but there is still a significant knowledge gap on Es and its controlling factors in subtropical forests where forest productivity and transpiration are both very high. In this study, Es and the possible controlling factors such as stem temperature (Ts), sap velocity (vs), and other climatic variables were simultaneously measured in a Pinus elliottii plantation of Subtropical China from January 2014 to July 2015. Temporal dynamics of Es followed similar trends as Ts at a 1-cm depth with bell-shaped curves. The monthly Es values were significantly higher during the fast-growing season (April to October) than in the slow-growing season (November to next March). However, temperature sensitivity (Q10, the relative increase of Es with a 10 oC rise in temperature) fluctuated throughout the entire year without a clear pattern. Significant and exponential relationships were found between Es and Ts, with correlation factors higher during the slow-growing season than in the fast-growing season. Additionally, the coefficients of determination of Es to stem temperature were highly divergent with respect to tree size during the fast-growing season but not in the slow-growing season. The residuals (∆Es), calculated as the difference between the modeled fluxes (Ep) based on night-time data at zero sap flow and the measured fluxes (Em) during the daytime when sap flow occurred, became more prominent during the fast-growing season. Thus, significant and positive correlations were observed between the ratio of ∆Es to Ep and vs during the fast-growing season (r^2=0.59, $p<0.01$) but not in the slow-growing season. Combined with the maximum value of vs, sap flows could potentially reduce the measured CO_2 efflux to up to 25% of those predicted values on temperature alone during the daytime. Our results clearly demonstrated that temperature was not sufficient to quantify Es and the effect of sap flow on Es must be concluded in any models simulating stem respiration and carbon budgets in forest ecosystems.

Key words: Pinus Elliottii, Stem CO_2 Efflux, Stem Temperature, Sap Flow

The Impact of Objective Function Weight on hydrological calibration of PEST-HSPF

Jincheng Li, Wei Gao, Xuexiu Chang

Yunnan University, China

Abstract: In the multi-objectives calibration of hydrological simulation, different weights of objective functions directly affect the calibration results, and how to determine the weights of different objective functions is a key step of hydrological calibration. To investigate the influence of objective functions weights on hydrological simulation, the upstream watershed of Niulanjiang River was selected as a case study to

establish a hydrological calibration model by the PEST (Parameter ESTimation) - HSPF (Hydrological Simulation Program-Fortran) model. Daily flow data from 2007 to 2012 was used to calibrate the HSPF model using PEST. Through changing the objective function weights, the goodness of fit of the model was recorded to estimate the impact of different weights on the performance of PEST – HSPF simulation. The results indicate that: (1) when the weight of single objective function (daily flow, month flow, exceedance flow days) of PEST - HSPF rises, Nash coefficient of the model and the relative deviation present nonlinear variation response； (2) higher prediction ability and lower error can be obtained when the three weights of the objective functions are set within 1-10 orders of magnitude; (3) the weight of exceedance flow days has a greater influence on the ability to prediction while the weight of daily flow has a greater influence on the fluctuation of relative deviation. The results are supposed to be a guideline for selecting objective function in PEST-HSPF simulation or setting appropriate weights for favorable calibration results.

Key words: Hydrological Model, Automatic Calibration, Parameters Estimation, Objective Weight

Comparetion of 12 Empirical Equations for Potential Evapotranspiration Calculating with Data from 11 Climate Zones in China

Lingling Zhao

Guangdong Academy of Sciences, China

Abstract: Hydrological model is an important tool in simulating the effect of changing environment on hydrological cycle and water resources. Pontential Evpotranspiration (PET), which can be estimated from atmospheric forcing directly, is the main input variable of hydrological model in addition to the precipitation. But a lot different equations are available to calculate PET, ranging from aerodynamics based concepts and temperature as well as radiation based concepts to combination equations. Moreover, China is a large country with considerable climatic variation. Thus, it is necessary to analyize the situable of Empirical Equations for Potential Evapotranspiration Calculating in China. This paper divided China in 11 climate zones according to the climatic regionalization. Based on the data of minmum temperature，maximum temperature, average temperature, relative humidity, sunshine duration, wind speed from 227 national meteorological observatories. Firstly, the PET of 227 national meteorlogical observatories was estimated using 13 empirical equations with original parameters. Secondly, based on the PET caculated by Penman-Monteith method, the parameters of the other 12 methods were adjusted using the optimization

method of least squares method. Then the PET of annual spatial distribution and seasonal inner distribution patern that estimated with original parameters was compared with that of adjusted. Finally, according to the suitable criterion and the above analysis, the applicability of 12 potential evapotranspiration estimation methods in different climate zones of China was determined.

Key words: Potential Evapotranspiration, Applicability Analysis, Climate Zone, China,

Analysis of Spatio-Temporal Distribution of Rainfall Causing the Landslide in Lanzhou City in the Recent 25 Years

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1 Chang'an University, China; 2 Lanzhou Jiaotong University, China

Abstract: On the base of daily rainfall of national meteorological station from 1991 to 2015 and eight local rainfall stations in Lanzhou city, the research six rainfall characteristic indexes relating with loess landslide. Utilizing M-K (Mann-Kendall) non-parametric test, Morlet wavelet analysis, Kriging interpolation, the paper studied temporal variability and spatial distribution characteristics of rainfall causing the landslide in Lanzhou city. The research results show: (1)The annual rainfall in Lanzhou city in the recent 25 years was insignificantly decreasing, it declined at the rate of 1.1229mm/a, the number of moderate rain days and annual rainfall intensity was significantly decreasing. The seasonal characteristics of rainfall was significant in Lanzhou city, rainfall mainly concentrated in months from April to October. Continuous rainfall, cumulative rainfall, moderate rain, heavy rain and torrential rain causing the landslide mainly concentrated in months from July to August; (2)Except for the obvious increase of monthly rainfall in September, the rainfall in spring and autumn was on the increase insignificantly, in addition to the apparent decrease of monthly rainfall in July, rainfall in summer had an unobvious downward tendency; (3)There was a significant cycle about 7～9 years for rainfall in July, a cycle about 3～5 years for rainfall in May and an unapparent period about 1～3 years for rainfall in the other months except the months in winter; (4)Rainfall in Lanzhou city had evident characteristics of spatial differences, overall, there showed a decrease trend from northwest to northeast. The research analyzed spatio-temporal distribution of rainfall causing the landslide in Lanzhou city in 25 years and provided the base for the research and development of the early warning system about the loess landslide induced by rainfall in Lanzhou city.

Key words: Spatio-temporal Distribution of Rainfall, Lanzhou City, M-K Test, Wavelet Analysis, Kriging Interpolation

Responses of Streamflow and Sedimentation to Precipitation and Forest Changes from 1965 to 2011 at Watershed Level

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1 Guangzhou Institute of Geography, China; 2 The National Environmental Satellite, Data, and Information Service(NESDIS),National Oceanic and Atmospheric Administration (NOAA) , China

Abstract: Vegetation restoration usually has positive effect on soil erosion control and carbon sequestration. However, the hydrological effect of changes could be positive or negative, and even more complicate under a changing environment. Understanding how variations of forest and precipitation affect water resources and sediment is important for sustainable water management and afforestation. In this study, we analyzed long-term precipitation, runoff, potential evapotranspiration, and sediment concentration observations during 1965 - 2011 from the gauge or meteorological stations over the Dongjiang watershed (113.87°-115.87°E, 22.63°-25.23°N), one of the main tributaries of the Pearl River basin. Based on the relationships between cumulative sediment load and cumulative precipitation, the study period was divided to three phases including 1965-1984 (P1), 1985-1994 (P2), and 1995-2011 (P3). Time series analyses were applied to detect the temporal trends. Hurst analysis was used to measure the long-term memory in these variables. Long-term data on vegetation cover changes based on satellite images and forest inventories were investigated for each phase. A theoretical model was applied to model runoff coefficient based on the ratio of precipitation to potential evapotranspiration (P/PET) the watershed characteristics (m) affected by the cover changes, and further to explain the physical mechanisms behind them. We found that large-scale vegetation restoration projects (1985-1994) have significantly reduced soil erosion from 1994 onwards, and the sediment shows significantly declining trend (P-value < 0.01) in both dry season and wet season. However, no significant runoff reduction was found related to forest restoration. These findings imply that forest recovery has contributed to soil erosion control without reducing water resources in this subtropical region.

Key words: Forest Restoration, Watershed Management, Hydrological Modeling, Sedimentation,

Runoff and sediment Characteristics and Response to Climate Change and Human Activities along the Yellow River in Ordos ─ A case study in Ten Great Gullies

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Abstract: Change and influence mechanism of hydrological process is complex, how

to scientifically evaluate the runoff and sediment changes and its driving force has received considerable attention. Using non parameter test, climate elasticity approach, and hydrological model, this paper presents a detailed investigation on the changes of flood process, annual streamflow and sediment load. The results show that the occurrence frequency of hyperconcentrated floods is 74% in XiLiuGou basin, Before 1980, the relationship slope between the annual maximum flow and maximum sediment is 1.5787, but after 2000, the slope values were reduced to 0.3319, it shows that under the same flow conditions, sediment concentration reduces to one fifth of the last century 80's, through gradual trend test (Mann–Kendall test), and abrupt change test (Pettitt test) method, a significant decline in runoff and sediment load is detected, and abrupt changes occur in 1997. Then, an integrated approach combining the climate elasticity approach and hydrological modelling approach was applied to attribute the detected runoff changes to climate change and human activities. The relative contributions of climate change and human activities to runoff changes are 23%, 77 %, respectively. The result indicates that human activities, including comprehensive control of soil and water conservation and the operation of check-dams were the major driving forces of the streamflow decrease in the Ten Great Gullies Basin.

Key words: Upper Reaches of Yellow River, Ten tributaries, Stream flow, Climate Factors,

Estimating Litter Carbon Stocks on Forest Land in the Qinling Mountains of China

Wanlong Sun, Xuehua Liu

Tsinghua University, China

Abstract: Forest ecosystems are the largest terrestrial carbon sink on earth, with more than half of their net primary production moving to the soil via the decomposition of litter biomass. Therefore, changes in the litter carbon (C) pool have important implications for global carbon budgets and carbon emissions reduction targets and negotiations. Litter accounts for an estimated 5% of all forest ecosystem carbon stocks worldwide. Given the cost and time required to measure litter attributes, many of the signatory nations to the United Nations Framework Convention on Climate Change report estimates of litter carbon stocks and stock changes using default values from the Inter-governmental Panel on Climate Change or country-specific models. In China, the country-specific model used to predict litter C stocks is sensitive to attributes on each plot in the national forest inventory, but these predictions are not associated with the litter samples collected over the last decade in the national forest inventory. Here we present, in order to reveal the forest restoration process of forest tree species and the influence of the carbon flow mechanism in Qinling Mountains, provide theoretical

basis for the forest science management. This research adopts the direct collection of litter and space instead of time series method, the comparative study that three forests (natural forest, secondary forest, and artificial forest) of different elevation with different tree species on litter production, composition, monthly dynamic and litter production of dominant species, the decomposition rate and turnover. Our work may suggests that Intergovernmental Panel on Climate Change defaults used to estimate litter carbon intemperate forest ecosystems may grossly overestimate the contribution of this pool in carbon budgets.

Key words: Forest Ecosystem, litter Carbon Stocks, The Qinling Mountains

Effects of Hypoxia on Survival of Greater Yellow Croaker (Larimichthys Crocea) at Different Conditions of Temperature and Fish Weight

Xiaolian Gu

Shanghai Natural History Museum, Shanghai Science & Technology Museum, China

Abstract: Hypoxia events (low dissolved oxygen conditions), often occur in East China Sea in the summer. Hypoxia may cause harmful effects on greater yellow croaker (Larimichthys crocea), an economically important fish, but their consequences are not well known. We investigated mortality of hypoxia in greater yellow croaker to determine how the extent of mortality varies with the severity of hypoxia and to explore how vulnerability to hypoxia changes across fish size, and temperature. Hypoxia tolerance of greater yellow croaker was tested at two temperatures, 25 and 30℃, and three dissolved oxygen (DO) concentrations, 1.0, 1.3, and 1.6 mg/L, at three sizes fish with mean weight of 58.6, 112.5 and 167.3g. Survival analyses were performed on the data relating survival rate to dissolved oxygen concentration, duration of exposure, fish size, and temperature.

LC50 estimates ranged from 1.25 to 1.33 mg/L DO for greater yellow croaker. Greater yellow croaker exposed to 1.6 mg/L DO showed no mortality in 24 h at 25℃, and only 7% mortality at 30℃.

Greater yellow croaker exposed to 1.3 mg/L DO showed 87% mortality in 24 h at 25℃, and 93% at 30℃. Greater yellow croaker exposed to 1.0 mg/L DO experienced 100% mortality in 3.7 h at 30℃, and in 5.5 h, at 25℃.

There was an effect of size on hypoxia tolerance, with small size being less tolerant than large size, in greater yellow croaker.

Our experiments showed a 24-h acclimation to sublethal levels of hypoxia significantly reduced mortality upon subsequent exposure to lethal hypoxia concentrations. Our results indicate that direct mortality due to hypoxia will vary with size, temperature, and Pre-acclimation.

Key words: Hypoxia, Mortality, Sea, Fish

Changing Land Use and Its Impact on the Habitat Suitability for Wintering Anseriformes in China's Poyang Lake Region

Xuguang Tang

Southwest University, China

Abstract: As an internationally important wetland for migratory waterbirds, China's Poyang Lake region has experienced substantial changes in land use during the past two decades owing to climate change and anthropogenic disturbances. Recent dam constructions on the Yangtze River and its tributaries for agriculture and hydroelectric power exert strong effects on the hydrological regimes of this lake. However, few studies have investigated how the land-use changes through time affect the habitat suitability for wintering Anseriformes—the largest community in this region. Thus, it is necessary to timely monitor changes in the habitat quality and understand the potential factors that alter it. In this study, three periods (1995, 2005 and 2014) of typical environmental indicators that have direct impacts on foraging and resting for the Anserformes, including proximity to water (density of lakes, rivers and ponds), human disturbances (density of residences and various road networks), preferred land cover types and food availability (NDVI), are integrated to develop a habitat suitability index model for habitat mapping. The results indicate that long-term lake shrinkage in low-water periods led to greatly expanded wetlands in these years, which provided more suitable habitat for migratory waterfowl. The amount of highly suitable habitat in 2014 was nearly twice as much as in 1995. Recent survey data from 1997 to 2013 also revealed an increase in the population size, and confirmed the improvement of habitat suitability in the Poyang Lake region. Spatial analysis revealed that land use changes contributed most to the improved habitat coverage between 1995 and 2014. However, the relative significances of these transformations for highly suitable and moderately suitable habitats are strikingly different. Increases in wetland and paddy field area are the main reasons for explaining these improvements, respectively. The framework model proposed in this study will help governments to evaluate habitat conservation and restoration for protecting waterbirds in a spatially explicit way.

Key words: LUCC, Habitat Suitability, Poyang Lake, Waterbirds

The Risk of Vegetation Drought under Varying Climate Conditions over China

Zhiyong Liu

NOAA, China

Abstract: Climate change significantly impacts the vegetation growth and terrestrial ecosystems. Using satellite remote sensing observations, here we focus on investigating the vegetation dynamics and the likelihood of vegetation-related drought under varying climate conditions across China. We first compare the temporal variations of Normalized Difference Vegetation Index (NDVI) and climatic variables over China. We find that there is no significant change in vegetation over the cold regions such as Northwest China, Inner Mongolia, and Qinghai-Tibet Plateau where warming is significant. Then, we propose a joint probability model to estimate the likelihood of vegetation-related drought conditioned on different precipitation or temperature scenarios in growing season across China and identify the risk patterns of vegetation-related drought. To the best of our knowledge, this study is the first to examine the vegetation-related drought risk over China from a perspective based on joint probability dependence. Our results indicate that for most months of growing season the lands with high likelihood (> 50%) of drought are dominantly found in arid and semiarid zones (e.g., Inner Mongolia, Northwest China and Qinghai-Tibet Plateau) under scarce precipitation scenario. These lands still experience a high drought risk even when precipitation is at a relatively high level. Under low temperature condition, the drought likelihood over 50% is found in different parts of China, e.g., in Northeast China (in April, May and October), Northwest China (in April–October), Qinghai-Tibet Plateau (in April–October), and North China Plain (in April, June and October). When shifting to high temperature condition, the drought likelihood remarkably declines to a lower level in most of these areas. These findings provide insights for decision makers to evaluate drought risk and develop drought mitigation strategies in a warming world. The proposed methodology also has a great potential to be applied for vegetation-related drought risk assessment in other regions worldwide.

Key words: Vegetation Dynamics, Vegetation Drought Risk

T2-05: Climate Change and Land Use/Land Cover Change on Hydrology: Modelling

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Mingming Zhang[1], Shuwen Yang[2]

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Abstract: Vegetation restoration usually has positive effect on soil erosion control and carbon sequestration. However, the hydrological effect of changes could be positive or negative, and even more complicate under a changing environment. Understanding how variations of forest and precipitation affect water resources and sediment is important for sustainable water management and afforestation. In this study, we analyzed long-term precipitation, runoff, potential evapotranspiration, and sediment concentration observations during 1965 - 2011 from the gauge or meteorological stations over the Dongjiang watershed (113.87°-115.87°E, 22.63°-25.23°N), one of the main tributaries of the Pearl River basin. Based on the relationships between cumulative sediment load and cumulative precipitation, the study period was divided to three phases including 1965-1984 (P1), 1985-1994 (P2), and 1995-2011 (P3). Time series analyses were applied to detect the temporal trends. Hurst analysis was used to measure the long-term memory in these variables. Long-term data on vegetation cover changes based on satellite images and forest inventories were investigated for each phase. A theoretical model was applied to model runoff coefficient based on the ratio of precipitation to potential evapotranspiration (P/PET) the watershed characteristics (m) affected by the cover changes, and further to explain the physical mechanisms behind them. We found that large-scale vegetation restoration projects (1985-1994) have significantly reduced soil erosion from 1994 onwards, and the sediment shows significantly declining trend (P-value < 0.01) in both dry season and wet season. However, no significant runoff reduction was found related to forest restoration. These findings imply that forest recovery has contributed to soil erosion control without

reducing water resources in this subtropical region.

Key words: Forest Restoration, Watershed Management, Hydrological Modeling, Sedimentation,

Runoff and sediment Characteristics and Response to Climate Change and Human Activities along the Yellow River in Ordos ─ A case study in Ten Great Gullies

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Abstract: Change and influence mechanism of hydrological process is complex, how to scientifically evaluate the runoff and sediment changes and its driving force has received considerable attention. Using non parameter test, climate elasticity approach, and hydrological model, this paper presents a detailed investigation on the changes of flood process, annual streamflow and sediment load. The results show that the occurrence frequency of hyperconcentrated floods is 74% in XiLiuGou basin, Before 1980, the relationship slope between the annual maximum flow and maximum sediment is 1.5787, but after 2000, the slope values were reduced to 0.3319, it shows that under the same flow conditions, sediment concentration reduces to one fifth of the last century 80's, through gradual trend test (Mann–Kendall test), and abrupt change test (Pettitt test) method, a significant decline in runoff and sediment load is detected, and abrupt changes occur in 1997. Then, an integrated approach combining the climate elasticity approach and hydrological modelling approach was applied to attribute the detected runoff changes to climate change and human activities. The relative contributions of climate change and human activities to runoff changes are 23%, 77 %, respectively. The result indicates that human activities, including comprehensive control of soil and water conservation and the operation of check-dams were the major driving forces of the streamflow decrease in the Ten Great Gullies Basin.

Key words: Upper Reaches of Yellow River, Ten tributaries, Stream flow, Climate Factors,

Estimating Litter Carbon Stocks on Forest Land in the Qinling Mountains of China

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Abstract: Forest ecosystems are the largest terrestrial carbon sink on earth, with more

than half of their net primary production moving to the soil via the decomposition of litter biomass. Therefore, changes in the litter carbon (C) pool have important implications for global carbon budgets and carbon emissions reduction targets and negotiations. Litter accounts for an estimated 5% of all forest ecosystem carbon stocks worldwide. Given the cost and time required to measure litter attributes, many of the signatory nations to the United Nations Framework Convention on Climate Change report estimates of litter carbon stocks and stock changes using default values from the Inter-governmental Panel on Climate Change or country-specific models. In China, the country-specific model used to predict litter C stocks is sensitive to attributes on each plot in the national forest inventory, but these predictions are not associated with the litter samples collected over the last decade in the national forest inventory. Here we present, in order to reveal the forest restoration process of forest tree species and the influence of the carbon flow mechanism in Qinling Mountains, provide theoretical basis for the forest science management. This research adopts the direct collection of litter and space instead of time series method, the comparative study that three forests (natural forest, secondary forest, and artificial forest) of different elevation with different tree species on litter production, composition, monthly dynamic and litter production of dominant species, the decomposition rate and turnover. Our work may suggests that Intergovernmental Panel on Climate Change defaults used to estimate litter carbon intemperate forest ecosystems may grossly overestimate the contribution of this pool in carbon budgets.

Key words: Forest Ecosystem, litter Carbon Stocks, The Qinling Mountains

Effects of Hypoxia on Survival of Greater Yellow Croaker (Larimichthys Crocea) at Different Conditions of Temperature and Fish Weight

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Abstract: Hypoxia events (low dissolved oxygen conditions), often occur in East China Sea in the summer. Hypoxia may cause harmful effects on greater yellow croaker (Larimichthys crocea), an economically important fish, but their consequences are not well known. We investigated mortality of hypoxia in greater yellow croaker to determine how the extent of mortality varies with the severity of hypoxia and to explore how vulnerability to hypoxia changes across fish size, and temperature. Hypoxia tolerance of greater yellow croaker was tested at two temperatures, 25 and 30℃, and three dissolved oxygen (DO) concentrations, 1.0, 1.3, and 1.6 mg/L, at three sizes fish with mean weight of 58.6, 112.5 and 167.3g. Survival analyses were performed on the

data relating survival rate to dissolved oxygen concentration, duration of exposure, fish size, and temperature.

LC50 estimates ranged from 1.25 to 1.33 mg/L DO for greater yellow croaker. Greater yellow croaker exposed to 1.6 mg/L DO showed no mortality in 24 h at 25℃, and only 7% mortality at 30℃.

Greater yellow croaker exposed to 1.3 mg/L DO showed 87% mortality in 24 h at 25℃, and 93% at 30℃. Greater yellow croaker exposed to 1.0 mg/L DO experienced 100% mortality in 3.7 h at 30℃, and in 5.5 h, at 25℃.

There was an effect of size on hypoxia tolerance, with small size being less tolerant than large size, in greater yellow croaker.

Our experiments showed a 24-h acclimation to sublethal levels of hypoxia significantly reduced mortality upon subsequent exposure to lethal hypoxia concentrations. Our results indicate that direct mortality due to hypoxia will vary with size, temperature, and Pre-acclimation.

Key words: Hypoxia, Mortality, Sea, Fish

Changing Land Use and Its Impact on the Habitat Suitability for Wintering Anseriformes in China's Poyang Lake Region

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Abstract: As an internationally important wetland for migratory waterbirds, China's Poyang Lake region has experienced substantial changes in land use during the past two decades owing to climate change and anthropogenic disturbances. Recent dam constructions on the Yangtze River and its tributaries for agriculture and hydroelectric power exert strong effects on the hydrological regimes of this lake. However, few studies have investigated how the land-use changes through time affect the habitat suitability for wintering Anseriformes—the largest community in this region. Thus, it is necessary to timely monitor changes in the habitat quality and understand the potential factors that alter it. In this study, three periods (1995, 2005 and 2014) of typical environmental indicators that have direct impacts on foraging and resting for the Anserformes, including proximity to water (density of lakes, rivers and ponds), human disturbances (density of residences and various road networks), preferred land cover types and food availability (NDVI), are integrated to develop a habitat suitability index model for habitat mapping. The results indicate that long-term lake shrinkage in low-water periods led to greatly expanded wetlands in these years, which provided more suitable habitat for migratory waterfowl. The amount of highly suitable habitat in 2014 was nearly twice as much as in 1995. Recent survey data from 1997 to 2013 also

revealed an increase in the population size, and confirmed the improvement of habitat suitability in the Poyang Lake region. Spatial analysis revealed that land use changes contributed most to the improved habitat coverage between 1995 and 2014. However, the relative significances of these transformations for highly suitable and moderately suitable habitats are strikingly different. Increases in wetland and paddy field area are the main reasons for explaining these improvements, respectively. The framework model proposed in this study will help governments to evaluate habitat conservation and restoration for protecting waterbirds in a spatially explicit way.
Key words: LUCC, Habitat Suitability, Poyang Lake, Waterbirds

The Risk of Vegetation Drought under Varying Climate Conditions over China

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Abstract: Climate change significantly impacts the vegetation growth and terrestrial ecosystems. Using satellite remote sensing observations, here we focus on investigating the vegetation dynamics and the likelihood of vegetation-related drought under varying climate conditions across China. We first compare the temporal variations of Normalized Difference Vegetation Index (NDVI) and climatic variables over China. We find that there is no significant change in vegetation over the cold regions such as Northwest China, Inner Mongolia, and Qinghai-Tibet Plateau where warming is significant. Then, we propose a joint probability model to estimate the likelihood of vegetation-related drought conditioned on different precipitation or temperature scenarios in growing season across China and identify the risk patterns of vegetation-related drought. To the best of our knowledge, this study is the first to examine the vegetation-related drought risk over China from a perspective based on joint probability dependence. Our results indicate that for most months of growing season the lands with high likelihood (> 50%) of drought are dominantly found in arid and semiarid zones (e.g., Inner Mongolia, Northwest China and Qinghai-Tibet Plateau) under scarce precipitation scenario. These lands still experience a high drought risk even when precipitation is at a relatively high level. Under low temperature condition, the drought likelihood over 50% is found in different parts of China, e.g., in Northeast China (in April, May and October), Northwest China (in April–October), Qinghai-Tibet Plateau (in April–October), and North China Plain (in April, June and October). When shifting to high temperature condition, the drought likelihood remarkably declines to a lower level in most of these areas. These findings provide insights for decision makers to evaluate drought risk and develop drought mitigation

strategies in a warming world. The proposed methodology also has a great potential to be applied for vegetation-related drought risk assessment in other regions worldwide.

Key words: Vegetation Dynamics, Vegetation Drought Risk

T2-06: Linking Ecological Observations in Space and Time for Global Understanding of Environmental Change

Ecosystems Sustainability: Channelling Observation and Experimentation to Better Understand and Face the Complex Future Trends

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Abstract: While climate change-related challenges are increasingly acknowledged by scientists and policy-makers alike, they are viewed from too narrow an angle. The resulting policies are indeed often constrained reducing energy and materials consumption, preserving biodiversity, mitigating the impacts of climate change and adapting to future changes. We need to adopt a more systemic approach if we are to truly understand and respond to the changes affecting ecosystems and the services they yield.

Further developments in tools and methodologies would enable us to accurately explore future scenarios in facing environmental change, and better encompass their human dimension. An integrative approach based on observation, experimentation and modelling would serve as a backbone to our building synergies across environmental research infrastructures, with a view to fine-tune our forecasting abilities. In other words, scientifically-sound scenarios are the cornerstone in making climate science policy-relevant and contributing substantially to how we prepare and plan for future uncertainty.

To achieve this, we need to give scientists the tools they need. Environmental research infrastructures indeed yield unprecedented innovation potential in examining a broad range of plausible future scenarios, through the combination of social and environmental systems under conditions of uncertainty, human choice and complexity. Channelling our observational and experimental capabilities would allow us to comprehensively test our hypotheses and fully understand the "why" and the "how" – as opposed to the "what" alone. The unknown abounds in relations to the state of future ecosystems directly impacted by many with non-linear behaviour we have yet to master. We would therefore call for additional experimentation on ecosystems, to be integrated with observation, analysis and modelling capabilities, with a view to venture realistic and holistic scenarios for the future.

This presentation would contribute a proactive vision for our symposium's overarching goals in harnessing innovation and technology and addressing pressing needs from a

broad array of decision-makers. Our proposed approach stands at a crossroads between a scientific and societal imperative in developing ecological forecasts at the widest scale possible; an increasing focus on mechanistic studies across various ecological disciplines and methodological and technological improvements enabling studies in macro-ecology. This would not only determine our innovative design processes, it also leads us to pinpoint the most adequate and cost-effective way to answer a given question, choosing the best of several available options with a view to enable decision-makers. As such, we would push in favour of integrating diverse science domains; align all data and analysis performed by a variety of directly impacted stakeholders. In doing so, we would rely on the unprecedented bandwidth of research infrastructures to effectively collate observational and experimental measurements, in a cycle of continuous improvement and interpretation at the frontier of today's environmental science.

Key words: Experimentation, Observation, Macro-ecology, Research Infrastructures

A Forest of Stars: Eco-Evolutionary Dynamics as a Cosmological Analogue

Barry W. Brook, John Dickey, Andrew Cole, Jessie C. Buettel

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Abstract: The 'forest of stars' project sought to foster a cross-disciplinary relationship between biological sciences (ecology and evolution) and physics (astronomy). Many methods used by environmental scientists to make inferences and uncover generalities in complex systems. These include experiments, long-term monitoring, and the use of observed spatial and temporal patterns to infer deep eco-evolutionary processes. But real-world logistical constraints limit the extent and duration of such measurements. Earth-bound astronomers face similar challenges when trying to infer the drivers and consequences of change at the cosmic scale. Astrophysicists study the aggregate attributes of statistical populations of 'static' entities (e.g., snapshots that span the evolution of a large sample of stars or galaxies), and use space-for-time substitution to infer dynamical processes and test models. By observing data from 'frozen instants' of events, trends and processes that operate on time scales far beyond the lifespan of any person, both eco-evolutionary and cosmological researchers are able to infer how phenomena are triggered, morphed in form, and 'die'. Here we report on the results of a joint empirical study of two spatio-temporal datasets—one ecological (patterns in tall-eucalypt forest plots) and one cosmological (galactic populations of stellar spectral classes) —in which the analytical tools of ecology and astrophysics were interchanged, with the goal of drawing novel insights. The work revealed useful analogies, and

uncovered common and fundamental models of system change, including novel methods for linking pattern to proess in data sets of dynamic systems with long turnover times. This collaboration represents a genuine, innovative attempt to merge ideas and methods across starkly different research fields, and has practical implications for how data is visualised and modelled. The results also carry implications for how tall forests are likely to respond to future environmental change.
Key words: Forest Ecology, Pattern and Process, Ecosystem Dynamics, Global Change

Landuse Change Trends in Southern Sichuan Rural Areas, China: From the Observation of a Small Scale Landscape Change

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Abstract: The landuse in the rural areas in China has been greatly changed, especially in recent decade. In my presentation, the landuse change in Southern Sichuan rural area, China, is demonstrated with pictures and maps and the motivation factors behind the change are analyzed. The landuse change trends in Southern Sichuan rural areas are predicted based on the national and local development strategy, my observation, and the interview on local officials and peasants.
Key words: Landuse Change, Policy Factor, Development, Southern Sichuan

Creating an Integrated Network from Long-Running Ecological Research Studies in Australia to Improve National Ecological Understanding and Management

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Abstract: Ecosystems across the globe are changing at a rate greater than that of any previous period in the Earth's history. This rate of change is only expected to increase in future decades. There are many factors—operating from local to global scales—that influence ecosystem dynamics, including climate, soil, water, nutrients, vegetation

distribution and diversity, and faunal distribution and diversity, among others. Healthy ecosystems are essential to national and global security, economic prosperity, and human wellbeing. It is therefore vitally important, as an interconnected global community, that we address these challenges in an integrated and effective way, and at scales appropriate to meet the challenges faced. How, or indeed if, Australia's Long Term Ecological Research Network can be used, in-part, to create an enhanced global ecological-research community is a topic for discussion within this Symposium. To inform this discussion, this presentation provides an overview of LTERN, and how to date, the network has worked to improve national ecological understanding, facilitate better management, and enable broader research.

As way of background, in 2012, the establishment of LTERN brought together some of the longest continuous environmental monitoring programs in the southern hemisphere. These 12 researcher-led monitoring programs were 'networked' to form a component of the Australian Government's Terrestrial Ecosystem Research Network.

These long-term monitoring programs cover a diversity of ecosystems, including tropical rainforests and savannas, temperate woodlands and tall forests, heathlands, and alpine and deserts. They each range in geographical scale, with some larger than individual countries. The value and productivity of these individual long-term research programs is clear but how these site-based research networks can best be used to inform an integrated global research network remains a challenge. In our view, this can only be achieved through additional infrastructure investment where central to the design is the continuation of these decades-long observations on the ground.

Key words: Long-Term Research, Ecological Monitoring, Australian Ecosystems, Global Ecological-Research Community

Global Synthesis of the Spatio-Temporal Distribution of Antibiotics in Different Environmental Mediums

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Abstract: Antibiotics have been widely used for agriculture, aquaculture, and livestock as feed additives and growth promoters in recent decades. Because antibiotics cannot be completely absorbed and most of them are excreted by urine and feces, antibiotics are disseminated in different environmental mediums through fertilization and irrigation with manures, sewage sludge, sediment, reclaim water and surface water which are polluted by antibiotics. Antibiotics would persist in environment through bioaccumulation and a complex cycle of transformation and diffusion, and this will threaten the sustainability of agriculture and ecological security. The management and

risk assessment of global antibiotics pollution require synthesis of spatial data on the occurrence and distribution of antibiotics in different environmental systems. In this study, 4 groups of antibiotics, including tetracyclines (TCs), fluoroquinolones(FQs), sulfonamides(SAs) and macrolides(MLs) were. The measured environmental concentrations (MECs) of selected antibiotics in waters and sediments which have been published were collected. Using literature synthesis and quantitative analysis, the types, spatial and temporal distribution of antibiotics in different environmental mediums at worldwide scale were analyzed. Results of study found that: (1) the environmental contamination of antibiotics has become a global issue. Majority of antibiotics investigations were distributed in China, Europe and America. (2) The usage and MECs of antibiotics were higher in developing countries than developed countries. Particularly, relatively high concentrations of antibiotics observed were mainly distributed in industrial zones, for example, Hebei province of China and Patancheru of India. (3) The concentrations of antibiotics in aquatic environments decreased from 1999 to 2016, with the consumption and usage of antibiotics restricted or banned in some fields in recent years. On the contrary, the concentrations in sediments were higher in recent years. This may because the adsorption of sediment and the sustaining emission of antibiotics, which indicated that these compounds were not effectively distilled and tended to remain near the original region. (4) Significant positive correlations between the concentrations in water and GDP were found both in developing and developed countries. We suggested that the occurrence and spatial-temporal distribution of antibiotics in environmental mediums still need more quantitative analysis in further studies.
Key words: Global, Antibiotics, Spatial Distribution, Environmental Mediums

Broad and Deep in Observation Network: Lessons Learned from Satellite Ecology Initiative

Hiroyuki Muraoka

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Abstract: Changes in biodiversity, ecosystem structure and functions, and their services, are of central interests and crucial tasks of current environmental sciences under climate change. For example in forest ecosystems, influences of / responses to climate change in plant physiological and ecological characteristics have been focused by ecological, atmospheric and remote sensing sciences as these processes are responsible for carbon cycle as part of biogeochemical cycles and food web in ecosystems, and hence earth system. Particularly, phenology of forest canopy is now focused intensively as it is a fundamental biological mechanism which is quite sensitive

to climatic condition and plant's resource availability, and also because it cuts across the processes and scales from single leaf to ecosystem, and then to continents. In order to detect the changes of these ecophysiological processes and find consequences with ecosystem functions under changing environments, long-term monitoring and integrated analysis are the key methodologies. In addition, interpretation of optical remote sensing data by ecophysiological viewpoints would allow us to find the cross-scale behavior of plants at local scale and ecosystem functions at regional scale. This paper will introduce our long-term and interdisciplinary observations and analysis at a "super-site" for forest ecosystem functions, namely "Takayama site" located on a mountainous landscape in central Japan. We have been clarifying the phenology and its inter-annual variation in single leaf photosynthesis, canopy leaf area, and resulting canopy photosynthesis of the forest. In addition, open-field warming experiment for the canopy trees enabled us to examine the hypothesis on temperature-dependent changes in leaf phenology and photosynthesis. We are also attempting to develop a model to use satellite remote sensing data to estimate forest photosynthetic capacity in regional scale, by detecting essential variables responsible for such ecological processes. By sharing these 'deep' investigations and 'broad' approach namely "Satellite Ecology" concept in a super-site, we are willing to discuss how do we promote the long-term and interdisciplinary Earth observations by networking.

Key words: Long-Term Ecological Research, Forest Ecosystems, Observation Network, Carbon Cycle

Are Declining Populations of Wild Geese in China "Prisoners" of Their Natural Habitats?

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Abstract: While wild goose populations wintering in North America and Europe are mostly flourishing by exploiting farmland, those in China (which seem confined to natural wetlands) are generally declining. Telemetry devices were attached to 67 wintering wild geese of five different species at three important wetlands in the Yangtze River Floodplain (YRF), China to determine habitat use. Fifty individuals of three declining species were almost entirely diurnally confined to natural wetlands, 17 individuals from two species showing stable trends used wetlands 83% and 90% of the time, otherwise resorting to farmland. These results confirm earlier studies linking declines among Chinese wintering geese to natural habitat loss and degradation affecting food supply. These results also contribute to explaining the poor conservation status of Chinese wintering geese compared to the same and other goose

species wintering in adjacent Korea and Japan, Western Europe and North America, which feed almost entirely on agricultural land, liberating them from winter population limitation.

Key words: Chinese Geese, Declining, Confined to Natural Habitats

Dynamics of Eco-Evolutionary Patterns in Forest Ecosystems

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Abstract: The use of observed patterns to infer underlying biotic and physical drivers of eco-evolutionary dynamics is a challenge for population, community and conservation ecology. This is because whilst an understanding of process is required to make useful predictions and test theory, it is static or progressive patterns that are most readily observed in ecological systems. Here we report on the analysis of an extensive ecological dataset which we attempt to make explicit links between pattern and process, based on spatially explicit plot-based information from tall eucalypt forests spanning continental Australia. These data were analysed using a combination of point-pattern statistics, likelihood-based inference and pattern-oriented modelling. We demonstrated that at the local scale, the basal area and density of the understory species was closely related to climatic factors, whereas the eucalypt canopy trees were not. At a broader scale, the continental-level analysis revealed that community diversity and carbon storage were decoupled in Australia, the former being driven largely by biogeographic factors and the latter by a latitudinal gradient and evapotranspiration. The spatial and temporal patterns observed in these tall eucalypt communities imply a strong sensitivity to future climate change. A strength of our approach is the ability to test ideas about pattern and process with a dynamic forest system that integrates both short and long turnover times.

Key words: Global Change, Forests, Pattern and Process, Ecological Modelling,

Copper Pollution Increases the Resistance of Soil Archaeal Community to Changes in Water Regime

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Abstract: Increasing efforts have been devoted to exploring the impact of environmental stresses on soil bacterial communities, but the work on the archaeal community is seldom. Here, we constructed microcosm experiments to investigate the

responses of archaeal communities to the subsequent dry-rewetting (DW) disturbance in two contrasting soils (fluvo-aquic and red soil) after six years' copper pollution. Ten DW cycles were exerted on the two soils with different copper levels, followed by a six-week recovery period. In both soils, archaeal diversity (Shannon index) in the high copper-level treatments increased over the incubation period, and archaeal community structure changed remarkably as revealed by the non-metric multidimensional scaling ordinations. In both soils, copper pollution altered the response of dominant operational taxonomic units (OTUs) to the DW disturbance. Throughout the incubation and recovery period, the resistance of archaeal abundance to the DW disturbance was higher in the copper-polluted soils than soils without pollution. Taken together, copper pollution altered the response of soil archaeal diversity and community composition to the DW disturbance, and increased the resistance of the archaeal abundance. These findings have important implications for understanding soil microbial responses to ongoing environmental change.

Key words: Archaeal Community, Resistance, Dry-Rewetting Disturbance

Assessing Ecosystem Health Changes of Lake Poyang, Using Aquatic Ecological Integrity Indices from 2010-2015

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Abstract: Abstract Lake Poyang, as one of the seven international important wetlands and the largest freshwater lake in China, the evaluation of the health status changes of this lake is of considerable importance for ecosystem maintenance and environmental management. Given its particular hydrodynamic characteristics and rich biodiversity, such a comprehensive metrics system was developed, combination of physical, chemical, biological (phytoplankton, zooplankton, benthic macroinvertebrate, wetland vegetation, bird population abundance, and related fish species of interest), and social service indicators (drinking water and illness, flood storage capacity, sand mining, and shallow lake management). Based on Lake Poyang's ecological integrity indices (LP-EIIs) and reference and impaired conditions defined by Historical condition (HC), Least disturbed condition (LDC), National Standards, and authoritative ecologists' suggestions, the final health status for Lake Poyang from 2010 to 2015 showed a tendency of deterioration. In addition, temporal and spatial variations of individual indicator and overall health conditions were explored. It showed that Lake Poyang suffered from various degrees of damage, and these differences demonstrated the effects of human activities on ecological health over the past years, thereby finally a more scientific and management strategy had been provided in the paper.Keywords:

ecosystem health changes, ecological integrity indices, health assessment, Lake Poyang
Key words: Ecosystem Health Changes, Ecological Integrity Indices, Health Assessment, Lake Poyang

Phenotypic Plasticity in Two Mollusk Sister Species across Their Range Overlap Area: A Physiological Perspective

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Abstract: Amid global climate change, a central question today is how the distributional range of multiple species will change, or what species will go extinct and which ones will not. Global environmental change is having an impact on marine species distributions in two distinct ways. Firstly, it is altering barriers to dispersal and secondly it is changing local environmental regimes. Along ocean's temperate Eastern boundaries, such as Humboldt currents, the upwelling of cold, nutrient-rich waters is tightly correlated to the presence of topographic features. Upwelling waters in eastern boundary currents are supersaturated in CO_2, have low O_2 concentrations and low pH. Mollusks are ecologically important rocky intertidal organisms that are sensitive to changes in both seawater temperature and chemistry. The limpet genus Scurria is comprised of rocky intertidal species inhabiting exclusively the rocky shores of the South Eastern Pacific. Here, we examine the plastic phenotypic responses of two sister Scurria species, Scurria zebrina and S. viridula, across a strong upwelling area (Talcaruca) where the rear and leading edges of their geographic ranges overlap. Using ecological surveys, physical monitoring, and laboratory and field experiments, we examine the interpopulational variability in their behavioral, morphological, physiological and metabolic responses.

Our monitoring program of shoreline water temperature showed a discontinuity in the latitudinal gradient in annual mean and variance in situ sea surface temperature (SST) and carbonate system parameters across our study region with major variation around upwelling site. The equatorward populations of S. viridula exhibited higher values in VO_2 but differences between localities were not significant. Individuals from southern population showed significantly lower VO_2 from the other populations of S. zebrina. The best-fit models describing the Thermal Performance Curves of S. viridula and S. zebrina populations revealed the usual left-skewed shape of TPC curves. Populations of S. zebrina were not restricted by temperature at the rear edge of their distribution. Instead, they seemed to be restricted by pH, which was reflected in the lowered capacity to deposit CaCO3 and the higher VO_2 observed at Talcaruca, around their geographic range edge. On the other hand, the leading edge populations of S. viridula

showed a steady decrease in metabolic rates towards higher latitudes, as it encountered it polar range boundary. The more acute response to heat stress and lower carbonate shell assimilation was observed for S. zebrina, the rear edge species. The sister limpet S. viridula, showed plastic performances across the range overlap of both species even at localities of recent expansion. As suggested by previous studies, key physiological and life history characteristics of mollusks will be impacted by the increased levels of ocean acidification and warming brought about by global climate change in the ocean. The differential performances across the distributional range overlap observed in our study for the leading and rear Scurria species, can shed light on the differential capacity of phylogenetically related species to deal with a suite of environmental stressors, and the role of these drivers to shape distributional range.

Key words: Thermal Performance Curve, Trade-Off, Reaction Norm, Marine Ecology

Long-Term Ecosystem Research (LTER) - Streamlining Continental and Global Scale Ecosystem Research by Combining Primary Investigator Driven Bottom-Up and Interoperability Focussed Top down Approaches

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Abstract: Society and the human use of natural resources depend on continuously available and well-functioning ecosystem services. Ecosystem structures and functions providing these services interact in extremely complex spatial patterns from local to global and encompass both biotic (organic, living) and abiotic (inorganic) components. The time scale of interactions ranges from microseconds up to phenomena driven by variations in Earth's orbit or earth geological cycles (e.g. ice ages and the Milankovitch cycles). Ecosystem and biodiversity research are challenged to disentangle processes and their drivers across the appropriate temporal and spatial scales in order to understand the planet or “earth system” in search of answers to the great challenges facing humanity like climate change, loss of biodiversity, eutrophication and pollution. Key questions for managing and sustaining ecosystem services in the face of continuing global change are: How are ecosystems/biodiversity changing or adapting to global-change pressures? How do the global change pressures interact? What are determinants of ecosystem resilience? What are the thresholds resulting in system shifts? How can we respond locally, nationally and at international levels to support systems that are more resilient to global change effects? Changes in ecosystems are caused by many factors that act at multiple spatial and temporal scales. The amount and quality of data necessary for understanding their cross-scale interactions is far beyond that which

a single environmental scientist and even a single research site can collect, process and synthesize. Embracing the era of "big ecology" and its associated “big data" requires the establishment of a “network of networks” consisting of existing research infrastructures with the capability to integrate data, information and expertise from many sites distributed widely across Europe and around the globe. In the vast field of ecosystem research and monitoring the eLTER Research Infrastructure represents the “exemplary system research” link between large scale monitoring schemes (mainly domain specific) and small scale experimental sites. LTER is thereby dedicated to further streamline an infrastructure pool to support both basic research and knowledge production on sustainable use of natural resources, including e.g. food and raw materials, across scales in currently about 50 countries. The unifying approach of all sites and platforms involved in LTER is based on four conceptual pillars: (1) Long-term: dedicated to the provisioning, documenting, continuous collection and use of long-term data on ecosystems with a time horizon of decades; (2) In-situ: data generation at different spatial scales across ecosystem; (3) Process orientation: aims at identifying, quantifying and studying the interactions of ecosystem processes affected by internal and external drivers; (4) System approach: LTER enables the investigation of ecosystems, the critical zone, earth systems, environmental systems, socio-ecological systems with the common denominator being „systems“, i.e. the earth’s surface system receiving solar energy, where abiotic and biotic components interact at different scales, and the human use of such systems and their services takes place. The presentation will provide an overview of recent strategy building and developments of LTER in response to the above challenges in Europe (eLTER Research Infrastructure, LTER-Europe) and the International LTER network (ILTER).

Key words: LTER, LTER-Europe, Long-term Ecosystem Research, ILTER

Biodiversity in Limestone Quarries: Species Richness and Flora Diversity in Forest Fragments and Reforestation Sites across Two Philippine Biogeographic Subregions

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Abstract: Rapid vegetation assessment using the Variable Transect Method was conducted in natural forest fragments and old reforestation sites in six active quarry sites in two major Philippine Biogeogrpahic sub-regions (three quarry sites in Luzon Island and three in Mindanao Island) and in one Luzon protected secondary forest over

limestone. Different life forms (trees, pandans, herbaceaous understory, grasses, pteridophytes, proto-terrestrial herb, vines, epiphytes and hemi-epiphytes) were included in the assessment. Species diversity, abundance and composition and structure were compared across different forest conditions within and across islands. Based on NMDS analysis, old reforestation sites clustered distinctly regardless of island and site while natural forest fragments in Luzon Island clustered among them, which was distinct and separate from the natural forest fragments in Mindanao Island. After testing for normality using the Shapiro-Wilk test, MANOVA comparisons showed differences in forest conditions were statistically significant (R2=0.11946, P=0.001) regardless of site or island. Furthermore, there was also significant difference between forest fragments of Luzon and Mindanao islands while rehabilitation sites between islands showed no significant difference. When Fisher's alpha, Shannon's index and Chao-1 were computed and compared using ANOVA for the different forest conditions, no statistical difference was found. Only the natural forest fragments and old reforestation sites in Mindanao Island showed significant difference. These findings showed that exotic species-based reforestation sites have very low but similar species richness and flora diversity regardless of where they are planted while natural forest fragments that persist in degraded conditions continue to exhibit high species richness and flora diversity where they are found, and the high species richness and flora diversity were different between the Luzon and Mindanao biogeographic sub regions. These findings emphasize the importance of forest fragments of the different sub regions in the conservation of plant species diversity and maintenance of natural forest ecosystems.

Key words: Natural Forest Fragments, Exotic-Species-Based Reforestation, Luzon and Mindanao Biogeograhic Sub-Regions, Active Limestone Quarry

Linking Plant Functional Traits to Shifts in Subtropical Forest Composition Under Climate Change

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Abstract: Over the last three decades, significant changes in the composition of tree species have been observed in species-rich subtropical forests of Dinghu Mountain in Southern China, which are considered to be associated with climate change over the same period. However, the specific underlying mechanisms remain unknown. To explore the potential mechanisms involved, we hypothesized that the observed changes resulted from variable sensitivities of different tree species to environmental change, which might be quantified using observed functional traits. The long term (1978-2010) demographic data of 48 dominant tree species from a permanent forest plot was divided

in three categories depending on their trends in abundance dynamics, and demarcated as “increasing” (20 species), “no change” (10 species), and “decreasing” (18 species), respectively. We then analyzed the differences of 12 key functional traits among the three categories. We found that tree species exhibiting high photosynthesis rates, leaf phosphorus and nitrogen content, specific leaf area, stem hydraulic conductivity, leaf turgor loss point, and low wood density had increased their abundance, while species that showed opposite trait values had decreased in number. Our results support the hypothesis that functional traits are good predictors of tree species dynamics in response to climate change in subtropical forests, and offer a new approach to predict changes that are likely to occur in forest tree species composition under global change scenarios.

Key words: Drought Stress, Hydraulic Conductivity, Photosynthesis, Warming

Phylogenetic Determinants of Latitudinal Variation in Absorptive Root Traits from Boreal to Subtropical Forests

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Abstract: As the most distal part of the root complex, absorptive roots are essential for the water and nutrient uptake of plants. To date, the degree to which phylogenetic information contributes to absorptive root variation and evolutionary trends remain unclear, even though high cross-species variation and phylogenetic conservatism have been reported for absorptive root traits. Here, six absorptive root traits were measured for 254 species from subtropical to boreal forests. These traits included root diameter (RD), specific root length (SRL), root tissue density (RTD), root carbon (RC) and nitrogen (RN) concentrations, and the C: N ratio. We aimed to disentangle the influences of phylogeny, soil, and climate on large-scale variation in absorptive root traits, and to test the assumption that to enhance the uptake capacity of resources by plants, there is a general pattern of root evolution towards thinner roots for both woody and nonwoody species. RD, SRL, RC, and RN exhibited significantly, but weakly, latitudinal patterns, which were explained largely by phylogenetic information. More importantly, RD of extant angiosperm families decreased with divergence time, irrespective of woody and nonwoody species.Our results highlight the important role of phylogeny in determining root trait variation, providing the new evidence for the

directional evolution of thinner root.

Key words: Absorptive Root, Evolutionary Pattern, Phylogeny, Forest Transect

Assessing Elements of Change in a Tropical Mangrove: Multidimensional Relationships between Mollusc Assemblages and Habitat Complexity across Spatiotemporal Scales

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Abstract: Baseline information on ecology of molluscs, specifically bivalve and gastropod assemblages in mangrove ecosystems are deficient in some aspects. Unknown responses of mollusc assemblages to changes in mangrove habitats for example are generally hindered by lack of ecologically guided studies across spatial scales on lesser known species, and fragmented data caused by irregular gaps in time ranging from years to decades. Changes in mangrove habitats often caused by human activities has led to the reduction of mangrove habitat complexity. Simplification of complex habitats could have negative impacts on mollusc diversity and abundance. Human induced modification of mangroves has become more apparent as observed in Malaysia. In Penang, a metropolitan island North of Peninsular Malaysia, large areas of mangrove forests were lost, converted and reclaimed in housing projects, urban structures and aquaculture ponds. The status of macrofaunal diversity and habitat complexity in these mangroves however are unknown. To identify mollusc assemblage structure and relationships with habitat complexity, samples of mollusc with habitat structures comprising pneumatophore densities, organic matter biomass and sediment grain size were sampled simultaneously. Sample collection was conducted based on a multifactor, hierarchical, partly nested sampling design ranging from larger (km) to smaller (cm-m) spatial scales across forests, intertidal height, sites and plots, repeated over five sampling occasions. A total of 21 gastropod and 4 bivalve species were recorded throughout this study, almost similar to the numbers found by Sasekumar in 1974 in his classical work of mollusc species in a Malaysian mangrove. This was unexpected considering the significant expanse of human activities occurring near some of the study sites. The high number of mollusc species however, may not be a clear indicator of mangrove ecosystem health. Out of the 25 species found, a common pattern of greatest abundance was usually associated with one or only a few species, which indicated possible dominance of more tolerant, opportunistic species that may have adapted to a disturbed mangrove landscape characterized by high organic matter. This could explain why greater densities of a gastropod species, Assiminea brevicula was found in the more disturbed mangrove sites when compared with lower densities

found in established, less disturbed mangrove sites. Significant relationships between molluscs and habitat characteristics occurred at the metre (intertidal height) to kilometre (forest) scale. Different combinations of habitat characteristics that explained mollusc assemblage patterns also changed across time. Findings from this study stresses the need for detailed experimental designs based on habitat utilization by molluscs in mangroves to minimize confounding effects and inaccurate assumptions caused by spatiotemporal variations. Therefore, in anticipation of significant human modifications occurring during this timeline, changes in assemblage patterns have to be elucidated, predicted and to some extent managed for the preservation of diversity and ecosystem function in mangroves.

Key words: Tropical Mangrove, Mollusc, Complexity, Spatiotemporal

Establishing Plant Aridity Sensitivity Using Stable Carbon Isotopes on Bioclimatic Gradients

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Abstract: Climate change is rapidly altering the composition and distribution of the world's vegetation. Climate-driven migration has already been detected for some species, but many will be unable to disperse fast enough to keep up with climate shifts, particularly where habitat is fragmented. We therefore need a better understanding of how plant species can adapt in situ to be able to project the future composition and distribution of global flora.

Measurement of stable carbon isotope ratios (δ13C) in the leaves provides an integrated measure of water use efficiency and is a long-standing approach to detecting water stress in C3 plants. By measuring carbon isotope ratios from several individuals of species across an aridity gradient, we derive a sensitivity index which can be used to compare the sensitivity of species and infer in situ vulnerability to future aridification. We can also develop similar rankings for entire vegetation assemblages or regions.

To investigate the feasibility and utility of this approach, we present data from ~2000 individual plants from 250 C3 species collected on three bioclimatic transects: the North-East China Transect (NECT; 145-710mm MAP), the South-West Australian Transitional Transect (SWATT; 250-800mm MAP), and a South Australian transect (TREND; 160-980mm MAP).

In examining differences between plants of different types and origins, we test the universal scaling hypothesis postulated by Prentice et al. (2010), which suggests that

C3 plants have similar patterns of stomatal adjustment, irrespective of phylogeny and traits, including life form. If universal scaling were supported, plant attributes could be disregarded for the purposes of modeling community and regional ecophysiology. We find that most tested species do not conform to the universal scaling model, and propose a new model of four response modes: regional scaling, biotic homeostasis, insensitive response and contrary response. We discuss potential mechanisms for each response mode and their ecological ramifications.

Finally, we consider the broader utility for these data, including environmental monitoring and combining isotope data with species distributions to improve predictive vegetation mapping under future climate change scenarios.

Key words: Climate Change, Ecological Forecasting, Management Strategies, Global Change

T2-07: Eastern Asian Grasslands under Environmental Changes Towards Sustainable Future

Shrub Encroachment and Its Ecological Impacts on Temperature Grasslands in China

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Abstract: Shrub encroachment has occurred in many places in arid and semiarid grasslands, and could substantially alter species composition and cause changes in ecosystem structure and functions. However, the distribution patterns and ecological impacts of shrub encroachment still remain large uncertainties, field evidence is lacking particularly with respect to the vast China's northern grasslands. In this study, we conducted a large field survey across grasslands in northern China to identify the distribution pattern, community structure, and regional differentiation of the shrub encroachment. We also examined the soil organic carbon (SOC) changed associated with the shrub encroachment in Inner Mongolia grasslands. The results showed that shrub encroachment in China's grasslands occurred mainly in the Inner Mongolia plateau, the southern slope of the Altai Mountains, the western mountains of the Junggar Basin, and the northeastern of the Qinghai-Tibetan Plateau. The mean shrub cover of the shrub-encroached grasslands (SEGs) is 13.45%, including 14 shrubs species from 5 families. Moreover, the SEGs in northern China could be divided in six community types. The climate and soil factors could explain 34.4% of the total variation in the community composition, of which climate was the major controlling factor for the community structure. Our results also showed that SOC density was significantly lower in SEGs than neighboring controlling grasslands, and the changes of SOC density by shrub encroachment showed significant correlation with soil nitrogen and phosphorus content, but no significant correlation with annul precipitation or mean annual temperature in Inner Mongolia grasslands. Our study provides first large-spatial scale survey concerning with the shrub encroachment in relation to distribution pattern, community structure, and SOC changes for the vast northern China's grasslands, which should provide an insights into our understanding on shrub encroachment and its ecological impacts in Asia grasslands.

Key words: Shrub-Encroached Grasslands (SEGs), Community Structure, Biodiversity, Soil Organic Carbon (SOC)

Ecosystem Dynamics in the Returning Rangeland to Grassland programs, China

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Abstract: Grassland in arid, semi-arid and alpine areas has been experiencing severe degradation in recent decades. To enable restoration of grassland vegetation and sustainable development, the Returning Rangeland to Grassland (RRG) programs was initiated in 2003. Based on the remote sensing images, meteorological data and ground observed data, this study utilized data fusion, ecological model simulation and scaling transformation to construct the regional macro ecosystem structure, ecosystem quality and dynamics in regions hosting RRG programs. Fractional vegetation cover (FVC), leaf area index (LAI) and net primary productivity (NPP) were utilized to indicate ecosystem quality. We examined the spatiotemporal characteristics of ecological structure and ecosystem quality in regions where the RRG programs were implemented from 2000 to 2010. Additionally, we analyzed the ecosystem evolution characteristics and the driving mechanism of the ecosystem change. Grassland ecosystems were dominant in the study area. The ecosystem structure was stable, but grassland experienced local change in farmland, wetland and desert locally. FVC showed a slight increasing trend for grassland; LAI tended to fluctuate but tended to also increase; NPP increased, ranging from 218.23 gC/(m2 ×a) in 2000, to 226.30 gC/(m2 ×a) in 2010, a 3.70% increase. Ecological conditions differed in spatially; overall there was improvement but with areas of localized deterioration.The spatiotemporal variations of ecosystem were mainly controlled by the ecological restoration projects, climate change and human activities. The RRG programs restored degraded grassland and promoted natural grassland protection. The warming-wetting trend observed over this time promoted the restoration of vegetation. Human activities such as overexploitation resulted in conversion of grassland in farmland in some area.

Key words: Ecosystem Dynamics, the Returning Rangeland to Grassland Programs, Ecosystem Structure, Ecosystem Quality

Assessing Impacts of Grazing Intensity on Vegetation Characteristic and Soil Chemical Properties of Alpine Meadows in Eastern Part of Qinghai-Tibetan Plateau

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Abstract: Grassland degradation mainly caused by overgrazing is one of the greatest

problems related to the livelihood of nomads in the eastern part of Qinghai-Tibetan plateau. A study was carried out to determine the impact of different grazing intensities on the vegetation characteristics and soil chemical properties of alpine meadows in Hongyuan county in southwest China (31°51'～33°19' N, 101°51'～103°23' E) at an average elevation 3500 m (Fig. 1). The grazing intensities GI, GII, GIII and GIV were defined according to the number of livestock and the frequency of grazing. The two-way indicator species analysis (TWINSPAN) technique was used for vegetation classification with twelve vegetation groups identified (Fig. 2). The detrained correspondence analysis ordination technique was used to detect the vegetation distribution under different grazing intensities and soil moisture content which were associated with detrained correspondence analysis axis 2 and axis 1, respectively. Our results shows that overgrazing caused significant reduction in community structure, such as total aboveground biomass, vegetation cover, canopy average height and species number. In additiion, the soil organic matter was significantly affected by grazing in this area. The organic matter content of 0-10cm layer of GII, GIII and GIV decreased 64.51%, 65.38% and 82.40% comparing to GI treatment. There was no distinct tendency in total nitrogen content, total phosphorus and total potassium in different grazing intensities. Finally, 45 sites of alpine meadows were classified by DCA ordination in eleven groups (Fig. 3). The results shows that grassland ecosystem in this area is in decline. Over all, it is the first grazing intensity research in the eastern part of Qinghai-Tibetan plateau. Our research will give a reference to manage the grazing intensity. It is beneficial for the sustainable grazing in the eastern part of Qinghai-Tibetan plateau.

Key words: Vegetation, Grassland Degradation, Grazing Intensity, Alpine Meadows

Effects of Altered Temperature and Precipitation on Ecosystem Respiration in Alpine Meadow on the Central Tibetan Plateau

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Abstract: The global mean temperature is expected to increase with concomitant changes in precipitation worldwide, and the Tibetan plateau is predicted to be exposed to an even higher magnitude of warming. Given that temperature and water are two key drivers for ecosystem biogeochemical processes, the altered temperature and precipitation is expected to significantly impact the rate of carbon flux from terrestrial ecosystems to atmosphere. Ecosystem respiration (Re) is a major component of terrestrial carbon cycling, which is greatly dependent on temperature and precipitation. Examining responses of Re to climatic controls is crucial for understanding future

alpine ecosystem carbon cycling. However, information about the interactive effects of altered temperature and precipitation on Re in alpine meadows are still unclear. A reciprocal transplantation experiment was conducted spanning an altitude and climatic gradient to investigate the effects of climatic controls on Re and its temperature sensitivity (Q10) in alpine meadows on the central Tibetan Plateau. Microclimate conditions, Re, aboveground biomass (AGB) and soil organic carbon (SOC) were measured for both control plots and transplanted plots. Our results indicated that transplanting to higher altitudes (cooling) had negative effects on both AGB and Re regardless the changes in precipitation, whereas transplanting to lower altitudes (warming) increased AGB and Re without precipitation reduction but decreased AGB and Re with precipitation reduction. The difference of plant biomass due to transplanting were positively correlated with the change of Re. We attributed the inconsistency effects of warming on Re largely to the changes in plant functional and plant biomass regulated by precipitation in alpine meadow. Generally, warming decreased Q10 while cooling had the opposite effect, whereas the warming and cooling effects on Q10 were also constrained by precipitation. The difference of Q10 due to transplanting was negatively correlated with the changes of growing season air temperature (GST), but positively correlated with that of GSP, SOC and AGB. Our study highlights the crucial importance of the interactive effects of altered temperature and precipitation when evaluating the effects of climate change on Re in the alpine meadow on the Tibetan plateau.

Key words: Ecosystem Rrespiration, Reciprocal Transplantation, Alpine Grasslands, Tibetan Plateau

Nitrogen Addition Deteriorates Nematode Community through Increasing Litter Accumulation

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Abstract: Atmospheric nitrogen (N) deposition resulting from anthropogenic activities has greatly changed ecosystem functioning and services. Soil nematodes are ubiquitous in terrestrial ecosystem with high diversity, occupy multiple trophic positions in soil food web, and play a key role in ecosystem nutrient cycling. Thus, understanding the response and underlying mechanisms of soil nematodes to N addition will contribute to elucidate potential cascade effects of N deposition on the soil food web. We examined response of soil nematode to N addition and litter in a 6-year field experiment, and quantified the direct effects of N and litter on nematode total abundance, Shannon-Wiener diversity (H'), mature index (MI), enrichment index (EI), structure

index (SI) and channel ratio (NCR), and indirect effects through altering soil moisture, pH, available N, plant diversity, shoot, root and litter biomass with structural equation modeling (SEM). There were significant interactive effects between N addition and litter on soil nematode community. N addition significantly reduced nematode total abundance, H', MI, EI and SI in the double litter treatments, and increased NCR at other two litter levels. Without N addition, increasing litter significantly increased nematode total abundance and NCR, while with N addition, increasing litter reduced nematode H' and MI. Results of SEM revealed that N addition reduced nematode total abundance, H', MI and EI and increased NCR through increasing litter biomass that negatively affected relative abundance of fungivores, and decreased SI through increasing shoot biomass. Litter had direct negative effect on MI and positive effect on NCR, and had indirect negative impact on total abundance and H' through decreasing root biomass. The negative effects of N and litter on abundance and MI were counterbalanced by the indirect positive effect through increasing plant H'. Our study demonstrated that N addition could deteriorate nematode community through increasing litter accumulation in grassland. The negative impacts of litter on nematode H', MI, EI and SI with N addition demonstrated that grassland management that reduces litter accumulation such as grazing and mowing profits the complex and stable soil food web and subsequent ecosystem functions under the scenarios of N deposition.

Key words: Nitrogen Deposition, Grassland, Soil Food Web, Structural Equation Modeling

Grazing Effects on Soil Respiration in Kubuqi Desert of Northern China

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Abstract: Temporal variation of soil respiration (Rs) in Artemisia ordosica Krasch. Shrubland was evaluated in the Kubuqi Desert of Inner Mongolia, China to better understand soil C emission in desert ecosystems. Diurnal and seasonal Rs was measured in enclosed and grazed sites during May to September 2011. Analysis of variance indicated no significant difference ($P>0.05$) in Rs between the two sites, yet diurnal Rs increased with soil water content (SWC). A hysteresis offset was observed between Rs and air temperature (Ta) at both sites. The time lag between Rs and Ta was 2-4 h in August when SWC was high and 6-8 h in May, June, July and September when SWC was lower. Daily mean Rs showed strong seasonal variation under both grazing conditions, which coincided with the seasonal dynamics of SWC. Rs was correlated

with SWC at the diurnal scale (r=0.75, P=0.006 for enclosed site; r=0.83, P=0.004 for grazed site) and seasonal scale (r=0.97, P=0.002 for enclosed site; r=0.91, P=0.033 for grazed site). SWC and Ta were also correlated (r=0.57, P<0.001 for enclosed site; r=0.33, P=0.009 for grazed site). SWC explained 40-50% of the variation in Rs at the enclosed site and 40-70% at the grazed site. The combination of Ta and SWC explained 60-90% of the variation in diurnal Rs and more than 80% of seasonal variation in Rs at both sites. Our results emphasize that SWC was the dominant controlling factor for Rs in A. ordosica shrubland and that grazing had little impact on Rs in the Kubuqi Desert.
Key words: Artemisia Ordosica, Grazing, Soil Respiration, Soil Water Content

Climatic Variations in Recent Years on the Tibetan Plateau and Its Effect on Annual NEE and Ecosystem Respiration - an Example in an Alpine Meadow

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Abstract: Grassland occupies about 50% of the Tibetan Plateau (TP) and acts as a carbon sink nowadays. Climate warming may increase the productivity of the grassland on the Plateau. It may also accelerate carbon releasing at the same time, especially when grassland degradation occurs. Since August 2001, intensive field observations of energy balance and CO_2 flux has been induced on the TP at Haibei Alpine Meadow Ecosystem Research Station (37°37'N, 101°19'E, 3250m a.s.l.) by a Japan–China cooperation project. Preliminary analyses of the first three years data suggest that (1) the Qinghai-Tibetan Plateau plays a potentially significant role in global carbon sequestration, because alpine meadow covers about one-third of this vast plateau, and (2) the annual NEP in the alpine meadow was comprehensively controlled by the temperature environment, including its effect on biomass growth (Kato et al., 2006). Although there were no any climatic warming trend during the recent 16 years, very large climatic variations were observed. In order to know to what extent that annual net ecosystem CO_2 exchange (NEE) and ecosystem respiration changes with climatic variations especially temperature variations, 16 years of climatic variations and its effects on annual NEE and ecosystem respiration were analyzed. We fitted the Michaelis–Menten equations of the light–response curve to the alpine meadow ecosystem getting the ecosystem-scale light-response curve and then get the relationship between the parameters of the light-response curve and temperature and

other meteorological elements. The parameters obtained described very well the shape and amplitude of the responses of the maximum gross photosynthesis (Amax) and the initial slope of the light response curve (a). By using the model, climatic warming effect on annual NEE and ecosystem respiration were predicted.

Key words: Alpine Meadow, Climatic Variation, Light Response Curve, Michaelis–Menten Equation

Microclimate and Livestock Grazing Influence CO_2 Fluxes in an Alpine Grassland on the Qinghai Tibetan Plateau

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Abstract: The Qinghai-Tibetan Plateau (QTP) contains one of the largest areas of alpine grasslands in the world. With a quite large area about 2.5 million km^2, and a high altitude more than 4000 m a.s.l., the QTP is vital pasture for livestock for thousands of years. Additionally, the QTP is located upstream and upwind of more than 40% of the world's human population, making it an important region for maintaining water and air quality resources. Since the alpine grasslands on the QTP are under pressure to increasing livestock grazing and recent global warming, many studies have been conducted to demonstrate present status on the grasslands ecosystem structure and function. However, there are still many uncertainties on effects of livestock grazing and global warming on the alpine grasslands due to there are various types of grasslands showing different topographic conditions and different land use management. To disentangle such the two effects on the alpine grasslands, we have conducted long term ecological research focused on carbon dynamics in an alpine grassland which include both winter and summer pasture from 3200m to 4200m on the QTP since 2007. Our data on grazing intensity estimated by difference in biomass between grazing exclusion and controlled plot suggests livestock grazing decreased with altitude. As for data on CO_2 fluxes, GPP, ER, and NEP as a balance observed by chamber technique, suggests that livestock grazing considerably increased ER and/thus depressed NEP in lower altitude. Meanwhile, GPP significantly decreased under little grazing intensity observed in the grazing exclusion plot, probably due to plant growth stimulate by livestock grazing. Our long-term data will provide useful information on sustainable future of the alpine grasslands on the QTP in a changing world.

Key words: Alpine Grassland, Livestock Grazing, Global Warming, CO_2 Flux

Soil Organic Matter Properties in an Alpine Grassland Used as Summer Pasture on the Qinghai Tibetan Plateau

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Abstract: Cold and humid climate in short growing season in alpine grasslands on the Qinghai Tibetan Plateau (QTP) may facilitate soil organic matter. Recent carbon dynamics studies on the QTP have reported that plentiful soil organic matter (SOM) is stored in these grasslands. In addition, alpine ecosystems such as the QTP is considered to be very sensitive to ongoing global warming as well as both the Polar Regions, thus understanding of qualities of SOM may play an important role in the global carbon cycle. It is therefore, necessary to elucidate chemical properties of SOM in the QTP grasslands.

To demonstrate the qualities of SOM in alpine grasslands located in various altitudes, we established permanent study plots from 3200 m to 4200 m along a southwest-facing slope on the Qilian Mountains in the QTP. The slope is located ca. 12km northeastern to Haibei Alpine Meadow Ecosystem Research Station, CAS (37º36'N, 101º20'E). Soils were taken from each horizon of the soil profile in each study plot which has been protected from livestock grazing since ca. 2006. Soils were classified as Camisoles at 4200 and 4000 m and Phaeozems at 3800 and 3400 m.

In this presentation, we focus on the chemical properties of SOM in the Phaeozem soil at 3400 m plots which dominated by typical alpine shrub, Potentilla fruticosa. The TOC content in the surface soil (0-30 cm) was 116.8, 58.2 and 50.5 g kg^{-1} soil for A1 (0-9 cm), A2 (9-18 cm) and AB (8-27 cm) horizons, respectively. That in the upper subsurface soil (Bw1, 27-56 cm) was 35.6 g kg^{-1} soil, and that in the lower subsurface soil (60-100 cm) was 27.2 and 28.4 g kg^{-1} soil for Bw2 (56-79 cm) and for Bw3 (79-100 cm), respectively. The averaged percentage of SOM composition in each horizon by a NaOH extractants was 21% of humic acids (HA), 16% of fulvic acids and 63% of humin, and the differences of the composition among soil horizons were not applicably different. However, the yields of HA increased noticeably by a pretreatment with the HCl solution. This suggests a portion of the HA in the Phaeozem soil exist as a Ca binding form. The HA in the surface horizons classified in type Rp and B, which were considered relatively lower degree of humification. Indeed, results of 14C age analysis in these HA and in the bulk SOM indicate modern. In addition, results of 13C NMR

analysis on the HA were characterized as the typical spectra of Cambisols HA. On the lower subsurface soil, the HA were classified into Type A, which are considered to be most stable against chemical and biological oxidation among HAs and have been found commonly in the surface soil of Andosols in Japan and Chernozems in Europe. The 13C NMR spectra of the HA in this subsurface soil were similar to those in the black soils, Andosols and Chernozems. Such shapes of the spectra suggest to be exist char-derived components in the HA. The 14C age of the HA is estimated as ca. 4900 YBP. These results show that this QTP soil stores up stable and recalcitrant SOM in the subsurface horizon.

Key words: Soil Organic Carbon, 13CNMR, recalcitrant organic matter, Qinghai Tibetan Plateau

Comparison of Ecological Status after Restoration in Hulunbeier of China

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Abstract: The common environmental problems in Northeast Asia were dust and sandstoms. For prevention and control of desertification, three conutries(China, Japan, Korea) agreed to launch research activities. Our team of Korea WG2 studied vegetation and physiological characters in Hulunbeier of China from 2014 to 2016. Data of vegetation cover, number of species, soil humidity and EC along the soil depth, soil respiration, and chlorophyll contents are on the decrease tendency for 3 years. Plant height and soil temperature increased. Multivariate anlaysis (DCA, PCA, Cluster) classify 3groups and show the succession trend according to restoration as time passed. In principle, vegetation vitality decreased. However, we still have analysis or factors (soil moisture etc.) to consider. The results of ordination might imply normal change of restoration during the succession process.

Key words: Restortation, Desertification, Sand Dune, Grassland

Does Precipitation Drive Facilitation by Alpine Cushion Plants in Dry Himalayas?

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Abstract: It is challenging to understand variable patterns of plant interactions with elevation in dry mountains where precipitation may vary little or even decrease with increasing elevation. Such uncertainty questions the stress gradient hypothesis (SGH) that facilitation increases with increasing environmental severity along elevation. We tested the hypothesis that facilitation by cushion species generally increases with increasing leaf δ13C and decreasing satellite-derived vegetation index (NDVI) regardless of elevation, reflecting a general negative relationship between plant interaction and water availability. We measured relative interaction index (RII) for differences in species and individual numbers within and outside cushions and related cushion traits in two cushion species along elevation transects in dry Himalayas, Nepal. Site-specific NDVI was calculated from 30-m Landsat images. We observed nonlinear patterns in RII, leaf δ13C and NDVI with elevation. NDVI mainly explained the variation of δ13C (ranging from -26.50‰ to -28.99‰) in a strong negative correlation, reflecting considerable variations in water availability along transects. RII was positively correlated with δ13C and negatively with NDVI when elevation was controlled, which was further supported by literature data on 7 cushion species in the Tibetan Plateau and our additional field data for another cushion species in Nepal. RII was uncorrelated with cushion size under the same environment at any elevation. Leaf nitrogen varied little with elevation and showed no correlation with RII and δ13C. Data support our hypothesis, indicating that δ13C and NDVI can serve as general predictors of spatial variations in cushion facilitation in remote high-mountain environments. This is consistent with the stress gradient hypothesis and provides evidence that water availability mainly drives facilitation by cushion plants in the alpine belt of dry Himalayas. Our study introduced new ecological indicators of environmental severity in relation to facilitation by cushion plants, which can be easily quantified in remote high-mountain environments. The Himalaya is one of the most sensitive alpine regions to global warming with unpredictable precipitation change. Climate change in alpine habitats may have a large consequence on plant interactions that are related to biodiversity and ecosystem stability. The general relationship between RII and NDVI found across species and sites suggests a new way to predict interaction intensity of cushion plants in response to climate change at high elevations.

Key words: Alpine Plants, Climate Change, Elevation Gradient, Interaction Intensity

The Relationship between Grassland Species Richness and the Management in Long-Established Golf Cources in Japan

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Abstract: [BACKGROUND] Semi-natural grasslands are one of the most important habitats for plants in Japan. However, the species richness of semi-natural grasslands have decreased because of land use change. Most of semi-natural grasslands were abandoned and the area was declined in several decades. Remaining semi-natural grasslands are confined to agricultural land use and commercial grasslands. In agricultural land use, field margins of traditional paddy fields are one of the most important grasslands, which has species-rich vegetation. Some of endangered species exist in the commercial semi-natural grasslands such as ski slopes, pastures and golf courses. Whereas long-established pastures and ski slopes were investigated, golf courses were not formerly investigated. Rough and out-of-bounds in golf courses might plays a role for seed source and refugia of grassland species, if the management method of the course matches the lifecycle of grassland species. [AIM] The objective of this study is to clarify the management methods and the availability of golf courses for conservation of grassland plants by investigating the vegetation in the long-established golf courses including oldest course in Japan. [METHODS] Greenkeepers of each golf course were interviewed to determine the management methods of grasslands about all plots such as frequency and height of mowing, and application of fertilizer and chemical herbicides. We four golf courses in Hyogo Prefecture, western Japan. All courses had histories more than 60 years (113, 90, 86 and 60 years, respectively). We made flora lists of grassland species in each golf course in 2012-2015. We set 50 plots (1m * 1m) in rough and out-of-bounds of each course in 2015-2016. We recorded the cover of all vascular plants in each plot. [RESULTS & DISCUSSIONS] Management methods varied from non-intensive to intensive. Total number of species in a golf course varied from 55 to 79. Species richness of each golf course in a plot varied (mean: 11.3, 5.2, 8.1, 4.0; range: 3-23, 1-21, 1-23, 1-17). Numbers of management methods in a course were different among golf courses and related to the mean species richness in a plot, but did not relate to the total number of species in a golf course. The main dominant species were Pleioblastus chino var. viridis and Zoysia japonica. The management method, especially mowing height and frequency, related to dominant species, species richness in a plot. Plots that P. chino var. viridis dominated were under higher mowing point (mean: 18.4 cm) and infrequent mowing (mean: 3.5 times / yr) and had higher species richness (mean: 10.3). These plots had many grassland plants and were characterized by grassland species such as Liriope minor, Arundinella hirta and Miscanthus sinensis, and often included Adenophora triphylla var. japonica, Gentiana scabra var. buergeri, and Sanguisorba officinalis. Plots that Z. japonica dominated were under lower mowing point (mean: 4.8 cm) and frequent mowing (mean: 13.7 times / yr) and had low species richness (mean: 3.4). We concluded that long-established golf courses under non-intensive management can play a role of refugia and seed source for grassland plants.

Key words: Conservation, Land Use Change, Mowing, Semi-Natural Grassland

Long-Term Overgrazing Effects on Stem Elongation and Internode Allometry: Insights from a Natural Pasture Grass

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Abstract: Recently, there has been growing concern about how natural pasture grass individuals will respond to increased grazing intensities by large herbivores in semi-arid regions. Limited plant stem elongation is hypothesized to be the primary cause of decreased plant growth in response to long-term overgrazing (LOG). However, it is largely unknown how LOG-induced changes in stem elongation are mediated by internode traits. Here, we experimentally investigated the effects of LOG on plant stem elongation and internode allometry in Leymus chinensis. Plant size and internode traits, such as internode length (IL), internode diameter (ID), and internode number (IN), from L. chinensis individuals were measured according to their phytomer position from the base to apex. Plants were sampled from LOG and grazing exclusion experimental pastures in typical steppe regions of northern China during peak-growth. The results revealed that IN and their distributions were dramatically changed in response to LOG. Although LOG negatively affected IL and ID of each L. chinensis internode from the base to apex and eventually stem length, the plasticity index of IL and ID increased initially and then decreased from the lowermost to the uppermost internode in response to LOG. These contrasting responses of internode traits were the result of the allometry between internode traits which were determined by both LOG and internode position. Ultimately, IL and IN were shown to be key traits influencing reduction in stem length under LOG conditions and explained 52.51% and 47.49%, respectively, of variation in stem length. Overall, our findings suggest that the limitation of L. chinensis stem elongation induced by LOG is mediated by the plasticity and allometry of internode traits. This result emphasizes the sensitivity of individual plants to LOG and is potentially valuable for optimal management of grazed grasslands.

Key words: Degraded Pasture, Rhizomatous Grass, Overgrazing

Ecological Principles of Grassland Management in Tibetan Plateau

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Abstract: To mitigate the impacts of grassland degradation on the Qinghai-Tibet Plateau (QTP), China has been implementing large-scale conservation programs and has invested about 42 billion RMB (7 billion US dollar) in recent decades. However, such move is faced with great challenges of trade-off among ecological function,

livestock production and herdsmen livelihoods. Scientific assessments, as well as technical and policy issues, have not fully captured the complex ecological, social, and economic dynamics of the challenges facing grassland management on the QTP. Pastoral livestock production on QTP is characterized by a disequilibrium system between livestock seasonal nutrient requirements and herbage production in both quality and quantity, which forces herdsmen to keep larger numbers and longer term raise of livestock, both leading to grassland overgrazing. To solute those problems, an integrated crop-livestock system is promoted to improve the efficiency of livestock production and at the same time to conserve natural grassland for a sustainable Tibetan Plateau.

Key words: Tibetan Plateau, Grassland Management, Ecological Principles

Earlier Leaf-Flushing Suppressed Ecosystem Productivity by Draining Soil Water in Mongolia

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Abstract: Recent earlier greening trends are believed to enhance terrestrial ecosystem productivity. However, advanced onset of growing season may also deplete soil water in early spring, leading to summer water stress for plant growth. In this study, we linked soil wetness with start of growing season (SGS) to examine the responses of ecosystem productivity to water stress during 1982 to 2011 in the land ecosystem of Mongolian Plateau. Results showed that, though not significant, earlier SGS has tendency to enhance spring productivity at north part of the study area. Nonetheless, we found the suppressed summer photosynthesis (3.52 g C m^{-2} $season^{-1}$ with per day SGS advance) due to phenology-induced water stress dramatically reduced annual carbon assimilation (4.42 g C m^{-2} yr^{-1} with per day SGS advance, $R2 = 0.40$, $p<0.05$). Thus, phenology-associated changes in soil moisture has profound potential in regulating seasonal and annual productivity in arid and semi-arid ecosystems of Mongolian Plateau. Such relationship between SGS and GPP was neither observed in wetter forest ecosystem ($R2 = 0.04$, $p>0.10$) nor in the agricultural area ($R2 = 0.03$, $p>0.10$) where operations such as irrigation practice may alleviate summer water stress. Therefore, at the scale of the entire study area, earlier growing season did not translate to higher productivity ($R2 = 0.006$). On the contrary, advanced SGS aggravated growing-season water stress, which in turn, supressed annual carbon assimilation in the Mongolian ecosystem. This mechanism implies the advanced greening trends may not necessarily lead to more carbon uptake in terrestrial ecosystems but rather a carbon loss, especially in the arid and semi-arid regions.

Key words: Gross Primary Productivity (GPP), Start of Growing Season (SGS), Soil Water Stress, Mongolian Plateau

T2-08: Interactive Effects of Climate Change and Land Management on Vegetation Dynamics and Ecosystem Functions: Field Evidence and Modeling Projections

Modelling the Impacts of past and Future Climate Changes on Watershed Vegetation Dynamics in an Arid Environment

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Abstract: Vegetation structure and function are strongly influenced by climate on timescales of decades to centuries, primarily through temperature changes and water availability. Impacts of climate change on vegetation dynamics have been widely documented at a very broad scale (national or global) scale and a very coarse grid resolution (e.g., half degree). However, such type of studies remain challenging and have rarely been done at a finer scale, such as a watershed with a complex topography, due to both data and technique limitations. In the present study, the MC2 dynamic global vegetation model is used to simulate the responses of potential vegetation to past (1980-2010) and future (2010-2070) climate changes at a relatively high spatial resolution in the upper Heihe River Basin, a major inland river watershed in the arid western China. The MC2 model is calibrated and validated against various observational and inventory data, and forced by high-resolution climate and soil data. We used one future climate projection (RCP4.5) which simulates warmer weather by the end of the next century. Vegetation responses come from the MC2 model include vegetation types, structure (LAI, leaf area index), carbon cycle variables (e.g., total vegetation carbon and net primary production), and water cycle variables (e.g., actual evapotranspiration and streamflow). The results of the simulations underscore the potential large impact of climate change on arid ecosystems, and the need for further use and development of dynamic vegetation models using various ensembles of climate change scenarios.

Key words: Climate Change, Dynamic Global Vegetation Model, Vegetation Dynamics

Disentangling the Interactions among Climate and Management Drivers in Grassland Ecosystem Changes

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Abstract: Detection and attribution of historical ecosystem dynamics to climate changes is valuable to understand the ecosystem mechanisms and develop adaptation management strategies, but is particularly challenging for managed ecosystems as climate and management factors changing over time in a tangle. We used a mechanistic ecosystem model to examine the drivers that led to the observed patterns on an experimental grassland, either dry (rain-fed) or fully irrigated, under constant grazing and fertiliser management over a long term period (1960-2004). This was done by running and comparing a bunch of scenario simulations to extract the effects of the changes in climate, atmospheric CO_2, soil properties and species composition on plant production (annual net herbage accumulation, NHA) and soil organic carbon (SOC) after the model have reproduced the monitored NHA and SOC dynamics. We found that (1) the increase in NHA was majorly a consequence of soil fertility improvement under the sustained grassland management, and less importantly of climate and CO_2 changes; (2) the climate change effects on NHA was positive on dry but negative on irrigated grassland, and on the irrigated grassland the negative effect of climate change on NHA offset the positive effects of rising atmospheric CO_2; (3) the lack of significant increasing trend in NHA along with soil fertility improvement in irrigated grassland, unlike in dry grassland, was a result of cancelling out between the increase in soil N supply from soil fertility improvement and a decrease in legume content and associated symbiotic N fixation (SNF). Our results suggest a positive feedback existed between NHA and SOC in dry grassland, but the feedback was broken in irrigated grassland by a decline in legume content, and the small reduction in SNF with legume decline had a large effect on NHA due to the recycling of N input in ecosystems. Our results are a progress towards the understanding of the mechanisms underlying ecosystem dynamics, especially the interactions between grassland succession and environmental and management changes, and are useful to develop management strategies to raise the grassland production and soil carbon.

Key words: Temperate Grassland, Climate Change, Land Management, Ecosystem Modelling

Changing Relationships between Ecosystem Leaf Area and Evapotranspiration over Time and Space

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Abstract: The amount of leaf area in an ecosystem is often quantified as Leaf Areas Index (LAI, total surface leaf area per ground area), an important indicator of ecosystem structure. LAI has been used as a surrogate for plant live biomass, resources availability (i.e., light, water, and nutrients), productivity, and ecosystem health and to assess ecosystem functions and services at a large scale because leaf area information can be readily estimated remotely. This paper uses case studies to examine linkages between leaf area index and evapotranspiration (ET) across biomes from alpine meadows to coastal wetlands, and across land uses from forest lands to an urbanized environment. We found that leaf area dynamics is an important factor regulating seasonal variability of ET and thus water yield. Future climate change, rising CO_2, and landuse/land cover change are likely to affect the watershed hydrological cycle by altering ecosystem LAI through changes in plant species, phenology, physiology, and productivity. Existing ecohydrological models should incorporate changes in LAI at multiple scales to better project ecosystem response to future environmental changes.
Key words: Evapotranspiration, Leaf Area Index, Modeling, Ecohydrology

Foliar N and P Stoichiometry of Functional Groups on Qinghai-Tibet and Inner Mongolian Plateaus

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Abstract: Ecological stoichiometry provides an important method to reveal plant nutrient utilization and environmental adaptation strategies. Studying the ecological stoichiometry of different functional groups could help to reveal the formation mechanism of plant element characteristics on a regional-scale. Only a few studies have considered the contribution of functional groups to plant N, P stoichiometry on regional and global scales. In this study, we considered the four functional groups, legume, grass, sedge and forb, to explore the formation mechanisms of plant N, P pattern at a regional scale. Foliar Nitrogen (N) and phosphorus (P) concentrations were determined for 329 foliar samples collected at 132 sites along China Grassland Transect (CGT). For regional analysis the CGT was divided in the Qinghai-Tibet plateau alpine region (QTP) and Inner Mongolian plateau steppe region (IMP). Grass N and P concentrations were

relatively lower than those of other functional groups. Trends of N and P variation of the four functional groups differed for geographical regions and in relation to climatic factors. Patterns of plant functional group stoichiometry in the two regions differed with grass and sedge respectively having more important roles in the foliar N, P stoichiometry in IMP and QTP. The results indicate that each functional group have its specific pattern of foliar elements plant, so species composition has an important functions in determining regional-scale stoichiometry and that climatic factors affect regional foliar N, P contents mainly through changes of plant species composition rather than through changes of climate.

Key words: Climate, Grassland Regions, Plant Functional Groups, Ecological Stoichiometry

Will Changing Drought Regimes Create Novel Forest Ecosystems in the Southern United States?

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Abstract: The pace of environmental and socioeconomic change over the past 100 years in the Southern US has been rapid. Changes in fire regimes, climate, and land use have shaped the structure and function of most forest ecosystems. New stressors such as air pollution and invasive species have contributed to and interacted with climate and fire to alter current forest conditions. These current forest conditions provide a template for how forests will respond in the future. Over the remainder of the twenty-first century, an accelerating pace of climate and socioeconomic changes will influence the future range of variation in southern forests. Some of these impacts will be direct (i.e., changes in growth rate), while other impacts will be indirect (i.e., new disturbance regimes). The impacts of drought may be especially impactful, as drought has both direct (growth and mortality) and indirect (changing disturbance regimes) effects on forests. Using a series of case studies, I examine how these new these new drought-mediated disturbance regimes interact with current forest condition and socioeconomic drivers, with an expectation for the creation of novel forest ecosystems and conditions. Furthermore, I examine the implications of novel ecosystems for provisioning of ecosystem services and potential management options.

Key words: Novel, Forests, Drought, Ecosystem Services

Biomass Increment and Mortality Losses in Tropical Secondary Forests of Hainan, China

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Abstract: Secondary forests, created after severe logging, are an important part of China's forests. We investigated forest biomass and its accumulation rate in a tropical secondary forest using 38 plots on Hainan Island, China. These secondary forests are moderate carbon sinks, averaging 1.96–2.17 tC ha^{-1} yr^{-1}. Biomass increment is largely contributed by medium-sized (10–35 m) trees, which differ from selectively logged forest in the Amazon. Tree mortality accounts for almost 30% of the biomass increment and plays a negligible role in biomass accumulation estimates. Tree mortality rate is highly dependent on tree size. High mortality rate in small trees and seedlings might be related to competition due to elevated irradiance after logging. Regarding perspective biomass and its accumulation, tropical forests are susceptible to logging campaigns and need careful forest management.

Key words: Forest Management, Carbon Sink, Inventory, Dynamic Plot

Response of Alpine Vegetation Dynamics to Climate Variations and Human Disturbances in a Mountainous Watershed, Northwestern China

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Abstract: Detection and quantification the response of vegetation dynamics to climatic and anthropogenic change is fundamental for our understanding of the global atmosphere–biosphere interactions, and is a prerequisite for the development of strategies for the sustainable management of ecosystems. Leaf area index (LAI) is a critical parameter of ecosystem structure for understanding vegetation growth and functional response to climate change and human disturbances. However, because of the complex topography and associated diverse ecohydrological processes, it is often difficult to evaluate the influence of climate change and anthropogenic change on vegetation at the watershed scale in mountain regions. This case study detected the coupled spatial patterns of vegetation dynamics and climatic variabilities, as well as isolated the human disturbances during the past three decades within a watershed with a complex topography in the Upper Heihe River Basin, a complex multiple use

watershed in arid northwestern China. We apply several advanced statistical methods to identify the spatial patterns and dynamics of satellite-derived LAI and their close relationship with the variability of topography, air temperature and precipitation, and grazing history for the period of 1983-2012. Results show that watershed-wide mean LAI had an increasing trend overtime during the past decades, presumably as a result of global warming and a wetting climate. Human disturbances such as ecological restoration policies and intensive overgrazing may differ among the various sub-regions and also contribute to local LAI variations. We concluded that temporal and spatial LAI dynamics were affected by both climate variations and human disturbances in the study basin. Findings from this study are useful for land managers and policy makers to make better decisions in response to climate change in the study region.

Key words: Leaf Area Index, Climate Change and Variability, Human Activity, Upper Heihe River Basin

Potentialities of an Automated Chamber Network for Estimation of CO_2/CH_4 Sink/Source of Asian Terrestrial Ecosystems

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Abstract: Asian terrestrial ecosystems occupy vast areas from tropical forests and wetlands in Southeast Asia to boreal ecosystems in northern hemispheres, and as well as alpine ecosystems on the Tibet Plateau. These ecosystems make a significant contribution to the regional and global budgets of carbon dioxide (CO_2) and methane (CH_4). However, the regional budgets of CO_2 and CH_4 in Asian region and how these budgets will vary in the future remain highly uncertain with increasing population pressure, climate change, natural and human disturbances. Accurately quantifying CO_2/CH_4 balances is critical for setting targets for their emission reductions and to identify and promote effective mitigation strategies. Since the mid-1990s, we have been installing multichannel automated chamber systems at tundra in the West Siberian lowland, boreal forests in central Alaska, cool-temperate and temperate forests in Japan, Korea and China, subtropical forests in Japan, Mainland China and Taiwan, tropical seasonal forests in China and Thailand, tropical rainforests in China and Malaysia, and even arid grassland in Inner-Mongolia and wetlands on the Tibetan Plateau, for continuous measurements of forest floor CO_2 budget as well as net ecosystem production (grassland and wetland). Among the sites, eight of the systems are using for conducting soil warming experiments. Currently, the chamber network is expanding

rapidly in the Asian region. Our ultimate objective is to estimate the carbon budget of Asian terrestrial ecosystems as well as its response and feedback to regional climate change.

In recent years, with the rapid technical development of new sensors (e.g. CH_4 and N_2O analyzers), the chamber network is potentially applied for simultaneously measurement of major target GHGs (e.g. CO_2, CH_4, N_2O) budget together. This talk will present CO_2/CH_4 fluxes and their controls of representative Asian terrestrial ecosystems by using multichannel automated chamber systems.

Key words: Chamber Network, CO_2/CH_4 Flux, Tibet Plateau Wetland, Tropical Rainforest

Spatiotemporal Trends of Land Degradation and Its Driving Mechanism in Arid Land of Asia

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Abstract: As natural resource, land is the basic production materials and survival environment, and is also the base of life in ecosystem. Land degradation is a significant decline process of land productive capacity and land use value influenced by natural factors and human activities. It is the urgent need and to be solved problem to explore the driving mechanism of land degradation under the background of climate change, which contribute to the harmonious development of nature and human society. The arid region characterized fragile ecosystem is extremely sensitive to climate change, climate variation and irrational human activities can easily cause serious land degradation. The New Silk Road Economic Belt is located in the inland arid area in Asia, the serious soil erosion and land desertification are not conducive to the regional economic cooperation and sustainable development. It is necessary for monitoring and evaluating the present situation of land degradation, which has the theoretical significance for ecosystem restoration, regional economic cooperation and progress of the New Silk Road Economic Belt.

Based on GIMMS3g NDVI and MODIS NDVI remote sensing data, combining with the high spatial resolution climatological data, this paper tried to assess the land degradation, explore the driving mechanism and analyze the effect of human activity on regional land degradation quantitatively using the linear fitting, multivariate regression and residual analysis. The main purpose is to provide a scientific basis for prevention and control in land degradation in the New Silk Road Economic Belt. The main results were as follows:

The upward trends in temperature was significant, and upward trend in precipitation

was not significant, the variation in Palmer drought index and Standardized precipitation evapotranspiration index showed the study area were experiencing the drier and drier climate. The increase in potential evapotranspiration and decrease in drought index increase regional drought degree.

The correaltaion between annual NDVI and temperature, precipitation showed positive relationship in most region, with the percentage of 69.64% and 74.50%, respectively. The partial correlation coefficient between NDVI and drought index is highest. The NDVI negatively correlated with temperature and standardized precipitation evaporation index, positively correlated with precipitation and potential evapotranspiration.

The percentage of significant land degradation and more significant land degradation is 53.29% and 32.66%, respectively, in whole study area. The positive effect from human activities on vegetation varation loacated in India in South Asia, central part of central Asia and Turkey, the negative effect concentrated on the northern part of central Asia and northeast of China. The index of land degradation in tropical and subtropical is higher, which showed a lower land degradation degree. The index of land degradation in Montane Grasslands、Shrublands and Desert is lower, which showed a higher land degradation degree. Land degradation dynamic index suggested that human activities mainly made positive effect on regional vegetation changes and acted the strongest role to change vegetation in Montane Grasslands、Shrublands

Key words: Land Degradation, Climate Change, Human Activitiy, Residual Analysis

Effects of planting Density on Soil Moisture and its Temporal Stability in Rocky Mountain Area of Northern China

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Abstract: Planting density exerts great influences on the soil water content, soil permeability etc., and their temporal stability, thereby it has great implications for forest hydrology. This study was intended to investigate the effects of Chinese pine density on soil water content and its temporal stability. Specifically, we aimed to i) reveal how the tree planting density affect the soil water content and its spatial distribution along the soil profile; ii) answer whether the impacts of tree density on soil water content is significantly different between the various slope aspect; and iii) explore the temporal variability of soil water content when affected by different tree densities. Six plots on shady and sunny aspects with low, medium, high tree densities were employed in the study (being SHL, SHM, SHH, SUL, SUM, and SUH, respectively), and soil moisture content were measured at multiple depths within

0-60cm soil profiles during the growing periods of 2013 and 2014 by using Trime-T3 technique, which provide soil moisture content record every 2 days. Besides paired T test and one way ANOVA analysis used for significant difference examination, temporal stability was examined by calculating the mean relative difference (MRD), standard deviation of relative difference (SDRD), and ITS (index of temporal stability). The results showed that, (1) on the shady aspect, the mean soil water content (SWC) of the soil profile has no significant difference ($P>0.05$) between the various tree densities, irrespective of the climate dryness condition. However, on the sunny aspect, the plot with a low density (SUL) had the highest soil water content and presented a significant difference ($P<0.05$) with other densities (SUM, SUH), and this difference was more obvious in the relative dry year (2014). No significant differences of SWC were found between SUM and SUH in either 2013 (wet year) or 2014 (relative dry year), both displaying the lowest magnitude of SWC values. (2) At surface layer (0-20cm), SWC was greatly influenced by the tree density, showing a decrease trend with the increase of tree density on both shady and sunny aspects. Whilst at the sub-surface layer (20-40cm) and deep layer (40-60cm), results were various depending on the aspects. (3) On sunny aspect, the ITS of the lower tree density plot (SUL) is always higher than that of both SUM and SUH, irrespective of the climate dryness condition, indicating a highly temporal instability for SUL; whilst on shady aspect, the rank of ITS was SHL>SHH>SHM and SHM>SHL>SHH for wet year and normal year, respectively. By pooling the shady and sunny aspects data together, a significant relationship was found between ITS and SWC in lower tree density plots, whilst relationship was found on neither medium nor high tree density plots. This is probably due to the fact that the dry soil water condition as results of the higher demand of water use under the medium and higher tree densities limited the soil water dynamic, whatever the climate dryness was. We concluded that, in mountain rocky area of Northern China, change in tree density dose not absolutely resulted in a significant difference in soil moisture content between the different tree density. Slope aspect has played an important role in controlling the soil moisture content of the profile. However, it does not follow that ample soil water was available for relative higher tree density. Although relative higher tree density has a lower ITS value, its soil moisture content was also relative lower. This implied that the highly temporal stability was probably associated with the over-exhaust of water use of higher density planting, which, on the other hand, explained why no significant difference found between SUM and SUH, even though moisture regime was improved a litter in shady aspect. Therefore, to maintain a sustainable forest service, the relative higher tree density is not recommended.

Key words: Tree Density, soil Moisture Content, Temporal Stability, Rocky Mountain Area

Unexpected Consequences of Climate Change and Variability on Forest Structure, Function and Management

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Abstract: Globally, the most common impacts of climate change and variability on forest ecosystems are becoming increasingly felt and well understood. Whether the impacts of rising air temperature on evapotranspiration, productivity, decomposition or other ecosystem processes, many algorithms have been developed based on extensive field and laboratory experiments. In turn, these mathematical models are used to predict important near and long-term forest structural and functional responses to climate change. Many of these predictions such as forest water yield, carbon sequestration potential, and biodiversity stress have very significant socioeconomic implications. However, there are no antecedent conditions from which to compare the predictions of ecosystem change. All experiments have a limitation on the number of co-occurring variables that can be tested. Therefore, results are also limited in the scope of potential futures. This paper explores a series of newly emerging case studies to examine how combinations of developing environmental stress are impacting forest ecosystems in ways that have not been previously observed, and what implications these surprises could have on future forest management.

Key words: Climate Change, Forest, Impacts, Unexpected

Variation and Driving Factors of Soil Moisture at Multi-Scales--A Case Study in Loess Plateau of China

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Abstract: Currently, the ecological restoration of the Loess Plateau has led to significant achievements such asincreases in vegetation coverage, decreases in soil erosion, and enhancement of ecosystem services. Soilmoisture shortages, however, commonly occur as a result of limited rainfall and strong evaporation in thissemiarid region of China. Since soil moisture is critical in regulating plant growth in these semiarid regions, it is crucial to identify the spatial variation and factors affecting soil moisture at multi-scales in the LoessPlateau of China. In the last several years, extensive studies on soil moisture have been carried out by ourresearch group at the plot, small watershed, watershed, and regional scale in the Loess Plateau, providingsome information for vegetation restoration in the region. The main research results are as follows: (1) thehighest soil moisture content was in the 0–0.1 m layer with

a large coefficient of variation; (2) in the 0-0.1mlayer, soil moisture content was negatively correlated with relative elevation, slope and vegetation cover,the correlations among slope, aspect and soil moisture increased with depth increased; (3) as for the deepsoil moisture content, the higher spatial variation of deep SMC occurred at 1.2-1.4 m and 4.8-5.0m; (4) thedeep soil moisture content in native grassland and farmland were significant higher than that of introducedvegetation; (5) at regional scale, the soil water content under different precipitation zones increasedfollowing the increase of precipitation, while, the influencing factors of deep SMC at watershed scale variedwith land management types; (6) in the areas with multi-year precipitation of 370 - 440mm, natural grassis more suitable for restoration, and this should be treated as the key areas in vegetation restoration; (7)appropriate planting density and species should be given for introduced vegetation management; (8) it is imperative to balance the economic and ecological benefits so that the ratio of artificial vegetation and natural restoration can be optimized to realizesustainability of vegetation restoration.
Key words: Soil Moisture, Scale, Loess Plateau of China, Land Use

Time-Frequency Analysis of Environmental Controls on Net Ecosystem CO_2 Exchange over a Temperate Semi-Arid Shrubland

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Abstract: Our understanding of the variability of net ecosystem exchange of CO_2 (NEE) across different timescales needs to be improved, as indicated by terrestrial carbon cycle models that often fail to agree with data at multiple timescales over the measured dates. Especially, the environmental controls on NEE across timescales are less well studied in semi-arid shrublands compared to forests and grasslands, despite the high sensitivity of dryland ecosystems to climatic variability and change. Here we used time-frequency analyses, including the continuous wavelet transformation (CWT), wavelet coherence (WTC) and partial wavelet coherence (PWC), to investigate how photosynthetically active radiation (PAR), air temperature (Ta), vapor pressure deficit (VPD) and soil water content (SWC) modulate the variability (i.e., amplitudes and phases) of NEE in the time-frequency domain. Continuous (half-hourly) eddy-covariance measurements of NEE were collected over five years from a semi-arid shrubland in northern China. NEE showed clear daily and annual periodicities, and also oscillated strongly at intermediate scales (days, weeks to months). At the 1-day period, NEE showed significant spectral coherence with PAR, Ta and VPD throughout growing seasons, with NEE lagging PAR for about 1.0 hour, but lagging Ta and VPD for over 3.5 hours. At the 1-year period, NEE also co-varied with PAR, Ta and VPD

throughout time, with NEE preceding Ta by 19 days, but leading PAR and VPD by about 40 days. At intermediate periods, non-continuous areas of significant coherence were observed between NEE and environmental factors. Notably, near phase-locked relationships were observed between NEE and PAR during growing seasons (4- to 32-day periods). PWC revealed a greater modulating effect of PAR than that of Ta on NEE at intermediate periods during growing seasons. However, these intermediate-scale signals of PAR in NEE variations largely faded when there was a persistent spring or summer drought (i.e., low SWC). Our results indicate that PAR was the primary controlling factor of NEE at daily, weekly and monthly timescales in the semi-arid shrubland. Seasonal and annual variations in temperature may drive plant phenology (e.g., leafout and coloring) and thus modulating NEE. Drought events can obscure the transfer of PAR variability in-to NEE at scales from multi-days to multi-weeks, probably by affecting plant photosynthetic capacity and canopy leaf area index. Modeling efforts should take in-to account these multi-temporal correlations between NEE and environmental factors in order to improve model-data agreement across timescales.

Key words: Carbon Cycling, Climate Change, Drought, Wavelet

Spatial-Temporal Dynamic and Climate Response of Water-Use Efficiency in the Yangtze River

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Abstract: The interaction between carbon and hydrologic process is a key issue of how ecosystem responses to global climate changes. Water-Use Efficiency (WUE) is one of significant indicators to advance our understandings for coupling of carbon and water cycles in plant and ecosystem scales. Here the Lund-Potsdam-Jena Dynamic Global Vegetation Model (LPJ model) is applied to the Yangtze River Basin to contribute to our comprehension of the region impacts of climate changes. There are four typical regions chosen to study: Source (Yangtze River Source Region), upper reaches (Sichuan and Chongqing Province), middle reaches (Hubei Province), and lower reaches (Yangtze River Delta Area). We evaluate climate changes impact on Net Primary Production (NPP), Evapotranspiration (ET), and WUE of the Yangtze River Basin, as well as the sensitivity to temperature of NPP and ET of the watershed during 1961-2000. The investigation results show that: (1) Annual WUE shows a slowly increasing trend, but not pronounced. The upward trend in upper reaches region is larger than that of the middle and lower reaches. (2) The WUE is in the order of Sichuan and Chongqing ($0.61 gCmm^{-1}m^{-2}$), Hubei ($0.54 gCmm^{-1}m^{-2}$), Yangtze River Delta Area

(0.52gCmm^{-1}m^{-2}) and Yangtze River Source Region (0.10 gCmm^{-1}m^{-2}). The WUE of four regions have a positive correlation with precipitation while a negative correlation with temperature. There is a significant positive correlation between WUE and precipitation in Sichuan and Chongqing. (3) The sensitivity of WUE to temperature in the upper reaches is the lowest, but WUE appears an upward trend with temperature increasing. This may be due to poor site condition and NPP occupied dominant factor. The WUE of the middle and lower reaches are more sensitive to temperature change, and WUE is mainly affected by ET. It is likely to be in monsoon climate zone in middle and lower reaches. Such results demonstrate that the Natural Forest Protection Project in Yangtze River Basin has achieved initial success and the middle and lower reaches are more sensitive to climate changes.

Key words: The Yangtze River Basin, LPJ Model, Linear Trend Coefficient, Sensitivity Analysis

Recent Trends in Vegetation Greenness in China Significantly Altered Annual Evapotranspiration and Water Yield

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Abstract: There has been growing evidence that vegetation greenness has been increasing in many parts of the northern middle and high latitudes including China during the last three to four decades. However, the effects of increasing vegetation greenness particularly afforestation on the hydrological cycle have been controversial. We used a process-based ecosystem model and a satellite-derived leaf area index (LAI) dataset to examine how the changes in vegetation greenness affected annual evapotranspiration (ET) and water yield for China over the period from 2000 to 2014. Significant trends in vegetation greenness were observed in 26.1% of China's land area. We used two model simulations driven with original and detrended LAI, respectively, to assess the effects of vegetation "greening" and "browning" on terrestrial ET and water yield. On a per-pixel basis, vegetation greening increased annual ET and decreased water yield, while vegetation browning reduced ET and increased water yield. At the large river basin and national scales, the greening trends had positive effects on annual ET and had negative effects on water yield. Our results also showed that the effects of the changes in vegetation greenness on the hydrological cycle varied with spatial scale. Afforestation efforts perhaps should focus on southern China with larger water supply given the water crisis in northern China and the negative effects of vegetation greening on water yield. Future studies on the effects of the greenness changes on the hydrological cycle are needed to account for the feedbacks to the

climate.

Key words: Vegetation Greenness, Water Yield, Evapotranspiration, Afforestation

T2-09: Grassland Function and Its Adaptive Management

Biodiversity of the natural vegetation and its main influencing factors in western Inner Mongolia

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Abstract: 74 plant community plots were surveyed in Western Inner Mongolia during 2012 - 2014. These samples were divided four vegetation types, including temperate steppe, temperate shrub, meadow and desert. Four biodiversity indices (Patrick index, Simpson index, Shannon-Weiner index and Pielou index) were calculated to show the difference among the biodiversity of the four vegetation types. Climate and soil data were also collected during the survey. Pearson correlation analysis was conducted to reveal the relationship between biodiversity and environmental factors and Stepwise regression analysis was used for determining the dominant factors among all the environmental factors. The results indicated that: In Western Inner Mongolia, biodiversity indices were different among the four vegetation types. Temperate steppe and meadow were similar in biodiversity indices, which were also the highest among all, while the lowest was found in desert. Pearson correlation analysis showed that Patrick index, Shannon-Weiner index and Simpson index were all negatively and linearly correlated with mean annual temperature and potential evapotranspiration. Among all chemical property of the soil, pH, organic carbon and total nitrogen all influenced the biodiversity indices. Stepwise regression analysis showed that potential evapotranspiration and soil organic carbon were the most influential factors affecting Patrick index and Shannon-Weiner index. The only dominant factor of Simpson index was soil organic carbon. And the soil total nitrogen was most important for Pielou index.

Key words: Bioversity, Vegetation Types, Influencing Factors, Western Inner Mongolia

高寒草甸退化与恢复过程中土壤微生物群落功能多样性分析

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Abstract: 为研究高寒草甸、草甸退化及恢复过程中，其土壤微生物群落功能多

样性的变化，利用 BIOLOG Eco 微平板法，分析了青海省果洛藏族自治州玛沁县大武滩地区 9 个样地（未退化草甸、不同退化草甸、不同恢复年限人工草地）的土壤微生物对单一碳源的利用情况。结果表明：未退化草甸、退化草甸及人工草地其土壤微生物群落代谢活性差异显著。主成分分析表明，未退化草甸与退化及恢复草甸其土壤微生物对碳源利用差异显著，表明其群落结构有明显差异。相关性分析表明，土壤微生物群落多样性与土壤养分和植被性质有关，其中，平均颜色变化率(AWCD)、均一度指数（U）和丰富度指数(H ')之间有显著正相关关系，且与土壤营养状况、植被性质有显著相关性。因此，可通过土壤微生物群落功能多样性来指示土壤和植被营养状况，为高寒退化草甸的恢复和改善提供理论依据。

Key words: 退化草甸, 土壤微生物多样性, BIOLOG Eco 微平板法, 土壤理化性质

Flexible Nitrogen Use of Common Plant Species

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Abstract: Nitrogen (N) availability influences the productivity and distribution of plants in temperate grasslands. Strategies to acquire soil N, such as direct uptake of organic compounds, ammonium or nitrate may facilitate plant species coexistence and ecosystem N retention. We examined variations among common and rare plant species in N uptake across three types of grasslands, using both the 15N natural abundance method and 15N labeling approach. We find that common plant species mainly used the most dominant N source (> 80%), but rare species tended to utilize less dominant N form across different types of grassland. We also find that common species had a plastic ability to switch the dominant N source. These findings suggest that changes in soil N availability due to climate change or land use may not threaten the dominant position of common species in a community.

Key words: Nitrogen Stable Isotope, Typical Steppe, Desert Steppe, Meadow Steppe

Changes in Soil Microbial Functional Diversity Induced by the Introduction of Black Locust along an Environmental Gradient

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Abstract: Investigate the soil microbial functional diversity in black locust and in native species under different vegetation zones, the soil microbial functional diversity

was determined using Biolog technique. The results showed that introducing black locust in different vegetation generated large variation on soil microbes. The trend of AWCD and functional diversity indexes in black locust was consistent with changes from the steppe to forest zones. The value of the Average Well-Color Development (AWCD) and functional diversity indexes of Richness Index (S), Shannon-Weiner index (H), Simpson index (D) and McIntosh index (U) were larger in the black locust soil than those in the native species soil under steppe and steppe-forest zones, but these were opposite under forest zones. There were significant differences in the utilization of carbon sources, especially reflected in the utilization of carbohydrates and amino acids. PCA analysis indicated that the numbers of carbon sources in relation to PC1 were 24. Carbohydrates, amino acids and carboxylic acids played major roles in the separation of principal component. The soil microbial functional diversities were influenced by the content of soil carbon and nitrogen and carbon source utilization patterns were influenced by the temperature and humidity. The effect of black locust on soil microbes exist the regional dissimilarity which must be considered in evaluating the influence of black locust on the soil ecological process and function.
Key words: Vegetation Zone, Black Locust, Soil Microbe, Functional Diversity

The Relationship between Functional Diversity/Species Diversity of Grassland Communities and Runoff Sediment Yield in Loess Hilly Region

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Abstract: In recent years, great efforts have been made to control the occurrence of soil erosion by restoring the plant communities in the ecosystem, but the effect is not obvious. The possible reason is that the current vegetation restoration strategy is too much in the vegetation cover, resulting in the formation of a large area of a single structure of vegetation, making the erosion efficiency of vegetation is low. At the same time, with the deepening of plant functional traits, trait-based methods are increasingly used to explain the relationship between community composition and ecosystem processes. Therefore, we established runoff plots with different functional structures in the ZhiFanggou watershed of Ansai County, Yan'an City, and measured the specific leaf area, leaf tissue density, and root length and root tissue density of the dominant species in runoff plots. Three functional diversity indices include community functional richness index (FRic), community functional evenness index (FEve) and community function divergence index (FDiv) were used to characterize the functional structure of the community. The effects of runoff time, runoff rate, sediment yield, total runoff and

sediment yield and its relationship with community functional diversity index were analyzed by field artificial rainfall simulation experiment. The results showed that the runoff end time decreased with the increase of the community richness index (FRic). At the same time, only the community functional richness index (FRic) has a negative effect, and the community function richness index (FRic) and slope total runoff also has a linear correlation. And compared with the Shannon-wiener index, Simpson index and Pielou index found that functional diversity than species diversity can better reflect the community erosion reduction capacity.
Key words: Grassland, Community Functional Composition, Erosion Control, Plant–Soil Interactions

Farmers' Environmental Perception and Adaptation of Different Livelihood Strategies in Desert Steppe

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Abstract: Environmental perception has been drowning more and more attention all over the world. Farmers' accurate perception is the premise of reasonable environmental behavior. It is significant to study farmers' perception and adaption to ecological-environment changes. Some international relevant researches find that the farmers can change land use patterns and life strategies to reduce the impact of climatic fluctuations on crop yield and agricultural income. Some domestic relevant researches find that the farmers in different area have different perceptions on ecological-environment changes. The farmers of same life strategies express strong space hierarchy for different ecological-environment problems. They pay close attention to the ecological-environment problems which are closely related to their subsistence activities. Farmers' perceptions and memories of extreme climate changes are associated with the time series of events. Farmers are the main parts of economic activities and they are also the basic decision-making unit in ecotone. Farmers rely on grassland resource and cultivated land resource more and more, and the way that farmers use grassland resource and economic management behaviors has become primary and the most immediate factors which influence the region ecological-environment changes. Therefore, this study researched environmental effect caused by the ways of production and lifestyles of ecological-environment changes. The main aim is to research formation mechanism of farmer behavior caused by environmental effects. It will provide the scientific basis to eliminating the ecosystem excessive interference.

Farmers' perception and adaption measures were studied using stratified random

sampling survey, participatory rural appraisal and investigation of plots. First, the natural, social and economic statistical data from county government departments were collected. Second, five unincorporated villages, 121 farmer samples were investigated, and 109 valid questionnaires were obtained. The following items were investigated: 1) basic family details; 2) Farmers' perception of ecological-environment changes; 3) Farmers' cognition of factors which caused ecological-environment changes; 4) Farmers' measures to extreme climate events; 5) Farmers' ecological attention to ecological-environment changes; and 6) Farmers' protection degree of ecological-environment changes. Third, the farmer households were classified three types according to the percentage of nonagricultural income, i.e. pure agriculture households, agriculture-dependent households and off-farm dependent households.

The results show: 1) the farmers' livelihood diversification was low, and the livelihood diversification index of the farmers was 1.49. The livelihood diversification index of pure agriculture households, agriculture-dependent households and off-farm dependent households was 0.51, 0.52 and 0.54 respectively. 2) Farmers perceived that the ecological-environment of study area became well. The index of environmental change perception declined from agriculture-dependent households to off-farm dependent households. Farmers' cognition of climate change conformed to the tendency of climatic index nearly 50 years. 3) Famers' awareness of environment enhanced. They were sensitivity to the environment changes. Pure farmer households paid attention to all kinds of extreme climate events, and agriculture-dependent households and off-farm dependent households concerned more about drought. They took a variety of measures to adapt ecological-environment changes, of which the main measures were to buy foods and fodder grass. When farmers encountered the extreme climate events, they took appropriate afterwards emergency measures, which was basically the passive adaptation. 4) Through increasing the input to the grassland, reducing cultivated land and grazing without permission, farmers maintained the stability of their own household agri-ecosystems.

It is concluded that establishing the stabilizing mechanism between household ecosystem and ecosystem can eliminate excessive interference caused by human activities gradually. It is beneficial to ecological construction, resource utilization and wild plants and animals preservation. But farmers' behaviors of different life strategies have some kinds of effect on ecological environment. It is necessary to solve the ecological-environment degradation problem in ecotone based on farmers' life strategies.

Key words: Farmers Livelihood Strategy, Environmental Perception, Environmental Adaptation

Population Changes behind Grassland Degradation in the Developing Countries

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Abstract: High immigration and fertility rates in Inner Mongolia, China, have led to a large-scale transformation of grassland farmland. Also, reduction of grazing land resulted in overgrazing, and hence grassland degradation. Such disappearance of grasslands has been most apparently seen in Horqin region of Inner Mongolia. This paper used technologies of remote sensing and geographic information systems to reveal the impacts of population changes on grassland degradation in Horqin, and underlying history and policy-related explanation, to make a quantitative study on the relationship between both. Results showed that the total population density in Horqin has increased from 10 to 42 people/km^2 from 1947-2011. A fast growth rate was observed prior to 1981, primarily due to the policies encouraging immigration and population growth. When these policies were terminated in 1981, the growth rate began to slow down. The linear trend coefficients of the population density indicated uneven population growth over time in each banner/county was uneven regarding the time series, with R2 from 96.8% of the linear trend equations significantly different ($p<0.05$). Population density was generally higher in central region, followed by southern and northern regions. Spatial features of population density varied across banners, as the immigrant population was affected by factors such as distance from farming areas, agricultural conditions and changes, urbanization, and mineral resource development. Correlations between the percentage of desertification areas and population density in Shaogen County of Ar Khorchin Banner and Bagaborihe Sum of Naiman Banner were 0.905（$p=0.035$）and 0.503（$p=0.387$）, respectively. It indicated that an increase in population density may aggravate the degree of grassland degradation, and this effect was even stronger in early than late stage of grassland degradation.

Key words: Developing Countries, Grassland Degradation, Population Density, Inner Mongolia

THEME 3

Urbanization and Regional Environmental Change

T3-01: Urban Ecosystem Services, Ecological Infrastructure and Ecological Management

Analyzing Spatial Patterns of Urban Carbon Metabolism and Distribution of Ecological Relationships: A Case Study of Yangtze River Delta, China

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Abstract: With rapid urbanization in China, the urban carbon metabolism imbalance has worsened greatly. In order to mitigate global warming, it is essential to understand the spatial pattern of cities' carbon transitions and explore the response of carbon emission to urban forms. In this study, we firstly took Yangtze River Delta as example by analyzing urban carbon metabolism over four consecutive years (1995, 2000, 2005, and 2010) and then using panel data analysis to explore how urban forms affect urban carbon emission. Finally, we used ecological network analysis to determine the ecological relationships between the components of the system, their distribution, and their changes over time. The analysis revealed that carbon flow of the network firstly increased and then decreased, and positive relations mostly outweighed negative relations. From parameter estimation of panel data analysis between urban form and carbon emission at the district level, we found that a more compact urban form can help lead to a low-carbon city and that mononuclear urban development leads to more carbon emissions. These results provide a theoretical direction for the development of low-carbon cities in rapidly developed regions in China.

Key words: Urban Carbon Metabolism, Urban Forms, Panel Data Analysis, Ecological Network Analysis

Litters of Different Landscape Plant Species Affect Earthworm (Eisenia fetida) Survival and Growth

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Abstract: Landscape plant litter is regarded as an important urban organic waste. Its ecological disposal and utilization plays an important role in material recycle and energy flow in urban ecosystem. Earthworm as a decomposer of organic matters has been used efficiently in reduction of organic wastes. However, the potential of earthworm in landscape plant litter management is unclear as effects of landscape plant

litter on earthworm survival and growth are poorly understood. Here we investigated the survival and growth of Eisenia fetida fed with litters of different landscape plant species. Litters of ten landscape plant species in South China were collected for earthworm cultivation mediums, including Bauhinia purpurea (C/N=21.9), Dracontomelon duperreanum (C/N=28.5), Ficus virens (C/N=42.3), Hibiscus tiliaceus (C/N=73.7), Lagerstroemia speciose (C/N=59.7), Mangifera indica (C/N=40.0), Michelia alba (C/N=14.2), Neolamarckia cadamba (C/N=24.8), Roystonea regia (C/N=16.5), and Zoysia japonica (C/N=22.5). Earthworms were fed in the cultivation mediums made up of litters (single species) and sand (1:9, W/W). The survival, growth and fecundity of E. foetida were observed after 10 days' feeding. Activities of earthworms under ammonia stress were analyzed and effects of different landscape plant litters on earthworm growth were further studied by subordinate function analysis. Results showed that both the highest survival rate and cocoons production of earthworms occurred in B. purpurea litter medium. Earthworms fed in L. speciosa litter medium all died. Earthworms in B. purpurea and Z. japonica litter mediums were stronger and had significantly higher net weight gain than other treatments. Though earthworms in H. tiliaceus litter medium had the highest relative feeding coefficient, their net weight gain was not observed. Earthworms in B. purpurea and F. virens litter medium exhibited the highest relative activity, while those in M. indica medium showed the lowest relative activity. Subordinate function values based on survival rate, cocoons production, net weight gain, relative feeding coefficient and relative activity coefficient followed a decreasing queue of B. purpurea, D. duperreanum, N. cadamba, Z. japonica, F. virens, R. regia, M. Alba, H. tiliaceus, M. indica, and L. speciosa. In this study, B. purpurea litter showed the best suitability for earthworm growth and fecundity, while L. speciosa litter killed all earthworms. The optimum C/N ratio of landscape plant litter for E. foetida growth was 20~30.

Key words: Urban Organic Waste, Earthworm, C/N Ratio, Ecological Disposal

Urban Metabolism Process Based on Emergy Analysis: A Cased Study of Shanghai

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Abstract: The research of urban metabolism process is a major step towards the design of sustainable development schemes and environmental management. This study systematic simulated and analyzed the mechanisms of Shanghai urban ecosystem from a thermodynamic point of view. This assessment model review and compile existing data and studies on environmental issues available primarily at some sources, which

include resource accounting and environmental impact assessment, and analysis the impact of urban metabolism includes production and consumption process on human health and ecosystems. Results pointed out the development of economy in Shanghai was closely correlated with the consumption of the nonrenewable resources and exerting rising load on environment; The total emergy use by the economic system, the imported nonrenewable resources from other province contribute most with increasing use from imported nonrenewable resources and the rapid growth of society fixed capital investment drive Beijing's economic development and GDP'S growing. This study provides an evaluation of the internal metabolic process in the urban ecosystem, and provide guidance to policy decisions.

Key words: Urban Metabolism, Emergy Analysis, Shanghai

Influences of Urban Expansion on Cultivated Lands in China

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Abstract: Urban expansion is the most direct manifestation of urbanization and urban land-use changes, and has far-reaching influences on cultivated lands. As the world most populous country, cultivated lands are occupied on a massive scale in the urban expansion process, thereby having a serious effect on grain output and safety. Although influences of urban expansion on cultivated lands have been widely and vigorously studied, relatively little attention has been paid to reveal its spatiotemporal characteristics systematically over a long timeframe. In this study, 32 Chinese municipalities and provincial capitals were chosen as subjects. First, arable lands occupied by newly developed urban lands in the past four decades were reconstructed using remote sensing and geographical information system (GIS) technology. Then, contribution rate and annual decrease area per city (ADAC) index were employed to describe the overall characteristics of contribution of arable lands for urban expansion. Lastly, comparisons of influences of urban expansion on cultivated lands were applied among four groups of cities: municipalities and provincial capitals, coastal cities and inland cities, cities located in the east and west of Hu Lines, cities in urban agglomeration in key construction stage (UAKCS), stable construction stage (UASCS) and initial construction stage (UAICS). Results indicate that (1) From the 1970s to 2013, cultivated land was the main land resource for urban expansion in China, nearly 7000 km^2 cultivated lands were occupied in the urban expansion process with ADAC far higher after 2000 (19.14 km^2) than that before 2000 (4.64 km^2). (2) The contribution rate of cultivated lands for newly developed urban lands ranged from 51.49% to 72.91%. Before the mid-1980s, cultivated land protection in China was still in the awakening stage, and the average contribution rate of cultivated lands for urban

expansion was 68.63%, far above that after the mid-1980s (58.03%). Due to the ceaseless conflicts between cultivated land protection and urban expansion, contribution rate for newly developed urban lands changed with obvious fluctuation, and two obvious peaks appeared in 2000 (64.10%) and 2008 (67.33%). (3) Occupied speed of cultivated lands in municipalities was obviously higher than that in provincial capitals. The maximum of this speed appeared earlier in municipalities (in 2003) than that in provincial capitals. Before 2003, occupied speed of cultivated lands accelerated, while decelerated with fluctuations after 2003. In the past four decades, occupied speed of cultivated lands in provincial capitals accelerated ceaselessly. (4) Generally, occupied speed of cultivated lands in coastal cities were far higher than that in inland cities, while lower in two short periods (1998-2000 and 2009-2013). (5) Newly urban lands occupied cultivated lands far faster in the East Hu Lines than that in the West Hu Lines, and their disparity reached the maximum in 2003 (annual 11.18 km^2 per city). Lastly, occupied speeds of cultivated lands by urban lands in UAKCS, UASCS and UAICS all accelerated with dramatic fluctuations, and reached the maximum in cities of UAKCS the earliest, followed by cities in UASCS and UAICS.

Key words: Urban Expansion, Cultivated Lands, Remote Sensing, Long Timeframe

Litterfall and dynamic of Evergreen Broad-leaved Forest on Jinyun Mountain

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Abstract: Forest litter is the substance produced by metabolism during the growth of plant.It connects plant with soil, maintains the fertility of the soil, and plays an important role in sustaining the material circulation as well as nutrient balance of the forest ecosystem. As a zonal vegetation of subtropical areas, evergreen broad-leaf forest is of abundant variety and high productivity, therefore, a research focusing on its litters and dynamics can help us better study the structure and function of ecosystem.In a word that global climate change is attracting more attention, studies concerning forest litter and its spatial and temporal dynamic becomes an important part of the climate change studies. We set 172 litter collectors in a 1 hm2 permanent monitoring plot on Jinyun Mountain and collected litter from January 2014 to December 2016. We firstly investigated the production and composition of the litter. Next, we examined the temporal and spatial patterns of litterfall for the dominant tree species. Then, we explore the effect of extreme snowfall on litterfall dynamics.The main conclusions of this study are as follows:

① The litter mass was 157.43 kg from 2014 to 2016. The total amount of the litterfall

was 18200.43 kg ·hm^{-2}, and the average amount was 6,066.81 kg ·hm^{-2} ·a^{-1}. Leaf litter accounted for 74.07 % of the total, with branch accounting for 13.24 %, flower and fruit for 7.69 %, others for 3.63 % and bark for 1.37 %, respectively.

② Monthly dynamic of total litter mass was the same as the dynamic of leaf litter. The trends of total litter mass changed largely under the influence of leaf litter.The peak of the total litter mass was in May and in October or November, while, the minimum of litter mass was collected in January or. The peak of the leaf litter was in May and October, and in January the minimum amount of leaf litter was collected.

③ The spatial distribution of the total litter mass maintained stable from 2014 to 2016 except the snowy weather disturbances.

④ The leaf litter mass was 13481.23 kg ·hm^{-2} from 2014 to 2016, of which 91.46 % was from evergreen trees and 8.54 % was from deciduous trees. The temporal patterns of leaf litter differed significantly between evergreen trees and deciduous trees.

⑤ Leaf litter from 12 tree species contributed to 94.12 % of the total leaf litter mass. Relative basal area was significantly positively correlated with the leaf litter mass, and the temporal patterns of leaf litter showed clear differences among these species. In this study, temporal patterns of leaf litter were classified in 3 types: the unimodal, the bimodal and the multi-modal type. The unimodal type included 3 evergreen trees (i.e. Engelhardtia roxburghiana, Symplocos setchuanensis and Adinandra bockiana) and 2 deciduous trees (i.e. Alniphyllum fortunei and Liquidambar formosana). The bimodal type included 5 evergreen tree species: Castanopsis fargesii, Machilus pingii, Elaeocarpus japonicus, Elaeocarpus duclouxii and Castanopsis carlesii. The multi-modal type included 2 evergreen trees: Cunninghamia lanceolate, Pinus massoniana.

Key words: Evergreen Broad-Leaved Forest, Litterfall, Litter Components, Litter Dynamics

Analysis on the Influencing Factors of New-Type Urbanization Development in Qingdao

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Abstract: New-type urbanization is different from the traditional urbanization, for it focuses on mitigating the challenges brought by fast urbanization. It is in the accelerating stage of Qingdao urbanization. Pay a great attention to new-type urbanization of Qingdao will not only profit the harmonizing the development of social economy and ecological protection of Qingdao City, but also provide a scientific theory for the development of new-type urbanization in Blue Economic Zone of Shandong

Peninsula, even the whole Shandong province.

Based on the social and economic data collected from 2005 to 2014, urbanization level, ecological environment, population, land use and economic development in Qingdao were analyzed. The results show that (1) the levels of urban development is different from one county to another, there is an obvious gradient from Jiaozhou Bay to the inland. The amount of towns with high-level quality is seldom, medium and small towns are popular. (2) Energy demand and sulfur dioxide emissions decreased year by year, but smoke dust emissions keeping on a high level. (3) The immigrant population is only a small portion to the whole city. However, the transforming population from rural population to the urban population is the main reason of citizen increase. The population is less educated and the majority of those are primary and junior secondary educated. Increase of the proportion of college students will drive well the new-type urbanization of Qingdao City. (4) Urban area in Qingdao has been over-expanded, the area of cultivated land is far less than the demand. (5) The development of the tertiary industry is the fastest, which provides a large amount of rural population with new jobs. With the economic development, the ratio of basic necessities consumption reduced gradually, and the citizens afford to more and more consumption on urban services. In the process of the development of new-type urbanization, Qingdao should pay attention to the coordinated development of environment, population, land use and economic structure.

Key words: New-Type Urbanization, Ecological Protection, Land Use, Economic Structure

Characterizing the Impact of Urban Morphology Heterogeneity on Land Surface Temperature in Guangzhou, China

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Abstract: The urban morphology is regarded as one of the main reasons for urban heat island (UHI). However, its effect on UHI in city-scale urban areas has seldom been examined. In this paper, we presented a rulebased regression model for investigating the nonlinear relationship between land surface temperature (LST) and urban morphology represented by building height, building density and sky view factor (SVF) across different dates in 2005. Results found that an urban morphology of medium building height and lower density significantly yielded higher LST variation levels, whereas the lowest LST variation levels occurred in high-rise and high-dense building arrays. Compared to building height, building density had a stronger influence on LST. Medium SVF values produced the lowest LST, whereas the largest and smallest SVF

values produced the highest LST. Results also showed how rule-based regression model offer great performance in detecting the nonlinear mechanisms of LST as well.
Key words: Urban Heat Island (UHI), Land Surface Temperature (LST), Urban Morphology

Effects of Foliar Trichomes of Tillandsia on the Retention and Resuspension of Atmospheric Particulates

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Abstract: Tillandsia velutina with typical foliar trichomes was selected as materials, and its trichomes were removed artificially to investigate the dust retention and resuspension under different wind strengths and different time. The results showed that leave dust retention with all the foliar trichomes was 22.19 ± 0.11 g/m2, which was significantly higher than those without foliar trichomes (11.95 ± 0.35 g / m2). More than 99.7% of the atmospheric particulates would be resuspended under the function of wind for those without foliar trichomes, while only 50.2% for those with foliar trichomes. Resuspension ratio increased significantly with the increase of wind speed or function time. Scanning electron microscopy (SEM) analysis showed that density of the foliar trichome had significant positive correlation with the particulates density. Therefore, effects of foliar trichomes of T. velutina on the retention and resuspension of atmospheric particulates was reflected not only in the total amount of atmospheric particulates, but also in the process of atmospheric particulate resuspension. Resuspension must be taken in account in the future study in order to accurately assess the relationship between vegetation and atmospheric particulates deposition.
Key words: Air Plant, Foliar Trichome, Air Pollution, Resuspension

Evaluation and Function Zoning of Ecological Environment in Urban Space

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Abstract: Function zoning of ecological environment has been an important tool used by local governments and central government to establish a harmonious relation between social and economic development and ecological environment in recent years. Guided by the concept and principle of ecological function zoning, the paper extends the method of ecological function zoning to the scale of urban space, and brings

forward the method for function zoning of ecological environment in urban space and its application mode. Based on evaluation of the ecological environment sensitivity, ecosystem service function importance, and socio-economic coercion, this paper divides urban space in four types, namely ecological environment restoration zone, ecological environment restoration zone, ecological economy bearing zone and ecological environment protection zone, by means of mutually exclusive matrix classification. Taking Taizhou of Jiangsu Province as a case study, this paper verifies the actual application of theoretical model and technical method, and brings forward the scheme for function zoning of ecological environment, as well as the measures for ecological environment protection and industrial development orientation of each function area, providing a scientific basis for Taizhou's ecological city development and construction.

Key words: Ecological Environment, Ecological Evaluation, Ecological Function Zoning, Matrix Classification Method

Quantifying the Effects of Impervious Surface Pattern on the Spatial Distribution of Urban Waterlogging Risk Area

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Abstract: Impervious surface cover ,a surrogate measurement of urbanization , is often regarded as a key parameter in determining the impact of urbanization on hydrological processes Few studies, however, have examined the influence of impervious surface configuration and scales effects . This paper investigates the importance of both the composition and configuration of impervious surface and scales effects on the ubran waterloging risk Area (UWRA) spatial distribution in Guangzhou ,China,using correlation analyses and partial redundancy analysis.The composition and configuration of impervious surface were measured by a series of landscape metrics, which were calculated based on a high-resolution land cover map.We found that(i) at less four spatial scales(from 1km*1km to 4km*4km) ,the compositon of impervious surface,especially in the percent cove of buidings, is more important than the configuration of impervious surface;at 5km*5km scale,the configuration of impervious surface, especially in Euclidean nearest-neighbor distance of buidings,landscape index shape of pavement is important than the composition of impervious surface;(ii) the combination of composition of impervious surface and configuration of pavement have more explanatory power than the combination of composition of impervious surface and configuration of buiding as well as the compositon of impervious surface alone in most of scales;(iii) At 5km*5km scale, the highest explanatory power is the three

variables combination of the composition of impervious surface and configuration of buidings and pavement.Consequently,the impact of urbanization on UWRA can be alleviated by the way which control the relative amounts of impervious surface and optimize their spatial configuration.

Key words: Impervious Surface Pattern, Urban Waterlogging Area, Correlation Analysis, Partial Redundancy Analysis

A Synthesis Analysis of Methods for Quantifying Social Factors in Social Ecological Systems

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Abstract: Increasingly people come to the realization that in order to address the pressing environmental problems and achieve long-term sustainable development, concepts and tools integrating natural and social sciences are needed. This realization brings to the rise of the concept- social ecological system (SES), which is a system formed through mutual infiltration and interaction between ecological and social elements. While the theoretical foundation of SES is solid, it is hard to put the theory to practice. One main issue is the difficulty to quantify impacts of the social factors and processes through policy-making and their implementations. In this synthesis analysis, we discussed some important methods about quantifying the effect of social components and processes in SES such as artificial neural networks and agent-based model. We evaluated the merits and limitations of these approaches using case studies in both United States and China. Finally, we highlighted the urgent needs and potential directions to develop new quantitative methods for SES studies.

Key words: Social Ecological System, Social Factor, Ecological Component, Quantitative Method,

Quantifying the Evenness and Fragmentation of Urban Greenspace in 9 Chinese Cities

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Abstract: Quantifying the spatiotemporal patterns of urban greenspace is crucial to understand the numerous ecosystem services provided by urban greenspace. Previous studies largely focused on a single city and characterized the net change of urban

greenspace due to urban expansion at city level, using medium resolution image data. However, few studies have investigated the fine-scale spatial distribution of urban greenspace and its change within cities, for example, along an urban-rural gradient. Here, using 2.5m high resolution imagery, we quantified the spatial distribution of urban greenspace and its change for 9 Chinese cities, by integrating the urban-rural gradient framework with landscape metrics. We used 5 landscape metrics, percentage of landscape (PLAND), mean patch size (MPS), patch density (PD), edge density (ED), and landscape shape index (LSI), and investigated their changes along an urban-rural gradient with 1-km distance rings for each city. These metrics were calculated based on land cover maps derived from 2.5m resolution ALOS and SPOT image data collected in 2005 and 2010, respectively. We found: 1) the percent cover of urban greenspace gradually increased with the increase of distance from urban core for both 2005 and 2010. Surprisingly, changes in proportional cover of urban greenspace, were greater in the urban core areas (0-8 gradient rings) than the average changes for the entire city for the 4 big cities (i.e., Beijing, Tianjin, Hangzhou and Nanjing), suggesting higher degree of changes in urban cores. 2) For all the 9 cities except for Shanghai, the proportional cover of greenspace in each of the gradient rings became similar in 2010, compared with 2005, suggesting urban greenspace became more evenly distributed along the urban-rural gradient. Similarly, the differences in the degree of fragmentation among the different gradient rings decreased from 2005 to 2010. Our results provide insights on urban greenspace dynamics along an urban-rural gradient, which may have important implications for urban greenspace planning and management.

Key words: Urban Greenspace, Urban-Rural Gradient, Evenness and Fragmentation, Ecosystem Services

Vegetation Change of the Slopes of the Nanjido Nonsanitary Landfill in Seoul, Korea

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Abstract: The Nanjido Nonsanitary Landfill in Seoul was turned in World Cup Park with a soccer stadium to host the 2002 World Cup. This area consists of two huge mountains of garbage, where all waste from Seoul was disposed in an unsanitary manner for 15 years from 1978 to 1993. The upper part of the landfill was transformed into a grassland park, where urban dwellers rest. In terms of the slopes, a forest and grasslands have been naturally developed on construction waste and unstable soil. The researcher analyzed the vegetation change of the slopes from 1999 to 2016.

Actual vegetation continuously changed for the 17 years. The size of landscape-tree-planting sites increased through park management. The natural forest can be divided largely into two groups: Salix spp. forest and Robinia pseudoacacia L. forest. The proportion of the Salix spp. forest increased from 12.0% in 1999 to 18.0% in 2008 and then decreased to 10.9% in 2016. The proportion of the Robinia pseudoacacia L. forest increased from 17.3% (in 1999) to 35.4% in 2008 and then slightly decreased to 33.3% in 2016. The big change in 2008 was due to Typhoon Kompasu. After that, in declining woody vegetation areas, the proportion of Ambrosia trifida L., a naturalized species, increased from 1.6% in 1999 to 7.4% in 2016. The proportion of arid grasslands, made up of Humulus japonicus Siebold & Zucc., etc., decreased from 32.0% in 1999 to 5.7% in 2016, due to the expansion of the Robinia pseudoacacia L. forest and landscape tree plantation. The vegetation of the slopes went through continuous changes, due to natural phenomena, such as typhoons, and vegetation management.

The researcher analyzed the process of natural vegetation change through research into permanent quadrats for plant community in 12 places. Salix spp. trees of the tree stratum were declining, and Robinia Pseudo-acacia L. trees were increasing in the sub-tree stratum and shrub stratum. This study found that regressive change, where indigenous species were declining while introduced species were increasing, was occurring. That is thought to be due to the unstable vegetation base of the nonsanitary landfill.

Key words: Urban Ecosystem, Park Management, Monitoring, Succession

Characterization of the Vascular and Cryptogamic Flora of the Green Roofs of Geneva (Switzerland)

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Abstract: The vegetation of rock slabs and walls, which includes a large part of bryophytes, finds refuge in cities, on structures of anthropic origin such as green roofs. Despite the many large-scale floristic inventories that have taken place in the main Swiss cities in recent years, the roofs, due to difficult access, have often been overlooked. In addition, few studies have focused on the flora of these biotopes. This work aims to characterize the flora of vegetated roofs and to observe the differences of structure and plant composition on intensive and extensive roofs of different age. Thirty green roofs were Geneva on which exhaustive and quantitative surveys of vascular plants and bryophytes were carried out. In order to describe the vegetation cover and to assess its ecological quality, different parameters were selected: the plant cover rate, the

specific richness, the specific frequency, the proportion of threatened species and the proportion of neophytes. In total, 21% of the vascular flora and 10% of the bryoflora from Geneva were observed on the roofs. Among the vascular plants, thirty-five threatened species at national and cantonal level were identified (mainly of spontaneous origin), including three species of high cantonal priority. For bryophytes, seven endangered species were found, including one, Pseudocrossidium revolutum, with a threatened status of extinction (CR) at the national level. Four species and one subspecies were new for the canton. Extensive roofs seem to play a greater role in the conservation than intensive ones for both groups of organisms. The plant cover appears to increase with the age of the green roofs as does the species richness; which varies according to the type of roof. In the case of vascular plants, intensive roofs have a higher plant cover rate, specific richness and rate of neophytes, whereas extensive roofs are more favorable for the development of threatened species. For bryophytes, extensive roofs have a greater specific richness and covering, as well as a better conservation role; however, these roofs are home to more neophytes. In conclusion, this study contributes to characterize the vegetation of green roofs and highlights their importance for conservation in urban areas. It will help propose management measures to improve their ecological quality and integrate them biodiversity monitoring.

Key words: Green Roofs, Bryophytes, Vascular Plants, Ecological Quality

The Quantitative Evaluation and Promotion Strategy of Ecological Carrying Capacity in Economically Developed Areas --A Case Study in Shaoxing, Zhejiang

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Abstract: Using entropy evaluation method and state-space techniques, constructing evaluation system of ecological carrying capacity of economically developed areas from three aspects: social, economic and resource-environment carrying capacity, quantitatively evaluating ecological carrying capacity of Shaoxing from 2002 to 2015. The results showed that: (1) the overall trend of ecological carrying capacity of Shaoxing in 2002-2015 is relatively stable, and the difference of townships is obvious. The ecological carrying capacity of Keqiao, Shaoxing and Xinchang counties in the non - core areas of the city is relatively high, and the carrying capacity of Shengzhou urban district, northern Shangyu district and Yuecheng district is relatively low. (2) Ecological carrying capacity is a comprehensive reflection of economic carrying capacity, social carrying capacity and carrying capacity of resources and environment, and the equilibrium carrying capacity of the majority of townships in Xinchang County

has reached the highest ecological carrying status at the township level, while the northern part of Yuecheng District The townships in the northern part of China have the lowest ecological carrying capacity due to the unbalanced carrying capacity of each dimension. (3) The regions with low economic carrying capacity are relatively stable in the interannual years and the regions with higher economic carrying capacity are unstable. Similarly, the regions with higher resources and environmental carrying capacity have a slight fluctuation, and the higher regional stability is slightly worse; The inter-annual volatility is the smallest and the trend is the most stable.Based on the results from each dimension, some effective measures were proposed to promote ecological carrying capacity in Shaoxing, to provide beneficial reference to the balanced and sustainable development of society, economy, resource and environment.
Key words: Ecological Carrying Capacity, State-Space Techniques, Economically Developed Areas, Promotion Strategy

Developing Partnerships to Enhance Pollination Services in Urban Areas

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Abstract: Urban environments are growing globally and are home to more than half of the world's human population. Pollinators supply a crucial ecological service, and finding ways to improve their lot is a major challenge. Research from the Urban Pollinators Project, a large-scale study of pollinators in UK towns and cities, indicates urban areas can contain high abundance and diversity of some pollinator taxa and identifies land uses and management practices that could improve urban habitat management for pollinators. Improving towns and cities for pollinators has the potential to enhance not only pollinator services in urban areas but also benefit pollinator populations across the wider landscape. Incorporating research findings in land management approaches to improve pollinator services and conservation in urban areas involves building partnerships with key stakeholders. I discuss steps being taken through knowledge exchange activities with policymakers, practitioners and NGOs designed to promote pollinator conservation in urban areas.
Key words: Urban, Pollinators, Pollination Services, Ecosystem Services

Tapping the Potential of Urban Green Spaces to Provide Ecosystem Services and Achieve Sustainable Urban Development in Pakistan

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Abstract: Pakistan is one of the fastest urbanizing countries in South Asia with urbanizing rate of around 3%. At present, Pakistan's current urban population is about 39% and it is expected to rise to 50% by 2025. It has ten cities having population greater than one million. This transformation from a dominantly rural to an urbanizing country has many negative environmental impacts such as loss of habitats and biodiversity, landscape changes, pollution, emission of greenhouse gases, heat island effect and increasing pressure on already scarce natural resources. Consequently, these urban centers are developing in poor, unsustainable, insecure and disaster-prone human settlements.

Pakistan is mainly an agrarian country and its major cities except Karachi are located in predominantly agrarian landscapes. These cities used to have well managed gardens, parks, green corridors, crop fields and water channels with tree avenues. In the last few decades, this "green capital" of Pakistani cities has been eroded and damaged on large scale leading to severe socio-environmental problems. With the increase in cities, the crop fields and green habitats in neighboring peri-urban areas are undergoing the similar phenomenon of encroachment and destruction.

These negative effects of urban development can be mitigated by the ecosystem services in the case of provision of clean air and drinking water, temperature control pollution abatement, and aesthetically useful areas for recreation and cultural integration. The most effective method in facilitating ecosystem services in cities is the management of urban green spaces. The role of urban green or natural areas in providing different ecosystem services and amenities of life to their inhabitants particularly the poor or resource-deficient sections of urban communities has been widely recognized.

In Pakistan, the sixth most populous country of the world, to offset negative impacts of urbanization, there is a need to collect and analyze authentic information on how urban green spaces can underpin ecosystem services, the extent of their demand, the capacity of green spaces to provide ecosystem services and negative pressures on these areas.

Pakistan is mainly an arid country and its main cities except Karachi are located in predominantly agrarian landscapes. The commonly found tree species in the urban areas are Acacia, Ficus, Eucalyptus, Dalbergia, Albizzia, Azadirachta, Prosopis, Salvadora, Mangifera, Morus, citrus and many exotic trees. Similarly the herbaceous flora mainly consists of plants belonging to families such as poaceae, euphorbiaceae, rosaceae, solanaceae, chenopodiaceae, malvaceae, fabaceae and lamiaceae etc.

Recently, an invasive plant, Parthenium hysterophorus is occupying large areas of urban green spaces.

This paper provides information about the current status of urban greenery in Pakistan, causes of its degradation and recommends measures to manage it to develop it as a major resource for sustainable urban development.

Key words: Urban Green Spaces, Ecosystem Services, Sustainable Urban Development, Pakistan

A Practice of Species Recovery Project in Unban Area—Take Chinese Water Deer Reintroduction in Shanghai as an Example

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Abstract: Reintroduction projects for recovery of endangered species are widespread, but mostly conducted in wild area, few in urban area. In Shanghai, we have conducted a reintroduction project for endangered species recovery since 2006. The target spices is the Chinese water deer (Hydropotes inermis), which was ranked as VU species in IUCN red list and under the second category of protected animals in China. The deer had lived in Shanghai and adjacent area in the history and vanished at the beginning of the 20th century. We planned three steps for the water deer reintroduction project. Firstly, we chose Huaxia Park (31°11′37″N, 121°38′35″E) as a pilot site to establish releasing herd in 2006. After two years, the water deer not only had adapted to the local climatic conditions but succeeded in reproduction as well. In 2008, we started wild training in an enclosed area in Punan Woodland (30°57′03″N-30°58′06″N, 121°17′58″E-121°18′36″E) for the second step. The deer in Punan Woodland were feed on native vegetation and only provided supplemented food in the winter. As the third step, we released 14 deer in Binjiang Forest Park (31°22′52″N-31°23′22″N, 121°30′52″E-121°32′03″E), which provided a semi-free ranging condition in 2009, in the same year, we released 15 deer at Nanhui East Shoal Wildlife Sanctuary (30°50′13″N-31°00′02″N, 121°53′03″E-121°58′25″E) where the water deer could move around freely. The population in Binjiang Forest Park is stable and the animals released were spotted by locals and tourists frequently. The population in Nanhui East Shoal Wildlife Sanctuary was monitored by radio collars in first year after releasing. In 2014, we surveyed the deer in Nanhui East Shoal by infrared cameras and captured two foraging water deer. We found the deer can be adapted to live in city woodland and wetland in Shanghai area. Shanghai has a scheme to build more protected areas for wildlife conservation, this could be more potential habitats for the Chinese water deer to thrive.

Key words: Shanghai, Chinese Water Deer, Urban, Recovery

Population Dynamics of Scattered Tree Species in the Urban Area of Kyoto, Japan

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Abstract: In Japan, the locations of ancient human settlements had been greatly influenced by convenience for production of foods, especially the rice cultivation, and some of those developed to the urban areas today.

Kyoto is historical city that locates in a basin of wide rivers, and surrounded by mountains. In this sort of alluvial plains, there was natural riparian vegetation that is highly dependent for regeneration on disturbances, and until recently, there are many types of remnant woodlands in the urban area of Kyoto. After WWII, however, the city area had quickly and densely expanded to the boundaries between mountains and alluvial plain, and as a result, many of scattered trees and woods were diminished. When we think about urban greens, the remnants of these trees are not negligible because they are important components in dynamics of fragmented woodland systems in urban area. Trees propagate not only by natural reproduction but also by plantation, which is another important aspect of urban greens.

This study focused on the population dynamics of trees that forms urban greens, and observed differences in effect of natural and man-made influence. The study area is a part of Higashiyama Ward, Kyoto City, Japan. We conducted 3 step researches; (1) Mapping the changes in distribution of greens from the 1980s to the 2010s using GIS, (2) Clarification of current distribution of tree species, (3) Survey on arboricultural activities. Three researches integrated to achieve the study goal, proposing a new idea of "city with woods".

Key words: Urban Woods, Population Dynamics, Planted, Natural Regeneration

Public Behavior, Awareness, and Perception of Household Solid Waste Recycling in Urban Areas of China: A Case Study

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Abstract: Rapid economic development, population growth, and urbanization result in

the generation of large amounts of household solid waste (HSW) in urban areas, especially in developing countries such as China. Improving the public awareness and performance, and then promoting a suitable waste management of HSW is perceived a challenging task in many communities. In order to investigate the public behavior, awareness, and perception of HSW recycling, a survey was conducted in 10 cities in China. The survey documented public behavior including main waste types (compostable), amounts (less than 1 kg/cap/day), disposal frequency (1 time/day), and disposal manner (common trashcan) of HSW. Most residents (89.6%) understood the issues of HSW and they (96.0%) were willing to recycle despite knowing little about it. Residents understood the importance of stakeholder involvement in HSW recycling and agreed that government should play a leading role and take positive action during the development of recycling programs for HSW in China. Two strategies clarifying the responsibilities and the roles of different stakeholders in HSW recycling were proposed. For residents, awareness of HSW recycling should be developed by education and publicity. For government managers, completed HSW recycling program involving suitable policies, sufficient facilities, monitoring, and an insurance mechanism should be established. This study provides scientific knowledge and insights that can help guide the development of appropriate policies and systematic recycling schemes concerning HSW management in China and other countries.

Key words: Household Solid Wastes, Public Awareness, Recycling Scheme, Waste Management

The Cooling Effect of Water Landscape in High-density Urban Built-up Area—A Case Study of the Center Urban District in Guangzhou

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Abstract: During rapid urbanization process, one of the most representative environmental problem in the world is the urban heat island (UHI) effect. In contrast to those warming effect, urban water bodies which are known as ‘urban cool islands’ (UCI), have been considered as an effective measure in alleviating UHI effects and improving urban thermal environment. Therefore, it is of great significance to study how the water landscape influence the urban thermal environment. In this study, the SPOT-5 and Landsat-8TIRS images are applied to extract the urban water landscape and land surface temperature (LST) in the center urban districts of Guangzhou, investigating the impact of water bodies’ characteristics on cooling intensity and influencing scale. The cooling effect intensity and influence scale are quantified as the

LST difference and distance between water bodies and continuous buffers. The result reveals that: (1) the water landscape characteristics (water area and shape index) had a strong correlation with the average temperature, and with the increasing of the landscape characteristics, the water average temperature is significantly decreased, but the trend of decline tends to be gentle; (2) the cooling effect intensity and influence scale are also found to determine by water bodies characteristics but not linear correlated with water bodies characteristics. The high proportion of built-up areas to some extent may increase the cooling effect intensity. Results of this study suggest that waster area, geometry and surrounding land-use type are important indicator for UCI formation, and help urban planners to design urban water bodies to have a better cooling effect.

Key words: Water Landscape, Urban Thermal Environment, Land Surface Temperature, Urban Cool Island

A Case Study on Linkage between Urban Form and Commuting Traffic CO_2 Emission

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Abstract: With the rapid urbanization process in China, a series of progressive urban issues such as greenhouse gas emissions increase, ecological land occupation, and environment pollution is an increasing concern. After a series of researches, the linkages between urban form and sustainable development has generally been recognized, but it still need to answer the question of what kind of urban form will make the city more sustainable? Traffic energy consumption is one of the most important sources of CO_2 emission, which has been increasing fast in recent years of China. The continued growth in traffic carbon emission will have a negative impact on urban sustainable development. In this context, the article will discuss urban form and pattern of traffic CO_2 emission using Xiamen city as an example. Land-use and road traffic network are taken as characteristic elements to describe urban form. Commuting traffic data are used with MOVES model to simulate the CO_2 emission on the scale of road segment. This study is expected to find linkages between urban form and traffic CO_2 emission. We hope it can help the work for sustainable development theory.

Key words: Urban Form, Commuting Traffic, CO_2 Emission, Sustainable Development

The Effect of Urban Landscape Pattern Evolution on Urban Heat Island Based on Observed Data

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Abstract: Based on homogeneity correction data (the daily temperature and relative humidity)from 15 weather stations during 1976-2016 in Ningbo area, using statistical and GIS analysis method, we analyzed 40 years of urban hot ecological environment of Ningbo area variables related to changes, mainly for urban heat island intensity, evolution and expansion trend. Combined with the study area evolution characteristics of urban landscape pattern in different stages of development in 40 years, we investigated the coupling relationship between urban expansion and urban heat island; It had a high rate of data the conclusion is urban effect of Ningbo on regional ecological environment climate index contribution, which indicates that the climate effect of Ningbo has important influence on the regional ecological the environment.
Key words: Ningbo, Daily Temperature, Urban Heat Island, Urban Expansion

Exploring the Spatial Distribution of Heavy Metal in Peri-Urban Topsoil of Eastern China

Shoujuan Li, Lei Yang, Fangkai Zhao, Long Sun

Abstract: Rapid urbanization has significant influences on soil processes, especially for peri-urban areas. Understanding the spatial variation of heavy metals in soil and its affecting factors in this region is an important issue for human health and ecosystem security. In this study, a typical peri-urban catchment named Zhangxi catchment located in the rapid urbanization area of eastern China was selected as study area. 4 sub-catchments which have different land use pattern were divided based on urbanization degree and 81 experimental sites uniformly distributed in the catchment were selected for soil sampling. The total metals for copper (Cu), zinc (Zn), lead (Pb), cadmium (Cd), nickel (Ni), arsenic (As) and chrome (Cr) were measured for each soil sample in laboratory. Statistics and spatial analysis were used to analyze the spatial distribution characteristics of soil heavy metals. Results of study showed that: (1) Contents of soil heavy metals in farmland were significantly higher than that in forests and orchards, and contents in orchards were slightly higher than forests. Human activities such as long-term fertilization may be the main reason for this difference. Limited human activities in forests lead relatively lower content of soil heavy metals. This result indicated that land use has significant influence on spatial distribution of soil

heavy metals in peri-urban areas. (2) Comparison of average contents of soil heavy metals in 4 sub-catchments showed significant differences between different sub-catchments. For example, the sub-catchment covered with high proportion of farmland showed relatively higher averaged content than sub-catchment covered with high proportion of forest. Land use structure determined the content of soil heavy metals at catchment scale. (3) Results GIS-based spatial analysis also showed that spatial distribution of soil heavy metals had close correlation with land use pattern. This indicated that land use pattern determined the spatial distribution of soil heavy metals. (4) The statistical analysis showed that soil heavy metals had no significant correlations with environmental factors, such as altitude, distance from road, and distance from river. The spatial distribution also showed that content of soil heavy metal increased with urbanization degree. Results of this study indicated that intense human activities in peri-urban areas influence the land use management and land use pattern, and this determined the spatial distribution of soil heavy metals in this area.
Key words: Heavy Metals, Spatial Distribution, Peri-Urban, Land Use Pattern

Urban Ecosystem Health Assessment for Typical Cities along the Belt and Road

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Abstract: As an important national policy, “the Belt and Road” also challenges more for environmental protection in China. The urban ecosystem health status of typical cities along the Belt and Road was focused on in this paper. The evaluation indicators of urban ecosystem health were first established by introducing the concept of urban vital organism. And the fuzzy comprehensive evaluation model was constructed when the indicator weights were determined by information entropy method. Then the relative health states of 11 cities were compared and analyzed including Shanghai, Guangzhou, Chongqing, Xi'an, Wuhan, Hefei, Chengdu, Tianjin, Qingdao, Quanzhou and Shenzhen. The limiting factors of different cities were identified, based on which the regulation suggestions were proposed. It is believed that the result is helpful for moving forward “the Belt and Road” strategy.
Key words: Urban Ecosystem Health, Urban Vital Organism, “The Belt and Road”, Fuzzy Mathematics

Greening Evaluation Integrated with Human Benefits in Three-Dimensional Thinking

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Abstract: Based on the vertical greening's tendency with scare land resources and the requirement of greening resources' refined spatial management in urban areas, evaluation indexes in three dimensional thinking were proposed with the consideration of greening resources' benefits to residents. Results showed that: (1) it is obviously important to propose these indexes because of the influences of greening resources' three-dimensional spatial distribution on its efficiency, and the primary contributions of greening resources to residents in urban areas. (2) These indexes could characterize the quantity and quality of greening resources including vertical greening, and distinguish its' spatial difference of greening resources' benefits. It is expected to be helpful for the distribution and planning of greening resources. (3) It could quantitatively reflect the value of urban greening resources from the point of human-centered thinking considering certain three dimensional space range of greening resources' benefits to urban residents in one position. (4) The total TGQ (Tridimensional Green Quantity) of Shenzhen case is 69 099.84m3, and the average TGI (Tridimensional Green index) is 7.37 with distinct spatial divergence. (5) Greening evaluation in three-dimensional thinking should be developed in basic theory, data capturing, indexes enrichment, etc.
Key words: Vertical Greening, Vertical Greening, Three-Dimensional Thinking, Greening Planning

Effects of Foliar Trichomes of Tillandsia on the Retention and Resuspension of Atmospheric Particulates

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Abstract: Tillandsia velutina with typical foliar trichomes was materials, and its trichomes were removed artificially to investigate the dust retention and resuspension under different wind strengths and different time. The results showed that leave dust retention with all the foliar trichomes was 22.19 ± 0.11 g/m2, which was significantly higher than those without foliar trichomes (11.95 ± 0.35 g / m2). More than 99.7% of the atmospheric particulates would be resuspended under the function of wind for those without foliar trichomes, while only 50.2% for those with foliar trichomes. Resuspension ratio increased significantly with the increase of wind speed or function

time. Scanning electron microscopy (SEM) analysis showed that density of the foliar trichome had significant positive correlation with the particulates density. Therefore, effects of foliar trichomes of T. velutina on the retention and resuspension of atmospheric particulates was reflected not only in the total amount of atmospheric particulates, but also in the process of atmospheric particulate resuspension. Resuspension must be taken in account in the future study in order to accurately assess the relationship between vegetation and atmospheric particulates deposition.

Key words: Air Plant, Foliar Trichome, Air Pollution, Resuspension

Investigation of the Impact of Urban Vegetation on PM2.5 Based on Remotely-Sensed Measurements: A Case Study in Shenzhen, China

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Abstract: The spatial and temporal distribution of atmospheric pollutants (especially PM2.5), which may cause adverse effects on human health and the environment, are affected by urban vegetation through deposition and dispersion processes. Although lots of studies have been conducted to investigate this effect, we still lack the knowledge of how urban vegetation reduces PM2.5 quantitatively. In this study, Landsat 8 data are used to retrieve the urban vegetation parameters (including Leaf Area Index, Fractional Cover and Normalized Difference Vegetation Index). Meanwhile, hourly PM2.5 concentrations over a period of one year (from 2014/05/01 to 2015/04/30) were obtained at eleven monitoring stations in Shenzhen, P.R. China. It was found that those sites with less vegetation (lower vegetation parameter values) frequently had high PM2.5 concentrations than other sites, whilst sites with more vegetation had lower PM2.5. The findings indicate that urban areas with proportionally higher concentrations of urban forestry may experience better air quality with regards to reduced ambient particulate matter.

Key words: Urban Vegetation, Air Pollution, PM2.5, Remotely-Sensed

Effective Measures of Revegetation along the Corridor of Qinghai Tibet Highway

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Abstract: Vegetation destruction and restoration aroused from highway construction in

high altitude region has long been the focus of highway practice. The task set a tough challenge in permafrost regions for its rigid cold and arid regional climate, barren soil, and barely no alternative for plant resources. The upgrading of Qinghai-Tibet highway is in the air, which might have such an immense impact on the roadside vegetation that corresponding alleviated measures were emergent to restore the sensitive ecology. we carried out a series of studies which include an investigation and review of the past measures taken by the Qinghai Tibet railway and other linear engineering construction project, an evaluation of environment restoration potential along the corridor, an experiment of revegetation involving the protection and reconstruction of topsoil and replant pattern of sod excavated from meadow expropriation. Evaluated by using environmental factors, natural vegetation restoration was zoned in GIS map, based upon which Qinghai-Tibet Highway Corridor was divided in 5 different zones and corresponding measures were advanced. Investigation and tracked evaluation of the effect of different revegetation measures taken by the highway, railway, electric transmission facilities in the zones which was hard to be revegetated in a long period, and some adapted measures were summarized. Improved measures of revegetation were experimented in an adjacent highway of G214, which including use of topsoil seedbank, inoculation of soil microorganisms, cover of different material, and contrast of sod layouts on the slope.

Successful technologies adapted to the regions may including follows:

（1）Comprehensive reinforcement of slope and revegetation;

（2）Spay of soil and seeds on the slope of soil with poor texture;

（2）Combination of topsoil seedbank with the sowing of seeds;

（3）Inoculation of 3 soil microorganisms on the native plants;

（4）Cover of the newly seeding area with plant fiber blanket;

（5）Replanting of sod framework plus seed sowing and effective cover.

Revegetation of highway slope involve a comprehensive scheme and systematic technologies in the highly cold and arid area, which including the seed resources, soil improvement, cover to improve, effective protection of topsoil and sod.

Key words: Qinghai Tibet Highway, Vegetation Protection, Revegetation Technology

Burgeoning Demand Drives Substantial Increases in Ecosystem Services Value Following Rapid Urbanization

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Abstract: Rapid urbanization is resulting in large scale land-use conversion, changing

ecosystem services supply and demand. Most studies have assessed supply only and have found decreases in ecosystem services value following urbanization. We assessed the impact of rapid urbanization on land-use and ecosystem services value from 1990 to 2010 in the Guangzhou-Foshan Metropolitan Area (GFMA), southern China, considering changes in both supply and demand. Land-use change was determined from Landsat imagery. Values of ecosystem services supply without accounting for demand change were calculated using a well-established benefits transfer method. To account for demand, ecosystem services values were then adjusted according to changes in population, wealth, and income elasticity of demand for ecosystem services. Built-up, Water body, Orchard, and Grassland expanded while Cropland, Forestland, and Unused land contracted. With demand held constant at 1990 levels, urbanization decreased the value of ecosystem services supply from US$4.631 billion in 1990 to US$4.430 billion in 2010 (-4.4%). However, during the same period the GFMA population nearly doubled and GDP increased 14-fold, driving large increases in demand. Our upper bound estimate of increasing ecosystem services value was US$65.907 billion in 2010 (+1322.9%). The influence of changing demand may be as much as 300 times that of changing supply. Dramatically increased ecosystem services value driven by massive demand growth for a largely fixed land supply necessitates much sharper focus on land-use planning to more carefully manage the impacts of rapid urbanization and to ensure the sustainability of ecosystem services supply for the wellbeing of burgeoning urban populations.
Key words: Ecosystem Services, Supply, Demand, Land-Use Change

Ecological Transportation Construction and Urban Environment Optimization

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Abstract: Urban traffic ecosystem has the openness, diversity, denseness, radiativity, convergence, high capacity characteristics and so on. Urban traffic is the lifeline of urban ecosystem, it shoulders the important transport task. With the advancement of urbanization, urban traffic has more and more influence on the urban ecological environment. After a brief review of the development course of the mankind transportation, summarizes the main problems of modern urban traffic, analyzes the basic features of ecological traffic, mainly include: accessibility, unobstructed, convenience, safety, environmental protection, economy, the standardization and advanced nature, etc. Discusses the method of ecological transportation construction and the urban environment optimization, mainly include: (1) strengthen the guide

function of the government transport policy; (2) use of science and technology means to improve the level of traffic management; (3) perfect and publicize the traffic regulations, strict law enforcement (4) scientific and reasonable greening urban roads; (5) control road motor vehicle number; (6) improve and rectify curing "disease car" and develop new means of transport; (7) according to the national conditions, go the way of the urban traffic road with Chinese characteristics; (8) construct ecological traffic culture with Chinese characteristics; (9) scientific layout with road construction related the piping and water road; (10) laying green road, give play to its multi-function of the effect. Do a good job in urban ecological transport system planning, construction and management that is conducive to the optimization of the urban environment and sustainable development.

Key words: Ecological Transportation, Urban Environment, Construction and Optimization, Sustainable Development

T3-02: Building Urban Green Infrastructure for Resilient Ecosystem Services in Socio-Ecological Systems: Theories, Strategies, and Practices

Analyzing Changes of Urban Green Spaces in 28 Megacities between 2005 and 2015

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Abstract: Urban green spaces are an important component of urban sustainable development. For this reason, the changes of urban green spaces have been extensively studied at local or regional scales. However, spatiotemporal patterns of urban green spaces at the global scale are rarely examined, which prevents us from gaining a better understanding of patterns and changes of urban green spaces in cities with different natural and social backgrounds. In this study we analyzed the spatiotemporal pattern of urban green spaces of 28 megacities (i.e., a city with a population > 10 million) across the world between 2005 and 2015. Land covers of these cities were mapped using Landsat satellite data and Google Earth Engine. Urban green spaces for 2005 and 2015 were then extracted from the land cover maps and their spatiotemporal dynamics and influencing factors were analyzed. The results showed that the percentages of green spaces varied significantly in these megacities. London are greener than other cities for both 2005 and 2015. The percentage of green space in Karachi, Pakistan is the lowest (less than 2%) in both 2005 and 2015. Twelve of the 28 megacities had net loss of green spaces between 2005 and 2015 (4.1%±2.5%); ten megacities became greener (3.2%±1.9%), and the rest six cities roughly stayed the same. Socioeconomic factors played a significant role in shaping these spatiotemporal patterns. In order to fulfill the urban sustainable development goals, cities facing decrease of green spaces need to act immediately to stop and even reserves the trend.

Key words: Megacities, Urban Green Space Change, Influencing Factors, Google Earth Engine

How Is the Spillover Effect of Urban Green Space Cooling in a 4D Scale?

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Abstract: Urban green space cooling effect can form a three dimensional (3D) cool island, the green space cooling effect may also seep out in three dimension and change with time. So far studies on such "spillover effects" of green spaces 4D cooling and how green spaces affects the "spillover effects" are still lacking. In this study, a small-sized green space, composed by three tree species, in Nanjing City, China as the study areas. Experimental observations were conducted to get micro-meteorological and soil temperature and humidity data. Specially, the 3D cloud point data of vegetation were obtained by the Terrestrial Laser Scanning (TLS). Based on these data, ENVI-met was used to simulate the 3D microclimate of study area during 24 hours in the summer, and the 4D spillover effect and gradient change characteristics of green space cooling were analyzed. The results indicated spillover effect spatiotemporal pattern is related to different cooling effect of tree species and the immediate surrounding land surfaces. In the vertical direction, the green space cooling effect can extend to outside of the patch boundary, but differed from tree species. The findings in this study imply that the way by using the green spaces in the urban design to mitigate urban heat island should consider their 4D spatiotemporal cooling characteristics and achieve to their best spillover effect of cooling.
Key words: Urban Green Spaces, Cooling Effect, 4D, Envi-Met

How Does Spatial Configuration of Trees Affect Urban Heat Mitigation Independent of Coverge?

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Abstract: Urban greenspace has significant cooling effects on urban heat. Recent studies investigating the effects of spatial configuration of greenspace show significant, but inconsistent results, including both positive and negative effects. To investigate the causes of this inconsistency, we compared Baltimore, MD and Sacramento, CA, USA, two cities with very different climatic conditions. We quantified and compared the relationships between the spatial configuration of trees and land surface temperature (LST) using different statistical approaches, and conducted the analyses using spatial units of different sizes, based on trees mapped from 1 m high resolution imagery. We found: (1) Trees' cooling efficiency was higher in Baltimore than in hotter and drier Sacramento. Additionally, percent cover of trees was more important than their spatial configuration in predicting LST in Baltimore, but the opposite was found in Sacramento. (2) Spatial configuration of trees affects LST more in Sacramento than in Baltimore, and the effects of spatial configuration of trees on LST varied greatly in terms of magnitude, significance, and even direction, between the two cities. (3) After

controlling for the effect of percent over of trees, mean patch size had significantly positive effects on LST in Baltimore, but negative effects in Sacramento. In contrast, edge density had negative effects on LST in Baltimore, but positive effects in Sacramento. (4) The relationships between spatial pattern metrics and LST are stronger with an increase of the size of the analytical unit. This study can enhance our understanding of the effects of spatial configuration of greenspace on urban heat island (UHI). It also provides important insights to urban planners and natural resource managers on how to mitigate the impact of urbanization on UHI through urban design and vegetation management.

Key words: Urban Tree Canopy, Spatial Configuration, Urban Heat Mitigation

Urbanization Impacts on Cooling Effects of Green Space

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Abstract: Rapid urbanization has made the natural landscape of the city quickly replaced by artificial surface, and at the same time inevitably produced the urban heat island effect (UHI). As the main body of natural landscape in the city, green space has the capacity to regulate urban climate by impacting the urban thermal cycle. A lot of studies have shown that green space has good cooling effect and is able to ease the urban heat island effect. The area, configuration and type of the green space, have been found to have large influence on land surface temperature. However, few studies are focused on the impact of urbanization on the cooling effects of green space. In this study, based on land surface temperature retrieved from remote sensing images, and setting the transects along the urban-rural gradient in different directions, the change of green space's cooling effect from urban center to rural center, is quantified. This study tries to reveal the difference of green space's cooling effect between urban area and rural area, aiming to improve the adaptability to urban heat island effect.

Key words: Green Space, Cooling Effect, Urbanization Impact, LST

Productive City——A New Mode of Urban Ecosystem

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Abstract: The survival of human beings and the development of cities depend on resources including food, energy, manufacturing materials and space. However, current urban production and consumption mode has already exceeded the capacity of these

resources. If current mode is still followed, then a series of crises such as ecological deterioration, environmental pollution, resource shortage, soil degradation and shortage of fresh water will increasingly get worse. At the same time, natural productivity will also continually decrease. It is urgent to figure out a comprehensive solution targeting at the contradiction between urban development and resource provision limit.

Along with the progress of urbanization, whether comprehensive capacity of cities could hold out future existence and survival will become the key in urban sustainable development. Accordingly, we should view urban development with a new view. The ultimate purpose of urbanization is to decrease resource consumption, excavate urban productivity potential and improve urban capacity, thus positively realizing the sustainability of human beings and nature. Such a new urban development mode (or special strategy plan) is usually referred to as "productive city".

This paper attempts to build and analyze the research framework of productive city from four dimensions including necessity, concept, strategy and vision, with a view of offering new ideas for future urban development.

Aiming at the core of urban issues in western countries and China, this thesis puts forward future urban development strategies as follows. (1) Turning cities from pure resource consumers to producers while decreasing resource consumption. (2) Developing local production and consumption system and integrating originally separate production and consumption mode. (3) Forming a balanced, diversified and healthy production system. (4) Forming the distributed network pattern according to the tendency of times. (5) Restructuring resources and space. All of these strategies conform to the construction principle of productive cities.

As such, this thesis clarifies the concept of productive city, which refers to a multi-layer county system in pursuit of sustainable development that integrates multiple functions including agricultural production, industrial production, energetic production, special production, cultural asset protection and waste usage based on green production methods. Within the minimum range of every layer, productive city could actively explore the potential of urban production so as to satisfy local residents' demands of sustainable survival and development to the uttermost. Subsequently, this thesis perceives the characteristics of productivity, initiative, ecology, integration, locality and hierarchy in detail.

After figuring out the concept, this thesis summarizes resource production strategies in cities as mentioned above, such as breaking up "special exclusiveness" of resources to make production in all possible spaces and all-dimensional integration. Afterwards, followed by the presentation of resource production method applicable for external space of the architecture, corresponding design methods for communities and cities are also raised.

Key words: Urban Ecosystem, Productive City, Ecologically Productive Area, Urban

Agriculture

Dynamic Characterization of Resilience in a Metropolitan City

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Abstract: Resilience has been a very popular term in academic and public discourse. Resilience has more of a relationship with system dynamic change than with sustainability. But how can we describe the resilience of a complex system? We suggest that the relationship between quantity of local residents and "floaters" with different environmental elements can show the dynamic characterization of resilience. We define floaters as laborers who come from other provinces to live and work in Shanghai, China for several years, but they do not have local ID. While local residents are people who live and work in Shanghai, and have a local ID. We have chosen 10 environmental, social and economic variables to represent social-ecological systems (SESs). Environmental data were collected from Landsat data and MODIS data; social and economic data were collected from official Shanghai statistical yearbooks. We developed a framework of evaluation based on a modified "Resilience Alliance Model" to combine these 10 variables. We used a spatial autocorrelation analysis approach to examine pairwise correlations between the variables through five years, from 2000 to 2015, in Shanghai.

We found that local residents cluster strongly with other variables after year 2010, but the quantity of floating people did not cluster with environmental variables. In 2015, the quantity of floating people decreased by 100 thousands in Shanghai, suggesting that these people did not affect this metropolitan city as we have imagined. Over-population and pollution are serious problems in Shanghai, but the system can be resilient to such changes.

Key words: Characterization of Resilience, Spatial Autocorrelation Analysis, Evaluation Framework, Shanghai

Thermal Environment of Zen Gardens in Kyoto, Japan: As a Guide for Designing Urban Spaces

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Abstract: Local public parks and recreation services, as a space for relaxation, exercise and communication, are supposed to benefit communities, towns and cities.

However, local parks in cities like Kyoto, Japan where the weather in summer is muggy hot, in winter is chilly and damp are not welcome by residents unless the thermal environment is planned strategically. Understanding comfort conditions outdoors and how people feel thermally comfortable are necessary for designing spaces for public use. Studying successful places from the past which survived the test of time is one of the best ways to understand how to design outdoor spaces thermally comfortable. Kyoto is famous for its beautiful Zen gardens with long history. The way to admire the gardens, generally, is to seat at verandas attached to halls and enjoy the view. Therefore, they are satisfactory examples for studying the way to create comfortable thermal environment for sedentary activities. This study is conducted to reveal how Zen gardens are successfully reducing radiation absorption at verandas in terms of radiation plays the most considerable role in causing discomfort in hot summer. This goal is addressed through: (1) study the composition of elements in the gardens such as structures, vegetation and water areas; (2) measure MRT (Mean Radiant Temperature) at verandas and measure radiation temperature of objects surrounding the verandas.

Key words: Thermal Environment, Radation, Zen Garden

Patch Size of Trees Affects Its Cooling Effectiveness: A Perspective from Shading

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Abstract: Increasing urban greenspace, particularly trees, has been widely recognized as an effective means for urban heat mitigation. Lots of uncertainty, however, occurs on how spatial configuration of trees affects their cooling effectiveness. A frequently asked question from urban planners is that whether a large greenspace patch has better cooling effects than several smaller ones, or vice versa. Here, we attempted to address this question by investigating the effects of patch size of trees on the two key cooling processes: shading and transpiration. We chose two typical tree species, Ginkgo biloba and Populus tomentosa, with 4 different patch sizes, and conducted the research in Beijing. We integrated field measurements of air temperature, relative humidity and transpiration rate with model simulation, and conducted the analysis at both the patch and within-patch level. We found: (1) Smaller patches had higher temperature, lower humidity and greater within-patch variations in temperature and humidity than larger ones. (2) With a fixed area of tree cover, a number of small patches can provide more shade than a single large patch, suggesting a monotonic increase of shade provision with the division of a large patch in smaller ones. (3) There was a non-linear relationship between patch size and transpiration rate, suggesting a maximum

transpiration rate might occur at certain patch size. By considering the joint effects of shading and transpiration, an optimal size of patch might occur, at which the joint effects of shading and transpiration are maximized.

Key words: Greenspace Patch Size, Cooling Effect, Shading, Transpiration

The Ecosystem-Service Performance Analysis of the Three-Hills and Five-Gardens Area in Beijing, China

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Abstract: "Three-hills and Five-gardens" refers to the Xiangshan (Fragrant Hill), Yuquanshan (Jade Spring Hill) and Wanshoushan (Longevity Hill), as well as the Jingyi, Jingming, Changchun and Yuanmingyuan gardens and the Summer Palace (Beijing Municipal Planning Commission, 2002). They are located in the foot of the Western Hills of Beijing that breed Chinese imperial gardens owing to the pictured landscape of hills, sparking streams and paddy fields (Yue, 2014). The Three-hills and Five-gardens have such a great collection of royal-garden features immersed in the surrounding nature, and none of imperial gardens in northwest Beijing are better known than them (Liu, 2010; Qian, 2016). Thence, nowadays the Three-hills and Five-gardens area is used to describe the Western Hill imperial gardens, and has been protected as the cultural relic's sites.

However, with the long-time urban growth, the integral natural landscape of the Three-hills and Five-gardens surrounded by mountains, and rivers and paddy fields have been replaced by a jumble of urban communities, cultural & educational, and commercial lands (Liu, 2011; Qian, 2016). It becomes a tough challenge to protect these Chinese classical royal gardens in the way of isolated sites. So the Three-hills and Five-gardens have been hoped as the potential key network of green infrastructure that ecologically benefits dwellers in the Center of Beijing (Yue, 2014). But what kind of ecosystem services could the Three-hills and Five-gardens actually provide? How about these ecosystem service capabilities? And what might affect their ecosystem service capability? The above questions become the basis of planning the Three-hills and Five-gardens as the whole green infrastructure network system and sustaining even boosting their ecosystem services.

This work aims to evaluate the regulation and supporting service of the Three-hills and Five-gardens for optimizing their service capabilities as urban green infrastructure. Carbon sequestration, runoff reduction and air purification was here. Integrating the theory of Invest model and Citygreen model, this paper firstly developed an easier approach to quantify carbon sequestration, runoff reduction and air purification based

on land use types, tree species and vegetation coverage, as well as topography. Then this paper analyzed the relationship between ecosystem services and landscape patterns to reveal the main factors of affecting the ecosystem-service performance. The result showed that the carbon storage and the air-pollutant adsorption of unit area in Xiangshan are in turn greater than those in Yuquanshan, Yuanmingyuan and the Summer Palace, while the runoff reduction of unit area in Yuquanshan and Yuanmingyuan is significantly smaller than that in the Summer Palace and Xiangshan; additionally, all three above services in Changchun Garden are the minimal among the Three-hills and Five-gardens. It was also illustrated that the integrated capability of ecosystem services selected in this paper were dominated by dual pattern factors of land cover and topography. For example, the Summer Palace that has mountain forests connected to open water bodies could better perform comprehensive ecosystem services—either the carbon sequestration, runoff reduction or air purification, although neither of them is the highest.

It is hoped that this quantitative performance analysis could make a probe in the resilience of ecosystem services that cultural green infrastructure could provide, and results in this paper could help to make the conservation-development management decisions of the Three-hills and Five-gardens in the future.

Key words: Ecosystem-Service Resilience, Landscape Pattern Performance, Regulation and Supporting Service, Cultural Service

Ecological Effects of Green Space Dynamics on Urban Heat Islands

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Abstract: Understanding how green spaces affect urban temperature is crucial for assessing thermal benefits of landscape planning. This study investigated green space dynamics and land surface temperature (LST) in the Beijing metropolis. Results show that (1) the area of green space dynamics accounted for 38.24 % of the total research area. (2) LST change was not significant in the unchanged (0-0.19 ℃) and exchanged green space (in the range of -0.02 ℃ to 0.25 ℃). However, there were minor decreases of LST in areas of green expansion (in the range of -1.11 ℃ to -0.67 ℃) and major increases in LST in the areas of green losses (1.64 - 2.21 ℃). The results indicated that the number of green spaces is not the only criteria that should be assessed for temperature mitigation. Ecosystem services of temperature mitigation are not equal between the loss and expansion of green spaces even within same area. Greater focus on protecting natural forests in cities might provide greater benefits for climate mitigation.

Key words: Urban Heat Island, Landscape Pattern, Landscape Design, Ecosystem

Services

Evaluation of the Seed Supply Potential on a Roof by Using Artificial Perches

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Abstract: [Progress Report] Green roofs provide many benefits, such as better regulation of building temperature, reducing urban heat-island effects, improving storm-water management, providing habitats for urban wildlife, and preserving biodiversity. In Japan, most green roofs are constructed for the purpose of better regulation of building temperature and reducing urban heat-island effects. Moreover, approximately 50 percent of green roofs are covered with turf and sedum mainly in order to increase the area of green space. Thus there are few green roofs for the purpose of preserving biodiversity in Japan. One of the example of green roof preserving biodiversity is brown roof in Swiss land. However, that biodiversity is made up of herbaceous plant, not woody plants. One of the example of green roof aiming at preserving biodiversity by using woody plants is ACROS Fukuoka, in Fukuoka prefecture, japan. ACROS Fukuoka was built in 1995 and 75 species and 35000 plants were planted on the roof. Now there are 120 species and 50000 plants because of planting, and seeds provided by birds and wind. It can be possible to construct green roofs where seeds from birds and wind growing and increasing. However, there is no research about seed supply potential on roofs. Thus it is difficult to plan such green roof. Therefore, the purpose of this research is to measure the seed supply potential. This research has begun in October 2016 and it was conducted at Kyoto University, in Japan. The sites were on the ground and on the roof of the five-story building. On each site, 4 seed traps were placed. The seed trap was fitted with a 2 meter high pole. At the top of the pole, a perch and artificial plastic leaves and fruits was attached. Leaves and Fruits were attached in order to induce birds. The contents of the seed trap was collected once every 2 weeks to once a month and the seeds were identified. On the roof, more seeds supplied by wind while fewer seeds provided by birds were gathered. On the roof, there were many barriers, therefore it might be difficult for birds to find perches. As for on the ground, building around the site would prevent wind. This research will continue until December 2017. In this research, only one building was used because of permission. Thus data on different height should be gathered. Collecting data can propose new construction method of green roof.

Key words: Green Roof, Artificial Perch, Urban Biodiversity

Exploring GIS Model of Urban Heat Island and Scenario Approach of Ecological Planning: A Case Study of Jiuquan Downtown, China

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Abstract: Urban Heat Island (UHI) has substantial impacts on urban low-carbon operation and ecological maintenance. In order to support effective mitigation countermeasures, various simulation strategies are correspondingly proposed to reflect physical contributors of UHI. However, some models are technically unable to cover the phenomena that simultaneously influence UHI effect despite their unique validness; besides, few modelling design is focusing on predicting future UHI that crucially varies with functioning ecological elements. This paper was to introduce a spatially explicit GIS model that integrates the advantages of multiple indexes, and apply the evaluated model to instruct the deployment and to inspect the performance of an ecological planning against UHI.

Under functional grain size, the dark surfaces with net heat absorption, the extra heat sources from human activities and the reduced air flows among urban structures are commonly recognized as three fundamental contributors of UHI effect. Accordingly and to enable both current and planning researches, solar radiation potential, extra heating intensity and land surface roughness were consulted as key variables to model UHI effect at identical scale. The potential incoming solar radiation was derived via area solar radiation modified by surfaces' photosynthetic absorption and solar reflectance index, while the intensity of extra heat sources was identified by the type and intensity of land use, both to composite the initial heat pattern that triggers air temperature rise. Positively correlated to the impedance of air movement, the land surface roughness was parameterized via structures' frontal area index zoned by hexagonal meshes. The model subsequently conceptualized theory of downdraught cooling and analogized methodology of least cost path, to spatially quantify ventilation influence on the initial heat that determines air temperature rise.

The Qiuquan downtown area, China, was exemplified to demonstrate such UHI modelling roadmap in a specific kind of cities at high altitude flat site featuring temperate arid and semi-arid climate. The argument relations in model were presented, formulated and evaluated based on those unique geo-patterns and local climate. As benchmark of the numeric simulation output, surface radian temperature data were obtained from remote sensed thermal images of the study region under temporal similarity. The spatial correlation analysis practically validated the ultimate model, the output data of which in one fit method were significantly compatible to that of Landsat TM/ETM+ near ground during several high temperature periods.

In application section, the model was employed first to recognize existing defects as the deployment instructor of UHI mitigation planning by assessing the current condition, then to exam the mitigating effectiveness of such planning by comparing the scenario assessment result with the current baseline. As conclusion, the implemented ecological planning would promote ecosystem services by reversing high UHI in some places and preserving low value in some others. Basically, engagement of integration model in the heuristic scenario could assist more resilient spatial decision against UHI issues which varied dynamically and systematically with ecological changes. Furthermore, the GIS-based algorithms could technically facilitate those UHI assessments at city scope of ecological planning which required huge computation capacity and instant information acquisition.

Key words: Urban Heat Island, Spatially Explicit Model, Least Cost Path, Scenario Planning

Temporal and Spatial Characteristics of Spontaneous Plants Niche Width and Niche Overlap in Beijing Olympic Forest Park

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Abstract: To identify the temporal and spatial distribution characteristics of spontaneous plants interspecific relationship in urban parks and provide helpful references to biodiversity conservation and low maintenance planting design in future urban landscape, we took Beijing Olympic Forest Park as an example. 123 sample plots were using a 200 meters' grid placed over the park. Each plot is a 20m×20m square, and all plots were surveyed 7 times from March to November in 2015. Combined with the calculation of niche width of 56 main species and niche overlap between 10 species, the research ultimately reveals the temporal and spatial characteristics and landscape features of the spontaneous plants in this urban park. A total of 128 plant species were recorded belonging to 98 genera and 32 families. Among them, the tenth species with the maximum frequency, such as Lagopsis supine, also have relatively high ornamental values. In spring, summer and autumn, niche width of different species showed distinctive dynamic characters. Species niche width in roadside and woodland were the highest among all habitats, and Setaria viridis, Taraxacum mongolicum and Crepidiastrum sonchifolium were generalists with the highest niche width value. Temporal and spatial patterns of niche overlap demonstrated that with the change of season, the utilization of resources in different species tended to be differentiated, and there was more fierce competition between the community of roadside and waterside. Niche overlap between species showed different temporal and spatial patterns, with the

highest overlap between Viola prionantha and Orychophragmus violaceus in April (0.520), S. viridis and Chenopodium album in June (0.362), V. prionantha and O. violaceus in August (0.516), and S. viridis and Plantago asiatica in November (0.739). The lowest overlap were between S. viridis and Potentilla supina in April (0.007), Potentilla supina and L. supina in June (0.017), C. sonchifolium and L. supina in August (0.003), and C. album and Inula japonica in November (0.000). Revealing the characteristics of species temporal and spatial distribution characteristics will be of great value to the plant choice and design of sustainable and low maintenance landscape with high biodiversity.

Key words: Interspecific Relationship, Diversity, Distribution, Low Maintenance

Assessing Structure, Function and Value of Street Trees in Dalian, China

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Abstract: Urbanization adversely impacted the environment and quality of life in cities. Street trees, account for a relatively small fraction of urban forest, but are prominent due to its impacts on improving environment quality, saving energy and reducing stormwater runoff. However, ecosystem services and values of street trees are often disregarded because their monetary worth is unknown. Thus, it is important to quantify the ecosystem services benefits of street trees. In this study, we quantified structure and function, as well as value of street trees in Dalian by using a computer tool - i-Tree Street model. The street trees in Dalian are dominated by Ginkgo biloba, Platanus hispanica, Sophora japonica, which together account for 63% of the 77,492 trees (mainly composed of small and medium trees). The structure value of these trees is estimated at $208 million. The annual value of all ecosystem services is $4.8 million ($62.1 per tree), including energy savings ($1.9 million), carbon dioxide reduction ($0.1 million), air quality benefits ($0.5 million), stormwater runoff reduction ($0.6 million), and property value benefits ($1.7 million). We also found that tree species and ages have an important effect on the ecosystem services benefits. Our study demonstrates that street trees can make a great contribution to enhance ecosystem health and promote a better quality of urban life. Information on structure, ecosystem services and their benefits of street trees can be useful tools for trees planning and management.

Key words: i-Tree Streets, Urban Forest, Ecosystem Services, Tree Benefits

T3-03: Biological Adaptation in Urban Environments- Drivers, Responses and Implications for Future Cities

Building Urban Landscapes That Facilitate Biological Adaptation in Organisms

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Abstract: The development and growth of cities around the world is significantly impacting both local and global biodiversity. Urban areas create environmental conditions that can exert new and novel selective pressures on organisms, and often under accelerated timeframes compared to more natural environments. There is a growing interest in understanding the role of biological adaptation and micro-evolution in filtering the non-human species that persist in urban areas or which become locally extinct. Understanding the biological adaptations that allow organisms to persist in these landscapes has the ability to contribute not only to our understanding of urban ecological systems, but also to our fundamental knowledge around biological adaptations of organisms more broadly. This information will be critical if we are to design and manage urban environments under the pressures of global climate change and rapidly expanding populations of people living in cities and towns. In this presentation, we review the existing evidence around biological adaptation and micro-evolution of organisms in urban environments, present a framework for approaching future research, identify critical research questions and discuss how this knowledge might contribute to the development of urban landscapes that are better able to allow organisms to survive, adapt and persist. We also highlight the urgent need to refine the terminology currently used to describe the adaptation of organisms to urban environments in order to improve scientific understanding and more effectively identify and communicate the actions required to create biodiversity and adaptation friendly cities and towns for the future.

Key words: Urban Ecology, Biological Adaptation, Ecology for Cities

Comparing How Urban Context Influences Functional Traits across Taxonomic Groups

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ABSTRACT: Urban environments exert a range of pressures on the organisms that encounter them. These pressures range from chronic impacts, such as habitat loss and the urban heat island, through to acute impacts such as pesticide applications, and new lighting installations. Different organisms can respond to these impacts in multiple ways. From a life history perspective, this can include changes in feeding opportunities or behaviour, movement or dispersal patterns, or the likelihood of successful reproduction. Understanding which of these life history related traits are most influential for different taxonomic groups, and whether there are consistent patterns in the response across multiple groups provide important insights into how we can soften urban landscapes to allow a greater diversity of species to share our cities with us into the future.

This presentation outlines a project led by members of UrBioNet: a global network for urban biodiversity research and practice funded through the US National Science Foundation's Research Coordination Network (RCN) program. UrBioNet is developing a global database on urban biodiversity and hosting several other initiatives to connect urban ecology research and practice around the world. This project addresses the question: *Does the urban context (of a site) influence the functional traits of multiple taxonomic assemblages in consistent ways?* In the spirit of the Research Coordination Network program, which aims to increase collaborations around the world, we are inviting anyone interested in contributing to this project to participate, and we have established a simple and transparent system to manage this large-scale collaboration. This presentation will introduce the project in greater detail, and outline

the process through which any interested parties can become involved.

The Influence of Multiple-Scale Habitat Structure on Bird Community in Urban Parks

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Abstract: There have been 438 bird species recorded in Shanghai since early 20th century, 85.2% of which are migratory birds. Thus, protecting birds in Shanghai not only benefits the local biodiversity, but also promotes bird conservation throughout the entire migratory region. Urban parks are one of the main types of urban green space and they are important habitats for wild birds. Improving the vegetation composition and structure was a feasible and efficient method for improving bird conservation in urban parks. This study may explain how the bird community responds to different vegetation compositions and provide important insights urban re-vegetation with respect to biodiversity conservation in a city experiencing rapid urbanization.

On microhabitat scale, multiple linear regression models confirmed that both vegetation complexity and structure had significant positive effects on the bird community composition. Moreover, we confirmed that the vegetation horizontal coverage, particularly the horizontal shrub coverage was essential to birds living in heavily human disturbed areas.

On vegetation components scale, we concluded that trees were one of the most important vegetation components that enhance the bird species richness and diversity in urban green spaces because they provide roosting, nesting, hiding, and foraging sites. The shield function of shrub cover was an important habitat component and the ground layer provided food resources to bird community.

On habitat type scale, our research emphasized that habitat types significantly influenced the structure of bird communities in the urban parks in Shanghai.

On patch inside parks scale, multiple linear regression models confirmed that there was significant positive correlation between bird richness and the number of Water patch (WNP) and Grassland patch shape index (GSI). There was significant negative correlation between bird richness and the largest patch index (LPI).

On urbanization scale, urbanization level index was positive correlative with Corvidae and the dominance of dominant bird species. However, Urbanization level index was negetive correlative with Pycnonotidae, Laniidae, Emberizidae, Aegithalidae and winter resident. Homogenization appeared along the urban gradient. The dominance of dominant bird species became more dominant along the urban gradient.

Key words: Bird Community, Urban Parks, Scale, Urbanization

No Evidence of Adaptation to Ecological Traps in Urban Odonates

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Abstract: Organisms have adapted to use a range of environmental cues for selecting the optimal habitat. However, recent anthropogenic disturbance can reduce the quality of the environment, although the cues for habitat choice may remain unchanged. Thus, the environmental cues are no longer reliable, leading to poor habitat choices – even when optimal habitats are available – and the behaviour for habitat selection becomes maladaptive. This is known as an "ecological trap", and can lead to population declines or even extinction. In the case of dragonflies and damselflies (the Odonata), horizontally polarised light is used as a cue for detecting suitable water bodies. However, many other surfaces strongly reflect horizontally polarised light, such as cars, gravestones, and solar panels, which mislead odonates in ovipositing on these surfaces. Many of these polarised-light-reflecting surfaces are frequently found in cities, which increase selective pressures in urban populations. Moreover, previous studies have shown age-induced shifts in the polarotactic behaviour of odonates, with young adults avoiding polarised light (i.e. negative polarotaxis) and sexually-mature adults showing positive polarotaxis, making older adults particularly susceptible to ecological traps. Here, we investigate the potential of odonates to adapt to ecological traps in urban areas and the role of ontogeny in this response. We compared the strength of the polarotaxis between urban and rural odonate populations using (i) multiple-choice field experiments in sites of urban-rural land classes using test surfaces of various light-reflecting characteristics, (2) laboratory dual-choice experiments to test preference for horizontally polarised light against non-polarised light on the Blue-tailed damselfly (Ischnura elegans); (3) laboratory dual-choice experiments using reared I. elegans from a common garden experiment to evaluate the role of phenotypic plasticity and to analyse the association between ontogeny and polarotaxis in odonates. The results from the field and laboratory experiments using field-caught adults showed that rural individuals have a significantly stronger preference for horizontally polarised light compared to urban individuals. However, the results differed vastly when the individuals from the common garden experiment were tested: adults show a strong preference for horizontally polarised light with increasing age, but no difference between urban and rural populations was found. This suggests ecological traps exert a strong selective pressure on urban odonates, and though urban populations showed a lower affinity towards horizontally polarised light compared to odonates from rural areas, this behaviour was not found to have a genetic component. This could be due to the short time period of contact with these novel surfaces in an evolutionary context,

which is insufficient for populations to adapt and, in turn, can lead to abrupt population declines and/or extinction. However, phenotypic plasticity may play an important role in order to avoid ecological traps, possibly via ontogenetic shifts in the polarotactic response. To conclude, we highlight ecological traps as a prominent threat particularly to urban populations, and mitigating the negative impacts of ecological traps in urban wetlands is imperative in order to maintain stable populations in urban areas.

Key words: Polarotaxis, Plasticity, Ontogenetic Variation, Dragonflies

Effects of Dissolved Organic Matter from Sewage Treatment Plant on Plankton Community in Large Urban River

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Abstract: Dissolved organic matter (DOM) is an organic continuum or mixture with different structures and molecular weights. DOM in aquatic systems originates from a range of sources. Allochthonous DOM transported from the surrounding landscape to the water body, is influenced by the geology, land use and hydrology of its origin. Other DOM sources are created in situ through aquatic plants', planktonic (phytoplankton and zooplankton) and microbial activity, which may provide an independent source of organic matter, or a recycling mechanism for that which has been transported to the water body. Human activity is also an important source of DOM, much of which is believed to be labile, which can enter the aquatic system through direct point discharges, diffuse leaching and aerial dispersal. These different sources of organic matter are important sources of nutrients in the aquatic environment, and often combine with metal elements and organic pollutants. Therefore, their quantity and quality can affect the growth and metabolism of various organisms (phytoplankton and zooplankton) in the aquatic environment. In the present study, to analyze the impacts of DOM influx from the sewage treatment, particularly composition of DOM, on the dynamics of water quality and plankton community in large urban river (Han River, South Korea), we used the fluorescence spectroscopic techniques to measure the DOM of water and plankton. Fluorescence spectroscopy can provide reliable tool to measure the structure characterization of DOM, and to monitor and understand DOM transformations in aquatic systems. Water and plankton (phytoplankton and zooplankton) samples were taken from the main channel of river with two treated sewage water releasing points. The relationships among water quality, plankton community structure and introduced DOM were analyzed, and the impacts of DOM on biological community of large urban river was estimated.

Key words: Fluorescence Spectroscopy, Dissolved Organic Matter (DOM),

Zooplankton, Han River

Comparison of Resistance against Environmental Stress Factors between Endemic Fish Species in Asian Countries and Invasive Largemouth Bass.

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Abstract: The introduction of alien species occurs frequently around the world for a variety of reasons, including commercial purposes. Some exotic species successfully settled down and often became dominant species. Such a successful establishment of exotic species may result in negative impacts on endemic species and consequently affect the regional biological diversity. As a representative example, largemouth bass (Micropterus salmoides) was widely spread after it was introduced in Korea and Japan, and became one dominant species in most Korean rivers and lakes. To prevent the spread of exotic species, studies on the ecological characteristics of species related to the influx, diffusion and settlement are very important. Especially, in aquatic ecosystems where various environmental disturbances are existing such as eutrophication and chemical pollutions, tolerance to environmental stress can be a key factor determining the successful settlement and distribution of exotic species. This study aimed to compare the species-specific tolerance to environmental stresses of exotic species and endemic species quantitatively, and estimate the competitive potential of exotic species when environmental disturbance occurs. We selected largemouth bass as a target exotic species, and Asiatic ricefish (Oryzias latipes) as representative endemic species. Common carp (Cyprinus carpio), which is known to be resistant to environmental disturbance, was also included in the study. As quantitative indicator of the stress level, cortisol, a hormone known to be elevated in blood levels, and Heat Shock Protein (HSP), a protein that maintains homeostasis from shocks caused by various stress factors were used. As the disturbance factors, conceivable combination of environmental stresses including chemical pollution and water temperature was tested. The stress levels of three fish species under different concentrations of potassium dichromate ($K_2Cr_2O_7$), which is used as a standard toxic substance in the OECD fish acute toxicity test, were measured using cortisol and HSP. The effects of the water temperature and their combined effects were also tested through long-term culture experiments. An individual container was used to observe the growth rate of the individual and measured environmental stress indicator at 20℃, 25℃, and 30℃ with different concentrations of potassium dichromate. For the test of temperature, the water temperature was increased by 1℃ per day from 20℃ to target

temperatures. The relationships among growth of fish species and quantified stress levels were analyzed and the species-specific sensitivities were determined.

Key words: Invasive Species, Micropterus Salmoides, Water Temperature, Heat Shock Protein (HSP)

Spectral Characteristics of Purple Sunbird Calls in Urban Habitats of Delhi, India

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Abstract: Birds habitats are modifying due to the rapid development of town areas. An important characteristic city is anthropogenic noise emitted from vehicles and machines. These noise hampers the vocal communication occurring between individuals of different species living in the urban areas. Purple sunbird (Nectarinia asiatica Latham) is a common bird species found across different habitats like garden, groves, cultivated and scrub country as well as light deciduous forest. It is very easily seen in urban gardens, park and on road side plantation. So spectral characterization of its calls was assessed to understand the acoustical adaption of Purple sunbird. The calls were recorded in morning from 6am to 9am at different urban sites from 10th March to 10th April. We analysed calls of 20 different male Purple sunbird found in different habitats and spatially 500m apart. The calls were recorded in Sound Device T722 recorder via Monodirectional ME67 Sennheiser microphone. The calls were recorded in .wav format and then spectrograms were prepared on Raven Pro1.5 Software. It was found that the Purple sunbird song bouts have three different types of syllables. First introductory note is of very short duration of 0.04 secs and in frequency range of 4000 to 6500 Hz. This is followed by note of small frequency range from 5000 to 6500 Hz but of longer duration of 0.165secs. The third type of note has wide frequency range from 3000 to 7000Hz and duration is also long for 0.1 secs. These three different notes were found in all recording of the 20 individuals. The results suggest that the high and wide frequency range of vocalization is a mode to overcome the masking effects of anthropogenic noise. The results are in support of Acoustic adaptation hypothesis given for birds living in noisy habitats.

Key words: Anthropogenic Noise, Purple Sunbird, Acoustic Adaptation Hyopthesis, Spectrogram

Spatial and Temporal Effects on Railway Use and Movement by Grizzly Bears in Banff National Park

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Abstract: Wildlife-vehicle collisions are a known source of mortality for various species, and the awareness has led to widespread mitigation measures that have successfully reduced road-associated mortality. Unfortunately, railways have been largely overlooked, despite a growing reliance on rail transport and high rates of wildlife-train collisions, including for species of conservation concern. This situation occurs in Banff National Park, where train collisions are currently the leading cause of recorded mortality for a threatened population of grizzly bears whom inhabit a heavily human-dominated landscape. We analyzed an eight-year data set from GPS-collared grizzly bears and modelled railway selection using resource selection functions with habitat, human use and topographical covariates. Further, we explored if particular types of habitat use may infer greater collision risk, e.g. locations where bears travelled along versus crossed the railway line. Our results indicate that bears tended to enter the railway in areas with high habitat productivity that are close to areas with anthropogenic food, but not close to high concentrations of people. Further, bears were more likely to demonstrate prolonged railway use when alternative travel routes were constrained by steep terrain. Railway use was more apparent in the spring and fall seasons, which are periods associated with high caloric requirements for bears. And, movement speed was slower on than off the railway, suggesting that bears may be seeking out rail-associated forage. Taken together, results to date suggest that bears select the railway where forage (natural or train-spilled grain) occurs in combination with rugged topography. Lastly, we did not find a strong or significant correlation between locations associated with concentrated railway use or movement and previous bear-train collision locations, which makes predicting future mortalities and location-specific mitigation suggestions an ongoing challenge.

Key words: Grizzly Bear, Train Collisions, Resource Selection Functions, Banff National Park

Vascular Plants Established on the Masonry Stonewall for Regional Biodiversity Conservation and Enhancement in Urban Chongqing, China

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Abstract: Chongqing is the world's largest mountain city with slope accounts for 93% of the area. To maximize useable area, hundreds of stone retaining walls of various dimensions were widely built to support the unstable slopes in the process of urban construction. Besides, the downtown area holds different construction periods of the ancient city wall with varying well-preserved degrees. Such vertical habitats, using traditional techniques, have permitted many kinds of spontaneous plants growth, including large trees up to 20 m tall. In recent decades, the traditional construction method has been abandoned and replaced by modern reinforced concrete structures, and many walls have been brought deleterious modifications to or demolition. The walls-cum-vegetation has become a precious and irreplaceable natural-cum-cultural heritage.

Since June 2016, some 370 walls with notable woody plant colonization in urban district were studied. We explored the diversity of all the vascular plant species along the wall base upwards to top of the stone walls, synoptic assessment of habitat properties, and relationship between habitat factors and vegetation occurrence. Further analyzed dispersal mechanisms of these colonized plants.A total of 178 species of vascular plants were recorded.belonging to 124 genera and 80 families. Of these, there were 121 monotypic genera and 41 monotypic families. The tree flora is dominated by Moraceae.and particularly Ficus virens and Broussonetia papyrifera. The dominant species of herbaceous plants are vines (Parthenocissus tricuspidata, Anredera cordifolia) and ferns (Pteris vittata, Cyrtomium fortunei).

Chongqing locates in mid-subtropical, compared with Hong Kong’s masonry wall trees investigation in southern subtropical and Nanjing’s diversity of vascular plants in the ancient city wall in northern tropical , to comparaed between different climatic zone compared with Hong Kong’s masonry wall trees investigation in southern subtropical and Nanjing’s diversity of vascular plants in the ancient city wall in northern tropical, to concluded that the difference of plant diversity between different climatic zone.

As a consequence of extensive urban development and intensive human activities. The vegetation has been damaged severely in the urban area .Stonewalls has become the precious seedlings and root sprouts of native species. Which implies that they play important roles for maintaining the regional biodiversity.

Now, perpendicular afforest has become a hot topic, and the vegetation of stone wall can decorate the drab neighborhoods, increase the type and coverage of city green space, also increase the eco-efficiency. Screening of native species which fit the local climate is an excellent choice. The findings would improve knowledge of a special and valuableurban habitat and its biota, also could inform management and conservation of the urban ecological heritage.

Key words: Masonry Stonewall, Biodiversity Conservation, Urben Chongqing, Natural-Cum-Cultural Heritage

The Influences of City- and Local-Scale Factors for the Urban Thermal Environment\

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Abstract: The thermal environment influences many biophysical processes, such as phenological characters of plants, behaviors of animals and the hydrologic cycle. Through these processes the thermal environment further influences patterns of organisms and ecological processes at a larger scale. Conversely, factors at different scales also influence the thermal environment. Under the circumstances of climate change and rapid urbanization, not only human beings but also some animals and plants would have to adapt to the urban thermal environment. Therefore, understanding the patterns, drivers and impacts of the urban thermal environment becomes more and more important for the sustainability of our planet. Through a study of air temperatures of cities in China, we found that the urban heat island (UHI) was influenced greatly by many factors and showed no obvious patterns when the city size was small. When the city size was bigger, the intensity of the UHI decreased a little at first and then increased along with the city size. The intensities of the UHI of different cities varied greatly when city size was small, and it might partly due to the impacts of the local-scale factors. Through a further case study of Beijing, we found that the city size at the city-scale and the proportion of the developed land at the local-scale both influenced air temperatures but their relative importance changed over time. When the city size was small, the local-scale factor was more important, especially when there was more greenspace locally. If not, the city-scale factor would cause heat stress in summer. When the city size was large to some extent, the local-scale factor was not significant anymore, and the city-scale factor became the overwhelming factor for the air temperature. These results suggested that small cities could improve their thermal environment by adding more greenspace or modifying the landscape patterns at the local scale, but as for big cities, controlling their sizes would be more effective for cooling.

Key words: Air Temperature, Urbanization, City Size, Scale

Photosynthetic Responses of Urban Greening Trees to Light Intensity and CO_2 Concentration under Different Types of Pavements

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Abstract: Studies about photosynthetic responses of urban greening trees to light

intensity and CO_2 concentration under different types of pavements are still limited. A field experiment was designed with three treatments: the control (the non-paved), pervious pavement and impervious pavement, and the leaf light and CO_2 response curves of net photosynthetic rate of two common greening trees (Fraxinus chinensis Roxb and Acer truncatum Bunge) in Beijing were measured in the 4th year after planting. Results showed that the leaf light and CO_2 response curves of net photosynthetic rate of F. Chinensis and A. truncatum were better fitted by the modified rectangular hyperbola models. The maximum net photosynthetic rate of F. chinensis significantly decreased under impervious pavement, it was mainly because that the initial carboxylation rate reduced significantly indicating Rubisco activity was inhibited, the saturated intercellular CO_2 concentration decreased significantly, and the light respiration rate significantly reduced which inhibited the protection mechanism, avoiding the damage of photosynthetic apparatus and the decline of photosynthetic electron transport and light phosphorylation, of light respiration by using excess energy. The maximum net photosynthetic rate of A. truncatum also decreased significantly under impervious pavement, the main reasons were that the light saturation point dropt significantly which means light inhibition would happen more easily, the photosynthetic ability significantly decreased which inhibited the photosynthetic electron transport and phosphorylation activity, the initial and the maximum carboxylation rates were significantly reduced indicating Rubisco activity was inhibited, and the triose phosphate utilization efficiency decreased significantly which inhibited the RuBP regeneration. No obvious impact of pervious pavement on response parameters of F. Chinensis and A. Truncatum was found, indicating adopting pervious materials on hardening pavements may not significantly restrict the growth of certain urban trees.

Key words: Impervious Pavement, Photosynthesis, Response Parameter, Urban Tree

Human-Modified Landscapes: A Potential Habitat for Conservation of Baya Weaver (Ploceus Philippinus) in Northeast India

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Abstract: The homegardens are very common human-modified land use system in Assam. The current study was undertaken to understand the contribution of these systems in conservation of Baya Weaver (Ploceus philippinus). The type of host trees, height and diameter, location and spatial arrangement of host trees chosen for nesting and the number of complete and helmet stage nests were taken in account for this study. A total of 2357 individuals of potential host trees for nesting of P. philippinus were

found belonging to Areca catechu (2272), Cocos nucifera (56), Phoenix sylvasticus (13) and Borassus flabellifer (16). Among 2272 individuals of A. catechu, 96.5% (n=2192) and 3.5% (n=80) of individuals were arranged in block and row pattern respectively. Out of these 80 individuals of A. catechu planted in row pattern, 47.5% (n=38) had nests (complete and helmet stage) on them. In total, 293 nests (both complete and helmet stage) were observed in A. catechu, out of which, 46.1% (n=135) were complete nests. It was found that Areaca catechu planted in single row was the most preferred tree species for nesting by P. philippinus among the other plant species. The homegarden owner's value this bird species for its ecological role as a natural biocontrol agent and were tolerant to the activities of the bird in their homegarden. This study therefore suggests that homegardens can be potential nesting habitat for conservation of P. philippinus.

Key words: Homegarden Agroforestry Systems, Human-Modified Land Use, Baya Weaver, Areca Catechu

Microclimatic Variations of an Abrupt Urban Forest Edge

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Abstract: Fragmented forests result in various forest edges, and the microclimate which may affect biotic components within the forest edge were different from the forest interior, especially under extreme weather condition. Suitable management of forest edges enables the support of the interior forest, especially in protecting the remnant forest in urban areas. In order to know how the microclimate varies in abrupt urban forest, we conducted our research in an abrupt forest edge of Seoul. We chose air temperature, relative humidity, soil temperature, soil moisture, photosynthetically active radiation (PAR) and leaf area index (LAI) as factors, and analyzed the variation of each factor across the forest edge. The result showed that each factor had different gradients influenced by forest edge. Significant differences were found in relative humidity at within 30m and air temperature within 20m; soil temperature, soil moisture and PAR had the smallest influence by 10m and no significant differences of LAI was found from the forest boundary to the interior forest. Temporal variation was calculated by air temperature and relative humidity showed that it varies throughout the day, and the peak values were found late in the afternoon. Finally, we also discussed the main drive factors of this phenomenon and how it can be used for managing the forest edge zone.

Key words: Edge Effect, Urban Forest, Microclimate

Estimation of Multiple Environmental Stress Using Biomarkers: Quantitative Approach Using Daphnia Magna under Temperature Stress and Presence of Kairomones

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Abstract: In aquatic environment, a variety of stresses coincidently effects on living organisms. Given the interactive effects of environmental stress (additive or synergistic), aquatic organisms can be seriously affected even under a low stress condition. However, the existing endpoints used for assessment process are mainly focused on a severe stress level for population persistence (mortality or decreased reproductive rate). Such extreme endpoints often do not cover the low-level effects of environmental stress. In addition, aquatic community are intricately structured from many organisms, it is necessary to consider the effects of biological interaction (eg. predation) on other environmental stresses. Therefore, it is important to develop integrative approach from which to predict the effects of multiple stressors under a low-level stress condition. Temperature is a dominant factor determining population dynamics and a major projective stress in the future scenario due to on-going global warming. The presence of predator determines a community structure, and its direct and indirect impacts, such as release of info-chemicals (eg. kairomones) were often studied as important factor affecting the prey organisms. These factors may effect on organisms interactively. Daphnia magna can be used as suitable species for the estimation of the both effects since it has high sensitivity to various environmental stresses and play an important role in freshwater ecosystems as a primary consumer. In the present study, we estimated the low-level effects of elevated temperature and the presence of kairomones on D.magna by experimental and quantitative approaches using three biomarkers. First, in order to determine the single stress effect, Daphnia neonates were separately exposed to each stress with different levels. During exposure periods, individual growth patterns were analyzed. To test the low level stresses quantitatively, we used decreased aerobic metabolisms and energy reserves (as fatty acids), and elevated expression of heat shock proteins (HSPs) as biomarkers expected to be available for detection and evaluation of low-level environmental stresses. As a second step, the interactive effects of the two stresses were tested by multiple exposure experiment with the measurement of biomarkers. The liner relationship between the growth of D.magna and the measurement of biomarkers were estimated.

Key words: Multiple Effect, Aerobic Metabolisms, Fatty Acids, Heat Shock Proteins

The Effect of Urban Expansion on Waterfowls in Kunming City, SW China

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Abstract: The adaptation of waterfowls to the wetland changes caused by urban expansion is an important issue in the world today. Urban expansion of Kunming city over the past 40 years experienced the process of far from, close to and around the Dianchi Lake in the southern suburbs, the wetlands suffered reclamation, occupy, pollution and reconstruction, causing significant impact on waterfowls in the wetlands. Based on field data collected at 34 sampling sites for 24 consecutive months around the Dianchi Lake, it was recorded 122848 waterfowls which belonged to 67 species and 14 families, of which 26 species were wintering migrants (accounted for 38.81%) and 19 species were passing migrant bird, (28.36%), and the dominant species were Black-headed Gull(Larus ridibundus, accounted for 77.17%), Coot (Fulica atra, 8.81%), Moorhen(Gallinula chloropus,3.67%) and Little Grebe(Tachybapus ruficollis,3.28%). Effect of urban expansion on waterfowls were mainly in 3 aspects. The changing habitats modified waterfowl clusters, CCA analysis showed that the axis I divided the 34 sampling sites in 3 classes, built wetland park, under construction wetlands and pastureland and cultivated lands, and the corresponding waterfowl groups were those preference for human habitats, wetland forest and grass, mud beach, and no preference; Waterfowl species changed, 8 species recorded before disappeared while 13 species new-record were found. Waterfowls distributed differently, Black-headed Gull foraged in urban areas moved to the suburbs wetlands along the lake shore where human population crowded, shorebirds assembled in artificial mire habitats, and the geese, ducks and other wintering birds decrease, scattered or avoided the human crowds. In general, urban expansion of Kunming city created special habitats for more waterfowls, especially those favored for human interference, but expelled the timid waterfowls. Enough natural wetland habitats with little human interference should be protected or reconstructed for waterfowls during urban expansion.

Key words: Urban Expansion, Waterfowl, Natural Habitats, Human Interference

THEME 4

Biogeochemical Cycling and Ecosystem Health

T4-01: Understanding Ecosystem Carbon Dynamics from Field Manipulative Experiments

Effects of Thinning on the Understory Vegetation Community and Its Photosynthetic Characteristics in a Subtropical Pinus Massoniana Plantation

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Abstract: Thinning affects understory vegetation communities and their photosynthetic characteristics by changing the environment, especially light and soil conditions. The residual effects at different times post-thinning remain poorly quantified, however. We investigated the effects of thinning (25% basal area decrease) in a subtropical Pinus massoniana plantation at two post-thinning times: 0.5 (T0.5-yrs) and 2.5 years (T2.5-yrs). Thinning significantly increased understory vegetation density (+104.9% and +142.4%) and aboveground biomass (+191.1% and +239.2%) at T0.5-yrs and T2.5-yrs. Thinning also significantly increased the Shannon-Wiener index and Pielou index of the understory vegetation, and decreased the Simpson index. Species richness significantly increased at T0.5-yrs, but it decreased by T2.5-yrs. Thinning improved new-leaf and old-leaf carbon fixation capacity of three dominant plants (except Woodwardia japonica old-leaf). The photosynthetic characteristics of these species showed no response to environmental changes following thinning, although they exhibited some common changes with respect to leaf morphological attributes and chlorophyll content. Thinning influenced leaf photosynthetic activity primarily via increasing new-leaf length or width and reducing old-leaf chlorophyll b concentration at T0.5-yrs, while reducing new-leaf length, specific leaf area, and all leaf chlorophyll concentration at T2.5-yrs. These results provide new insights in how forest biodiversity and carbon balance respond to management measures.

Key words: Thinning, Understory, Vegetation, Community, Photosynthetic, Characteristics, Pinus Massoniana Plantation

Variation of Tree Allometry across Forests in Central Africa and Its Consequences on the Estimation of Biomass and Carbon Stocks

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Abstract: Quantifying the biomass and carbon stocks contained in tropical forests has become an international priority for the implementation of the REDD+ initiative. There is an urgent need for accurate methods to estimate this important biomass and carbon stock, and monitor biomass and carbon stock changes. Many techniques exist to estimate forest biomass at different spatial scales, but all ultimately rely on allometric equations calibrated on destructive measurements of individual tree biomass, in order to convert forest inventory data in biomass estimates. For many tropical forest ecosystems, that are structurally complex and species rich, these allometric equations have not yet been developed and general allometric equations (models calibrated on biomass data from all regions and all types of tropical forests) are being used instead, with possibly local adjustment of tree height-diameter allometry with non-destructive data. Variation in height-diameter allometry and in crown-diameter allometry across forest types and environmental conditions have been demonstrated to be of extreme importance for the estimation of biomass and carbon stocks in tropical forests, but yet poorly explored in central Africa. In this study we aimed to determine the variation in tree height-diameter and crown-diameter allometry across central African forests and the consequences for biomass and carbon stocks. Tree allometry data were systematically collected in two of semi-deciduous forest sites in northern Republic of Congo that have vastly different substrate and soils (clay soils on quartzite and sandy soils on sandstone plateau), and forest communities, but similar rainfall regimes (~ 1700mm and a 2-3 months dry season). These data will be analyzed to test two hypotheses: (i) tree allometry strongly varies across forest types with contrasted environmental conditions (and specifically soils), and (ii) both allometry and forest structure contributed to the greater biomass of the site on rich soil (quartzite substrate). Our newly collected data for two sites in northern Congo will be confronted to existing allometry and inventory data available elsewhere in the Congo basin (including our previous work in Cameroon) to get a broader picture of allometric variations and its consequences for the estimation of biomass and carbon stocks.
Key words: Biomass, Allometry, Central Africa, Rainforests

Experimental Throughfall Reduction Barely Affects Soil Carbon Dynamics in a Warm-Temperate Oak Forest, Central China

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Abstract: Changing precipitation patterns could affect soil carbon (C) cycling in

China's forests. A throughfall reduction (TFR) experiment was conducted in a warm-temperate oak forest in central China to examine effects of reduced summer (May – Sept) precipitation on total soil respiration (SR), heterotrophic soil respiration (HR), autotrophic soil respiration (AR), soil microbial biomass, and fine root biomass from 2013 to 2016. Rain-out shelters excluded ~ 50% of the growing-season, and ~ 30% of the annual throughfall. Although soil moisture was significantly reduced during TFR (May – Sept), microbial biomass and HR remained unaffected. SR, AR, as well as fine root biomass increased during TFR in a comparable dry year, but remained unaffected during all other years. Annual rates of SR (TFR: 5.7 - 5.8 ton ha^{-1} y^{-1}; control: 5.0 - 6.0 ton ha^{-1} y^{-1}), HR (TFR: 4.2 - 4.9 ton ha^{-1} y^{-1}; control: 3.9 - 5.0 ton ha^{-1} y^{-1}), and AR (TFR: 0.9 – 1.5 ton ha^{-1} y^{-1}; control: 1.0 - 1.1 ton ha^{-1} y^{-1}) were all unaffected by TFR. Our results indicate that a mild, steady, reduction in summer precipitation does not affect soil organic matter decomposition in the oak forest ecosystem studied, though changes in fine root allocation can influence temporal dynamics of AR and SR. Low SR rates during a natural dry-spell indicate that SR can be significantly decreased under more severe drought than imposed by the TFR treatment. Our data suggest a comparable low soil moisture threshold of ~ 10 vol% for SR in the studied soil.

Key words: Throughfall Reduction, Soil Respiration, Oak Forest, Drought

Effects of Nitrogen and Phosphorus Additions on Soil Prokaryotic Communities in a Tropical Forest

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Abstract: Elevated nitrogen (N) deposition may aggravate phosphorus (P) deficiency in forests in the warm humid regions of China. To our knowledge, the interactive effects of long-term N deposition and P availability on soil prokaryotic communities in tropical forests remain unclear. We conducted an N and P manipulation experiment with four treatments: control, N addition (15 g N m−2·yr−1), P addition (15 g P m−2·yr−1), and N and P addition (15 + 15 g N and P m−2·yr−1, respectively) in an old-growth forest in southern China after 7 years. Both N and P additions significantly affect soil prokaryotic diversity and microbial abundance. There was significant interaction between N addition and P addition on soil microbial communities. P addition had the larger influence on prokaryotic communities than N addition. Our results suggest that these nutrients are co-limiting, and that P rather than N is limiting in this tropical forest.

Key words: Nitrogen Addition, Phosphorus Addition, Soil Microbial Community

Extreme Atmospheric Nitrogen Deposition Event Affect Methane Oxidation in Moist Acidic Tundra

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Abstract: It has been reported that extreme deposition of nitrogen (N) can occur in Arctic ecosystems where over 90% of the annual N deposition were often found in just a few days. Since Arctic ecosystems are typically N-limited, input of extremely high amount of N could substantially affect ecosystem processes. CH_4 is a potent greenhouse gas that has 25 times greater global warming potential than CO_2 over a 100-year time frame. Ammonium is known as an inhibitor of methane oxidation and nitrate also shows inhibitory effect on it in temperate ecosystems. However, effect of N addition on Arctic ecosystems is still elusive.We investigated inhibitory effects of extreme N deposition on soil methane oxidation in moist acidic tundra. Ammonium nitrate was added in-situ with 3 rates: control (0 kg N $^{ha\text{-}1\ yr\text{-}1}$), low N (10 kg N $^{ha\text{-}1\ yr\text{-}1}$), and high N (100 kg N $^{ha\text{-}1\ yr\text{-}1}$). CH_4 fluxes were measured using a static chamber method. DNA was extracted from soil samples and methane oxidizer abundance was measured by real time qPCR targeting pmoA gene. N added plots exhibited a greater CH_4 emissions than those in control plots, suggesting lowered methane oxidation by N additions. However, there were no significant differences in methane oxidizer abundance between control and N added plots.

Key words: Arctic Moist Acidic Tundra, Extreme Nitrogen Deposition, Methane Oxidation, Methane Oxidizer

Whole Ecosystem Warming and Elevated CO_2 Treatments in a Forested Boreal Bog – Initial Results from the First Two Years of Treatments

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Abstract: Since August 2015, the Spruce and Peatland Responses under Climatic and Environmental Change (SPRUCE) climate change experiment (http://mnspruce.ornl.gov/) in Northern Minnesota, USA, has exposed 12 m diameter plots of an ombrotrophic Picea mariana – Ericaceous shrub – Sphagnum bog ecosystem

to long-term temperature (T) (0 to +9 ℃) and since June 2016, elevated CO_2 treatments (ambient or + 500 ppm). We examined plant carbon and water relations of Picea mariana (black spruce), Larix laricina (tamarack), and several Ericaceous shrubs including seasonal patterns of gas-exchange, water potential (ψ), and sap flow. Maximum summer Tair in N Minnesota reaches ~35 ℃, and optimal photosynthetic activity for P. mariana at the site peaks between 35-38 ℃. The SPRUCE experimental treatments have pushed Tair up towards 45 ℃ in the warmest plots resulting in substantial physiological stress. In addition to their direct impacts, the T and CO_2 treatments have dramatically impacted soil water availability, vapor pressure deficit and day's dew point is reached. Once the T treatments began, leaf porometry, sap flow and phenological observations indicated an extended physiologically active season in both spring and fall in the warmest treatments that may increase annual net ecosystem carbon gain, if not offset by observed increases in CO_2 and CH_4 release from the peat surface. But an extended growth season could also result in plant vulnerability to extreme cold events, as was evident by premature foliar senescence in warmer plots following a hard spring freeze event in 2016. In addition, the drying heat has resulted in additional foliar damage, indicated by large reductions in predawn water potentials (even in the spring), quicker drying following rain events, and water stress reached earlier in the day. Midday mean summer ψ was -1.5 MPa for P. mariana foliage, higher than the co-occurring L. laricina (-2.0 MPa), but lower than shrubs (-1.1 MPa). Based on hydraulic measurements of excised tissue, P. mariana foliage remained higher that its turgor loss point (TLP), while midday L. laricina foliage often reached its TLP. Initial gas-exchange results suggest some photosynthetic and respiratory acclimation to both temperature and CO_2 treatments, although the degree of acclimation was species-specific. These results indicate the potential for shifts in community composition due to differential biochemical acclimation, and differential heat and water stress among the dominant species. These complex interactions between phenology and growing season length, vulnerability to frost, drought and heat waves, and plant acclimation to a changing climate all provide critical data necessary to evaluate the impacts of a changing climate on northern peatlands in global dynamic vegetation models.

Key words: Ecophysiology, Photosynthesis, Water Potential, Climate Change

Long-Term Tree Biomass Recovery in an Australian Tropical Forest Following Logging and Different Intensity Silvicultural Treatments

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Abstract: Almost half of the world's tropical forests are managed for timber production. Those managed tropical forests are an important global carbon sink. Hence, understanding the long-term effects of management practices on biomass or carbon of tropical forests is important. However, there is uncertainty about the time period required to recover to pre-disturbance levels, and how the recovery periods are influenced by disturbance intensities. We addressed this problem by analysing data from sample plots which had been established in 1967 in an Australian tropical forest. Aboveground biomass were measured following selective logging and subsequent silvicultural treatments of three different intensities over a period of 48 years. We also investigated how growth, recruitment and mortality of trees drive biomass recovery according to the level of intensity of silvicultural treatments. Silvicultural treatment intensities reduced aboveground biomass between 45.1% and 67.2% of their pre-treatment levels. By 2015, the biomass in the low and medium silvicultural treatment were almost equivalent to their pre-logging biomass, but biomass in logging only treatment and high intensity silvicultural treatment have not recovered to their pre-logging biomass levels completely. Aboveground biomass changes in each treatment was largely driven by stem increment growth (76.4 % averagely) with a minor contribution from recruitment and mortality. In logging only control, low and medium intensity treatments, biomass changes from growth was contributed more by remnants than recruits. However, in the high intensity treatment, recruits and remnants contributed similarly to biomass increment from growth. Biomass changes was dominated by fewer species and individuals in silvicultural treatments than logging only treatment. Biomass in high intensity treatment needs more time to recover to its pre-logging level than those in the low and high intensity treatment which recovered within 50 years. High intensity treatment pushed forests back to the earlier successional state where biomass increment was dominated by recruits. Our results also highlight the importance of diameter increment rates of large trees for rapid tree biomass accumulation in disturbed tropical forests. If reducing carbon emission and shortening the time period for biomass recovering to pre-logging levels are desired, low intensity silvicultural treatments in terms of thinning small trees of low commercial values and preserving large remnants is suggested.

Key words: Biomass, Recovery, Tropical Forests, Silvicultural Treatments

Effects of Stand Age on Carbon Storage and Belowground Carbon Allocation in Three Temperate Forest Types in Northeastern China

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Abstract: The large area and standing tree volume of temperate forest in Northeastern China make the region a potentially significant portion of the Chinese carbon budget, yet little is known about the effects of forest type, age class and their interaction on carbon storage and soil organic carbon density (SOCD), total belowground carbon allocation(TBCA) and SOC turnover time. We measured different vegetation and soil carbon storage and partitioning, including soil organic carbon content(SOCC), soil CO_2 efflux(RS) and heterotrophic CO_2 efflux(RH) and estimated annual aboveground litterfall, TBCA , SOCD and SOC turnover time in one broadleaf deciduous Betulaplatyphylla (Bp) forest and two managed conifer plantations: Larixgmelinii(Lg) and Pinuskoraiensis(Pk) in 2006. Our objectives were to (1) determinethe effects of forest type and age class (7-9 yrs, 18-20 yrs and >47 yrs)on the carbon storage invegetation, detritus and SOCD; and (2) quantify TBCA and SOC turnover time in the three forest types and different age classes. Our analysis showed that both forest type and age had significant effects on leaf area index, vegetation, detritus carbon density and SOC turnover time. There was also a significant effect of forest type, but not age, on SOCD and TBCA. There was an interaction between forest type and age for living biomass, detritus and total vegetation carbon stock. The SOCD ranged from 96.52 to 141.53 Mg ha^{-1}in Bp forest, from 136.38 to 197.82 Mg ha^{-1}in the Lg plantation and from 120.12 to 206.28 Mg ha^{-1}in the Pk plantation.The dominant contribution to total ecosystem carbon density was SOCD (54%-98%) and depended on age group. Detritus was a minor component (<4%) of total ecosystem carbon storage. The TBCA was 349 gC m-2yr^{-1} for Lg,524 gC m-2yr^{-1} for Pk and 676 gC m-2yr^{-1} for Bpfor18-20 yrs age group and 294gC m-2yr^{-1}, 449 gC m-2yr^{-1} and 787gC m-2yr^{-1} for Lg, Pk and Bp forest at age group of >47yr, respectively. The mean SOC turnover was 28 years for Bp. 44years for Pkand 67years for Lg. We concluded that forest type exerts a strong control on the carbon partitioning and allocation, TBCA and SOC turnover time, while age only affects the vegetation carbon storage and SOC turnover time.Our results indicate that age effects should be considered in aboveground and belowground carbon processes in temperate forest ecosystems.

Key words: Carbon Partitioning, Total Belowground Carbon Allocation, soil Organic Carbon Density, Temperate Forest

Above- and Belowground Plant Functional Traits and Soil Properties Predict Grassland Greenhouse Gas Emissions

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Abstract: The use of plant traits to predict ecosystem function has been gaining much recent attention. Aboveground plant traits, such as leaf nitrogen (N) content and specific leaf area (SLA), have shown strong relationships to ecosystem productivity, respiration, and nutrient cycling. Increasing plant functional trait diversity has been suggested as a possible mechanism by which high plant diversity can increase ecosystem carbon (C) storage. However, determining if belowground plant traits can be predicted by aboveground traits, and if both above- and belowground traits can be used to predict soil properties remains poorly understood. Further, the ability of above- and belowground traits to predict ecosystem functions such as C fluxes under field conditions has not been comprehensively assessed. In the current study, we used both a mesocosm and an in situ field experiment in temperate grassland to investigate if above- and belowground traits are related in a consistent way and if plant traits, both aboveground and belowground, can be used to predict soil properties and ecosystem C fluxes, such as net ecosystem exchange (NEE). We found that some aboveground traits, such as shoot N and C, and various organic polymers, showed moderate relationships with belowground traits, including root dry matter content, root diameter, root N, and various organic polymers. In addition, certain shoot and root traits (i.e., shoot/root N, shoot C, root diameter) were found to predict a number of soil properties, including inorganic N concentrations and microbial community structure. Using structural equation modelling (SEM) we showed that above- and belowground traits and soil properties could be used to improve predictions of NEE, both in the mesocosms and in the field experiment in situ. These results demonstrate that although relationships exist between above- and belowground plant traits, such relationships aren't always particularly strong. However, certain plant traits were important for improving predictions of NEE. This means including other parameters (i.e., soil properties, environmental conditions) alongside plant traits is essential to improving the predictive capacity of ecosystem process models. Our findings highlight the usefulness of including above/belowground plant traits in models that aim to predict C fluxes under field conditions.

Key words: Carbon Cycling, Plant Traits, Aboveground-Belowground Interactions, Temperature Grasslands

Soil Nitrogen Determines Greenhouse Gas Emissions from Northern Peatlands under Concurrent Warming and Vegetation Shifting

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Abstract: Background/Question/Methods
Boreal peatlands contain an enormous pool of stored soil carbon that is dependent upon – and vulnerable to changes in – climate, as well as other interacting factors, such as nitrogen availability and plant community composition. However, how nutrient availability affect the direct and interactive effects between concurrent changes in both the abiotic and biotic variables environment interact to drive changes in ecosystem processes in these nutrient-poor ecosystems is unclear In this study, we manipulated the temperature, plant community composition, nitrogen content, and Ncontentvegetation composition of boreal peatland plots to determine how these factors affect ecosystem processes and greenhouse gas emissions
Results/Conclusions
While methane (CH_4) and nitrous oxide (N_2O) levels responded significantly to manipulation, ecosystem respiration might respond in an insignificant fashion. Strikingly, although warming was associated with higher CH_4 emissions, the concurrent addition of N counteracted most (79%) of this effect, perhaps due to nitrogenous oxidation of CH_4 triggered by warming. The presence or absence of grass-like plants had a stronger impact on warming-induced CH_4 emissions than the presence or absence of shrubs, due to the positive effect on dissolved organic carbon (DOC) quality as a consequence of the presence of grasslike plants. Warming alone did not increase N_2O emissions, but did interactively accelerate N_2O emissions with the addition of N, and this interaction was modulated by the plant community composition. Our study is the first to reveal these complex interactions under an N-unlimited condition, and suggests that the responses of GHG emissions to future warming and shifting in plant community composition are largely depend on the N availability.
Key words: Boreal Peatlands, Greenhouse Gases, Plant Functional Group, Climate Change

Growing Season Methane Emissions from a Permafrost Peatland and a Freshwater Marsh in Northern China

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Abstract: Ecosystem-scale CH_4 fluxes were measured using the eddy covariance method to compare three growing seasons of CH_4 exchange in their pattern, magnitude and dominant drivers from a non-permafrost freshwater marsh and a permafrost peatland in northern China. We found great differences in seasonal pattern and

magnitude of CH_4 exchange from the two wetlands. The CH_4 emission peaks of the peatland ecosystem, appearing in late growing seasons, were more than two months later than those of the marsh ecosystem. Total seasonal CH_4 emission from the peatland ranged between 0.38~1.40 g C-CH_4 $^{m-2}$ which was more than an order of magnitude smaller than those of 19.71~ 23.4 g C-CH_4 $^{m-2}$ from the marsh. For the peatland ecosystem, average soil temperature of different depths acted as the dominant control of seasonal CH_4 variability with the influence of thaw depth significantly intensifying during the late growing season, while for the marsh ecosystem, surface soil temperature and net ecosystem CO_2 exchange were the main controlling factors. This study presented the first detailed comparison of ecosystem-scale CH_4 exchange in two main typical wetland ecosystems of northern China. Our results suggested that the great differences in magnitude and the different responses to changes in environmental and biophysical conditions should be considered when estimating CH_4 exchange from different wetland types, with particular emphasis on climate warming response in order to better predict future CH_4 feedback from northern wetlands.

Key words: Methane Emission, Northern China, Peatland, Marsh

Effects of Thinning on Carbon Budgets in a Coniferous Plantation in Subtropical China

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Abstract: Forest thinning is a commonly used silvicultural technique to improve wood quality and provide economic returns, and is also a severe disturbance which have great effects on CO_2 exchanges of forests. As thinning removes part of the photosynthetic leaves but optimizes the canopy structure, the gross primary productivity (GPP) would be changed. In addition, thinning introduces woody residue to soil surface, which potentially promote the ecosystem respiration (Re). Therefore, it is complicated to estimate the changes of carbon budgets of a thinned forest. Moreover, the carbon budgets are climate-dependence and have great inter-annual variations. It brings large uncertainties to estimate the effects of thinning.

The impacts of forest thinning on the carbon budgets were investigated through two-tower parallel observations based on eddy covariance (EC) technique. Tower 1 was set in a control plot and Tower 2 was in a thinning plot. The carbon fluxes observed by the two EC systems showed very good linear relationship. It is reasonable to use the two-tower system to eliminate theinter annual variation of carbon fluxes induced by climate variation and to evaluate the thinning effect on ecosystem carbon budget more precisely. Observation results indicated that the thinning (with an intensity of 20% in

stand volume) reduced net ecosystem productivity (NEP) by 11.5%. The exact reason is that thinning obviously reduced the ecosystem GPP and improved the ecosystem Re simultaneously.

Key words: Carbon Budgets, Thinning, Forest, Eddy Covariance

A Comparative Analysis to Quantify the Biogeochemical and Biogeophysical Cooling Effects on Climate of a White Mustard Cover Crop

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Abstract: During the COP21, agriculture was recognised as a strategic sector and an opportunity to strengthen climate mitigation. In particular, the "4 per 1000" initiative relies upon solutions that refer to agro-ecology, conservation agriculture, that could lead to increase carbon storage. Among those agro-ecology practices, including cover crops during fallow periods is considered as a fundamental agronomic lever for storing carbon. However, if biogeochemical benefits of cover- crops (CC) have already been addressed, their biogeophysical effects on climate have never been quantified and compared to biogeochemical effects. This comparative study (CC vs. bare soil), quantified and compared biogeochemical (including carbon storage) and biophysical effects (albedo and energy partitioning effect) of CC on climate.

An experimental campaign was performed in 2013 in Southwest France, during the fallow period following a winter-wheat crop (and before a maize). The experimental plot was divided in two: the northern part was maintained in bare soil (BS) while white-mustard (WM) was grown during 3-months on the southern part. On each subplot, continuous measurements of CO_2, latent and sensible fluxes (by eddy covariance) and solar radiation were acquired. Also, N_2O emissions were measured by means of automatic chambers on each subplot. Moreover, by using a Life-Cycle-Analysis approach, each component of the greenhouse gas budget (GHGB) was quantified for each subplot, including emissions associated to field operations (FO). To quantify the albedo induced radiative forcing (RFα) caused by the white-mustard, the bare soil subplot was used as a reference state (IPCC, 2007). Finally, the net radiative forcing for each subplot was calculated as the sum of biogeochemical and biogeophysical (albedo effect) radiative forcing.

The white-mustard allowed a net CO_2 fixation of 63 g $C^{-eq.m-2}$, corresponding to 20% of the net annual CO_2 flux that year (-332 g $C^{-eq.m-2}$). Through the WM seeds, the amount

of C imported to the field increased by 2 g $C^{-eq.m-2}$. As the white-mustard was buried and used as green manure for the next cash crop, the amount of C exported (when harvesting winter-wheat) was unchanged. Thus, the WM improved the NECB and reinforced the sink effect by 65 g $C^{- eq.m-2}$. Nevertheless, growing a CC leads to additional emissions associated to FO. They represented only 3 g $C^{-eq.m-2}$ and can therefore be considered negligible. However, N_2O emissions were reduced during the WM development. Finally, the GHGB of the WM subplot (- 73 g $C^{-eq.m-2}$) was a significant sink while the GHGB of the BS subplot was close to neutral (-12 g $C^{-eq.m-2}$). By increasing surface albedo, the WM induced a biogeophysical cooling effect (-81 g $C^{-eq.m-2}$) equivalent to the GHGB of the WM subplot. In other words, the white-mustard cooling effect (compared to bare soil) is doubled if both biogeochemical and RFα are considered. This cooling effect was reinforced by the 53% increase in latent heat flux during the WM development. Finally, we estimated that the albedo cooling effect could be increased by 5-fold by maintaining the WM during 6-months. We conclude that through both biogeochemical and biogeophysical effects, cover crops represent a strong mitigation potential.

Key words: Comparative Analysis, Cover Crops, Carbon and Greenhouse Gas Budget, Albedo

Understanding Soil Carbon Dynamics in a Warm Temperate Oak Forest and Tropical Plantations by Manipulated Warming and Drought

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Abstract: Increasing global temperature and changing precipitation regime associated with global climate change is expected to exacerbate and engender regional drought events. Any potential change in the rate of soil respiration induced by biotic or abiotic factors will have strong impact on the global carbon cycling and subsequently climate change. On the other hand, soil organic matter is the carrier of nutrients cycling, thus understanding the soil carbon dynamics and their responses to the predicted warming and drought are crucial not only for the mitigation of climate change but for the forest restoration and sustainable forestry. We manipulated soil temperature by using infrared heater, and precipitation by using throughfall exclusion panels in both a warm temperate forest and subtropical plantations in China, in the past five years. The interaction effects between climate warming and precipitation reduction on soil CO_2 flux and fine root turnover were also evaluated.

Our results showed that ~ 50% throughfall reduction in growing season significantly

decreased soil moisture but soil heterotrophic respiration and microbial biomass were unaffected in the warm temperate forest. Throughfall reduction increased total soil respiration, soil autotrophic respiration and fine root biomass in a comparable dry year, but had negligible effect during other years. In contrast, the effect of throughfall reduction on soil respiration was remarkable in the two tropical plantations, which was significantly decreased by 16.82% and 22.20% in the whole year and wet season in Castanopsis hystrix plantation. The soil respiration in Pinus massoniana plantation was significantly decreased by 6.08% (whole year), 7.68% (wet season) and 3.61% (dry season), which was associated with the significant changes in soil microbial community structure and the microbial function.

Manipulated soil warming by 1.62 ~2.11 ℃ in a warm temperate forest (Quercus aliena, from 2011 to 2015) showed significant positive effect on soil respiration and its temperature sensitivity (Q10). Where soil respiration were increased by 37.5% and 42.0%, while Q10 values were increased 18.5% and 22.9% respectively in the initial two years, but the positive effect diminished as the continue of warming, which could be attributed to the warming-induced increases in microbial biomass. A three-year soil warming experiment in the tropical Castanopsis hystrix plantation increased heterotrophic respiration (Rh), but suppressed root-dependent respiration (Rrd). The responses of Rh and Rrd to warming varied with season, being greater in the dry-cool than the wet-warm season. The decreased Rrd and increased Rh appear to have offset each other and resulted in unaltered Rs under the warming treatment.

Interaction effect between soil warming and throughfall reduction was investigated in the warm temperate forest (Quercus aliena dominant) during the growing seasons (May–November) of 2011 and 2012. Soil temperature was elevated by 1.23–1.66 ℃ relative to the ambient temperature, and throughfall was reduced by 50%. Either climate warming or precipitation reduction may increase soil CO_2 emission and fine root turnover, but this stimulation in warm temperate forests will be largely counteracted if climate warming accompanies with simultaneous precipitation reduction at the climatic transitional zone.

Key words: Climate Warming, Drought, Soil respiration, Forest

Response of Microbial Activity and Methanogens Community on Invasive Plant under Warming in a Salt Marsh Ecosystem

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Abstract: Several recent studies have indicated that an increased temperature could

exacerbate the intensity of plant invasions within natural ecosystems, but little is known of how rising temperature impacts the belowground characteristics of these invaded plants in wetlands. In this study, we examined the effects of rising temperature inputs on microbial activity and community of plant rhizosphere invaded by reed, Phragmites australis, Spartina in salt marsh ecosystem in USA and China. Quality and quality of the DOC and phenolics were affected by warming. Laccase activity increased although laccase abundance not effect by warming. Methanogens abundance increased with invasive sites in rising temperature. That means plant invasion will accelerate methanogens biomass revealed the potential for larger C accumulation by warming.

Key words: Salt Marsh, Invasive Plant, Warming,

Effects of Remediation Plants on Soil Rhizosphere Microbial Communities and Functions in Ganzhou Rare Earth Mine Tailings

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Abstract: Many ecological problems including vegetation destruction and erosion have been brought by disorderly mining rare earth ores in Ganzhou, causing seriously environmental damages. Recently, ecosystems in mine tailing areas are being regulated by kinds of remediation methods like plant remediation, in which rhizosphere microbes play important roles. Compared with bared mine tailings in Zudong ion-absorbed rare earth ores in Longnan county, the effects of different remediation plants like eucalyptus and pine on soil physico-chemical properties, rhizosphere microbial activities were analyzed to discover the functions that microbes play during plant remediation. The results showed that, 1) physico-chemical properties of soils after plant remediation have been improved significantly, in particular after eucalyptus remediation ($P<0.01$); 2) bacteria, accounting for 85%, ranked first in the quantity of rhizosphere soil microorganism and was the most sensitive to eucalyptus rhizosphere effect, and fungi was the prior but much more than actinomyces, which was only 0.35%; 3) soil enzyme activity was enhanced by plant remediation, and the correlation analysis showed that soil urease activity, phosphatase activity and dehydrogenase activity was positively correlated with soil available N, available P and organic matter, respectively ($P<0.01$). Taken together, all the results revealed that soil nutrient, microbial communities and enzyme activity are interacting to regulating ecological environment during plant remediation, and we hope plant growth-promoting rhizobacteria would be found and isolated, and plant-microbe associated remediation would be used for ecological reconstruction in Ganzhou mine tailings in the near future.

Key words: Rare Earth Mine Tailings, Plant Remediation, Rhizosphere Soil Microbes,

soil Enzyme Activity

Estimating Vegetation Biomass Using Very High Resolution Satellite Image in a Karst Watershed of Guizhou Province, southwestern China

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Abstract: Vegetation biomass in karst terrain has been rarely measured because the steep and harsh mountainous limestone landscape limited our ability to sample woody plants. Satellite observation, especially in high spatial resolution, is therefore an important surrogate to estimate biomass of karst forest and shrubland. In this study we build an Artificial Neural Network (ANN) model using very high resolution (VHR) satellite imagery and field biomass measurements to estimate the aboveground biomass (AGB) in the Laqiao Watershed, a typical peak-clump depression terrain in southern Guizhou province, southwestern China. A Back Propagation ANN (BP ANN) model was developed. Seven vegetation indexes including the Atmospherically Resistant Vegetation Index (ARVI), Enhanced Vegetation Index (EVI), Normalized Difference Vegetation Index (NDVI), Difference Vegetation Index (DVI), Green Normalized Difference Vegetation Index (GNDVI), Ratio Vegetation Index (RVI), Soil-Adjusted Vegetation Index (SAVI), two spectral bands of Pléiades-1A, and one geomorphological parameter were selected as inputs while the AGB as output. Vegetation biomass at 88 plots estimated by allometric functions was used as training data (66 plots, 75%) and validation data (22 plots, 25%). Data-model comparison showed that the ANN model performed well with the absolute RMSE of 9.72 t/ha, which is 6.27% of the average AGB. On the base of the newly developed ANN model, a AGB map in the Laqiao watershed was produced. The estimated AGB of the main forest type in the watershed, the evergreen and deciduous mixed forest, was 182.65 t/ha in average. The large distributed shrubland and tussock had averaged AGB of 42.25 and 9.68 t/ha, respectively. This finding indicated that the spatial distribution pattern of AGB estimated by the new ANN model in the karst basin is consistent with the field investigation. This model can be further used to estimate vegetation biomass in the regional scale of karst lanscapes distributed in the surface of the Yun-Gui Plateau.

Key words: Aboveground Biomass, Artificial Neural Network, Vegetation Indices, Very High Satellite Image

Effects of Manipulated Nitrogen Deposition on Soil CO_2 Emission and Related Biochemical Properties in N-Rich City Lawn

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Abstract: The aim of this study was to investigate the effect of nitrogen (N) deposition on soil CO_2 emission (soil respiration, SR), dissolved organic matter (DOM), and microbial biomass in N-rich soil. A field experiment was conducted in a city lawn soil (N-rich soil) with three N treatments (i.e., the control, low-N, and high-N treatments). SR rates and other soil properties were measured during an experiment period of 500 d. Under the N treatments, β-glucosidase activities and reducing sugars decreased, which resulted in significant decrease of SR rates. The N addition treatments caused soil NH^{4+} and NO^{3-} accumulation and soil acidification. At the end of experiment, the N addition decreased bacterial biomass, but did not affect fungal biomass. Both phenolic compounds and phenol oxidase activities significantly increased under the N treatments. It was concluded that SR rates and microbial activities were significantly inhibited by excessive N input in the N-rich soil. Soil pH played an important role on controlling soil microbial composition. Our results also suggested a shift from polysaccharide hydrolysis to recalcitrant phenolic metabolism under N addition in N-rich soils.

Key words: Soil Respiration, N Deposition, Enzyme Activities, Microbial Biomass

Phragmites Australis Meets Suaeda Salsa on the "Red Beach": Effects of an Ecosystem Engineer on Salt-Marsh Litter Decomposition

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Abstract: Suaeda salsa is a pioneer species in coastal wetlands of East Asia and recently an ecosystem engineer species, Phragmites australis, has started to enter in S. salsa communities owing to either autogenic or external drivers. The consequences of this phenomenon on the ecosystem functions of coastal wetlands are still unclear, especially for decomposition processes. Here we compared the decomposition rate of S. salsa litter, and associated litter chemistry dynamics, between sites with and without P. australis encroachment. We conducted a litter transplantation experiment to tease apart the effects of litter quality and decomposing environment or decomposer community

composition. Our results showed that P. australis encroachment led to higher carbon and phosphorus losses of S. salsa litter, but equal losses of total mass, lignin, hemicellulose and nitrogen. P. australis encroachment might affect decomposition rate indirectly by making S. salsa produce litter with higher lignin concentrations or via increasing the fungal diversity for decomposition. Moreover, P. australis as an ecosystem engineer might also alter the allocation of total phosphorus between the plants and the soils in coastal wetlands. Our findings indicate that P. australis could impact aboveground and belowground carbon and nutrient dynamics in coastal wetlands, and highlight the important consequences that invading plant species, especially ecosystem engineers, can have on ecosystem functions and services of coastal wetlands, not only in East Asia but probably also elsewhere in the world.

Key words: Aboveground and Belowground Processes, Carbon and Nutrient Cycling, Ecosystem Engineer, Litter Decomposition

Ecosystem Biomass and Carbon Pools in an Age-Sequence Warm Temperate Pine Forests

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Abstract: We investigated the successional development of above- and belowground ecosystem biomass and carbon (C) stock in an age-chronosequence of five pine (P. tabulaeformis) plantation stands (18-, 20-, 25-, 38-, and 42-year-old) in Lingkong Mountain, Shanxi Province, China. Biomass and C pools of above- and belowground live and dead trees, shrubs and herbs vegetation, litter-falls were determined from plot-level inventories and destructive tree sampling. Mineral soil C stocks were estimated from soil stainless cylinder. Tree biomass became the dominating ecosystem C pool with increasing age in this warm temperate pine age-chronosequence, reaching 75.98, 83.63, 111.74, 160.24, 189.40 Mg•ha^{-1} in 18-, 20-, 25-, 38- and 42-year-old stands, respectively. Stem wood was the major aboveground C pool in each stand containing 38.18, 42.28, 56.54, 86.36 and 95.74 Mg C•ha^{-1} in the 18-, 20-, 25-, 38-, and 42-year-old, respectively. Total belowground biomass in roots increased steadily in 18-, 20-, and 25-year-old stands, and then raised sharply in 38-, and 42-year-old stands, particularly from the 18- to the 42-year-old stands, ranging from 36.2 to 101.48 Mg•ha^{-1}. Shrubs and herbs C stock was 1.13, 0.99, 0.76, 0.80 and 0.83 Mg C•ha^{-1} in the 18-, 20-, 25-, 38-, and 42-year-old stands, respectively, indicating there was no interaction between ground vegetation C stock and stand age across the entire chronosequence. Seasonal rates of litter-fall components were significantly higher during autumn in all age-sequence stands, contributing 34.39-49.30% in all seasons,

and litter-fall during the autumn period was up to twice as great in 42-year-old stands, compared to 18-, 20- and 25-year-old stands. Mean total C stock of mineral soil from 0 to 100 cm depth increased with age-sequence, was 71.89, 79.79, 88.60, 102.68, and 100.30 Mg C•ha^{-1} in the 18-, 20-, 25-, 38-, and 42-year-old stands, respectively. Mineral soil was the dominant C pool in the three younger stands (58.58, 57.69, and 53.44% in 18-, 20-, and 25-year-old stands), whereas, trees C stock became the major C pool in the two older stands (53.49 and 53.66% in 38- and 42-year-old stands). Tree biomass became the dominating ecosystem C pool with increasing age in this warm temperate pine forest, and the effect of stand age may lead to the changes in the relative biomass allocation among the tree biomass.

Key words: Biomass, Carbon stock, Carbon Sequestration, Chronosequence

The Attenuation Soil Respiration Response to Soil Warming in a Transitional Oak Forest in Central China

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Abstract: Global rising temperatures profoundly affect terrestrial carbon cycling, and examination of soil respiration in response of ecosystems to warming should shed light on feedbacks between soil ecological process and future trajectories of climate change. However, spatial heterogeneity across biomes and uncertainty of mechanisms exacerbate the difficulty of predicting feedbacks between edaphic carbon exchange and future climate change. Our study aimed to document the effect size of warming changes as the duration of soil warming increased.

A field soil warming manipulated experiment was operated in an oak natural forest (Quercus aliena) at a transitional climatic zone in central China from 2011 to 2015. The significant increment of annual mean soil temperature varied from 1.62 ℃ to 2.11 ℃ compared to the ambient plots. There were significant positive effects of soil warming on soil respiration and temperature sensitivity, which increased by 37.5% and 42.0% (soil respiration), 18.5% and 22.9% (temperature sensitivity) in initial two years. Similarly, the positive trends of soil respiration and temperature sensitivity gradually diminished as the duration of warming increased. The down-regulation of soil respiration and temperature sensitivity response to warming may be attributed mainly to the warming-induced increases in microbial biomass. On the other hand, soil enzyme activities was related to the changes of soil respiration, which may exert more impact on temperature sensitivity relative to microbial biomass.

Our results point to the attenuation response of soil respiration to microbe properties

under warming scenarios at the climatic transitional zone and highlight microbial processes should be taken in consideration to global carbon cycle models.

Key words: Soil Respiration, Microbes, Attenuation Response, Carbon Cycling

Effects of Management Practices on Soil Organic Carbon Pool and Greenhouse Gas Emission in Chinese Chestnut Plantations

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Abstract: Management practices can markedly alter the physical, chemical and biological properties of soils. However, the effects of management practices on soil organic carbon (SOC) pool and greenhouse gas (GHG) emission in plantations are poorly understood. In this paper, the impacts of long-term intensive management (including chemical fertilizer application, deep tillage and understory vegetation control) on soil organic C pool in a Chinese chestnut plantation was examined, and the effects of various management practices (understory vegetation management, fertilization and biochar addition) on the soil greenhouse gas emission was investigated as well.

Our results showed that SOC stock and concentrations of water soluble organic C (WSOC), hot-water soluble organic C (HWSOC), microbial biomass C (MBC), and readily oxidizable C (ROC) decreased with increasing duration under intensive management. For the chemical composition of SOC, the contents of O-alkyl C decreased, while the contents of aromatic C and carbonyl C and aromaticity increased as duration under intensive management increased. Understory management did not change the seasonal pattern of soil GHG emissions; however, as compared with the Control, the understory removal treatment increased soil CO_2 and N_2O emissions and CH_4 uptake, and the treatments of replacing understory vegetation with either Medicago sativa L. or Lolium perenne L. increased CO_2 and N_2O emissions and reduced CH_4 uptake ($P < 0.05$). In addition, soil GHG fluxes, total global warming potential (GWP), and SOC, WSOC, MBC and NO3--N concentrations were markedly increased by fertilization, regardless of the understory replacement treatment ($P < 0.05$), but they were increased by understory replacement only in the fertilized plots. In comparison with the application of fresh bamboo leaf, pyrolyzed bamboo leaf (biochar) application decreased CO_2 effluxes and increased C sequestration in the soil. As compared to the control treatment, the annual cumulative N_2O flux was decreased by 20.5% by the biochar treatment, while the annual cumulative CH_4 uptake was increased by 25.3%.

To conclude, long-term intensive management reduced the total and labile SOC stocks

in bamboo forests and alternative management regimes should be developed to increase C sequestration of soils in intensively managed Chinese chestnut plantations in subtropical China. In addition, the addition of biochar could markedly increase the SOC stock and reduce the GHG emission. However, its long-term effect needs to be investigated in the future.

Key words: Soil Organic Carbon Pool, Greenhouse Gas Emission, Forest Management

Latitudinal Patterns of Soil Microbial Carbon Utilization Ability along the NSTEC

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Abstract: The biological community structure and function in ecological processes are intimately linked, and their relationshipis one of the central issues in ecology theory.However, little information is availableregarding the relationship betweenmicrobial community structure and function at large scales. Along the North–South Transect of Eastern China (NSTEC), nine forests representative oftemperate, subtropical, and tropical biomes were examined. Soil organic matter (SOM) decomposition rate, microbial structure, enzyme activity, and carbon substrate utilization were investigated using incubation experiments, phospholipid fatty-acid (PLFA) analysis, fluorescence method, and Biolog-Eco microplates, respectively. We found that there were considerably different substrate utilization profiles among the temperate, subtropical, and tropical forests. Soil microorganisms from the temperate forests mainly metabolized high-energy substrates, while those from the subtropical and tropical forests used all substrates equally. Soil silt & clay content and tree species traits both shape the latitudinal variation of soil microbial substrate utilization profiles.SOM decomposition rates were significantly higher in temperate forests than in subtropical and tropical forests which consistentwith the latitudinal pattern of soilmicrobial biomass carbon (MBC) concentrations.In addition, SOM decomposition rates were significantly andnegatively related to soil dissolved organic carbon (DOC) concentrations, carboxylicacids, polymers and miscellaneous substrate utilization, indicating that soil microbes assimilatedmore soil substrates, thereby reducing CO_2emissions. The soil microbial community structure and functions were significantly correlated along the NSTEC. Soil carbohydrate and polymer substrate utilization were mainly related to soil G+ bacterial and actinomycic biomass, but amines and miscellaneous to soil G− bacterial, fungal biomass and F/B ratio. The different groups of microbial biomass also made different contribution to the production of soil enzyme activities. The relationship between soil microbial

community structure and functions confirmed thehypothesis of functional dissimilarity. Overall, our resultsrepresent a contribution to the understanding of spatial variation mechanism of soil microbial carbon utilization and the relationship between soil microbial community structure and functions.

Key words: Labile Carbon, soM Decomposition Rate, Microbial Substrate Utilization, Microbial Community Structure

T4-02: Biodiversity Monitoring for Global Conservation Targets

Estimation of the Punjab Urial (Ovis Vignei Punjabiensis) Population Using Non-Invasive Genetic Sampling

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Abstract: Background:
Punjab Urial (Ovis vignei punjabiensis) is wild sheep and has been categorized as vulnerable by IUCN (2016). The major threats to this species include; fragmentation of its home ranges, illegal hunting and poaching of both adults and lambs. In addition, lambs are kept as pets and their meat is also consumed by the native community. Also, ram horns are prized as trophy in certain area. To formulate the recommendations for conservation and management of existing urial population, the information about genetic assessment and population size is a pre-requisite. We are aiming to use the increasingly popular non-invasive genetic sampling techniques in combination with field data rather than conventional method. Using DNA analysis of fecal sampling, we are intended to estimate population size of urial by individual identification. In addition, estimation of males and females present in the study area. Further parasitic disease load will also be estimated.
Methodology:
Stool samples of Punjab urial will be collected which is a non-invasive genetic sampling approach. The host species will be confirmed designing Punjab urial specific primers followed by a PCR. After confirmation of host species, molecular markers will be individual identification. Sex-linked markers will be used for gender identification. Barcode primers will be designed to check presence/absence of nematodes. These PCR products will be sequenced using next generation sequencing. Sequencing results will be analyzed using bioinformatics tools.
Outcomes: In the proposed project will give an estimate of the Punjab Urial population in Mianwali District, as well as number of males and femals present in study area. In addition presence/absence of nematodes will also be estimated.
Key words: Punjab Urial, Conservation, Barcoding, Nematodes

Finding the Essential: Improving Conservation Monitoring Across ScalesCarlos

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Abstract: Across the globe, designated areas are managed for a variety of conservation objectives, from the protection of keystone species to the conservation and maintenance of entire ecosystems and the regulation of human activities. These differences in conservation objectives, together with contrasting geographic and social-ecological realities, are reflected in the amount of resources and information needed to fulfill those objectives. Also, due to changing environmental, demographic, social and political conditions, future expectations for the role of these conservation areas may change and could include new conservation objectives that were previously not considered. In the last decades, as biodiversity and ecosystem health declined globally and following the failure to achieve the 2010 targets for biodiversity, a modified set of global targets for conservation was created (i.e. Aichi Targets and the Strategic Plan for Biodiversity 2011-2020). At the same time, there was a shift in area-based conservation from strict nature protection that excludes human activities, to management strategies that account for the value nature has for humans, hence shifting from a purely ecological focus to a socio-ecological approach. To fully account for progress towards these new conservation targets, monitoring systems will have to capture not only information on biodiversity but also on the outputs of ecological processes and the related effects on human well-being. This will require the implementation of new monitoring approaches that allow a wider characterization and quantification of social-ecological systems and the optimization of available operational resources. Here we develop a systematic approach, based on the idea of "essential variables" to identify, describe and use essential variables to improve and facilitate conservation monitoring. Our focus is protected areas, but the lessons learned also apply to other conservation management areas. Essential variables were originally proposed as a tool to facilitate the study, reporting, and management of change in climate, environmental conditions, and more recently biodiversity. Essential variables are a minimum set of measures that can be quantified globally and capture major dimensions of biodiversity and ecosystem change across scales and realms. We show how the concept of essential variables could be applied to conservation with the final goal to facilitate a better design of monitoring schemes and improve protected areas' monitoring strategies.

Key words: Essential Variables, Conservation Areas, Monitoring Systems

The Global Virome Project: A Network of Viral-Diversity Monitoring

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Abstract: Emerging infectious diseases (EIDs) represent a significant public health and economic issue. The majority (~60%) of EIDs recorded since 1940 were caused by zoonotic (animal) pathogens, with most of these (>70%) caused by pathogens with a wildlife origin and have caused significant recent outbreaks (e.g. SARS, pandemic influenza, MERS, Ebola and Zika). The frequency of pandemics is increasing, driven by rapid demographic and environmental change and globalized trade and travel. In this presentation, we will consider the scientific, economic rationale and technical framework for a global initiative to identify and characterize almost every significant potential viral threat in animal reservoirs. We will discuss how a global network of viral-diversity monitoring may improve pandemic preparedness, and reduce response times and associated costs, and propose that it is achievable over the next ten years at a cost of less than $3.5 billion. The Global Virome Project may herald the beginning of the end of the pandemic era.
Key words: Viral Diversity, Monitoring, Network, Virome,

The Relationship between Community Structure of Ground-Dwelling Vertebrates and Habitat Types in the Wanglang Natural Reserve

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Abstract: The community structure of grand-dwelling vertebrates in the Wanglang Natural Reserve, Sichuan Province, was examined in relation to a wide range of habitat changes associated with logging, tourism, and restoration measures. Eight sampling sites from a range of habitats were monitored using drift-fences and pitfall traps from August to November 2006. A total of 778 individuals representing 21 species of vertebrates were captured in 75 d, including three species of amphibians, one species of bird, and 17 species of mammals. The capture rate of vertebrates was 32.4%. The vertebrate community was dominated by four species with high abundance. The relative abundance of the species was correlated with their distribution ranges ($P < 0.001$). Each species was trapped on different dates. Fifteen species were captured within 14 d, no new species were captured from day 15 to 30, and rest of the six species were captured after 30 sampling days. For long-term investigations, 15–30 days interval is enough to encounter vertebrate species from this method. The cumulative number of species at the sampling site exhibited a logarithmic growth curve. After 40–60 specimens were trapped, 70% of the overall species richness in one sampling site was monitored. In general, changes in the quality of habitat resulted in considerable differences in species composition, abundance, and distribution pattern of community structure, with a marked decline in diversity and evenness indices, and a substantial

increase in the proportion of dominant species. The diversity of vertebrates in different habitats indicated that species diversity index (2.099) and evenness index (0.875) was highest, but the species dominance index (0.149) was lowest in weakly disturbed primary forest. Both primary shrubland with tourism and secondary shrubland experiencing spontaneous recovery from logging had moderate indices. In contrast, the secondary forest with artificial recovery had the lowest species diversity index (1.337) and evenness index (0.520), but the highest species dominance index (0.454). Based on the similarity index of community structure, a phenogram was reflected in three assemblages representing weakly disturbed, partially disturbed, and heavily disturbed habitats. Among three disturbance factors, timber harvest accounted the high level of disturbance and 42.9% difference in species composition between logged and un-logged forest communities after 50 years of clear cutting. Species most affected by tourism were associated with primary forest under an intermediate level of disturbance, whereas after 50 years of regeneration, the spontaneous recovery produced a mixed community structure that had recovered and exhibited higher species diversity.

Key words: Ground-Dwelling Vertebrates, Drift-Fence Pitfall Traps, Wanglang Natural Reserve

Freshwater Biodiversity Observation Network

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Abstract: Built on existing regional and global networks, the thematic Freshwater BON (FWBON) will be an important mechanism to collect, standardize and distill freshwater biological information in products that will improve the observation, reporting and protection of freshwater biodiversity. It will enable the global scientific community to describe the relationships between biodiversity, organism abundance, system productivity, and ecosystem services. FW BON will promote the establishment of best practices for global biodiversity observations by: (1) improving the collection of harmonized data, (2) developing data standards and methods for data management and dissemination, (3) facilitating data sharing without compromising national concerns, (4) integrating biodiversity information with physical and chemical data, and (5) generating products to guide the management of rivers and their catchments, lakes, wetlands and subterranean aquatic ecosystems. Freshwater BON seeks to integrate independent historical and current biological/ecological surveys and databases and fill gaps with new observations that incorporate new remote sensing methods, novel molecular (eDNA) technologies, traditional biodiversity and environmental research tools, and coordinated experiments and process studies. It will support modelling

efforts aimed at estimating current, as well as future distribution and populations of freshwater biodiversity to support decision making by various stakeholders at local to global scales. FW BON will also develop the framework for integrating biodiversity with other essential environmental variables (Essential Water Variables) and databases by working with GEO Water, GEO Wetlands, GWOS, and other national and international groups.FW BON will contribute to the development and measurement of Essential Biodiversity Variables in freshwater environments and contribute methods and tools for BON in a Box, and thereby contribute to the establishment, further development and global coordination of national freshwater biodiversity monitoring programs.

Key words: Freshwater Biodiversity, Essential Biodiversity Variables, GEO BON, Aichi Targets

Progress toward the Construction of China Butterfly Diversity Monitoring Network

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Abstract: As the objective tool to assess biodiversity changes, large-scale biodiversity monitoring can produce reliable, accessible and timely monitoring data for assessing management effectiveness of biodiversity conservation and developing more effective policy. "China biodiversity conservation strategy and action plan" (2011-2030) has prioritized the construction of a comprehensive biodiversity observing network. Since 2016, Nanjing Institute of Environmental Sciences (NIES) is leading an interagency partnership with the domestic related research institutes, universities and civil society organizations, and set up a national butterfly diversity monitoring network supported by the Ministry of Environmental Protection of the PR. China (MEP). After years of planning, one hundred and thirteen standardized sample regions were established by 2016, containing 582 fixed-route transects with a total length of 1108 km in 31 provinces, autonomous regions and municipalities of China. At present, under the joint efforts of the experts and teachers from 53 cooperation units, the annual observation of 2016 has been completed. Hundreds of thousands of records were loaded onto the database, and relevant analysis report is awaiting introduction in the Ministry of Environmental Protection with a view to provide support for decision-making.

Key words: Biodiversity Conservation, Butterfly Monitoring, Environmental Protection

Promoting the Biodiversity Monitoring of Birds in China through the Camera-Trapping Network: Status, Challenge and Outlook

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Abstract: During the past two decade, camera-trapping has been widely used in biodiversity monitoring and wildlife research across China. Most of the existing camera-trapping projects focus on mammals, and the birds are frequently considered by-catch records. We analyzied 152 wildlife camera-trapping researches in China since 1995, on the basis of an exhaustive review on Chinese and English literature, including published articles, reports, public news and addtional unpublished datasets. The results showed that at least 360 wild bird species, belonging to 16 orders and 54 families and accounting for 26.26% of total number of China bird species, have been documented by camera-trapping since 1995. Passeriformes was the order with the most recorded species (251). On the family level, Turdidae was the taxon with highest number of recorded species (54), followed by Timaliidae (46) and Phasianidae (37); there were 23 families which each had only one species recorded. Ground- and understory-dwelling forest birds accounted for the majority of all bird records, in terms of either species richness or camera detections. Published bird records were characterized by regional imbalances. Sichuan and Yunnan provinces were the most surveyed provinces, with 15 and 9 sites respectively. Sichuan recorded the highest species richness (148), followed by Guangxi (66) and Zhejiang (63). A total of 111 new regional new species recorded had been reported. Given the fact that there are still remarkable camera-trapping data which has not been published, we speculated that the actual recorded bird species should be higher. These results indicated that camera-trapping can produce considerable bird distribution data of high accuracy, high quality and large amount, which may make significant contribution to the biodiversity monitoring and regional inventory of birds in China. For terrestrial birds such as Galliformes, Turdidae and Timaliidae, a standardized long-term monitoring network based on camera-trapping is advocated, and such a monitoring network could also provide data complement and support for the diversity monitoring of other taxa.

Key words: Biodiversity Monitoring, Camera-Trapping, Bird Inventory, Monitoring Network

Population Ecology of Bufo Gargarians Minshanica in Zoige Wetland：Based on Artificial Cover

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Abstract: Over recent decades, the population size of amphibians is declining seriously, so the living status of amphibians is attracting more and more attentions of ecologists and conservationists. Zoige wetland is not only the largest plateau peat bog in the world, but also one of the biodiversity conservation hotspots in China. Three species of amphibians inhabit in this region, Rana kukunoris, Narorana pleskei, and Bufo gargarizans minshanica. Some existing researches showed that the populations of the three species are decreased in different degrees. In the study, we monitored the population ecology of Asiatic toad in Zoige wetland using artificial cover from 2011 to 2014. The results showed that: the population fluctuated obviously in sampling sites; the data of age structure showed that the population is increasing; the number of individuals had an apparent positive linear relationship with the distance from the brook($p<0.01$); individuals increased along with the distance from the brook; line shape was more effective than square shape in monitoring this species($p=0.018$); we also found that the fatness of sub-adults of Asiatic toad did not exhibit significant differences among seasons. We hypothesize that the Asiatic toad has strong migrational capacity, they may migrate along a fixed routes circularly, for these species which has a large home range and long migrational distance, like Asiatic toad, we should protect the optimal habitats and prevent these habitats from fragmentation.
Key words: Artificial Cover, Asiatic Toad, Population Ecology, Zoige Wetland

China Biodiversity Observation Network: Overall Design, Field Protocols and Recent Achievements

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Abstract: Biodiversity has continued to decline over the past four decades. Parties to the Convention on Biological Diversity (CBD) has adopted the Strategic Plan for Biodiversity 2011-2020 and set the Aichi Targets to 'take effective and urgent action to halt the loss of biodiversity' (CBD 2010). Biodiversity monitoring is useful for identifying species in decline or at risk of extinction, determining sustainable levels of utilization, and assessing the effectiveness of conservation measures. Biodiversity monitoring can provide timely and accurate data for regional or national management needs and policy making. Lack of monitoring data can reduce the capacity for informed decision-making and timely reporting on progress towards conservation targets. It is

crucial to detect and understand spatial-temporal biodiversity changes through monitoring for better allocation of conservation efforts and assessment of the progress towards relevant strategies and targets.

The design of a monitoring network requires cost-efficient allocation of monitoring sites across space, to ensure that monitoring sites are distributed in the most informative areas and the total number of sites is minimized. Properly designed monitoring networks can generate data to understand status and trends of biodiversity, and to assess progress towards conservation targets. However, biodiversity monitoring is often affected by poor sampling design. We proposed an approach to choosing optimized monitoring sites among large areas. Based on comprehensive distribution data of 34284 vertebrates and vascular plants from 2376 counties in China, we 564 optimized monitoring sites (counties) through complementarity analysis and heuristic knowledge of nature reserves. The optimized monitoring sites are complementary to each other and reasonably distributed, to ensure that maximum species are covered while the total number of sites and monitoring costs are minimized. Incongruence of optimized monitoring sites among different taxa indicates that taxa with different ecological features should be selected for large-scale monitoring programs.

The China Biodiversity Observation Network (China BON) was initiated in 2011 and supported by the Ministry of Environmental Protection of China. There are more than 500 sampling sites (counties, approximate 20% of the number of counties in China), with >8000 line transects and point transects. The objectives of China BON are to detect changes in species composition, distribution and population dynamics, assess threats to target species and to analyze conservation policy efficiency. It is currently focused on the monitoring of species diversity for mammals, birds, amphibians, butterflies and plants. Participants include professional staff, graduate student and volunteers from more than 400 universities, research institutes, protected areas and civil societies.

National standards and field protocols are implemented within the network. We developed 13 field protocols for monitoring indicator taxa including mammals, birds, amphibians, butterflies and plants. Methods to set up plots and line and/or point transects, indicators for monitoring, time and frequency for monitoring, methods on data collection and quality control, team requirements and human resource training were illustrated in these field protocols.

Key words: Complementarity Analysis, Sampling Design, Field Protocols, Biodiversity Observation Network

A Preliminary Report on Wildlife Camera-Trapping Monitoring by Systematic Sampling in Kuankuoshou Nature Reserve, Guizhou Province

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Abstract: In order to systematically explore the wildlife resources in Kuankuoshui National Nature Reserve (Kuankuoshui NR), Guizhou province, infrared cameras were placed in north area of Kuankuoshui NR by means of systematical sampling, the results showed: 1)five species were recorded firstly which was very helpful to local bio-inventory, including Garrulax maesi, Luscinia cyane, Turdus boulboul, Dremomys pyrrhomerus, newly recorded in Kuankuoshui NR, and Turdus feae was new provincial record in Guizhou; 2) the dominant species with high Camera Shooting Ratio (CSR) including Chrysolophus pictus (CSR:1.09%), Bambusicola thoracica (0.44%), Dremomys pyrrhomerus(3.16%), Sus scrofa(0.69%), Muntiacus reevesi(0.49%), etc. All of these species had different kinds of daily activity rhythms, Sus scrofa showed a secondary peak (8:00-9:00) and a main peak (11：00-13：30) a day, Muntiacus reevesi showed two peaks as well (9：30-11：30 and 17：00-19：00), Dremomys pyrrhomerus had not obvious peaks but more active from 8:00 to 10：00. Bambusicola thoracica had several peaks a day and Chrysolophus pictus performed very active in two time periods (10：00-11：00 and 16：00-17：00); 3) The types of habitat ($\chi 2=3.891$, $P=0.421<0.05$) and elevation ($\chi 2=3.049$, $P=0.389>0.05$) both showed no significant influences on CSR in the monitoring area. Through camera monitoring with systematical sampling, we can systematically and perfectly reveal the biodiversity of birds and mammals of Kuankuoshui NR, which will be helpful to regional bio-inventory, conservation policy-making, and the further ecological studies.

Key words: Kuankuoshui National Nature Reserve, Camera-Trapping Monitoring, Systematical Sampling, Birds and Mammals Inventory

GEO BON: Developing Biodiversity Monitoring for Global Conservation Targets

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Abstract: The member states of the Convention on Biological Diversity have agreed on an ambitious set of targets for biodiversity in the year 2020. There is now the need to assess progress on those targets and beyond by using the best available information. In this session we will present the efforts by the Group on Earth Observations Biodiversity

Observation Network to developing national biodiversity observation networks using the Essential Biodiversity Variables framework, in order to support assessment of the Aichi Targets and future biodiversity assessments.

Key words: Biodiversity, Monitoring, GEO BON

Amphibian Monitoring in Mountains around Sichuan Basin in Southwestern China

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Abstract: Amphibians are sensitive to environmental changes and play a key functional role in the connection of aquatic and terrestrial ecosystems, and thus are often regarded as critical "early warning systems". Many of their populations are undergoing rapid decline and therefore a long-term monitoring system is imperative to identify immediate threats to the animals. Since 2011, amphibian monitoring has been carried out in Mountains around Sichuan Basin under supports from Ministry of Environmental Protection of the People's Republic of China and Chinese Academy of Sciences. Here we report the primary results of amphibian monitoring at ten areas around Sichuan Basin, covering a region with W104.28°~ 110.04°, N26.83°~ 33.66°. From 2011 to 2013, we surveyed in six areas using three methods. A total of 1701 individuals in average representing about 35 species belonging to nine families were monitored. From 2014 to 2016, ten areas, four added, were monitored. A total of 3586 individuals in average representing about 51 species belonging to nine families were monitored each year. Compared with the distributed species in monitoring areas, 68% of the total species had been monitored. This work has been proceeding steadily and efficiently. In addition, within China, ten monitoring areas distributed in Mountains around Sichuan Basin, the total species had been monitored is 38% of the total species had been monitored in China. Thus, generally speaking, amphibian monitoring in Mountains around Sichuan Basin is fundamental to monitoring amphibians in China.

Key words: Biodiversity Monitoring, Mountains, Sichuan Basin, Amphibian

An Overview of mammal Biodiversity Monitoring Network in China

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Abstract: Biodiversity monitoring is the basic work and important means for understanding the changes of biodiversity, assessing the effectiveness of management,

and formulating protection policies. The China national Biodiversity Conservation Strategy and Action Plan (2011-2030), which was released in 2010, has prioritized the establishing of the Biodiversity Monitoring Network System. Since 2016, the Nanjing Institute of Environmental Science， Ministry of Environmental Protection has established a demonstration network of mammal diversity monitoring in conjunction with relevant scientific research institutes and universities, using infrared camera traps to monitor large and medium-sized mammals. The first batch of 58 standardized mammal observation areas was set up with the focus on the Yangtze River Economic Zone, taking in account the representative nature reserve, the core distribution area of rare, endangered species and the national key protected species. Three sample plots were set up in each sample area, and 20 cameras were set up in each sample plot. 3480 infrared cameras were set up. Through the data collection and analysis, we will obtain the species, quantity, distribution and human disturbance of the large and medium mammals in the observation area, to assess the trends of population dynamics, to analyze the impact of environmental changes and human activities on wildlife diversity, and to provide the technical support for the development of national biodiversity conservation related management measures and policies.

Key words: Biodiversity Monitoring, Mammal, Infrared Camera Traps

Building an Interoperable Network of Biodiversity Observation Systems in support of Conservation and Sustainable Development

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Abstract: While the status and trends of biodiversity are continuously deteriorating, the scientific community is faced with the challenge of mainstreaming biodiversity in policy making. At the same time, governments and decision makers are asked to report on their progress to halt this biodiversity crisis and to promote sustainable development. Underpinning this is the need to produce relevant and trustworthy information on biodiversity status and trends and the mechanisms driving these trends. It is thus critical to improve both the supply of biodiversity information and the integration of this information into policy and decision-making. This need has for instance been repeatedly stated by the Parties to the Convention on Biological Diversity who stress the necessity for the development of more effective biodiversity observation systems that support sustainable development policy and help track global and national biodiversity targets. The Group on Earth Observations – Biodiversity Observation Network (GEO BON) is working with national and regional partners around the world to enhance existing, and build new, efficient and powerful Biodiversity Observation

Networks (BONs) that directly support conservation and sustainable development policy. Considering that biodiversity, its benefits for society, and the drivers that impact it act across borders, it is important that a national observation systems do not develop and operate in isolation. GEO BON and its partners are thus promoting a network of BONs that draw from, align with and contribute to broader regional and global biodiversity observation efforts in order to improve our collective ability to detect and attribute biodiversity trends. Furthermore, GEO BON is developing a framework for observation systems that focus on producing relevant data that effectively informs national and sub-national policies and meet the need of decision makers. We will present the work of GEO BON and its national, regional and global partners to develop such a flexible framework and design process, based on the Essential Biodiversity Variables, for the establishment of interoperable national Biodiversity Observation Networks. In particular, we will discuss approaches, tools, lessons learned, challenges, and opportunities for the development of Biodiversity Observation Networks across scales.

Key words: Biodiversity Monitoring, Aichi Targets, Observation Networks, Reporting

Publishing open biodiversity data in ecology: standards and benefits

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Abstract: In the world of sharing biodiversity data, the data from ecology are among the most valuable and highest in quality. Ecological datasets are characterised by documented sampling protocols and methods, presence-absence and abundance data on taxa in space and time, and dominance of zero-inflated species-to-site matrices. The heterogeneity and additional levels of complexity of these data often cause significant delays in standardizing and formatting open data from ecology, in contrast with collections and citizen science communities. Concerns about data sharing are common barriers in ecology—not least because novel and unique data translate in new papers that bring grants, projects, students and positions, generating more data in turn. However, open data policies increasingly require individual researchers, research groups, universities, journals and publishing houses to share the data behind graphs and conclusions through a growing number of ways to archive and share tabular data. As a result, half-measures are taken to address calls for data transparency, with possibilities for reproducibility and reuse hampered by the lack of international data standards for accessing ecological data through a single, trusted access point.Not anymore: by promoting the publication of open-access sampling-event data through GBIF.org, GBIF (the Global Biodiversity Information Facility) and Group on Earth Observations

Biodiversity Observation Network (GEO BON) hope to make ecological data more widely available for further study. GBIF.org is the world's largest index of species occurrence data, providing free and open access to more than 700 million occurrences from more than 30,000 datasets published by over 800 institutions. Its near real-time infrastructure is now widely used, supporting more than one substantive use in peer-reviewed research per day. Under the auspices of Biodiversity Information Standards (TDWG), the biodiversity informatics community supported additions to Darwin Core (DwC) standard that enable the mobilization of sampling-event data, particularly species abundance, derived from environmental, ecological and natural resource investigations that follow standardized protocols for measuring and observing biodiversity. In September 2015, GBIF released updates to GBIF.org and the Integrated Publishing Toolkit (IPT), its free, open-source data publishing software, that allows, publication of sampling-event datasets and enhances indexing and discovery of these datasets. This presentation will highlight recent improvements GBIF has made to support the publication of sampling event datasets and data reuse perspectives opened through GEO BON. Drawing on exemplar datasets, the presentation aims to promote this new data standard and data sharing pathways. In addition to metanalyses and other types of academic data reuse, sharing formatted data from ecological projects improves adequacy of global decision-making in biodiversity policy – it's time to contribute.

Key words: Darwin Core, Event Core, Essential Biodiversity Variables, Sampling Event

Diversity and Monitoring of Butterfly along Danjiang River Basin in Shaanxi (Province), China

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Abstract: The butterfly community structure and diversity along the Danjiang River basin were investigated and monitoring from 2006 to 2014 and compared their similarities and differences among the five representative habitats coupled with environmental change. A total of 219 species belong to 5 families and 108 genera were recorded. The family Nymphalidae had the highest diversity index (2.9305) and richness index (1.8022). The family Hesperiidae had the highest evenness index (0.7189), and the family Papilionidae had the highest dominance index (0.8351). Biogeographic composition of butterfly fauna shows that 25 species (11.42%) belonged to the Palaearctic region, 67 species (30.59%) belonged to the Oriental region, and 127 species (57.99%) were widespread.The community structure and diversity of butterflies are influenced by main vegetation types and habitat disturbance to some

extent. The index richness among the five habitats varied from the highest in ZL (3.3967) to the lowest in GF (1.8545). The diversity and evenness index were the highest (3.9463, 2.8747), but the dominance index was the lowest (0.0944) in ZL. The dominance index was the highest in GF (0.7535). DS and EL had the lower butterfly diversity and equitability values, which could result from the replacement of natural and seminatural habitats with cropland or urban development.

Key words: Lepidoptera, Biodiversity, Richness Index, Danjiang River Basin

Sea Turtle Hotspots and Their Connectivity in the Gulf of Mexico and the Caribbean

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Abstract: The identification of areas of sea turtle aggregation visited throughout its lifetime, and their spatial connectivity, is of the highest importance for guaranteeing the viability of these large marine vertebrates. The Gulf of Mexico (GoM) is home to five of the six species of sea turtles inhabiting the Atlantic, with the waters of the continental shelf off the Yucatan Peninsula being crucial for their development, feeding and migration. For decades, more than 90% of the conservation and research efforts have focused on the nesting females and hatchlings, producing an information gap for in-water life-stages where sea turtles spend more than 95% of their life. This work aims to spatially evaluate sea turtle aggregation spots from a regional perspective to encompass their main life stages: (1) in-water hatchlings, one of the least studied stages, linked to Sargassum drifts that in this case represent their potential aggregation areas; (2) juveniles that usually occupy near-coast, shallow, productive areas; and (3) post-nesting females, the most studied life stage, which are known to widely use and connect extreme points in the GoM. The results show that there are at least two major multispecies aggregation zones in the continental shelf off the Peninsula, which are also linked to rocky and coral reefs, both considered highly biodiverse ecosystems. Important links were found between nesting beaches in south GoM with feeding grounds in north GoM, as well with multispecies aggregation spots in the Caribbean. This is a key contribution for the conservation and strategic management of biodiversity, providing a spatially explicit baseline for decision-making in cases of major contingency such as oil spills and the impacts of threats of global concern such as climate change.

Key words: Satellite telemetry, Landsat Imagery, Sargassum, Yucatan Peninsula,

The Species Richness, Community Structure, and 10-Year Changes of Large Mammals in Southwestern China: Are We Looking Towards a Brighter Future?

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Abstract: The Mountains of SW China is one of the global biodiversity hotspots characterized by its rich and unique large mammal fauna. Although some of the charismatic large mammals (e.g., giant panda Ailuropoda melanoleuca and takin Budorcas taxicolor), have been globally well-known and long used as flagship species for wildlife and biodiversity conservation, the status, structure and long-term dynamics of the large mammal community have been poorly studied.

From 2004-2016, we conducted surveys using standardized camera-trapping protocol at 12 nature reserves (1000+ locations, &gt 100,000 camera-nights) across 5 mountain ranges, and collected additional camera-trapping data from another 20+ reserves from most recent literatures. We resurveyed 5 reserves in 2014-2016 that were surveyed during 2004-2006 to detect the 10-year changes of large mammal community.

The results indicated, 1) significantly lower species richness compared to baseline list in each reserve, especially of carnivores (56.2% species missing, most significant in Felidae, Canidae and Viverridae) ; 2) incomplete trophic structure characterized by the elimination of apex predators (leopard Panthera pardus and dhole Cuon alpinus); 3) overall increase of mammal diversity during the past 10 years in the 5 resurveyed reserves indicated by Wildlife Picture Index; 4) remarkably increased numbers of free-ranging livestock, possibly leading to the decline of sympatric large herbivores.

We speculate that both the rapid defaunation and human-introduced bias during previous inventories contributed considerably to the gaps we found in SW China. We conclude that the "baseline" species lists created at reserve or county levels are not representative of the current local diversity for the large mammal communities. However, those "baseline" lists have been long considered the finest-scale species distribution data in China and are the foundation of multiple biodiversity assessments at both state and global level. We argue that such assessments may overestimate the current richness of large mammals across this region simply due to the flaws and biases of reference data. We suggest these reserves, their responsible government authorities and future studies cease to use these "baseline" species lists for conservation planning and biodiversity assessments. There is a critical need to establish a regional or state-wide monitoring program following a systematic sampling design and standard protocol. Researchers and conservation managers shall pay close attention to the ecological consequences of the loss of large predators and the potential trophic

cascading effects in SW China in the near future.

Key words: Biodiversity Monitoring, Biodiversity Assessment, Large Terrestrial Mammal, Camera-Trapping

Vertically Alternative Distribution Research of Amphibians in Leigongshan Nature Reserve

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Abstract: Spatial distribution pattern of species is the core problem in biodiversity theory. The Leigong Mountain with altitude range from 648 m a.s.l to 2179 m a.s.l is the peak of the Miaoling Mountains range which is located between the Yangtze River and Zhujiang River. In this mountain, a total of 37 amphibian species have been recorded. To study the spatial distribution patterns of amphibians, we had monitored 30 amphibian species in this region from 2014 to 2016.

Several approaches were used to evaluate distribution patterns of amphibians in Leigong Mountains. The index of Shannon-Wiener diversity and index of Pielou evenness were used to measure the diversity of elevation gradient; The index of ecological niche breadth, the index of coincidence and the similarity coefficient of Sorenson were applied to measure vertical distribution pattern of amphibians; Stevens method and Cross-species method were used to test the Rapoport's rule for amphibian rang along the elevation gradient in Leigong Mountain Nature Reserve.

The thirty amphibian species belong to nine families and 25 genera. In terms of distribution elevation range, among the nine families, the family Megophryidae distributed widest, but the families Cryptobranchidae and Microhylidae distributed narrowest. Among the 25 genera, the distributive elevation range of Sylvirana is the narrowest, and that of Vibrissaphora is the widest. Most of the genera are distributed at the altitude from 800m to 1400m.

The species diversities(E) and evenness(H) at different altitudes were as follows, 600～799m H = 2.694，E = 0.275; 800～999m H = 3.048, E = 0.450; 1000～1199m H = 3.448, E = 0.432; 1200～1399m H = 3.377, E = 0.427; 1400～1599m H = 2.158, E = 0.272; 1600～1799m H = 1.296, E = 0.211; > 1800m H = 0, E = 0. The index of niche breadth shows the wider ecological species, the smaller populations. The index of niche overlap shows fewer species have the same niche. The similarity index shows the similarity between the adjacent altitude zones below 1600 m was higher than the adjacent altitude zones above 1600 m. below 1400 m, species replacement is relatively smaller between the adjacent altitude zones, the similarity index above 1400 m is higher, and the replacement between the adjacent altitude zones is relatively distinct above

1400 m. The result of Stevens method shows that the correlation is R2 = 0.6887, with statistical significant (<0.05); the result of Cross-species method show the correlation is R2 = 0.42, with statistically significant >; 0.001), meaning that the Rapoport rule is applicable to amphibians of Leigongshan Natural Reserve.

Key Words： Spatial distribution pattern; Leigong Mountain; Amphibian; vertical distribution.

Key words: Spatial Distribution Pattern, Leigong Mountain, Amphibian, Vertical Distribution

Developing Biological Survey Design for Systematically Obtaining Habitat Map

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Abstract: Quality of habitat map is crucial to success for ecosystem management and conservation planning, as, for example, the decision-making of strategic reserve placements is often based on available habitat data. However, there is no systematic framework to obtain habitat map through population survey that tell us how accurate habitat information would be obtained given a survey design. In reality, ad hoc or conventional manners are often applied. Designs for population survey may inherently involve multiple spatial scales to be determined by managers given time and monetary constraints, such as the spatial extension of the ecosystem under concern, resolution to map the individual distribution, and spatial scale of each survey unit. Any changes in these spatial scales may affect the quality of habitat distribution map obtained through an ecosystem survey. Therefore, to develop a systematic framework for biological survey, we need to understand the mutual dependence of these spatial scales on the quality of habitat map. With a relatively sessile species such as plant or coral species in mind, a mathematical model to assess the accuracy of habitat map is developed. The developed theory is capable of examining various survey designs and scenarios, such as using different spatial scales and individual detection rate, as well as assuming different individual distribution patterns. Regardless of individual distribution pattern assumed, the choice of resolution to map the individual distribution largely affects accuracy of habitat map, such as the average rate to map presence individuals correctly. The tradeoff between the accuracy of habitat map and the resolution to map the individual distribution is found, associated with an equivalent asymptotic behaviors at sufficiently small and large scales to map the distribution. The developed theory may facilitate management decision-making and inform the design of data gathering.

Key words: Biological Survey, Ecosystem Management, Ecological Modeling

Amphibian Species Contribute Similarly to Taxonomic, but Not Functional and Phylogenetic Diversity

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Abstract: Understanding how biodiversity affect ecosystem functioning is a central question in conservation ecology. Previous biodiversity studies primarily focused on taxonomic diversity despite the fact that biodiversity has a multitude of facets. In recent decades, the more commonly methods that used to quantify biodiversity are focusing on species traits and genetic variation within populations, communities and ecosystems (i.e. functional and phylogenetic diversity). To date, however, empirical studies of how individual species contribute to different biodiversity facets are still relatively rare. The aim of the present study was to assess whether amphibian species contributed similarly to multiple aspects of biodiversity. We predict that amphibian species can contribute similarly to taxonomic diversity, but they display specific unique portions collectively of functional and phylogenetic diversity. To test this prediction, amphibian species monitoring were did in Emei Mountain in southwest China from 2013 to 2015. A total of 24 species were monitored and null models were used to obtain 190 random communities. A set of 11 functional traits were then used to quantify functional diversity, and sequences of 16s rRNA gene of mitogenome were used to calculate phylogenetic diversity of each community. Our results demonstrated that despite individual species contributed similarly to taxonomic diversity, they have more idiosyncratic contribution to functional and phylogenetic diversity. We then observed that species in different conservation status differed significantly in functional traits, which, however, had the same contribution to taxonomic diversity. Interestingly, it was not the most (i.e. endangered species), but the medium interested species of conservation (i.e. vulnerable/near threatened species) displayed significantly higher contributions to functional and phylogenetic diversity. In conclusion, the present study supported the claims that species-based metrics in conservation ecology is not appropriated. Alternatively, the critical contributor species to different facets of diversity should be maintained of conservationists to support local biodiversity of amphibian communities.

Key words: Amphibian Species, Taxonomic Diversity, Functional and Phylogenetic Diversity, Conservation

Status of Vascular Plant Species on Hainan Island

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Abstract: Maintaining plant diversity on tropical islands is a priority for biodiversity conservation. Hainan Island, located in the northern tropics, is the second largest island in China with high plant diversity. Several updated plant lists of local flora have been published after decades of field investigations. In this paper, we investigated the plant diversity on Hainan Island by conducting extensive field surveys and a literature re-view. Results indicated that, as of December 2015, there were 6,036 vascular plants recorded on Hainan Is-land with voucher specimens or practical materials. Among these species, 1,220 species were revised as syn-onymously, 4,579 species were wild (including 483 endemic and 512 rare and endangered species), 163 were naturalized species (including 57 invasive species) and 1,294 species were cultivated species. Since the pub-lication of Flora Hainanica in 1964, a large proportion of newly recorded species were mainly wild or intro-duced species, and accounted for 35.9% and 75.9% of their corresponding totals, respectively.
Key words: Flora, Rare and Endangered Plants, Endemic Plants, Naturalized Plants

Design of Essential Biodiversity Variables Based on Genetic Information: Progresses and Perspectives

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Abstract: Reducing the rate of biodiversity loss and curbing detrimental biodiversity change are among the most important missions of mankind in a changing planet. Parties to the United Nations (UN) Convention on Biological Diversity (CBD) thus set the Aichi Targets for 2020 to offer guiance to the global biodiversity conservation actions. Partners from the Group on Earth Observations Biodiversity Observation Network (GEO BON) have developed Essential Biodiversity Variables (EBVs) in terms of genetic composition, species populations, species traits, community composition, ecosystem structure and ecosystem function. At the levels of species and ecosystems, indicators have been designed from multi-aspects. In contrast, genetic indicators have not get enough emphasis and indepth study though they have been initially developed. As a matter of fact, genetic information can offer more precise base for indicator design to monitor the internal dynamics of biodiversity. Further, we can get insight in the dynamics of biodiversity change from the evolutionary perspective and conserve the integrity of genetic elements to ensure a sustainable future for human well-being. The past decades witnessed the rapid progresses of the molecular technologies, which makes the genetic information easily available in a short time. Currently, the genetic

information of a variety of biological taxa has been produced and open to the public in the global Genbank database. Thereinto, many rare and endangered species, and domesticated animals and cultivated plants emphasized in the CBD targets were included. It offers a good opportunity for us to develop genetic indicators at a wider spectrum. Here, we reviewed the recent progresses of EBVs design based on genetic information and envisaged the development of genetic indicators to monitor the progresses towards the corresponding biodiversity conservation targets in the future.
Key words: Essential Biodiversity Variables, Indicator, Genetic, Consevation Targets

The Saturniidae of Barro Colorado Island, Panama: A Model Taxon for Studying the Long-Term Effects of Climate Change?

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Abstract: The Saturniidae are among the largest moths and are best represented in the Neotropics. We provide an updated list of the 72 species of Saturniidae collected on Barro Colorado Island (BCI), Panama, during the period 1958-2016. This list will serve as baseline data for assessing long-term changes of saturniids on BCI in the future, as 81% of the species can be identified by their unique DNA Barcode Index Number, including four cryptic species not yet formally described. A local species pool of 60+ species breeding on BCI appears plausible, but more cryptic species may be discovered in the future. We use monitoring data obtained with light traps to analyze recent population trends on BCI for saturniid species that were relatively common during 2009-2016, a period representing perhaps > 30 saturniid generations. The abundance of 11 species, of 14 tested, could be fitted to significant time-series models. While the direction of change in abundance was uncertain for most species, two species showed a significant increase over time, and forecast models also suggested continuing increase for most species during 2017-2018, as compared to the 2009 base year. Peaks in saturniid abundance were most conspicuous during El Niño and La Niña years. In addition to a species-specific approach, we propose a reproducible functional classification based on five functional traits to analyze the responses of species sharing similar functional attributes to climatic anomalies. Our results suggest that the abundance of large species with good dispersal abilities may increase concomitantly with rising air temperature in the future, as short-lived adults may allocate less time to increasing body temperature for flight, leaving more time available for searching for mating partners or suitable oviposition sites.
Key words: Insects, Climatic Anomalies, DNA Barcoding, Functional Groups

The First Step for Butterfly Monitoring in China: Overview of Jiangsu Butterfly Monitoring Scheme (2010-2016)

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Abstract: In 2010 a butterfly monitoring scheme covering the whole province was launched in Jiangsu, China. In the support of Helmholtz Centre for Environmental Research (UFZ) Germany, transect line method were used in 28 fixed lines in different city in Jiangsu. As the first Butterfly Monitoring Scheme in China, Jiangsu Butterfly Monitoring Scheme (JSBMS) has entered the eighth year in 2017. In the past seven year, JSBMS has made six achievements including: 1) Background information of Jiangsu butterfly diversity has been renewed, 12 new record species from five families have been recorded; 2) Monitoring network including transect-lines monitoring and sample sites monitoring has been formed, the number of transect-lines has been increased from 28 in 2010 to current 55, and 175 sample sites for butterfly monitoring in different 13 cities of Jiangsu have been identified. 3) China's unique mode getting the public involved in butterfly conservation has formed, that is: Expert and his team bring along primary and secondary school teachers and their students, and these children impact their parents and other people in the communities they live in. So far, there have been nearly 5000 students from different primary schools, secondary schools and universities joined some activities of JSBMS. 4) The use of multiple media (TV, newspaper, internet, community activities) yielded high responsiveness from the public and high recruitment of volunteers. 5) Thousands of monitoring information have been collected to set up database for Jiangsu Butterfly Monitoring Scheme. Analysis integrating climate change and habitat change data is in progress; 6) Jiangsu Butterfly Monitoring Scheme provides referential experience for launching butterfly monitoring scheme in other provinces of China.

Key words: Butterfly Monitoring, Transect Line Method, Public Involvement, China

T4-04: Science of Life Community and Sustainable Development

Discussion on the Important Role of "Water" in the Operation of Human Living Community

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Abstract: In this paper, through the innovative theories of Living Community "life is a the dynamic performance of a material body under certain environmental conditions by the role of information", "life survives in operation of community" and other arguments, and by concentrated experiences of dozens of people, the water factor, as a carrier of Living-Community Information, has conveyed the information in human body and system through a variety of human channels. So large amount of formal measured data were collected to prove that "an important environmental factor of water" of the community life, as a carrier of human living information, promotes the operation of the human living community, speeds up the metabolism, improves the overall health status. This demonstrates the coordination of "water" and "Living-Community Information" in harmony, as well as the important function in improving the vitality of life, to maintain the important role of human health.

Key words: Living Community, Living-Community Information, Water Factor

Simulation of C&N Cross-media Metabolism in Municipal Solid Waste Treatment System and Study on Management approach for Ecosystem Health Optimization

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Abstract: Complex material metabolism and cross-media migration of pollutants happen in municipal solid waste treatment system, which is a key sector for material change between urban ecosystem and external environment. However, considering the emission to multiple environmental mediums such as air, water and soil, currently many pollution control technologies can’t remove pollutants completely. Focusing on the pollution control effects of certain single environmental medium will cause the transfer of environmental pressure among different mediums, leading to more serious secondary or potential environmental impacts. This study analyzed the metabolism and migration mechanism of essential elements—C and N and their release to air, water and

soil in the treatment, disposal and recycle process of municipal solid waste. On this basis the system analysis model of elements cross-media metabolism was built to simulate the metabolic flow and migration of C and N among atmosphere, hydrosphere and pedosphere in multiple forms in municipal solid waste treatment system. Essential flows and technical steps of elements cross-media metabolism were recognized using sensitivity analysis. By setting plenty of managing and technological paths based on Monte Carlo simulation, cross-media metabolic feature and the synthesized environmental impacts of multimedia in different scenarios were analyzed, providing references for establishing an improved environmental management mode aiming to optimize urban ecosystem health. The results showed that under the mainstream treatment processes of landfill, composting, incineration and anaerobic fermentation in China, remarkable cross-media migrations of pollutants existed in the municipal solid waste treatment system. Through these four processes, 68%, 99%, 82% and 56% of input carbon and nitrogen pollutants were released back to the environment, respectively, which brought significant environmental impacts. Cross-media pollutants migration in different technological steps caused different multimedia impacts, as consequence the integrity and cooperativity of multimedia protection should be considered for technology choice and distribution. Under the optimized technology path, the multimedia synthesized environmental impact could be reduced by 48%~71% in the future 12 years compared to current situation. The cross-media perspective illustrated in this study provides meaningful references for optimizing the cycle metabolism of C and N in municipal solid waste treatment system and establishing environmental management mode targeting for urban ecosystem health.

Key words: Municipal Solid Waste Treatment System, Carbon and Nitrogen, Cross-Media Metabolism, Ecosystem Health

A Study on the Relationship between Living Vitality and Living Community Structure

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Abstract: In this paper, a method of human fibroblasts (HSF) treated with "Living-Community information", which was extracted from plants, to promote the proliferation of HSF, thus the vitality of HSF in different living communities was detected. The results showed significant changes in their vitality in different concentration gradients, which showed by a parabola that the range of biological vitality per unit mass varied greatly with the change of community structures. The results showed that the change of the structure of living community affected the

expression of biological vitality.

Key words: Living Community, Fibroblasts, Biological Vitality, Living-Community Information

An Integrated Specification for the Nexus of Water Pollution and Economic Growth in China: Panel Cointegration, Long-Run Causality and Environmental Kuznets Curve

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Abstract: Environmental degradation and development nexus has received increased attention and emerged as one of the most attractive empirical topics of immense interest among economists and ecologists. Of particular research interest to the research concerns on the environmental Kuznets curve (EKC) hypothesis. The EKC hypothesis states that in the early stages of economic development, environmental quality deteriorates with increase of pollution emissions, but as the economy continues growing beyond a certain threshold, that emission begins to decline and environmental quality improves, forming an approximately inverted U-shaped curve. Validity of the EKC hypothesis indicates that the development vs. environmental protection dilemma can be resolved. Hence, finding evidence in support of this hypothesis might have promising implications for sustainable economic growth in the future. Despite some developments in the field of EKC in recent years, there is still mixed and ambiguous knowledge of the relationship between pollution and economic development, owing to the lack of a refined theoretical and analytic integrated framework and appropriate models, let alone little investigation for water pollution discharge.

Against this backdrop, our study concentrates on a Chinese context and makes efforts to develop an integrated manner to explicitly elucidate the relationship between economic growth and water pollution discharge, which provides a solid theoretical foundation. Our study could make a twofold contribution to the extant literature. First, empirically, it is initial attempt to simultaneously test the existence for the EKC hypothesis for chemical oxygen demand (COD) discharge and ammonia nitrogen (NH3-N) discharge related to economic growth. To this end, the balanced panels under the analysis consist of industrial and domestic water pollution, which covers 31 provinces data during the period separately from 1997 to 2014, and 2001 to 2014. Our dataset under analysis could provide comprehensive information on the historic behavior of underlying variables and aid understanding of the relationship between the variables. Second, methodologically, we propose a systematic framework for investigation of the EKC relationship. Concretely, a set of techniques including panel unit root tests,

cointegration tests, and Granger causality tests are conducted to examine the causal effects between COD/NH3-N discharge and economic growth, allowing for cross-sectional dependence, nonstationary, and heterogeneity. Further, we refine the Stochastic Impacts by Regression on Population, Affluence and Technology model which could precisely specify the functional form of the relation, and conduct the newly proposed semi-parametric fixed effects regression supplemented with traditional estimation to investigate the EKC relationship for COD/NH3-N discharge. when using the more flexible estimation technique, it does not place ex ante restriction on the shape of the relationship curve and can therefore address potential functional form misspecification. Our empirical results show long-run bidirectional causality between economic growth and COD/NH3-N discharge in China, and confirm the existence of the EKC relationship between economic growth and COD/NH3-N discharge. However, the fit part of the EKC relationship for COD/NH3-N in China demonstrates that Chinese economic development has not yet reached the certain level that could positively promote COD/NH3-N discharge reduction.
Key words: COD/NH3-N Discharge, Economic Growth, Panel Granger Causality, Environmental Kuznets Curve

An Assessment of Status of Community-Based Forest Enterprises and Their Impact on Local Community

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Abstract: The study was carried out in the randomly selected Community-based Enterprises of different districts of Nepal using data from the Sikre Bio-briquette enterprise, Godawari Kunda CFUG and Bihani CFUG which are concerned with the promotion of a variety of Non-Timber Forest Products (NTFP) like Bio-fuel, ecotourism and essential oil. With this study our main aim was to investigate the financial status particularly benefit cost ratio, net present value and internal rate of return of Community-based Enterprises. This study also focused to identify community perception on enterprises they entertained in their village and to analyze the contribution of enterprises in supporting rural livelihood through employment generation.

Al total 33 HH (15%) includes 6 HH (18%), 13 HH (39%) and 14 HH (42%) of Sikre-Bio-briquette enterprise, Godawari Kunda CFUG and Bihani CFUG respectively were randomly selected as respondents out of 216 households in three study sites for HH survey and semi-structured interview for primary data collection. Likewise, secondary data were obtained from literature and records of the enterprises. The

positive result of NPV and IRR concluded after available financial records have also shown that community based enterprises are economically possible.
The income received from CBE is a major source of financial capital to local poor, It can create opportunities for rural employment; cash incomes, human skill development. On average, the largest source of expenditure amongst participating enterprise was on salaries and wages (85%) contributed by briquette manufacturing followed by essential oil processing (13%) and Picnic spot only contribute (2%). On the other hand, in our observation at Godabari Kunda CF area, we found that some 18% out of 92 households' main occupations were business (restaurant owner and shopkeeper). It can show that opening Picnic spot based enterprise in community forests have been also playing vital role towards employment generating to local community.
Key words: Community Forestry, Community-Based Enterprises, Non-Timber Forest Products, Livelihood

Effects of Living Community on Sustainable Development of Agriculture

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Abstract: As a result of an extensive use of chemical fertilizers, chemical pesticides, chemical herbicides in the world, farmland, water, air, agricultural products and food have been seriously polluted. This has seriously hindered the sustainable development of human society, especially agriculture. In this paper, based on the experimental results of Living Community: "the vitality of life is propelled and regulated by information", plant-derived Living-Community information was used for the first time on a variety of field crops, demonstrating good effects of the plant-derived Living-Community information in promoting on plant growth and development. The test results show the pheromone not only significantly improved yield and quality of the crops, including rice, wheat, apple, grape, tea, rubber, coffee, tobacco, Dendrobium, Panax notoginseng, tomato, cucumber, but also enhanced their stress resistance, including plant disease resistance, insect resistance, drought resistance, water logging resistance, cold resistance, heat resistance and so on in strengthening the health of the plant body. Since EGF-C is the original substance for the plant growth, with its characteristics of non-toxic and tasteless, it is safe for the environment and food. Therefore, it is assumed this plant-derived Living-Community information will create a new way for agricultural sustainable development.
Key words: Living Community, Chemical Pollution, Living-Community Information, Stress Resistance

Egfc Promotes Bone Fracture Healing

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Abstract: To determine if Egfc promotes fracture healing.

Methods: Experimental animals: 12-week-old male C57BL/6 mice were subjected to tibial open fracture. After surgery, mice were divided two groups: Egfc treatment group; and PBS control group. Tibial fracture model: An intramedullary pin was inserted into the tibia at the knee and an open fracture in the proximal tibia diaphysis was performed. Specimens were harvested 7, 10, 14, 21 and 28 days after fracture procedure for micro-CT, histology, biomechanical testing and RNA analysis.

Radiographic and μCT analyses: Weekly radiographs were obtained to monitor bone healing. Specimens were scanned at 8.8-micron isotropic resolution using a Skyscan1176 at indicated time points. Callus total volume (TV), callus bone volume (BV) and callus bone mineral density (BMD) were determined.

Biomechanical torsion test: Fracture specimens were mounted on an EnduraTec TestBenchTM system with a 200 N.mm torque cell and tested in torsion at a rate of 10/sec until failure to determine the torsional stiffness, ultimate torque, ultimate rotation, and strain energy to failure.

Quantitative PCR: Real-time PCR analysis was performed using murine specific primers for chondrogenesis and osteogenesis related genes (Sox9, col2a1, colX, Runx2, Osterix, osteocalcin).

Histology & histomorphometry: Specimens were harvested at 7, 10, 14, 21 and 28 days, and fixed in 10% NB-Formalin for 3 days and decalcified for 14 days in 14% EDTA and then paraffin embedded. 3-m sections were cut and prepared and Alcian blue/H&E staining was performed. Histomorphometric analysis was performed using Osteometrics software.

Statistical analysis: Results were presented as the mean ± standard deviation. Statistical analyses included Student's t-tests and two-way ANOVA followed by Dunnett's test. >0.05 was considered as significant.

Results: Radiographic and μCT analyses showed that administration of Egfc enhanced bone callus formation. The fracture line was more obscure in Egfc group at day? μCT data showed a significant increase in bone volume of fracture callus in mice treated with Egfc for ? Days compared to controls.

Histological data showed that the progression of fracture healing was accelerated in Egfc treated group in C57BL/6 mice. However, less and smaller callus tissues were found in Control group. Histomorphometric data demonstrated that the cartilage area was increased in C57BL/6 mice treated with Egfc at day? And the woven bone area was increased at day? After Egfc treatment.

Results of biomechanical testing showed that treatment with Egfc enhanced bone strength in C57BL/6 mice. The maximum torque and stiffness were significantly increased at day? In Egfc treated group.
Gene expression data showed that the expression of cartilage marker genes (Sox9, col2a1, and colX) was increased at day? In Egfc treated group. The expression of bone marker gene (Runx2, Osterix, and OC) was increased at day? In Egfc treated group.
Conclusion: Our studies demonstrated that Egfc has anabolic effect to enhance fracture healing. Egfc could serve as a potential clinical anabolic agent promoting fracture healing process.
Key words: Living Community, Living Community Information-Egfc, Fracture Healing

Creation of an Artificial Tropical Rainforest Community

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Abstract: This paper describes the establishment of China Academy Xishuangbanna Tropical Botanical Garden, an artificial plant community of plants, more than sixty years ago and how it works harmoniously and well with the plant community over these years. It has been successfully created up to 40 meters of hight of plant community, more than 100 kinds of economic plants in 5 levels of the first international multi variety of artificial tropical rainforest. In addition to the creation of the initial manual layout management in the past 40 years, all depend on the relationships between the biological species without artificial management, for Living Communities form a self management, self regulation, operation structures, thriving and prosperous by themselves, which proved as long as the artificial layout is initially established in accordance with the laws of nature, the normal operation of the highest and most complex living community system on the earth's surface can achieve long-term self regulation.
Key words: Science Of Living Community, Tropical Rainforest, Artificial Community

The Embodiment of Living Vitality of Rubber and Tea Plants in Different Living Community Structures

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Abstract: Life survives by the operation of communities. The vitality of life is the representation and index of life, and it changes as the community structures change and it is expressed in the structure of the whole community. In this paper, two kinds of economic crops, rubber and tea, grown in a separate and mixed ways, were investigated by comparing their vitality, their economic yield, biomass, cold resistance, wind resistance, insect resistance, etc., in different community structures. We aim to illustrate the changes and differences of plant life vitality in different communities, promoting more effective ways of planting structures for the two crops, and possibly more crops in the future. Furthermore we confirm the broad prospects of application of the new theory of the "living community" in actual production.
Key words: Living Community, Rubber-Tea Community, Biomass, Stress Resistance

Assessment of Ethno-medicinal Plant diversity Of Una and Hamirpur District of Himachal Pradesh: A Case Study

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Abstract: The present study was conducted to explore ethno-botanical diversity and importance of local plants harnessing for medicinal purposes by the local people of Una and Hamirpur district which lies at Shivalik hills or outer Himalayas in Himachal Pradesh, India. We recorded total 159 plant species of 138 genera belonging to 68 families which were used to cure more than 33 different types of ailments. Across family-wise distribution, most important useful plants were recorded from ten families: Asteraceae, Euphorbiaceae, Fabaceae, Acanthaceae, Ceaselpiniaceae, and Moraceae, Solanaceae followed by Annonaceae, Convolvulaceae and Liliaceae. Therefore, these families accounted 43.7% plants of the total and exhibited most acclimatized plants within local environmental conditions. Further, fifty percent of the total recorded plants revealed as herbs contributed the major proportion followed by trees (29%), shrubs (11%), climber (9%), creeper and khumb (<1% each). It was observed that most utilized plant parts were leaves recorded from 55 plant species to cure different ailments followed by other components viz: whole plant (43), bark and seed (34 species each), root and fruits (32 each), flower (18) and other remaining were stem shoot, bulb, rhizome and tubers, respectively. People living at adjoining area of the forests have a direct influence to utilize those local plants for different ailments; therefore, they have good practices and vast information of traditional knowledge. Thus, aim of the present study was to collect information about ethno-medicinal plants which were not clearly documented earlier in the literature as well as to investigate the plant-human

interactions to understand the socio-ecological relationships.
Key words: Ethno-Ecology, Local People, Medicinal Importance, Edibility Index

The Protective Mechanism of Preconditioning of EGFC in Acute Middle Cerebral Artery Occlusion

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Abstract: The study is to investigate the effects of EGFC and its mechanism on acute middle cerebral artery occlusion (MCAO) in rats and to provide experimental evidence for the clinical transformation of EGFC.
Methods: Adult male SD rats were randomly divided MCAO group and low-dose EGFC group, middle-dose EGFC group, high-dose EGFC group. The right middle cerebral artery in rats were occluded by inserting a thread through internal carotid artery for 2h, and then reperfused. The EGFC groups were treated with intravascular EGFC (2, 4,6 μg) injection. MCAO group was treated with the same volume of saline. Animals were sacrificed at 24h. The content of IL-10、IL-17、TNF-α、MDA and SOD in serum were measured by enzyme linked immunosorbent assay (ELISA) technique. The brain slices were obtained after MCAO. TTC staining was used to determine infarct volume.
Results:1. Effect of EGFC preconditioning on cerebral infarct volume in rats: With the increase of the dose, the volume of cerebral infarction in rats decreased, indicating that EGFC had protective effect on brain tissue of MCAO rats.
2. Effects of EGFC preconditioning on the inflammatory response in rats: With the increase of the dose, IL-10 level of serum increased, and TNF-α, IL-17 decreased, showing that EGFC can inhibit the inflammatory response.
3. Effects of EGFC preconditioning on oxidative stress in rats: With the increase of the dose, MDA content of serum was significantly decreased, SOD activity was increased, reminding that EGFC can resist oxidative stress response.
Conclusion: Pretreatment with EGFC can reduce the infarction of rats with the acute middle cerebral artery occlusion by inhibiting the inflammatory reaction and oxidative stress.
Key words: EGFC, MCAO, Oxidative Stress, Inflammation

Living Community Structural Levels Determine the Expression of Biological Vitality

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Abstract: In this paper, three kinds of animal Drosophila melanogaster, kuangwuensis, and Hirude nipponica Whitman were their crude extracts with a clear functional vitality were separated and purified in this study. In this process, the vitality of the crude extract with overall vitality was changed until it disappeared completely. It was proved the life survival index -"vitality"- changes with the change of living community structures, which confirmed that the life vitality could not be separated from the community and exist in isolation, and the life vitality was expressed by the whole community.
Key words: Living community, Vitality, Living-Community Structural Levels

Decoding the Theory of Living Community from Signaling Pathway Point of View

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Abstract: Life is the dynamic expression of matter actuated by information in a certain community environment. Living community is the sole living state of all life. The biggest living community, we have known so far, is biosphere, the cell, which is a basic unit of life, is also a Life Community itself. The cells are actuated by many signaling pathways, the signaling pathways are a vital component of the living community of cell. In the paper, we describe a math way to identify a specific signaling pathway and methods to select a certain pathway from a signaling pathway community. In the long run, we can use these methods we developed to code signaling pathways and get the full control of cells, full control diseases and even full control of life.
Key words: Living Community, Signaling Pathway, EGFR, ERK

Health and Life of Community

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Abstract: According to Professor Yaozong Feng's descriptions in "Living Community": Community is the only state of life on earth and all lives work in

coordination with each other; the impetus and regulation mechanism of community operation is derived from information. We think human body is also a complex community structure made up of various forms, multi-level and different sizes of community interactions in balance. This dynamic balance of the living community determines the health of the human body.This article will expound the influence of the pheromone for the human body from four aspects: 1.Observations on the regulatory effects that Living-Community information works on human cell EGF receptors 2.Observations on the effects of Living-Community information on scalp improvement and germination effect by regulation of scalp cells community information3.Observations on the amelioration of Cataract by Living-Community information which regulates the community information of eyes4.Analysis on compensatory response of ameliorative area through sustaining actions of the pheromoneConclusion: The improvement and amelioration of Community is a series of complete processes, which includes the body adaptation, self-recovery ability and change. The compensatory repairing response will happen by means of continuous compensation and adjustment of the information to the local disordering community, to promote the upper community structure adjustment, and ultimately to achieve the purpose of the overall balance of operation. This will improve the adaptability and keep the human body in a dynamic state of health.

Key words: Living Community, Plant Source Living-Community Information, Human Health

Living-Community Theory and Sustainable Development

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Abstract: After 60 years of uninterrupted research, the author has proposed an original theory, the Living-Community theory. This is the summation of a great amount of experimental data and can be defined as the "Science of the survival of life." He has put forward six key research areas and concepts: 1. The Living-Community is the operating structure of organisms, promoted and regulated by a variety of information in the environment.2. The Living-Community is the only vital state of all life. Life cannot exist in isolation from the community.3. In the natural world all parts of the Living-Community, ranging in size from a single gene to the earth's biosphere, are connected via information pathways and form a complete, multi-dimensional network centered on living organisms.4. A living organism is the living expression of the resulting effect of information in a community.5. Life information is promoted and

regulated through the cell signaling pathways.6. The vitality of life is a dynamic indicator of life, subject to the structure and operating state of the Living-Community.Based on this Living-Community theory, the components carrying the information of life vitality have been found and extracted from plants. Furthermore, the channels through which this information enters cells and its mechanism of action have been discovered. It can be used in the treatment of very many human diseases, including cancer, cardiovascular and cerebrovascular disease, and diabetes. It is also useful for treating large areas of crops. Encouraging results have been achieved and the contribution of the Living-Community theory to sustainable development has been explored in practice.

Key words: Science of Living Community, Sustainable Development, Living-Community Information, Vitality

Relationships between Disease Diversity in Livestock and the Ecology and Phylogeny of Wildlife Assemblages

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Abstract: Livestock diseases can have devastating outcomes on the health of both humans and animals. A shared goal of ecology and epidemiology is to understand what shapes disease patterns. Previous studies found that livestock density may facilitate livestock diseases prevalence. Climate factors may also affect disease transmission, as high temperature and high humidity promote disease transmission. Moreover, diseases occurring in wildlife assemblages might spill over to livestock as wildlife serves as origins and reservoirs of many diseases. However, the relationship between host assemblage structure and livestock diseases is still highly debated. For example, changes in wildlife species richness in host assemblages can lead to a dilution effect or an amplification effect. The understanding of this relationship can be improved by understanding the evolutionary relationships of the species in the wildlife assemblage. To test the influence of variables related to livestock hosts, climate, and wildlife assemblage on livestock diseases, we analysed data on livestock disease diversity from 2005-2015, originating from > 800 provinces in 39 countries in Africa from the World Organisation for Animal Health. First, we used these data to calculate livestock disease richness per province. Then, using linear mixed models, we tested for relationships between livestock disease richness and livestock density, three variables related to wildlife ecology (species richness, mean pairwise distance, and phylogenetic diversity), and two climatic variables (temperature and precipitation). We used Akaike's

information criterion to rank these models. With the subset of best models, we applied a model averaging procedure and calculated the relative importance of the explanatory variables. We found that livestock disease richness increased with decreasing phylogenetic mean pairwise distance among wildlife species in the local assemblage and with increasing livestock density. Surprisingly, livestock disease richness was unrelated to wildlife species richness, but phylogenetic factors were better predictors, as these phylogenetic factors probably convey more information about ecological and functional differences among species. Hence, adding phylogenetic factors to analyses can improve our understanding of how wildlife community ecology influences the disease risks faced by livestock. We found that there were more livestock diseases in areas where wildlife species had smaller phylogenetic distances to each other, probably because pathogens are more likely to infect closely related species. This indicates that species relatedness can be used to predict local livestock disease pressure.
Key words: Livestock Diseases, Wildlife Assemblages, Phylogenetic Distance

A Study on Technology of Living-Community Information for Removing Browning in Tissue Culture

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Abstract: Browning phenomenon is a major problem in tissue culture, especially in the process of tissue culture of woody plants. It has become an obstacle that affects emergence rate of plants. In this paper, Living-Community information which was extracted from plants was applied to the tissue culture of Camellia hawk tea, and the results of a clear inhibition of browning seedlings have been obtained.
Key words: Living Community, Browning Phenomenon, Tissue Culture

Integrated Sustainable Development Evaluation Based on Human Well-Being Indices and Pressure Indices: A Case Study of the South China Sea Neighboring Countries

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Abstract: In the present study, an evaluating indicator system of regional sustainable development pressures was constructed based on catastrophe theory. An improved catastrophe model was used to calculate the sustainable development pressure index (SPI), which was combined with the human development index (HDI) proposed by the

United Nations Development Program (UNDP), to explore the human welfare and sustainable development pressures in 9 countries bordering the South China Sea in the period 2003-2013 based on statistical data provided by the World Bank. It was found that during the period of investigation, the level of human welfare in the region gradually increased, and the HDI steadily rose, with an average annual growth rate of between 0.29% and 2.50%; over the entire study period, Singapore, Brunei Darussalam, Malaysia, and Thailand were the top 4 countries ranked by the HDI in descending order, whereas Cambodia always ranked in last place according to the HDI. The sustainable development pressures in the South China Sea neighboring region were very high; China and Vietnam's SPI gradually increased, Singapore's SPI gradually declined, and the SPI of the other 6 countries (Brunei Darussalam, Malaysia, Thailand, Indonesia, the Philippines, and Cambodia) remained in a fluctuant equilibrium state. The development models in this region can be divided in 4 types: very high level human welfare, i.e., very high sustainable development pressures (Singapore and Brunei Darussalam); high level human welfare, i.e., very high sustainable development pressures (Malaysia, China, and Thailand); medium level human welfare, i.e., very high sustainable development pressures (Indonesia, the Philippines, Vietnam); and low level human welfare, i.e., very high sustainable development pressures (Cambodia). The different development models faced different resource-related, environmental, economic, and social issues. It is recommended that a country should explore its own development path based on the actual situations in the country to reduce sustainable development pressures. Besides, bilateral or multilateral cooperation should be actively carried out to solve the bottleneck problems that restrict the development of regional sustainable development.
Key words: Regional Geography, Sustainable Development, Evaluating Indicator System, Human Welfare

T4-05: Soil Organic Matter Dynamics under A Changing Climate

Responses of Seven Hydrolytic Enzyme Activities to Fertilizations of Mixed Inorganic and Organic Nitrogen in Songnen Meadow Steppe, Northeastern China

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Abstract: Nitrogen deposition normally alleviated soil N limitation, which further altered soil microbial biomass and enzymatic activity. Soil enzymes play a pivotal role in soil organic matter decomposition and nutrient cycling. Assessing the effects of elevated nitrogen deposition on soil enzymatic activity is essential for predicting how soil C storage and nutrient cycling respond to nitrogen deposition. Nevertheless, it is not clear yet whether the ratio of inorganic to organic N, N addition rate, and incubation time interactively or additively influence microbial biomass and enzymatic activity when they are taken in consideration together. To explore how soil microbial biomass and enzymatic activities response to different inorganic to organic N ratios mixed N addition and if and how this response depends on N addition rate and incubation time, we investigated the microbial biomass and seven hydrolytic enzyme activities under simulated N deposition using four different inorganic to organic N ratios and two rates (10 and 20 g N m^{-2} $year^{-1}$) of N addition during the 60 day incubation period. Soil samples were collected from the top layers (0-15 cm) of the Leymus chinensis meadow soil in April 2016 and then kept in a refrigerator at 4 ℃ prior to incubation. The experimental design was full factorial, with two rates of N addition (10 g N m-2 and 20 g N m-2) × four levels of N ratio, i.e., total inorganic N (T, inorganic N:organic N=10:0), low organic N (L, inorganic N:organic N=7:3), medium organic N (M, inorganic N:organic N=3:7), high organic N (H, inorganic N:organic N=1:9). In this experiment, NH_4NO_3 was chosen as the inorganic N sources, while urea and glycine were chosen and mixed equally as the organic N sources. All samples were incubated for 60 days in a dark incubator at 25 ℃ and at 60% water-holding capacity. Four sample replicates per treatment were harvested to determine soil microbial biomass, pH values and seven enzymatic activities (α^{-1}, 4-glucosidase, β^{-1}, 4-xylosidase, Cellobiohydrolase, β^{-1},4-glucosidase, L-leucine aminopeptidase, β^{-1},4-N-acetylglucosaminidase and acid Phosphatase) at day 30 and 60, respectively. Our results showed that N addition accelerated activities of the enzymes involved in C, N and P cycling during the 60 day incubation period. These enzymatic activities exhibited various responses to different inorganic to organic N ratios. The enzymatic activities under mixed N addition were

higher than that of single inorganic N addition and the M treatments (inorganic N: organic N=3:7) were the highest in most cases. The significant positive correlations between soil microbial biomass carbon and activities of the enzymes involved in C (α^{-1}, 4-glucosidase and β^{-1}, 4-xylosidase), N (β^{-1},4-N-acetylglucosaminidase) and P (acid Phosphatase) cycling were found in this study. The response of soil enzymatic activities to N addition not only varied with inorganic to organic N ratios, but also varied with N addition rate and incubation time. These findings indicated that mixed N addition alleviates soil N limitation and organic nitrogen components can supply utilizable C sources for soil microorganisms.

Key words: Enzyme Activity, Inorganic Nitrogen, Organic Nitrogen, Grassland

Effects of Litter Manipulation and Topography on Soil Nitrogen Cycling in a Temperate Deciduous Forest

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Abstract: Aboveground litter is intricately linked with soil nitrogen cycling, and it is still not clear to what degree the litter layer affects soil nitrogen pools and dynamics and if the effects are system specific. We examined soil microclimate, carbon and nitrogen pools and processes after three years Detrital Input and Removal Treatments (DIRT) in a temperate forest, and analyzed the possible effects of DIRT and topography. Litter removal increased soil daily maximum and mean temperature and diurnal temperature difference at 5 cm depth, and litter addition decreased diurnal temperature difference. In downslope soil, litter removal plots had significantly higher soil water content (SWC) than litter addition plots in May, 2016. Litter addition tended to decrease soil pH in downslope soil. Although DIRT changed soil microclimate, it had little effect on soil nitrogen pools and processes, except that in May litter addition significantly increased soil NO3- concentration at the upslope position. Topography and DIRT had significant interaction effects on SWC and soil carbon and nitrogen pools in early growing season, highlighting the role of litter layer in obstructing leaching and runoff.

Key words: Detrital Input and Removal Treatments, Litter Addition, Litter Removal, Carbon Cycling

The Impact of Arbuscular Mycorrhizal Fungi on the Abundance of Ammonia-Oxidizing Bacteria and Archaea under Nitrogen Addition

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Abstract: The impact of nitrogen addition on abundance of ammonia-oxidizing bacteria (AOB) and archaea (AOA) has been well documented, but how plant species and arbuscular mycorrhizal fungi (AMF) influence the abundance of AOA and AOB under nitrogen addition remains unclear. By taking advantage of a microcosm experiment, we detected the impact of plant species (maize and clover), arbuscular mycorrhizal fungi (control: no AMF, no root; AMF: AMF, no root; and root-AMF: root combined with AMF) with respect to different nitrogen addition levels (LN: 0 kg/ha, MN: 150 kg/ha and HN: 300 kg/ha) on the abundance of AOA and AOB. We found that AMF and root-AMF promoted the growth of maize at high nitrogen addition level, and promoted the growth of clover in LN. The nitrogen content of maize was significantly increased by both nitrogen addition and AMF, while nitrogen content of clover was only increased by nitrogen addition. The root colonization of maize increased at MN, while the root colonization of clover decreased at HN. The response of AOA and AOB to arbuscular mycorrhizal fungi was affected by nitrogen addition levels depending on different plant species. At low nitrogen addition level, AMF significantly decreased AOA abundance of maize and increased the AOA abundance of clover. In addition, root-AMF significantly decreased the AOA abundance of clover. While, AMF and root-AMF had no impact on the AOB abundance of both species. At middle nitrogen addition level, AMF significantly increased the AOA abundance of clover. AOB abundance of both species was significantly increased by AMF and root-AMF. At high nitrogen addition level, both AMF and root-AMF significantly decreased the AOA abundance of maize, while root-AMF significantly decreased the AOA abundance of clover. AMF and root-AMF significantly decreased the AOB abundance of maize, but had no impact of clover. These results suggest that plant species, AMF and nitrogen addition have significant effects on the AOA abundance (3-way ANOVA; $p < 0.001$), but not on AOB (2-way ANOVA; $p > 0.05$). These findings provide evidence that AMF may play an important role in mediating ammonia oxidizers.

Key words: Plant Species, Arbuscular Mycorrhizal Fungi, Ammonia Oxidizers, Nitrogen Addition

The Frequency and Freezing Temperature of Freeze-Thaw Cycles Affect the Quantity, Composition and Stability of Soil Dissolved Organic Matter

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Abstract: Purpose: Future climatic change is likely to increase the occurrence of soil freezing-thawing events in high latitude and/or high altitude zones. During freeze-thaw periods, large amounts of dissolved organic matter (DOM) were released in the soil but its biological and chemical features are still unknown. The object of the present study was to investigate the influences of frequency and freezing temperature of freeze-thaw cycles on the quantity, composition and stability of dissolved organic matter in temperate forest soils with different water contents. Materials and methods: Incubation experiments were conducted to simulate three times of soil freeze-thaw cycles (FTC) with different FT frequencies and freezing temperatures (-2^{o}C, -8^{o}C and -18^{o}C). Soils were collected from a mature broadleaf and Korean pine mixed forest and an adjacent white birch forest and settled with two moisture levels (40% and 80% water filled pore space).We studied the quantity, composition and stability of DOM in water extracts of forest soils during each freeze-thaw cycle, by measuring soil carbon dioxide (CO_2) flux, dissolved organic carbon (DOC) and nitrogen (DON), ultraviolet absorbance and parallel analysis modeling of fluorescence excitation-emission matrices (FEEMs). Results and discussion: Compared to soils incubated at 5oC constantly, FTCs significantly decreased CO_2 flux but increased the concentration of DOC and DON in soils. The decreasing freezing temperature and increasing soil moisture both significantly increased CO_2 fluxes and concentration of DOC and DON in soils during FTCs. The frequency of FTCs and freezing temperature interactively affected the concentration of soil DOC and DON, with the largest DOC concentration in soil after two times of FTC with high frequency and -18 oC freezing temperature. The FEEMs of water extracts were decomposed into three components: two humic-like fluorophores and a tryptophan-like fluorophore. The frequency and freezing temperature both significantly affected the concentration of all the three components of DOM. With the increasing times of FTCs, soil CO_2 flux were firstly limited by DOM concentration, but then controlled by microbial biomass. Compared to no freezing or freezing with -2 oC and -8 oC, soil experienced FTCs with deep freezing temperature (-18 oC) released more labile DOM. Conclusions: The present study indicated that the effects of freeze-thaw cycle on the quantity, composition and stability of soil dissolved organic matter were depended on the frequency, freezing temperature and times of FTCs as well as soil moisture. The results would be beneficial for our understanding of the properties and environmental functions of DOM released into the soil during freeze-thaw cycles in cold temperate zones.

Key words: Forest Soil, Carbon Dioxide, Dissolved Organic Carbon, Dissolved Organic Nitrogen

Relationship between Aboveground Biomass and Measures of Structure and Species Diversity in Quercus Mongolica-Dominated Forest, Mt. Jeombong

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Abstract: Relationships of standing biomass with biodiversity and structural diversity were examined in the Quercus mongolica-dominated forest in Mt. Jeombong, Gangwon-do. We examined the standing biomass of the Q. Mongolia community (311.1ton ħa^{-1}) from 2004 to 2013, and the observed major species were Q. mongoilca, Carpinus cordata, Tilia amurensis whose standing biomasses were 206.3ton ħa^{-1} (66.3%), 36.9ton ħa^{-1} (11.9%), and 30.6ton ħa^{-1} (9.8%), respectively. Although the number of Q. mongolica individuals was very small compared with total density, the reason that Q. mongolica showed the most biomass than other species is due to greater average diameter at breast height (DBH) and the higher number of DBH≥50cm individuals. We calculated the range of Shannon index (H') and Shannon evenness (J') in the Q. mongolica community, and they were gradually increased in time, showing 2.015~2.166, 0.673~0.736, respectively. Their H' and J' showed positive linear relationships with their standing biomass. This indicates that the spatial distribution of the standing biomass in Q. mongoilca community becomes more homogeneous with time and this homogenization appears in various species in the community. In addition, we estimated biomass-species index (BS) and abundance-biomass-speciesdiversity (ABS) and they also showed gradual increase in time, ranging from 3.746 to 3.811 and from 4.781 to 5.028, respectively. Their indices showed positive linear relationships with the standing biomass. This can be explained from the observations of variations in standing biomass with tree diameters as the differences in the average standing biomass in the community have reduced gradually in time. Moreover, it is expected that increase in the structure diversity of the Q. mongoilca community enhances the efficiency in carbon sequestration and productivity, so the community can be developed to a more sustainable ecosystem with more abundant resources. Thus, applications of uneven-aged plantations with considerations of local ecological properties can be a very efficient reforestation method to ensure stable support of biodiversity and productivity.

Key words: Standing Biomass, Biodiversity, Forest Structure, Linear Relationship

Study on Interspecific and Intraspecific Allelopathy of Pinus Thunbergii, Pinus Densiflora and Pinus Tabuliformis

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Abstract: The photosynthetic pigments (chlorophyll a, chlorophyll b, carotene and anthocyanin) and organic acids (citric acid, oxalic acid and malic acid) of the seedlings of Pinus thunbergii, Pinus densiflora and Pinus tabuliformis were studied by the water leaching solution of Pinus thunbergii, Pinus densiflora and Pinus tabuliformis. The results show: 1) the water leaching solution of Pinus thunbergii had no significant effect on Pinus thunbergii, Pinus densiflora and Pinus tabuliformis. 2) The water leaching solution of Pinus densiflora had significant effect ($P>0.05$) on Pinus thunbergii and Pinus densiflora, and had no significant effect on Pinus tabuliformis. 3) The water leaching solution of Pinus tabuliformis had significant effect ($P>0.05$) on Pinus densiflora and Pinus tabuliformis, and had no significant effect on Pinus thunbergii. 4) In this study, the promoting allelopathy of Pinus densiflora and the inhibitory allelopathy of Pinus tabuliformis were very significant ($P>0.05$), but the allelopathy of Pinus thunbergii was not significant.

Key words: Pinus Thunbergii, Pinus Densiflora, Pinus Tabuliformis, Allelopathy

The Inventory, Dynamics, and Temperature Sensitivity of Soil Organic Carbon across Tibetan Permafrost Regions

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Abstract: Permafrost regions hold roughly half of the world's soil organic carbon (SOC), representing the largest carbon stock in terrestrial ecosystems. The tremendous amount of SOC is of global significance because of its potential positive feedback to climate warming and associated permafrost thawing. However, substantial uncertainties exist in permafrost carbon cycle and its feedback to climate warming. In particular, the size and dynamics in SOC stock, and the temperature sensitivity of SOC decomposition remain unresolved. Here we addressed these issues in the largest high-altitude permafrost region – the Tibetan alpine permafrost region, by combining field sampling campaign and in-door incubation experiment, synthesizing multi-source datasets (meteorological, satellite, in-situ monitoring, modelling datasets), using a variety of statistical techniques (support vector machine, Monte Carlo simulations, linear mixed model, and structure equation model). Our results revealed that Tibetan permafrost stored a large amount of organic carbon in the top 3 meters, with a median

pool size being 15.31 Pg C (1 Pg = 10^15 g). Of them, 44% occurred in deep layers (100-300 cm). The results further revealed an overall accumulation in SOC stock in the uppermost 30 cm, irrespective of vegetation types from the early 2000s to 2010s, with a mean rate of 28.0 g C m^{-2} yr^{-1} (the 95% confidence interval: 15.2, 40.8) across Tibetan permafrost regions, mainly attributable to climate-driven increases in vegetation productivity. This SOC accrual only occurred in the subsurface soil, between depths of 10 and 30 cm. In addition, we found that the temperature sensitivity of surface (0-10 cm) SOC decomposition (Q10) was co-regulated by carbon quality and environmental variables across alpine ecosystems. This is different from previous results derived from temperate and tropical regions, where carbon quality was the only dominating driver of Q10 variation. Taken together, our findings have important implications for better understanding on permafrost carbon cycle and its feedback to climate change.

Key words: Tibetan Plateau, Alpine Permafrost, Carbon Stock, Carbon Dynamics

Relationship between Mangrove Produced Phenols and Fraction of Dissolved Iron in Mangrove Soil

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Abstract: In recent years, relationship between nutrition derived from land and marine production have been an attracting issue. In this academic current, as a part of the studies on which we have tried to clarify the mechanism of dissolved iron elution from mangrove ecosystem to marine ecosystem, this study aimed to find fractionation of dissolved iron in the mangrove floor soil after adding the leaf extracts to the soil. The soil samples were collected from different vegetation types and the dissolved iron was fractionated by the size fractionation method using different pore membrane filter. Additionally, relationship between the fractionation and phenolic content in the soil was investigated. Exp.1) Elution of dissolved iron from mangrove soil by adding mangrove leaf water extracts: Mangrove soil samples (n = 3) were collected from Iriomote Island in Okinawa in 2014 - 2015. Non-mangrove soils (n = 3) were also prepared as a control. Extract solutions were obtained from mixed solutions of water with leaf powder samples of R. stylosa, mangrove sp., and non-mangrove sp. (n=3). The fractionation of dissolved iron was carried out by using 0.22 μm and 0.025 μm pore size membrane filters. The amounts of dissolved iron in the filtrates were measured, according to Matsutani et al. (2013). Exp.2) Fractionation of dissolved iron in mangrove soil: Soil samples were taken from 4 points along the following each six line-transect settled in Komi area of Iriomote Is.; the seaward non-vegetation area (A), the seaward edge of R. stylosa forest (B), the central area of R. stylosa forest (C),

boundary area between R. stylosa and B. gymnorrhiza (D), the central area of B. gymnorrhiza forest (E), and the landward edge of B. gymnorrhiza forest (F). The samples were taken from 0 – 10, 10 – 20 and 20 - 30 cm depth at each sampling point. The fractionation and measuring of dissolved iron were carried out by the methods described in Exp. 1). Phenolic content was measured by Folin-Ciocaluteu method. As the results of Exp.1), the amounts of dissolved iron eluted from soil samples by adding extracts of R. stylosa were higher than the control (soil + Milli-Q) and its ratio of soluble iron which includes inorganic iron and complex iron was relatively higher than those in the non-mangrove extracts. Concerning to Exp.2, the dissolved iron and phenolic content were relatively higher in E and F points than those in the other points. The maximum values of the dissolved iron and the phenolic content in the soil samples were 19.7 mg and 29.9mg/100g DW (20 - 30 cm depth), respectively. Concerning to the fractionation, the ratio of soluble iron in D, E and F points were relatively higher than those in the other points. The phenolic content showed a strong significant positive correlation with both of the dissolved iron content and the soluble iron content in the soil samples, with the correlation coefficient of R2 = 0.735 (Fig. 1) and R2 = 0.734 (Fig. 2), respectively. According to the results above, it was assumed that dissolved iron was produced more in the area of B. gymnorrhiza forest, and its main body of iron was an organic complex with phenolic compounds supplied from mangrove litter. In addition, it was considered that the dissolved iron produced in the surface soil was carried away by tidal activity to be supplied to the nearby ocean as the dissolved iron content in the surface soils were lower than those in 20 - 30 cm depth soils.

Key words: Mangrove, Soil, Dissolved iron, Phenol

Response and Feedback of Soil Carbon Emission to Global Warming in East Asian Region

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Abstract: Soil temperature and soil moisture are the primary abiotic factors that control the pattern and magnitude of soil CO_2/CH_4 fluxes. The sensitivity of soil CO_2 efflux to temperature is generally represented using Q10. The high temperature sensitivity of heterotrophic respiration suggests that even a slight temperature increase caused by climate change will dramatically increase global SOC decomposition, potentially converting the terrestrial carbon sink in a net carbon source after the mid-21st century. Asian monsoon regions, influenced by the Tibeto-Himalayan Plateau, have sufficient rainfall and lack a subtropical dry belt. Thus, Asian monsoon forests

have higher net primary production than other ecosystems at the same latitudes. Consequently, their high productivity leads to abundant SOC accumulation. Thus, the response of heterotrophic respiration in Asian monsoon forests to global warming is expected to have important feedback on regional and global climate change.

Since the mid-1990s, we have been installing multichannel large automated chamber systems in a tundra in the West Siberian lowland, a boreal forest in central Alaska, cool-temperate and temperate forests in Japan, Korea and China, subtropical forests in Japan, Mainland China and Taiwan, tropical seasonal forests in China and Thailand, tropical rainforests in China and Malaysia, and even arid grassland in Inner-Mongolia and wetland on the Tibetan Plateau, for continuous measurements of forest floor CO_2 budget as well as NEP. Among the sites, seven of the systems are using for conducting soil warming experiments. Our ultimate objective is to estimate the carbon budget of Asian terrestrial ecosystems as well as its response and feedback to regional climate change.

Annual soil respiration was about 10-12, 15-20, 25-30, and 50-60 tC ha^{-1} for cool-temperate and temperate forests, warm-temperate and subtropical forests, tropical forests, and tropical peat swamp forests, respectively. Soil warming enhanced heterotrophic respiration by 8% to 20% per ℃ for the humid temperate and cool-temperate mixed forest in northern Japan, about 5% for the summer-drought forests in central Japan, and 10% to 15% for the subtropical forests in Japan and China. The Q10 value was about 3.0 for all of the seven forests. Furthermore, we did not find the acclimation of soil respiration after more than six years warming experiment, probably due to the soil in these forests contains much portion of soil organic matter.

Furthermore, we measured soil organic carbon isotopes (δ14C) profiles at each centimeter to 35 cm depth. Our results suggest beyond doubt that global warming will gain decomposition of decades-old carbon in forest soils and the warming-induced carbon emission will have significant positive feedback to the regional climate change.

Key words: Chamber Network, Soil Warming, Asian Monsoon Ecosystem, Soil Organic Carbon

Influence of Land Use and Soil Properties on Soil Priming Effect: A Worldwide Analysis

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Abstract: The mechanisms controlling the accumulation of carbon (C) in soil organic matter (SOM) and the liberation of C in the atmosphere is of primary interest in the

context of climate change. One of the key phenomena that can greatly affect SOM dynamics is priming effect (PE). It is defined as the acceleration of the mineralization of SOM after fresh organic matter (FOM) inputs. Generally, little information is available on the effect of soil properties and SOM pools on the magnitude of priming effect. Elucidating the effect of these soil factors can help to predict the PE and its influence on soil C and N cycles at a global scale. The objectives of this study were to: 1) quantify PE across a wide range of soils and land uses; 2) determine if PE responses vary by land use and soil depth; and 3) explore the control of soil properties and SOM pools on PE. To this end, we incubated a set of thirty five soils for 262 days after the addition of 13C labelled cellulose. Soils without cellulose addition were also prepared as controls. Major soil physical and chemical properties of soils were determined. The SOM of soils was separated by size and physical fractionation methods into four fractions (LF, POM, silt, clay) characterized by their weight, C and N content.

The results show that priming effect (PE) occurs in all studied soils and ecosystems including grasslands, croplands, forests, savannahs and orchard. The intensity of observed PE varied widely ranging from 27.9 ±11.3 to 445.3 ±11.9 mg C-CO_2 kg^{-1} soil. Land use didn't show a significant effect on PE ($p > 0.05$). PE was significantly higher in 0-20 than in 20-40 cm soil depth ($p < 0.05$). Moreover, PE is controlled by all soil pools and increase with their size which suggest that the decomposition process is co-limited by the size of soil pools and activity of decomposers. However, the intensity of PE depends on C: N ratios of the soil pools which support the idea of microbial mining of soil pools for nitrogen (N) availability. Collectively, these results demonstrate that PE is a common phenomenon and should be integrated in global ecosystem models in order to improve their accuracy of predictions.

Key words: Priming Effect, Soil Organic Matter Pools, Microbial N Mining, Land Use

Effects of Partial Throughfall Exclusion on Litter Decomposition in Natural Evergreen Broad-Leaved Forest in the Rainy Area of Western China

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Abstract: Litter, an essential component of forest ecosystems, plays an important role in maintaining soil fertility, sequestering carbon and improving soil biodiversity. Drought is an emerging threat to ecosystem functions of some forests around the world. Some studies have conducted throughfall exclusion experiments (TFF) in in natural

tropical forests to investigate the effects of precipitation changes on individual plants, community dynamics, and carbon budgets, but there are less TFF in evergreen broad-leaved forests.We conducted a 1 year-long field experiment to investigate how affected decomposition of natural evergreen broad-leaved forests along a precipitation gradient in the Rainy Area of Western China. Five levels of partial throughfall exclusion were established: control (no throughfall exclusion, CK), 5% throughfall exclusion (W1), 10% throughfall exclusion (W2), 20% throughfall exclusion (W3), and 50% throughfall exclusion (W4). Results showed that throughfall exclusion significantly (W2, W3 and W4 treatments) affect the process of litter decomposition. Over one year of incubation, throughfall exclusion treatments significantly suppressed the litter decomposition in W2, W3 and W4, while did not significantly affect in W1. The decomposition rate constants exhibited the following order: k(CK) > k(W1) > k(W2) > k(W3) > k(W4), W2, W3 and W4 treatments significantly increased the time for 95% decomposition (T95%) of foliar litter, 2.32, 3.47 and 3.60 a higher than that of CK (4.81 a), respectively. Furthermore, throughfall exclusion significantly (W2, W3 and W4 treatments) increased the remaining carbon (C), nitrogen (N), lignin and cellulose, while W1 treatment had no significantly effect. This study indicated that partial throughfall exclusion significantly suppressed the decomposition of foliar litter in the natural evergreen broad-leaved forest, the suppressing effect of throughfall exclusion on litter decomposition can be primarily explained by the inhibition of lignin and cellulose degradation by drought.

Key words: Throughfall Exclusion, Litter Decomposition, TFF, Rainy Area of Western China

The Response of Soil Microbial Community and Soil Aggregate to New Carbon Input

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Abstract: Soil microorganism additionally affects the stabilization and destabilization of soil organic matter (SOM) and soil carbon dynamics. Importantly, the physical protection of SOM in soil aggregates plays the dominant role for long-term soil organic carbon (SOC) stabilization. We used the label 13 C maize straws as the new input carbon to estimate the sources on which the microbial biomass is feeding. First we analyzed the response of soil microbial community to residue managements and contents of new carbon flowing in different microbial communities in no tillage and moldboard plough. Then the protection of soil aggregates on soil new input carbon was analyzed under incubation experiments. The results showed that (1) the in-situ

incubation of maize residue revealed that the microbial abundance increased with time in NT, and the highest microbial abundance occurred in the second stage of incubation in MP. Compared with MP, NT increased the microbial abundance in surface soil (0-5 cm) and promoted the fungal dominant role in microbial community. (2) The accumulation time of 13C in fungi was longer than in bacteria in NT; the content of 13C in fungi, actinomycetes and gram negative bacteria in NT was significantly higher than that in MP, on the contrary, it is higher in MP than in NT for bacteria and gram positive bacteria. Those results suggested that conservation tillage practice has potential for enhancing microbial metabolic activity. Meanwhile, it drives changes in microbial community structure to fungi dominant, which is beneficial for soil microbial and carbon accumulation. (3) During the 60 days incubation, the emission of soil $13CO_2$ under bulk soil were always higher than that under<0.25mm and>0.25 mm soil aggregates, the peak of the emission occurred at day 7 in all treatments. (4) The accumulation of soil $13CO_2$ under bulk soil was highest with the highest total soil microbial PLFA contents, followed by <0.25 mm soil aggregate, and >0.25mm soil aggregates showed the lowest accumulation of soil CO_2 with the highest soil fungi PLFA content at the end the incubation. The content of 13C in fungi PLFA under <0.25mm soil aggregates was highest among the treatment. Those results suggested that <0.25mm soil aggregates with the highest soil fungi PLFA were better to protect the stabilization of new carbon than < 0.25 mm soil aggregates during the incubation experiment.

Key words: Plant Litter, Soil Carbon Cycling, Soil Aggregate

Varying Effects of Six Gramineae and One Leguminous Grassland Species on Soil Organic Matter Cycling

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Abstract: Plant species vary in terms of the amounts and quality of rhizodeposition they produce. Depending on their exploitative or conservative growth strategy, they also differ in terms of the amounts of and the duration for which mineral N they retain in their body mass. Consequently, plants may affect the soil organic matter (SOM) processes by two ways: by controlling the amount and chemistry of C inputs in soil and by imposing a certain N balance in soil through N uptake and its return in soil (via C input). These two mechanisms by which plants can affect organic C processes are not clear to date.

To explore this question, we selected six gramineae species i.e. Trisetum flavescenes (Tf), Poa trivialis (Pt), Lolium perenne (Lp), Festuca arundinacea (Fa), Bromus erectus

(Be) and Brachypodium pinnatum (Bp) as well as a leguminous species i.e. Trifolium repens (Tr) that can fix atmospheric N and thus impose positive or the least negative N balance. It was hypothesized that the plants depositing higher amounts of fresh C will induce higher mineralization of SOM and more C will be stocked under the plants which impose least negative N balance in soil. All the plants were grown in monocultures in pots whereas bare soils were used as controls. All the pots were placed in a continuous 13C labelling environment in a mesocosm. The isotopic labelling allowed distinguishing soil-derived CO_2 efflux from plant-derived CO_2 and calculation of rhizosphere priming effect (RPE, soil-derived CO_2-C from planted soils minus CO_2-C from bare soils). The respiration measures were regularly carried out for planted as well as bare soils. After ~400 days of plant growth, soils were destructively sampled and analysed for various C and N pools i.e. microbial biomass, particulate organic matter, soluble carbon, mineral N, total N, nitrogen mineralization and immobilization rates.

The presence of plants accelerated the SOM mineralization significantly i.e. RPE was induced. All the gramineae species induced ~ 2 times whereas the legume induced ~ 4 times the SOM mineralization when compared to control soil. The RPE, when expressed per unit of fresh C respired from soil-plant system, varied across species and was the lowest for the legume. Whereas, fine and coarse POM contents, nitrogen mineralization rates and microbial biomass were significantly highest in legume treatment.

All the gramineae species induced similar rates of RPE despite varying in terms of rhizodeposition indicating the importance of quality of rhizodeposition in inducing the RPE. Moreover, the legume plant induced the highest RPE in contradiction to our hypothesis. However, when RPE was expressed per unit of fresh C respired from soil-plant system, an indicator of rhizodeposition, the legume plant induced the lowest amount of RPE, suggesting that the legume plant is inducing net storage of fresh C in soil.

Key words: Soil Organic Matter, 13C Isotopic Labelling, Rhizosphere Priming, Grassland Species

Spatio-Temporal Patterns of Soil Organic Carbon and pH in Relation to Environmental Factors in the Black Soil Region of Northeastern China

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Abstract: The northeastern black soil region plays a key role in food supply in China.

Identifying spatio- temporal variation of soil properties as influenced by environmental factors is essential for future agricultural development. A total of 5891 topsoil samples (0-20 cm) were collected and soil organic carbon (SOC) and pH were measured in Jilin Province, 2010. Geostatistics, multiple linear regression, and redundancy analysis (RDA) were used to highlight spatio-temporal patterns of SOC and pH and determine the relationship with environmental factors. Results showed that average level of SOC increased by 2.68 g/kg($p<0.001$) from 1980 to 2010 in Jilin Province. However, in Golden-Maize-Belt Counties (i.e., the major grain-producing areas of Jilin Province), the SOC content rapidly decreased, the largest drop reaching 24.83g/ kg. During the past thirty years, pH only had a small variation in the whole province, slightly increasing by 0.30 ($p>0.05$). Environmental factors could explain 64% and 78% of the spatial pattern of SOC and pH, respectively. The principal factors impacting SOC and pH included: precipitation, gully density, forest land and grain yield. In this region, there was significant covariation between natural and human factors in forming spatial pattern of SOC and pH. Compared to pH, anthropogenic disturbance had a larger influence on distribution of SOC.

Key words: Soil Organic Carbon, Ph, Geostatistics, Environmental Factors

Manipulated Throughfall Reduction Increased Soil Labile Organic Carbon Fractions by Reducing Aggregate Stability in a Southern Subtropical Pinus Massoniana Plantation

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Abstract: Soil labile organic carbon fractions, such as particulate organic carbon (POC), readily oxidized organic carbon (ROC), and dissolved organic carbon (DOC), have a much shorter turnover time and thus have been suggested as an early indicator of total organic carbon (TOC) change. As an important component of soil structure and fertility, soil aggregates have huge effects on soil physical, chemical and biological properties. To investigate the impacts of drought and precipitation pattern change on soil aggregates and organic carbon distribution in forest ecosystem, manipulation experiment of throughfall reduction was conducted in Pinus massoniana plantation in southern subtropical region, which included three 20m*20m plots for throughfall 50% exclusion and the control, respectively. Soil samples at 0-5cm were collected in April (dry season) and September (wet season) of 2016 from each plot. The contents of TOC and labile organic carbon fractions in soil and water stable aggregates were measured after dry-sieving and wet-sieving methods. Results showed that: (1) 1-2mm water stable aggregate was the main component of soil water stable aggregate. There was no

significant difference for soil aggregates mass fractions between the two seasons. (2) The TOC and ROC in water stable aggregates distributed similarly. They both had an alternative decrease-increase tendency in the treatment soils with the decrease of aggregate size, while in the wet season those in <0.25mm control soil aggregates decreased with the particle size. Regardless of season or treatment, soil POC was mainly distributed in large aggregates. (3) Compared with the control, throughfall reduction significantly increased soil available nitrogen and phosphorus, TOC, and ROC contents in dry season, and soil ROC and DOC contents in wet season, as well as the labile organic carbon contents in water stable aggregates. Especially, the TOC in dry season and TOC, POC and ROC contents in wet season of the <0.106mm aggregate were significantly higher in the treatment soil than the control. (4) The percentage of aggregate disruption (PAD) of >0.25mm aggregates under manipulated throughfall reduction was significantly higher than that of control, and that of wet season was 1.14 times of the dry season. However, the treatment significantly decreased the soil aggregate mean weight diameter (MWD) and significantly increased the mass fraction of <0.106mm water stable aggregate in the dry season. (5) Pearson correlation analysis showed that PAD significantly positively correlated with soil TOC, DOC and ROC content. However, there was no significant correlation between the mass fraction of different soil aggregates and soil organic carbon content, while TOC content of soil aggregate significantly positively correlated with soil labile organic carbon fractions. The results showed that the composition of soil aggregate was not significantly altered by season, while manipulated throughfall reduction increased the short-term supply of soil organic carbon through increasing the micro aggregate proportion, disrupting aggregate structure, reducing soil aggregate stability, and altering the distribution of organic carbon in soil aggregates.

Key words: Throughfall Exclusion, Labile Organic Carbon, Soil Aggregate, Plantation

THEME 5

Ecological Degradation and Ecosystem Restoration

T5-01: Vegetation Transitions in Boreal & Arctic Ecosystems: Mechanisms and Consequences

Shifts in Boreal Peatland Structure and Function in Response to Press and Pulse Disturbances

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Abstract: In the coming century, ecosystems globally will experience increases in both pulse (rapid and episodic) and press (gradual and persistent) disturbances due to the direct and indirect impacts of climate change. These disturbances are expected to alter core ecosystem characteristics, prompting rapid shifts in structure, function, and ultimately ecosystem states. Given the broad geographic extent and large C stocks of boreal ecosystems, our research is evaluating the impacts of different types of disturbances on boreal peatland and lowland forest vegetation community structure, productivity, and aspects of ecosystem carbon cycling. In a multi-factor growth chamber experiment, we simulated expected rises in atmospheric CO_2 concentration, increases in air temperature (warming) and water table drawdown (drying) in peatland mesocosms. To better understand climate-disturbance interactions, we are studying the impacts of two large fire seasons (2014 in the Northwest Territories and 2015 in Saskatchewan, Canada). We are investigating relationships between depth of burn, post-fire vegetation shifts, permafrost stability, and soil C decomposability and storage. Our ultimate goal is to provide a broad framework for understanding differences in state changes invoked by press versus pulse disturbance. For example, we have demonstrated that press disturbances, like climate warming, can prompt significant structural and functional shifts, supporting vascular vegetation expansion in northern peatland mesocosms. This in-turn alters belowground carbon chemistry, increasing the overall biodegradability of the dissolved carbon pool, presumably through increased root inputs. We have also found that pulse disturbances, like wildfires, fundamentally change ecosystem function, altering carbon quantity and quality at each forest site as a function of pre-existing structural features. Taken together this research provides foundational knowledge needed to identify generalizable effects of press versus pulse climate change disturbances on ecosystem structure, function and state in the coming century.

Key words: Boreal forest, Climate change, Carbon dynamics, Wildfire

Alternative Stable States in the Boreal Biome: How Many Are There?

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Abstract: Inferring ecosystem resilience to global environmental change is one of the most complex and urgent challenges in ecology. Most empirical studies have remained at relatively small scales. However, there are increasing attempts to infer resilience at continental and global scales based on the frequency distribution of tree cover derived from remote-sensing products. Recent studies have used this public resource to detect multi-modality in tree cover in the tropical and boreal biomes. Such patterns suggest alternative stable states separated by critical tipping points. This has important implications for the potential response of these ecosystems to global climate change. For the boreal region, four distinct ecosystem states (i.e., treeless, sparse and dense woodland, and boreal forest) were previously identified by using the Collection 3 data of MODIS Vegetation Continuous Fields (VCF). Since then, the MODIS VCF product has been updated to Collection 5; and a Landsat VCF product of global tree cover at a fine spatial resolution of 30 meters has been developed. Here we compare these different remote-sensing products of tree cover to show that identification of alternative stable states in the boreal biome partly depends on the data source used. The updated MODIS data and the newer Landsat data consistently demonstrate three distinct modes around similar tree-cover values. Our analysis suggests that the boreal region has three modes: one sparsely vegetated state (treeless), one distinct 'savanna-like' state and one forest state, which could be alternative stable states. Our work demonstrates data-dependent identification of alternative ecosystem states in the boreal biome, and provides important implications for predicting critical transitions that could happen abruptly at the biome scale in response to global environmental change.

Key words: Alternative Stable States, Resilience, Remote Sensing, Critical Transition

Interactive Effects of Water Table Draw down and Warming on Vegetation and Carbon in Boreal Peatlands

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Abstract: Climate change affects peatlands directly through increased air temperatures and indirectly through changes in water-table level (WL). The interactions of these two still remain poorly known. We determined the separate and interactive effects of

temperature and WL regime on vegetation and factors of relevance for the carbon cycle: plant community composition, phenology, and biomass production, shoot: root allocation, ecosystem respiration and photosynthesis in two boreal fens in Finland, ‘southern’ at 61 and 'northern' at 67.

Total biomass production varied from 250 to 520 g m-2, with belowground production comprising 25–63%. Warming had minor effects on phenology and maximum photosynthesis and negligible effects on community composition, biomass production and allocation. Water-level drawdown (WLD) clearly affected the contribution of different plant functional types (PFTs) in the community and the biomass they produced: shrubs benefited while forbs and mosses suffered. These responses were not depending on the warming treatment.

The observed change was also reflected in plant phenology, with different PFTs showing different responses. Following WLD, aboveground biomass production decreased mainly due to reduced growth of mosses. Aboveground vascular plant biomass production remained unchanged but the contribution of different PFTs changed. Belowground production increased following WLD in the northern fen only, but an increase in the contributions of shrubs and forbs was observed in both sites, while sedge contribution decreased. Maximum photosynthesis and ecosystem respiration increased with WLD and with decreasing WL.

Moderate warming alone seems not able to drive significant changes in plant productivity or community composition. However, if warming is accompanied by WL drawdown, changes should be expected in the relative contribution of PFTs, which will reflect in the altered carbon dioxide dynamics. Warming with WL drawdown could lead to profound changes in the function of peatland ecosystems. Consequently, hydrological scenarios are of utmost importance when estimating future function of peatland ecosystems.

Key words: Peatland, Water Level Draw-Down, Warming

Permafrost Thaw and Its Consequences for Ecosystem Functioning in the Arctic

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Abstract: Perennially frozen (permafrost) soils store twice as much carbon as is currently present in the atmosphere. Above-average climate warming at northern high

latitudes may cause rapid thaw of parts of these permafrost soils, stimulating decomposition and thus emission of greenhouse gasses. This potentially large positive feedback to our climate may, however, be counteracted by large release of nutrients in the soil, which may stimulate plant production and thus carbon sequestration. The net outcome of the changes in these two large fluxes is still uncertain, because we do not understand the plant-soil-microbe interactions that drive these processes.

We therefore investigated how the plants, soil mesofauna, soil microbes and soil nutrients in permafrost ecosystems interact, and how these interactions affect carbon dynamics during permafrost thaw and thermokarst formation. We experimentally increased active layer thickness in a subarctic palsamire for over 10 years. Further, we manipulated plant, soil fauna and microbial abundance in mesocosms of intact permafrost ecosystems for two growing seasons. We measured consequences for carbon dynamics of these systems and related this to changes in above and belowground plant community, and microbial and soil fauna abundance. Our results indicate that permafrost thaw does not only enhance decomposition and release of carbon from the soil, but also induces fundamental changes in plant-soil-microbe interactions and the belowground functioning of arctic ecosystems, which may modify the feedbacks from thawing permafrost ecosystems to our climate.

Key words: Permafrost, Arctic, Plant-Soil Interactions, Climate Warming

Lowering of Water Table on Boreal Peatlands Makes Forestry Use Possible– with Some Future Challenges!

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Abstract: Approximately 15 million ha of peatland have been drained to improve forest growth. Most of this area is in Northern Europe, while Finland holds the world record with close to 5 million ha of forestry-drained peatlands. Drainage aims to lower the water-table level, thus extending the rooting zone and improving its oxygen status, and increasing tree growth through improved root functioning. Especially on those mires that are originally wet drainage means an almost total change in vegetation. Many peatlands are well suited for forestry because of the relatively high soil nitrogen content, even though the nutrient regime of peatlands varies widely. Yet, since peatlands are highly dynamic ecosystems with an organic soil, they are likely to respond to land use with greater adverse environmental impacts, such as loading of watercourses and release of CO_2 from the soil, than mineral soil sites. Currently, the main targets for both research and political guidance concerning peatland forestry in Finland are to find management options for reducing the harmful impacts, and to

identify such areas that should be excluded from active, regulated forestry due to low productivity. Here, we review 1) the potential of continuous-cover forestry (CCF) to reduce harmful environmental impacts, 2) means to improve ecosystem condition with active management, and 3) identification and potential novel uses of low-productive drained peatlands.

Key words: Drainage, Continuous-Cover Forestry, Vegetation Change, Restoration

Can Early Warning Signals Be Used to Anticipate Tipping Points in Heterogeneous (Peat) Landscapes?

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Abstract: Peatland ecosystems are carbon storage hotspots: despite covering just 3% of the earth surface, about 20% of all terrestrial soil carbon is stored in northern peatlands. These carbon stores of global importance are put under pressure by changes in land use and climate, which have the potential to destabilize soil carbon stocks. Such transitions may occur smoothly or as a 'tipping point', where peatlands may abruptly and unpredictably 'tip' to a state of carbon uptake to a state with carbon emissions after exceeding a climatic threshold. Recent advances indicate that changes in regular spatial patterns of vegetation may function as 'early warning signals' to predict impending tipping points. Yet, such indicators critically rely on the assumption that the landscape is uniform.

In this study we explored the contribution of geomorphologic landscape variability to spatial vegetation patterning in peatlands. More specifically, we investigated the relationship between hummock – hollow pattern characteristics and landscape position for a peatland in northern Sweden. Vegetation pattern metrics were calculated from classified vegetation maps, derived from high resolution aerial images. Landscape descriptors were derived from high resolution digital terrain models. Results show that vegetation pattern characteristics vary systematically throughout the landscape, thereby hindering the application of early warning signals at the ecosystem level. This message is not merely of importance for understanding the complex interactions between vegetation, hydrology, and soil formation specifically for northern peatlands, but likely more generally applies to most ecosystems with systematic geomorphological variability.

Key words: Peatlands, Tipping Points, Heterogeneous Landscapes, Climate Change

Temperature and Vascular Plants Affect Soil Organic Carbon in Alpine Peatlands

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Abstract: Though northern peatlands cover only 3 % of the land surface they count as one of the largest terrestrial pools of organic carbon (C). This huge C pool is potentially threatened by direct temperature effects stimulating microbial degradation and indirect effects mediated by changes in vegetation composition. At present it is unknown to what extent the direct and indirect effects of temperature interact.

In this study we explored the effects of temperature and plant functional types (PFT: bryophyte, graminoids, and shrubs) on chemical composition of peat and dissolved organic carbon (DOC). To this aim two ombrotrophic peatlands at different altitude in the Italian Alps, so reflecting a temperature gradient. In each site, we focused on lawn habitats originally characterized by a mixed vegetation of the graminoid Eriophorum vaginatum and the shrub Calluna vulgaris. Within these habitats we collected DOC samples (10 cm depth) in selectively clipped plots dominated only by Sphagnum, Eriophorum or Calluna. Next to these clipped plots we took paired peat cores of 20cm deep directly under either Eriophorum or Calluna. For DOC we determined the isotopic signature (13C) in association with spectroscopic measurements (UV and fluorescence), whereas peat chemical composition was characterized by 13C and 15N, and pyrolysis gas chromatography/mass spectrometry (py-GC/MS).

Taken together our results indicate a substantial contribution of the roots from vascular plants to DOC and peat chemistry. The release of DOC from peat clearly increased with temperature and with vascular plant biomass, with minor effects due to the dominant PFT. The degree of peat degradation also increased with temperature, but it did show a significant PFT effect being generally higher under Eriophorum than under Calluna. This PFT effect was more pronounced at high than at low temperature. The link between the degree of peat degradation and vascular plants was confirmed by the presence and depth gradients of species-specific pyrolysis products, i.e. the methoxyphenols from lignin (marker compounds for vascular plants) and 4-isopropenylphenol (marker compound for Sphagnum).

We conclude that increasing temperature and increasing biomass of vascular plants act in concert to increase peat degradation, with the effect being more pronounced in graminoid-dominated than shrub-dominated habitats.

Key words: Temperature, Soil Carbon, Plant-Soil Feedback, Peatlands

Interactions between Plant Species Composition, Nitrogen and Weather Conditions and Its Consequences for Greenhouse Gas Exchange in a Boreal Mire

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Abstract: Boreal mires have played a major role for the atmospheric radiative forcing during Holocene by continuously withdrawing CO_2 from the atmosphere, currently stored as peat. Boreal mires also constitutes a most substantial contemporary source of the second most important greenhouse gas, methane. Both carbon accumulation and methane emission respond to changes in weather and climate and there are serious concerns about how the exchange of greenhouse gases will change in response to a changing climate. However, both the rate of carbon accumulation and the rate of methane emission in boreal mires are importantly controlled by the plant community composition. Thus, understanding the interactions between changes in plant species composition, weather and greenhouse gas exchange constitutes a major scientific challenge. Both short term, within season (phenology) as well as long-term directional changes in plant species composition and biomass development are important in controlling mire greenhouse gas exchange.

We use data from long-term field manipulations to understand how nitrogen and sulphur additions, greenhouse enclosures and wintertime snow removal experiments affects plant species composition and biomass and its subsequent effects on greenhouse gas exchange. The long-term manipulation experiments were carried out in an oligotrophic minerogenic area of the mire. The soil surface is fully covered by Sphagnum species characteristic for nutrient poor conditions, i.e. mainly Sphagnum majus, Sphagnum balticum and Sphagnum lindbergii. The field vegetation layer are generally dominated by a few species of sedges and dwarf shrubs.

Even after more than twenty years of treatments the abundance of some species are still changing, pointing to the importance of long-term field manipulations. Importantly, even if not surprising, we found most significant interaction effects, especially between nitrogen availability and greenhouse enclosures further stressing the importance of including interactions between the important drivers for plant species composition in long-term experiments. Both nitrogen addition and green-house enclosures have totally reshaped the vegetation of a nutrient poor boreal mire. In general nitrogen additions also increased the potential for methane production while green-house enclosures in general decreased the potential for methane production. The carbon accumulation have been mostly unaffected by the treatments despite the changes in plant cover. Also the long-term snow removal experiments affected the vegetation composition. More

specifically the sedge leaf biomass was reduced after > 10 years of wintertime snow removal which resulted in clear changes in peak season CO_2 exchange. The reduction in sedge leaf area in response to enhanced soil frost also reduced methane emission during the subsequent growing season.
In conclusion our results from the long-term field manipulations points to the importance of including all aspects of a changing climate on mire vegetation and its subsequent effects on mire carbon exchange.
Key words: Boreal Mire, Soil Frost, Nitrogen Additions, Green-House Enclosures

Shrub - Tree Interactions in Boreal and Subarctic Ecosystems: Paving the Way for Forest Advance?

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Abstract: Arctic and boreal ecosystems are warming twice as fast as the global average. Shrub and trees have expanded northward but the mechanisms that explain this woody expansion remain poorly understood. We conducted a series of field experiments in boreal and subarctic peatlands to assess the mechanisms that explain tree seedling recruitment and estimate the strength of positive feedbacks between shrubs and trees. Our results show that the shrub understory facilitates tree colonization by ameliorating extreme temperatures and reducing herbivory damage. We found stronger facilitative effects of shrubs on tree seedlings in subarctic peatlands than in boreal peatlands. In general, early tree seedling establishment is most successful in sheltered topographical microsites without summer frost. Our results indicate the existence of a positive feedback in which shrubs facilitate trees and in turn these further enhance shrub growth suggesting that shrubs are paving the way for greener tree dominated landscapes in the far northern hemisphere
Key words: Boreal Ecosystems, Shrub-Tree Interactions, Facilitation

The Role of Roots in Tundra Vegetation Change with Climate Warming

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Abstract: Global climate has been warming up for the last decades and it will continue in this century. The Arctic is the part of the globe that warms fastest and is more

sensitive to climate warming. As the major part of plant biomass in the tundra lies belowground, it is pivotal to investigate the role of roots to improve our understanding of climate warming effects on tundra vegetation. To determine the seasonal changes and vertical distribution of root biomass of different plant functional types, we sampled roots at a Siberian tundra site in the early and late growing season, from vegetation types dominated by graminoids and shrubs respectively. We distinguished the roots of graminoids and shrubs, and found that shrub roots grew earlier and shallower than graminoid roots, which enables shrubs to get more advantages over graminoids at the early growing season when nutrient pulses occur during snowmelt and soil thaw. The deeper roots of graminoids can help them to be more competitive if climate warming induces more nutrient release in the deeper soil. In a soil thawing and fertilization experiment, we further investigated the effects of increased thawing in the deep soil and increased nutrient supply in the upper soil on root biomass and its vertical distribution. We found that only sedges benefited from the increased thawing depth, probably through their deepest root distribution, while the shrubs, which were shallower-rooted, benefited from the increased nutrient availability in the upper soil. The deep-rooted grasses had the highest plasticity in vertical root distribution, which enabled them also to benefit greatly from the fertilization. Through a 15N injection experiment, we found that graminoids and shrubs differed significantly in their ability of taking up nutrients in the deep soil, which proved that rooting pattern plays an important role in plant competition and future vegetation change in the context of climate change. Our results show that tundra plants with different rooting strategies can show different responses to climate warming dependent on the relative warming impacts on the nutrient supply in shallow and deeper soil layers. This insight can help to predict future tundra vegetation dynamics.

Key words: Arctic Tundra, Root, Climate Warming, Vegetation Change

The Harvesting and Its Natural Recovery of a Subalpine Oak Quercus Aquifolioides Forest: Driving Forces in Restructuring Soil Microbiota and Understory Vegetation on the Eastern Tibetan Plateau

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Abstract: Uncertainty regarding how ecosystems will respond to changes after harvesting poses a serious challenge to the development of sustainable alpine forest management and conservation strategies in high altitude ecosystem. Ecosystem-based

management requires a better understanding on the consequential impact of harvesting and the subsequent recovering processes on microbial communities, understory vegetation and the driving forces that reshape their structure in a high altitude ecosystem. Present study examined the microbial communities and the understory vegetation among three age classes of post-harvesting stands and an uncut stand of subalpine oak Quercus aquifolioides forest on the eastern Tibetan Plateau in growing season, 2013. Harvesting posed highly significant ($p < 0.001$) effect on the edaphic properties and, also significantly ($p < 0.05$) led to rapid shifting in the structure of microbial communities (increased actinobacteria and AMF, and decreased other subgroup of microbe), increased the biomass and reshaped structure of understory vegetation. The abundances of fungi (18:1ω7c, 18:1ω9c) and G- bacteria (18:2ω7c, cy19:0) were significantly ($p < 0.01$) altered in response to harvesting and recovering processes, which might be sensitive indicators for recovering from harvesting in this ecosystem. Understory plant composition showed highly significant ($p < 0.01$) recovery difference in 20-yrs harvested stand as compared with uncut stands. Structural equation model (SEqM) revealed that recovering process promoted abundance of microbe and simultaneously inhibited biomass of understory communities by recovering of the overstory via litter and soil edaphic properties. Overstory had shown influence only on the understory plants, while litter and residue via edaphic properties indirectly positively influence both microbial communities and understory plants. Microbial communities had exhibited minor direct effect on the understory vegetation of the studied area. We therefore proposed that litter, residue and soil abiotic factors (soil temperature, pH, NH^{4+}, total nitrogen etc) played an important role in reshaping understory, microbial communities and overstory recovering. This study also highlighted the fact that the eco-habitat in response to recovering process after logging was becoming less suitable for the expansion of understory communities as well as the recovery of original understory communities and more suitable for microbial communities. Present study provides the understanding about the impact of litter, soil and overstory cover on understory and soil biota and thus benefits sustainable subalpine oak forest ecosystem management on the eastern Tibetan Plateau.

Key words: Logging Recover, Subalpine Oak Forests, Microbe, Structural Equation Model

Nitrogen Status and Major N Sources of Three Plants in Permafrost Peatlands of Great Hing'an Mountains, Northeastern China

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Abstract: Peatlands ecosystems are sensitive to the climate change and human disturbance. Located in the southern margin of the Eurasia permafrost zone, peatlands in Great Hing'an Mountains (GHM; 50°10′−53°33′N, 121°12−127°00′E) of the northeastern China, are undergoing changes in vegetation composition and function. However, plant nitrogen (N) status and N-use strategies are still not very clear, which is preventing the further exploration of the relationship between vegetation changes and the altering N availability and N cycle of peatlands in the GHM area. Foliar N concentrations and natural 15N abundance (δ15N) can provide useful information on plant N status and N-use strategies, respectively. This study investigated foliar N concentrations and δ15N in the leaves of three major plants (Carex callitrichos V. Krecz: graminoid, Betula fruticosa Pall.: deciduous shrub, and Ledum palustre L.: evergreen shrub) of the permafrost peatlands from 18 sites (mostly as natural reserves) of the GHM area. C. callitrichos had significantly lower leaf N (1.7 ± 0.3%) than B. fruticose (2.1 ± 0.2%) or L. palustre (2.2 ± 0.2%) ($P > 0.05$), which revealed differing N status between plants of peatlands in the GHM area. While leaf δ15N showed an opposite inter-species pattern. The relatively higher leaf δ15N values (+2.4 ± 1.3‰) suggested that C. callitrichos mainly used 'N sources with higher δ15N values (e.g., ammonium and/or organic N). Lower leaf δ15N values of B. fruticose (-5.0 ± 1.3‰) and L. palustre (-4.4 ± 2.0‰) indicated nitrate as a major N source. These results clearly reflected differing N status and major N sources between peatland plants in the GHM area, which could be useful to understand vegetation changes in response to altering ecosystem N availability.

Key words: Peatland, Great Hing'an Mountains, Stable Isotopes, N Uptake, N Availability, Foliar N

Responses of vegetation to climate change in the permafrost peatlands of Great Hing'an Mountain, Northeast China

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Abstract: Climate change is most pronounced at high northern latitudes, affecting the physical, chemical, and biological attributes of many ecosystems, including permafrost peatlands. Understanding how the vegetation in these ecosystems will respond to environmental change is essential to assess potential consequences for ecosystem functions such as carbon sequestration. We investigated plant biomass, and leaf N isotope concentrations in deciduous shrub Betula fruticosa Pall, evergreen shrub Ledum palustre L. and sedge Eriophorum vaginatum L in 19 peatland sites along a latitudinal gradient in mean annual temperature from the continuous permafrost zone to

discontinuous permafrost zone in the Great Hing'an Mountains in 2014. We found that total plant biomass increased with mean annual temperature, with belowground biomass responding more strongly than aboveground biomass. Leaf N concentrations of deciduous shrub and evergreen shrub were not significantly different between the sites. However, N concentration of sedge were lower in the north sites and natural abundance of 15N in the leaves decreased with temperature, irrespective of species. The response of different species to climate change could be different and deserve future more research.

Key words: Vegetation, Climate Change, Permafrost, Peatland

Linking Plant Community Composition and Soil C Pool, N Availability and Enzyme Activity in Boreal Peatland of Northeast China

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Abstract: Plant species diversity influence belowground ecosystem functions, however, there are a few data on the interactive effects of plant diversity on soil function in peatland. We survey plant species diversity, and determine soil carbon, nitrogen fractions and enzyme activity as well as bacterial community diversity in five different vegetation-types peatlands. Additionally, the interactions between plant species diversity, richness and soil biochemistry properties were investigated. We found a close relationship between plant species diversity and TC in both surface and subsoil layers. Plant diversity and richness appeared correlated with soil DOC, $NH4^{+}$-N in both soil layers and subsoil moisture and TN, as well as topsoil pH. Plant species diversity and richness were also positively correlated with urease activity in topsoil and protease as well as acid phosphotase activity in subsoil. Soil β-glucosidase, invertase, urease, protease, and acid phosphatase activity positive correlated with soil TC, TN, DOC, available N and soil moisture. Findings in this study demonstrate the plant community diversity is linked with soil C and N turnover involved by soil enzyme. These results will substantially improve our ability to fully understand the linkages between aboveground and belowground ecosystem in peatland.

Key words: Peatland, Species Composition, Plant-Soil Interactions, Nitrogen Availability

T5-02: Karst Ecosystem: Global to Local Significance, Degradation and Restoration

Transformation of the Slovak Karst Land Cover (Slovak Karst)

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Abstract: There is the evidence of a human being 15 thousand years ago in the Slovak karst region, when they began occupying the area that was mainly forested (apart from some meadow areas). What most affected the land were huge deforestration and exploitation of pastures at the turn of second and first centuries B.C. and large deforestration around villages and castles.

The primary reason for distinct changes in the use of the karst landscape over the last 50 years is establishing the institutionally protected natural area, the national park and biosphere reservation. At the same time, there were considerable changes in social situation of inhabitants (rising average age, emigration…), what resulted in the absence of agriculture in the major area of this region. Nowadays, the transformation of the protected karst area is a very topical and interesting issue, mainly in considering the relationship between nature protection and landscape "degradation" because of many legislative restrictions (in agriculture, construction activities, commercial forestry, sport activities, hiking etc.).

The land cover transformation was studied via historical military maps, aerial photos and present topological maps in 3 different localities – Jasov Plateau (east part), Zajačia brána (middle part) and Domica Cave area (west part). Land cover changes are evident in all these study areas evident. 30 to 50% pasture and meadow areas were transforming to bush land and forest, the typical mosaic (for this region) of vineyards and orchards disappear. The mosaic-like landscape of different land cover categories turned into the compact forest land mainly. Even this stage is desired in different foreign karst areas, in the Slovak karst, that is protected because of the xeroterm fytocenoses and developed Karren fields, the situation is problematic.

When evaluating the positive and negative effects it is necessary to think about vulnerability of the karst landscape. Humans and their activities are changing the whole character of country, character of vegetation, soil situation and m icroclimate. It is difficult to say, if all these processes are either positive or negative, but from the long-time view, it slowly comes to reversibility of derivative process.

Key words: Slovak Karst, National Park, Jasov Plateau

Tourism in Karst Ecosystem: Economic Development and Sustainability of Lijiang River Tourism

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Abstract: The spectacular karst landscape with abrupt eroded limestone hills and winding rivers of southern China attract tourists from all over the world. The four-hour cruise along the Lijiang River is one of the top five tourist attractions in China. With recent economic success there has been a big surge of tourists and concomitant increase in tour boats in the river despite a dramatic hike in ticket price. Rapid urban expansion and agricultural development has been drawing large amounts of water from the river. Hydro-electric dams constructed upstream interferes the natural flow of the river, which in turn interferes the navigation of tour boat. Extensive river engineering is employed to keep the river navigable at low water level. To determine the sustainability of Lijiang river tourism we examined i) mean monthly rainfall pattern, ii) stream flow, iii) number of tourists and tour boats per year, ticket price, and iv) river engineering expenditures from 1960-2010. The number of tour boat increased from 1 in 1963 to 500 in 2010. During this time the number of passengers increased from 400 to 2,210,000. Ticket price increased from < US$1 - $34 and river excavation costs increased from $< 1,000 to over $230 million. From 1990 to 2010 the number of irrigation pups increased from < 100 to 14,200 and water drawn for urban use increased exponentially. Seasonal water flow changed from pre-dam time with larger pick flow during mid-raining season and lower flow during late rainy season causing navigation difficulty. Since the GDP of greater Guilin, Guilin City and Yangshuo County all show a dramatic increase from 1990 to 2010 increase in tourism in the area will likely continue. We predict that tour boat traffic in Lijiang River at the current level is unsustainable. Furthermore, any significant climate change related shift in monthly rainfall pattern in the watershed will likely aggravate the situation even further.

Key words: River Cruise, Watershed Development, Water Extraction, River Flow Management

Integrated Emergy and Economic Evaluation of Three Typical Rocky Desertification Control Modes in Karst Areas of Guizhou Province, China

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Abstract: Guizhou Province of China is one of the key karst areas on earth, facing serious rocky desertification problems. It has been formally established as a national goal to control the rocky desertification in karst areas in Guizhou. After decades practice, some control modes were getting well known due to their superior economic or erosion control characteristics in typical karst areas in Guizhou. However, a unified integrated ecological economic evaluation on them is still lacking, which hindered the application of these modes. Three of the typical modes in this study for an integrated emergy and economic evaluation and compared with traditional agriculture systems in this region represented by corn planting (CP) mode. The three typical modes are pepper planting (PP) mode, pitaya cultivation (PC) mode, and honeysuckle-plum inter-planting (HPIP) mode. Furthermore, the ecological economic effects of adding two ecological engineering subsystems, i.e. livestock and biogas subsystems, in the PP mode were quantified for optimization sake. The results showed that the PP mode was the best mode for ecological-economic benefits, while the HPIP mode was the best with only ecological benefits under consideration. The addition of livestock subsystem into the PP mode could improve the economic benefit density of the system with a tradeoff of environmental loading, while the addition of the biogas subsystem could partially make this up. We suggest the local government to strengthen the technology support for these modes, to expand the production chains by developing livestock, biogas, agricultural products processing, and to support the products markets in combination with the poverty alleviation to improve developments sustainably.

Key words: Emergy Evaluation, Karst Rocky Desertification, Ecological Control, Pepper

Tradeoff Mechanism for Soil Conservation and Water Retention in a Karst Peak-Cluster Depression Basin in Southwest China

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Abstract: The topics of ‘Karst ecosystem services trade-offs mechanism as the core of this study. Two types of key ecosystem services, soil conservation and soil water retention, were focused on to conduct the study of ‘water and soil processes, ecosystem service trade-offs, and spatial scale integration’, because they are important for Karst rocky desertification containment. The peak-cluster depression is the most representative geomorphic type for Karst region, where the threat of rocky desertification is serious. The Sanchahe basin, located in peak-cluster depression region,

was selected as the study area. By the comprehensive application of field observation and laboratory experiments, statistical analysis and mechanism models, the research was conducted. Firstly, the correlation between ecological processes, including relationships between slope runoff and soil erosion, and relationships between soil water dynamic, surface runoff, infiltration and evapotranspiration, at different observation sites, and the coupling mechanisms was investigated. And then, this study detected the trade-offs between soil conservation service and water yield, and between soil water retention services with surface water yield, loss to groundwater and evapotranspiration. Furthermore, the trade-offs mechanism can be revealed by the combination of gradient analysis on topography, spatial analysis on land cover change and scenario analysis. The research findings could make important contribution to promoting the studies on the transitive relations between ecological processes, ecosystem services and their trade-offs, and on the spatial scales synthesis, and furthermore, this study will be helpful for deepening studies of Earth's Critical Zone science and Integrated Physical Geography in Karst region.

Key words: Karst Ecosystem Service, Soil Conservation, Water Rentention, Tradeoff and Synergy,

Some Features of Limestone Soil in Karst Ecosystem

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Abstract: Many features of limestone soil are controlled by the carbonate rock with rich calcium: ①the rate of limestone soil formation is very slow, and t he formation of 1m thickness soil last 0.25-7.88 million years. However, the rate of soil erosion in karst area is from several decade to hundred times than that of the soil formation. Therefore, the damage of the soil erosion is more serious than we think; ②the high concentration and good immobility of soil humus closely related with the high concentration and activity of calcium in soil, mainly the humic acid could be combined with the calcium in the soil to form stable humin calcium, however, the nutrient elements are slowly provided for vegetation growing; ③the content and validity of trace elements in limestone soil are unstable, the validity of trace elements would become more effective as the concentration of calcium and magnesium decreasing. By the way, the behaviour of zinc in limestone soil is in particularity, because of zinc in alkaline soil usually depositing; ④limestone soil has more clay component than other soils, because it is parent rock is carbonate rock which precipitated in clean shallow sea environment. So when the soil in high humus, it might have good aggregate structure and effectively to support moisture and fertilizer for vegetation growing; by contraries, when the soil in low humus, its aggregate stability is weak and the available moisture shortage,

therefore, the ability of the soil to resist soil erosion becomes low; ⑤the limestone soil types and their distribution controlled by karst geomorphology, the black limestone soil usually scatters in the upper hillside with 10-30 cm thick, the brown and yellow limestone soils are covered the foot of the hill, depression and valley, and they are usually as cultivated land, and the red limestone soil can be found in the peak forest plain area. During the limestone soil development and evolution, the losing and taking calcium action are the key factors. In other word, the rich calcium in karst environment retards the limestone soil to approach to zone soil. Therefore, the effective landuse planning should be based on understanding karstology, soil science and botanic nutrition well.

Key words: Limestone Soil, Karst Ecosystem, Calcium, Carbonate Rock

Mapping Karst Rocky Desertification in Yunnan Fault Basin, southwest China Using Landsat 8 Images

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Abstract: Karst rocky desertification (KRD) is a dynamic land degradation process associated with unreasonable land use by human, which is characterized by damaging vegetation, severe soil erosion and a large amount of exposed bedrock. KRD has now become one of the most serious eco-environmental problems in karst regions of southwest China. In this study, we explored a remote-sensed method to map the spatial patterns and degree of karst rocky desertification in Yunnan fault basin (i.e., Luxi county and Mengzi city), southwest China using Landsat 8 Operational Land Imager (OLI) images. First, pre-processing was applied to remotely sensed images, including radiometric calibration and atmospheric correction, which was performed by Fast Line-of-Sight Atmospheric Analysis of Spectral Hypercube (FLAASH) in the Environment for Visualizing Images (ENVI).Geometric correction was not operated due to the fact that originally downloaded Landsat 8 OLI images are L1T format, meaning that they have already been geometrically corrected. Vegetation fraction, bedrock exposure and slope were determined as three key indicators of KRD and extracted from remote-sensed data. Specifically, vegetation fraction was derived from normalized difference vegetation index (NDVI). A new index, termed as normalized difference rock index (NDRI), was proposed to quantify bedrock exposure. Slope data were generated from the ASTER GDEM. Then, a threshold method was employed to establish empirical marking systems for each indicator mentioned above. Each pixel was further graded depending on which interval it belonged to and a sum mark was then produced. Finally, different levels of KRD (non-KRD, mild, moderate, severe,

extremely severe) were classified in Luxi county and Mengzi city, Yunnan province based on the sum mark. Results show that non-KRD area in Luxi and Mengzi accounts for 12.46% and 12.90% of their total land area, respectively, indicating that more than 80% of the area has suffered different degrees of KRD in both regions. Moreover, in terms of the area of specific KRD level, both regions are dominated by severe level (35.52% for Luxi County and 44.65% for Mengzi city). Our results demonstrate that it is urgent time to handle KRD. This study provides an effective and economic way to monitor and evaluate KRD by remote sensing technology.

Key words: Karst Rocky Desertification, Remote Sensing, Fault Basin, Landsat 8

The difference of Vegetation Index Distribution Characteristic in Karst Region and Non-karst Region of Southwest China

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Abstract: The karst region in Southwest China is one of the largest exposed karst zones all over the world, which area could reach about 540,000 km^2, and its fragile ecosystem is a key point in karst scientific research field, and the vegetation characteristic of surface between karst region and non karst region is still unclear.Vegetation Index (VI) is a important parameter to study plant classification and inverse surface biophysical variables. Here we explored the difference of VI between karst region and Non-karst region by datasets of Normalized Difference Vegetation Index (NDVI) and Enhance Vegetation Index (EVI) from Moderate Resolution Imaging Spectroradiometer (MODIS) in 2000、2008 and 2015. We found the average VI of karst region in 2015 is about 0.586, and in Non-karst region is about 0.623, and it's comparatively small in karst region. And we also found from 2000 to 2015, the VI is increasing in both karst region and Non-karst region, so it shows the policy of afforestation and closed forest is taking effect.

Key words: Karst, Vegetation Index, Distribution Characteristic

Improving Ecosystem Services in a Karst Region, southwest China

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Abstract: To meet the needs of restoring and reconstruction of degraded karst ecosystems, this research was aimed to develop ecological protection and restoration technologies for the improvement of low stability of vegetation community, lag behind

of soil functionality recovery, and lack of sustainability of ecological restoration and reconstruction. We firstly explored the land degraded mechanism and adaptive restoring technologies for degraded karst areas in Northwest Guangxi based on Huanjiang Observation and Research Station for Karst Ecosystems, Chinese Academy of Sciences. Then, we proposed and established a comprehensive theoretical and technological system for the optimization and management of karst ecosystem functionality. This research could provide scientific and technological foundation for the comprehensive controls of karst rocky desertification and sustainable development of social economy in karst areas, Southwest China.

Keywords: degraded mechanism; adaptive restoration; karst; peek-cluster depression; rocky desertification

Key words: degraded mechanism, rocky desertification, adaptive restoration, karst, peek-cluster depression

The utilization of HCO3- by Chlorella and its influence on the carbon sink in a karst reservoir

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Abstract: Abstract: The influence on dissolved inorganic carbon (DIC) utilization and calcium carbonate precipitation caused by Chlorella， which take sample from Dalong karst reservoir in Guangxi province,was researched in closed systems with three difference dissolved DIC concentration. The results show that ①HCO3- can accelerate the growth of Chlorella, which is called HCO3- fertilizer; ②The precipitation amounts of Ca2+ causing by Chlorella HCO3- assimilation is more than the utilization amounts of Ca2+ ③Chlorella photosynthesis make δ13CDIC in the culture medium increase, and respiration make δ13CDIC in the culture medium decrease; ④In the environment with high HCO3- concentration, Chlorella absorbed 52.75% of HCO3- in Group A and absorbed 48.00% of HCO3- in Group B; While in the environment with low HCO3- concentration.

Key words: Karst reservoir, Chlorella, Carbon sink, δ13CDIC

Isotope Hydrogeochemistry of a Typical Subterranean Stream in Southwest Karst Areas, China

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Abstract: A hydrogeochemical and isotopic study were conducted on a subterranean karst stream, located in Guancun Village, Daliang Township, Rong'an County of the Guangxi Zhuang Autonomous Region, China. The chemical compositions of the Guancun subterranean stream (GSS) water in both winter and summer are dominated by Ca^{2+} and HCO^{3-}, and the relationships between K^{+}, Na^{+}, Cl^{-}, $NO^{3-}$and SO_4^{2-} implies that the GSS water has been polluted by agricultural activities. The hydrogeochemical processes of the GSS were controlled by calcite dissolution and precipitation and were driven by the CO_2 concentration by controlling the changes in the pH and PCO_2 in the water. The δ18O and δD values of the GSS fell around the global meteoric water line (GMWL) and local meteoric water line (LMWL), indicating the source of GSS water is precipitation. Some abnormal δ18O and δD values in the wet season suggest the GSS water may be affected by evaporation due to its use in an irrigation system and the GSS turns in a surface stream somewhere and flows for a relatively long time on the surface in the wet season. The δ13CDIC values of the GSS range from −13.46 to −11.27‰ in the dry season and from −13.86 to −9.53‰ in the wet season, indicating the GSS belongs to a semi-open system, and the δ13CDIC values in the GSS were formed by the δ13CDIC values of the soil CO_2 and carbonate dissolution in different proportions. According to the simplified mass balance formula, the contributions of carbonate dissolution to the dissolved inorganic carbon (DIC) of the GSS were 50.15−58.26% and 48.67−64.69% in the dry and wet seasons, respectively, suggesting that the contribution of carbonate dissolution in the formation of the DIC in Karst Groundwater is not necessarily 50%, which was calculated by the karstification formula. Sulfuric acid and nitric acid can cause the loss of DIC (ΔHCO3−) in dissolving carbonate rock, and the amounts ranged from 0.22−1.83 mmol/L with an average of 0.81 mmol/L in the dry season, and 0.15−1.44 mmol/L with an average of 0.71 mmol/L in the wet season. These losses of DIC represent that the half of the carbon sink may be produced by carbonic acid.

Key words: Hydrogeochemical, Stable Isotopes, Carbonate Dissolution, Subterranean Karst Stream

The Potential Role of Extreme Climate Events in Control of Karst Rocky Desertification

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Abstract: As with the global warming, the extreme climate events (such as extreme rainfall events and extreme droughts) are increasing, which has important effects on terrestrial ecosystems. The karst ecosystem was vulnerable to disturbance because of

its scare soil. The karst area in southwestern China is one of the largest concentrating karst regions, and it is suffering severe eclogical degration and rocky desertification. The Chinese government took great efforts to ecological restoration. However, the restoring vegetation is more vulnerable, and the degration may re-occur. Consequently, the extreme climate events may play an important role in restoration of degeaded karst ecosystems and control of karst rocky desertification.It is necessary to understand the potential responses of karst ecosystems to extreme climate events, which will provide theoretical basis for choosing more reasonable technologies and models for restoration of degraded vegetation and control of karst rocky desertification.

Key words: Karst Ecosystem, Extreme Climate Events, Karst Rocky Desertification

Comprehensive monitoring of carbon flux on an abandoned karst ecosystem in southwest China

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Abstract: Guizhou is the center of South China Karst and about half of its farmland is on sloping fields. Since 1990 more than one third slope farmland has been returned to ecological restoration. This process is a balance of society develop and ecosystem service. Recently, an ongoing study of water、carbon、energy exchange between an abandoned farmland and atmosphere has been carried out at Puding Karst Ecosystem Research Station. The slope corn farmland was abandoned to natural recovery at 2012 and the monitoring work began at March 2015. The carbon flux through each part of ecosystem were monitored simultaneously with an eddy covariance flux tower to observe ecosystem turbulent exchange, a LI-8150 Automated Soil Gas Flux System to observe soil respiration at 8 plots in the field, a LGR's Carbon Dioxide Isotope Analyzer with 8 gas inlets to observe cave CO_2 dynamic. Preliminary results show: First, the ecosystem behaves as a carbon sink after four years' restoration with an annual NEE of 432 g.c/m2 at 2016; Second, temperature is the key climate factor to control carbon flux dynamic between each component of ecosystem and atmosphere; Third, cave CO_2 is mainly came from soil respiration and its variation range from about 18000 ppm at autumn to about 2000 ppm at summer, therefore its role as a temporary carbon pool cannot be ignored in karst ecosystem.

Key words: Karst ecosystem, Carbon flux, Cave degassing, Soil respiration

Soil Available Nutrient Deficiencies Limit the Recovery of Degraded Karst Vegetation

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Abstract: As there are few acid insoluble materials in carbonate bedrock, the soil formation rate is extremely slow in karst areas. Thus, the soil depth as well as nutrients storage are extremely low. However, whether the total amount of soil nutrients is limited to degraded Karst vegetation recovery remains unclear. In this study, we compared ecosystem nitrogen (N), phosphorus (P) and potassium (K) stocks in two typical vegetation types, forest-shrub transition (FS) and secondary forest (F). The results showed that the biomass of FS and F is 70.54 and 210.63 Mg/ha, respectively; the corresponding N storage is 0.40 and 1.2 Mg/ha， respectively; The corresponding P storage is 0.051 and 0.15 Mg/ha, respectively; the corresponding K storage is 0.16 and 0.50 Mg/ha, respectively. If vegetation recovered from FS to F, required N, P and K amounts were 0.8, 0.1 and 0.34 Mg/ha, respectively. In FS stand, soil mass and corresponding total nitrogen, total phosphorus, total potassium, available nitrogen, available phosphorus and available potassium storage is 295.69, 1.65, 0.23, 2.75, 0.12, 0.00073 and 0.048 Mg/ha, respectively. The soil available nutrient storages in FS could not afford the required amounts by vegetation during the restoration. Nutrient deficiency caused by small soil stocks would restrict vegetation restoration in karst area, southwestern China.
Key words: Karst rocky desertification, vegetation restoration, soil nutrients

Rooting Depth Determined with Caves and DNA, and Implicating Water Use under Karst Terrain

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Abstract: The solute carbonate rock of karst in south China develops an epikarst zone with a high fissure and rich spatial structure underground, which is favor for root growth and extend to deep karst layer. Belowground vertical community composition and maximum rooting depth of karst terrain in three sites of Guangxi, China were determined by using DNA sequence variation to identify roots from caves 0–40 m deep. 21 sample sites including 15 sites at Guilin secondly forest, 3 sites at Nonggang national park primary forest, and 3 at Mulun National Park primary forest, were investigated. Roots from caves were identified by comparing their DNA sequences for

the internal transcribed spacer (ITS) region of the 18S–26S ribosomal DNA repeat against a reference ITS database and above cave ground species. The result presented root belong to 7 species extend to 10m, and two species to 29m. The result of stable isotope δD and δ18O analysis showed that water uptake by tree species Cyclobalanopsis glauca sourcing mainly shallow to depth relevance with wet to drought season, less source was from ground water. Even in the driest October, only 20% water use was from ground water. However, soil moisture did not change greatly except subsoil which was influenced by evaporation; meanwhile transpiration in March, July and October was fairly high. These result may implicate soil water must be supplemented by other source besides rain water. Consequently, combining root depth result, which rooting of C. glauca could be found at 5-10m and reaching to cave water, suggesting there would be the hydraulic lift by root which transport water from deep epkarst fissure water or ground water and deliver it at soil.

Key words: Karst, Rooting Depth, DNA Sequence, Water Uptake

Use of Unmanned Aerial Vehicles for Oblique Imaging Karst Rocky Desertification Assessment in Southwest of China

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Abstract: The increasing exploitation of karst resources is leading to severe environmental impacts because karst frequently occurs in the most fragile and vulnerable environments. Traditional image classification is difficult to use to map and assess KRD accurately because land covers in karst regions are often mixed; for instance, woody shrubs are often mixed with grass, trees, and rocks, and no existing vegetation indices can be directly used as an indicator to assess the degree of KRD due to the mixed land cover and topographic effects (shadow effects) in karst areas. Recently, UAV (Unmanned Aerial Vehicle, UAV) Photogrammetry and remote sensing technology has been rapidly developed. This technology has been widely used in forestry, agriculture and other fields. Due to UAV aerial photography can obtain very high spatial resolution aerial imagery, and generate Digital Surface Model (DSM) automatically based on aerial imagery. The aim of this study was to map KRD by combing land cover information with three dimensional structure of karst landscape, which derived from UAV Remote Sensing images. In this study, the study area is located in Stone Forest county of Yunnan province. The very high resolution images were acquired by using UAV (DJ M600 Pro) with airborne High Resolution Visible Light Camera platform. DSM was derived from the dense point cloud, which generated from the UAV images. The 3D orthophoto of study area was generated based on the

DSM. We divided the orthophoto in cubes in different sizes (2×2×2 m3 and 30×30×30 m3 respectively). And then, the proportion of fractional land covers, bare soil, exposed bedrock, and vegetation in every cube were calculated. Based on the proportion of fractional land covers, the degree of KRD maps were generated. The results indicate that the UAV photogrammetry, can be used to do KRD assessment and can get higher accurate desertification information, and less affected by mixed land covers. The UAV would be a powerful tool for KRD and other environmental issues monitoring.

Key words: Unmanned Aerial Vehicle, Karst Rock Desertification, DSM, 3D

Ecosystem Service Values Experienced Great Changes in the Rocky Desertification Area under the ICRDK

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Abstract: Rocky desertification (RD) has been termed as an incurable disease for ecology. The RD severity in Karst Mountains of southwest China is shocked owing to its huge area, serious water and soil erosion. Land degenerated seriously in this area. The ecosystem service values declined. After a national program of "Integrated Control of Rocky Desertification in Karst" (ICRDK) was completed, the area of different degree of RD lands changed greatly and, consequently, changed the total ecosystem service values. Thus, it was necessary to figure out this change. This study explored the changes based on the area and ecosystem service values of different land use types. In view of the existing problem of estimating the values in RD areas was lacking measured datum. This study constructed an index system to overcome the insufficient of estimation indictors and did field survey to get the datum.

The selected estimation ecosystem services in this paper were soil and water conservation (SWC), CO_2 fixation and O_2 release (CFR), nutrient accumulation (NA), biodiversity (BIO), soil organic matter production (SOM), landscape recreation (LR). The results indicated that the average ecosystem service value was lower when the RD was more severe. For the same degrees, the value of woodland＞farmland＞grassland ＞other unused land. The value of SWC of extremely severe RD land was higher than that of severe RD land; the value of BIO was influenced more by RD degrees than land use type, while the value of LR was less sensitive by RD degrees but more sensitive by land use type. After the implementation of the ICRDK, the total ecosystem service values increased. However, compared with the total investment, the increased value was relatively lower and, the existing great ecological deficit illustrates this problem. The input- output ratio of potential, mild and moderate RD lands are higher than other degrees. Given this, more investment should be put in RD areas and distribute more in

mild and moderate RD lands, while prevent degradation occurring in potential RD land.
Key words: Degraded Ecosystem, Ecosystem Service Values, Rocky Desertification, Integrated Control Rocky Desertification in China

T5-03: Structure and Function of Forest Canopy Trees, Recent Research Advances

Tree Crowns Scale Differently Across Latitudes

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Abstract: Crown structure affects the potential light harvesting therefore the competitive advantages of trees.We hypothesized that crown shape is a fundamental adaptive property then we tested whether this architectural traits varies across a wide range of environmental conditions. We selected about 12000 trees across a wide range of latitudes (from 51 S to 62 N) from the global allometric BAAD dataset in addition to other public datasets and our own data. We estimated the scaling relationships between crown traits (i.e. crown radius, crown depth and crown volume) and tree height across latitudes by reduce major axis (RMA) regression method. The results showed that scaling exponents of different crown traits varied differently along latitudinal environments. The scaling exponents of crown radius vs. tree height changed systematically from tropical (0.93, R2=0.88) to boreal forests (0.57, R2=0.89) leading to a variation of the scaling relationship between crown volume vs. tree height (from 2.92 close to the Equator to 1.91 in boreal zones). On the contrary, no latitudinal trends of scaling exponents of tree diameter and crown length vs. tree height were observed.The global analysis suggested that trees do not use all possible crown morphotypes (i.e. tree converge towards similar crown shapes) thus the adaptive landscape appeared relatively limited. Our analysis also provides a functional interpretation for the different forest structures observed across latitudes.
Key words: Allometry, Forest Structure, Morphotypes, Cost-Benefit

Wood Functional Anatomy Predicts Tropical Rainforest Tree Growth Better Than Other Functional Traits

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Abstract: Understanding growth patterns of tropical rainforest trees is paramount for contextualizing how rainforest will cope with a changing climate. Trait-based approaches have found popularity among researchers in modelling tropical rainforest tree growth and function, but many studies are still using "soft traits" such as wood

density and leaf mass per unit area as "run-of-the-mill" traits for modelling. The disadvantage of these traits is that they are only indirectly related to plant growth. Incorporating harder to measure traits such as hydraulic related wood anatomy traits and leaf carbon isotopes may provide more refined explanatory variables for tree growth and function. To examine how different traits explain tree growth, we first computed growth rates of 50 species of tropical lowland rainforest trees, using replicated trees of each species from data from long-term permanent monitoring plots in tropical northern Australia. We collected leaf samples using a canopy crane, and wood samples from tree trunks of these species at 1.3m height. As explanatory variables for plant growth rates, we measured and used leaf traits such as leaf mass per unit area, leaf area, leaf dry matter content, leaf carbon isotope content, and wood traits such as wood density, and wood anatomical features such as vessel diameters and vessel densities. Our preliminary results show that wood anatomical traits are superior explanatory variables for tree growth rates than other commonly measured traits. We recommend that future trait-based work modelling the drivers of tree growth should include a complement of wood functional anatomy traits.

Key words: Wood Functional Anatomy, Tropical Rainforest, Tree Growth, Plant Functional Traits

Tropical Trees Adapt in Functional Leaf-Stem Mass Balance, but Risk Collapse Due to Functional Unbalance under Drought and Warming

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Abstract: Trees control leaf and stem biomass to maintain functional balances in the gain, transport and loss of carbon and water. These functional balances shift across climatic zones, to adapt for growth-limiting factors. We hypothesized that tropical forest trees adapt leaf –to-stem biomass ratio to mean annual temperature (MAT) and mean annual precipitation (MAP), but also may risk functional unbalance under predicted climate change. We present empirical evidence for this hypothesis, using allometric information from 1711 trees of different species in different locations across the tropics. Our regression models show that at higher MAT, trees had a low leaf mass for a given stem mass over the whole tree size range, while only large trees showed this trend at lower MAP. Our models also suggest that under the projected 3-8oC warming for this century tropical trees risk functional collapse because they cannot maintain sufficient leaf mass for the amount of stem mass required for water transport. Increasing drought is expected to aggravate this unbalance for large trees. This study is

the first that shows how trees adapt in leaf- relative to stem biomass to temperate and precipitation in the tropics, and explains the observed drought/ heat induced tree mortality, particularly for large tropical canopy trees, in extreme warm and dry periods.
Key words: Canopy Tree, Architecture, Adaptation, Climate Change

Environmental Drivers of Canopy Height Variability in the Tropical Dry Forest in Coastal Oaxaca, southern Mexico

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Abstract: Vegetation ecology studies have identified canopy height as a highly relevant attribute of the plant community. Canopy height has been related to a broad range of fundamental ecological processes such as biodiversity maintenance and microhabitat provision for the fauna, carbon storage, and evapotranspiration regulation. Surprisingly, despite its importance few studies have attempted to identify the different drivers of this community structural attribute. In order to advance our understanding on the identity and role of these drivers, we examined the relationship between canopy height variation and environmental heterogeneity in a tropical dry forest of southern Mexico. We sampled vegetation in 15 localities distributed along a 100 km-long stretch of coastal plain of Oaxaca State; the heights of all individuals with a DBH $\geq$ 2.5 cm were measured. Shrubs and cacti were included in the sample, but lianas were excluded, as their heights are dependent on their host trees. Most individuals recorded (ca. 4500) concentrated in the 4 to 8 m height classes. As no single way to best describe canopy height has been proposed, we defined three plant height data sets to represent overall community canopy height at each site: (1) a set including all trees; (2) a set made up by the tallest trees representing 10 percent of all plants in the site; and (3) a set comprising the 10 tallest trees. The three sets were significantly correlated with each other, as well as with the mean diameter at breast height for each set. Data analyses included linear regression and structural equation modelling (SEM). All three sets showed the existence of an increasing East to West gradient in canopy height. The heights of the six most frequent species were positively correlated with community mean height by site, suggesting similar responses to the environment among species that are reflected at the whole plant community level. SEM revealed a strong effect of water availability, an environmental driver that in turn is correlated with elevation. Conversely, soil properties and other topographic variables had a less clear relationship with this community attribute. An implication of these results is that climatic changes involving water supply in the region will potentially affect canopy height and, consequently, overall ecosystem functioning.

Key words: canopy height measurement, environmental heterogeneity, structural equation model, water availability

Comparative Phenology and Growth between Lianas and Trees in Two Neo-Tropical Forests

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Abstract: In tropical forests, lianas are increasing relative to trees, with potential negative impacts for tree diversity, timber production, and carbon sequestration. Among the hypothesized drivers to cause this increase, differences in water availability due to longer and stronger dry seasons have acquired increasing attention. It has been suggested that liana ́s more efficient hydraulic architecture, due to their wider and longer vessels, and a deep root system, give lianas a competitive advantage over trees during water shortage. Thus, to test for differences in liana and tree performance, and plant water status, we assessed phenology, growth, and leaf water potentials in 16 liana and 16 tree species in two forests in Panama. A wet forest with a weak dry season located in the Atlantic coast, and a dry forest with a strong dry season located in the Pacific coast. In each forest, we selected a set of 8 liana and 8 tree species, with no overlap of species between the two forests. By using a canopy crane, we selected 2 individuals per species and 4 branches per individual. In each branch, we recorded monthly data of leaf loss, leaf production, flowering, fruiting, branch length extension, and branch diameter growth. We also collected 3 leaves per individual (6 per species) to measure pre-dawn and mid-day water potentials. Among our results, branch length extension and leaf number production was not significant different between lianas and trees in both, the wet and the dry forest. Although significant difference was not found between lianas and trees in the dry forest, an increasing pattern can be seen for lianas. The lack of significance may be due to the higher variance between liana species. Furthermore, we found that lianas maintain higher predawn leaf water potential than trees during the dry season in both forests. For midday water potentials, trees show a higher decrease in water availability than lianas in the dry forest, with the later having a better water status during the hours of maximum irradiance. No significant difference was found in the wet forest. These results suggest an advantage for lianas to maintain more active than trees during the dry season.

Key words: Liana, Tree, Canopy, Phenology

Canopy Transpiration of Woody Angiosperms in Tropical Forests with a Seasonal Drought Is Regulated by Plant Hydraulics and Trunk Capacitance

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Abstract: Canopy transpiration of forest woody plants is largely controlled by stomata in response to the fluctuation of ambient environment, which is in turn governed by water status of plants and chemical signals (e.g. ABA). Angiosperms evolved with active stomatal regulation to adapt to the changeable water conditions, with variation from isohydric to anisohydric behaviors. Stem hydraulic conductivity and water storage largely influence the canopy water status and thus stomatal behavior, and they are negatively associated with the resistance to cavitation induced by water deficit. It has been found that canopy stomatal control behavior is coordinated with trunk hydraulic efficiency and safety, e.g. plants with cavitation-resistant wood tend to have slow stomatal closure during drought, and vise versa. Lianas expose most their leaves in the uppermost canopy with a shallow leaf layer. Canopy trees have deep crowns and thus a large proportion of their leaves are partially shaded. In this talk, we address the questions whether lianas have more sensitive stomatal response to change of atmospheric conditions than trees and whether evergreen trees have more sensitive stomatal response and consume more water than deciduous trees, and stomatal sensitivity are related to xylem characteristics. We will summarize our recent findings based on sap flow, water potentials, xylem hydraulic characteristics measurements for several dozens of trees and lianas in tropical forests with a seasonal drought. We found that lianas generally had higher stem sapwood-specific conductivity so that are able quickly transport water from roots to the canopy but were less resistant to drought-induced cavitation than were evergreen trees. Lianas had more sensitive crown conductance response to fluctuation of vapor pressure deficit (m，crown conductance sensitivity) than did co-occurring trees and reached maximal transpiration at a relatively low vapor pressure deficit (<1kPa). During clear days in wet seasons, lianas were able to maintain higher water potential in branch stems compared to trees. In dry seasons, lianas largely reduced canopy transpiration because of stomatal closure although their water potentials were not low. These indicate the isohydric stomatal regulation in lianas. Compared to deciduous trees, evergreen trees had higher wood density and stronger xylem resistance to cavitation, whilst greater m. The m was positively correlated with the reference crown conductance and sapwood capacitance. Whole-tree mean daily water consumption was strongly and positively correlated with DBH (diameter at breast height). However, the evergreen species exhibited larger water

consumption than the deciduous ones at a given DBH, which was partly attributed to their larger sapwood area and leaf area index in the evergreens. We conclude that the canopy transpiration of tropical woody species is mainly regulated by stomatal regulation together with stem hydraulic characteristics.

Key words: Crown Transpiration, Water Potential of Plants, Xylem Resistance to Caviation, Stem Hydraulic Capacitance

Comparing Canopy Trees and Lianas in Tropical Forest - Understanding Performance from Allocation, Physiology and Anatomy to Whole Plants

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Abstract: An intriguing question is how large woody plants integrate the acquisition, transport, storage and loss of key resources, such as carbon and water, and maintain a stable structure at the same time. Woody plants are expected to maintain optimal balances among these different functions by optimally distributing the tissues that are associated with these functions. In angiosperm species, these are vessels in the xylem for water transport, fibres for strength, phloem for the transport of carbon and parenchyma for the storage of carbon, water and other resources. While recent literatures abound on functions of individual tissues, an integration is largely missing to explain tree growth. Therefore, we propose a new conceptual model that includes functions of hydraulic conductivity, hydraulic safety, carbohydrate conductivity, mechanical safety and buffer capacity (storage). As branches are seen as bottlenecks of tall plants, the study is being performed on branch level. Field work was done in a tropical forest in Xishuangbanna, South-east China. A canopy crane was used to take branch samples from forest canopy. We hypothesised that 1) lianas have higher hydraulic conductivity compared to trees, but they have lower hydraulic and mechanical safety; 2) canopy branches have higher hydraulic safety in order to deal with the extreme hot and dry condition. Therefore, they have higher mechanical safety, but lower hydraulic conductivity. Trade-offs between functions were tested using a wide spectrum of functional traits. Hydraulic conductivity were measured. Modulus of rupture and dry wood density were measured to estimate mechanical safety. Cavitation resistance were used to represent hydraulic safety. Permanent branch cross-sections were made to analyse tissue areas. Results indicate that lianas tend to have higher hydraulic conductivity and mechanical safety while keeping slightly higher hydraulic safety than trees. In lianas and trees, no trade-offs were detected between hydraulic conductivity, hydraulic safety and mechanical safety. We conclude that lianas have

hydraulic conductivity, hydraulic safety and mechanical safety well integrated compared to trees which could present as an advantage. Canopy branches can regulate hydraulic conductivity, hydraulic safety and mechanical safety without burden. Additional anatomical analysis are currently being conducted to better assess carbohydrate conductivity and buffer capacity and better evaluate differences in tissue-specific functions between lianas and trees.

Key words: Canopy, Physiology, Anatomy, Balance

Effects of light on the growth and death of different branching units in crowns of Sakhalin Spruce

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Abstract: Within a tree crown, local light conditions vary within a branch and among different branches. Although the role of light intensity in growth and survival of branches has been extensively studied, the effect of the spatial heterogeneity of light intensity on different levels of branching unit is poorly understood. We investigated the effects of light intensity on the growth and death of both primary branches (those branch off from the main stem) and secondary branches (those from the primary branches) in the whole crown. Results showed that light intensity and branch position had significant effects on the growth of primary branches (i.e., current-year shoot production and extension), but the effect of light intensity on the growth was greater than branch position. In contrast, the effect of branch position on the death of primary branches was equal to that of light intensity. It suggests that light intensity alone cannot completely clarify the growth and survival of primary branches. In contrast to primary branches, light environment to a large degree can explain the growth and survival of secondary branches. Our study suggest that the effects of light intensity on branch growth and death vary between different levels of branching units.

Key words: Branch Autonomy, Correlative Inhibition, Growth and Death, Light Intensity

Systemic Signaling in the Photosynthetic Induction Phase of Calamagrostis Angustifolia Wetland on the Sanjiang Plain

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Abstract: In this research, Calamagrostis angustifolia was taken as the experimental

plant to investigate the photosynthetic induction of the leaf that was not pre-illuminated (target leaf) after different number of leaves (system leaves) were illuminated with different PPFD. The main results acquired are as follows: (1) after the system leaves were illuminated, photosynthetic induction of the target leaf was significantly promoted. The time needed to reach 50% of the target leaf's maximal photosynthetic rate decreased by about 19%, and the time needed to reach 90% of the target leaf's maximal photosynthetic rate decreased by about 27%. (2) After pre-illumination 1, 2 or 3 system leaves, the photosynthetic induction of the target leaf was significantly promoted compared with the control leaf. The promotion extent caused by 1, 2 or 3 system leaves showed no significant difference between them. (3)After illumination to the system leaves with 100 μmol $^{m-2s-1}$, 400 μmol $^{m-2s-1}$ or 1200 μmol $^{m-2s-1}$ PPFD, the photosynthetic induction of the target leaves was significantly promoted. Illumination with 30 μmol $^{m-2s-1}$ PPFD to the system leaves did not significantly promote the photosynthetic induction of the target leaf. No obvious differences were observed between the promotion extents of the photosynthetic induction of the target leaves after the system leaves were illuminated with different light intensities. The results indicated that, the system leaves generate effective systemic signal only when the incident light is above a threshold value.

Key words: Photosynthetic Induction, Stomatal Conductance, Systemic Signaling, Calamagrostis Angustifolia Wetland

Application of UAV-Borne LiDAR in Deriving 3D Structures of Forest

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Abstract: Forest canopy plays a key role in ecosystem processes, including energy flows, biogeochemical cycles and the regeneration of understory plants. Three-dimensional (3D) forest structures are crucial to understand these forest ecosystem processes. Limited by the traditional surveying method, only a few structure parameters can be collected, and collecting these measurements is usually labor-intensive. As an active remote sensing technology, LiDAR (Light Detection and Ranging) can penetrate forest canopy and estimate forest 3D structure accurately. LiDAR sensors can be equipped on multi-platforms to collect data at different scales, such as terrestrial-based LiDAR, airborne LiDAR. The unmanned aerial vehicle (UAV) provides an alternative platform for LiDAR data acquisition, which can largely lower the cost and provide denser LiDAR points compared with airborne LiDAR. In this study, we implemented a low-cost UAV-borne LiDAR system, including both a

hardware system and a software system, to collect and process LiDAR data for biodiversity studies. The implemented UAV-borne LiDAR system was tested in three different ecosystems across China, including a needle-leaf–broadleaf mixed forest, an evergreen broadleaf forest, and a mangrove forest. Various 3D vegetation structure parameters (e.g., canopy height model, canopy cover, leaf area index, aboveground biomass) were derived from the UAV-borne LiDAR data. The results show that the implemented UAV-borne LiDAR system can generate very high resolution 3D terrain and vegetation information. Moreover, we have also tested to mount a hyperspectral sensor along with the UAV LiDAR system. The collected hyperspectral data can further provide spectral information of forest canopy and therefore help to recognize tree species information and biochemical components. The developed UAV-based hardware and software systems provide a turn-key solution for the use of UAV-borne LiDAR data in measuring forest 3D structures.

Key words: Near-surface remote sensing, UAV, LiDAR, Forest structure parameters

Effects of Fire on Understory Birds in Montane Forest, North-Eastern Tanzania

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Abstract: The Eastern Arc Mountain is a chain of forested mountains from Taita Hills in Kenya to north-eastern Tanzania down to Udzungwa National Park. It is part of the Eastern Afromontane global biodiversity hotspot with high biodiversity and remarkable concentrations of endemic species. Although fire is not considered among the major threats to these mountains, some of the forest blocks such as Ulugurus and West Usambaras have been seriously affected. However, there are very little data on how fires affect biodiversity in the areas. The current study to assess the effect of fire on understorey birds was conducted at Magamba Forest Nature Reserve, West Usambaras, between July 2015 and January 2016, five years post fire. Mist nets were used to survey understorery birds in burnt and unburnt forests. Nests were searched in both burnt and unburnt forests using time constrained method. Bird species composition between burnt and unburnt forests differed significantly with high diversity in burnt area. A considerable decline of forest interior bird specialists which was accompanied by amplified number of open area, forest edge and generalist species in burnt area was noted. Nests abundance between burnt and unburnt forests did not differ however diversity differed significantly and was high in burnt area. Nests of endemic and forest interior bird specialist such as Usambara Akalat and Spot Throat were not recorded in both burnt and unburnt areas. The observed change in vegetation structure composition

caused by fires could partly explain the avian community differences among sites. The burnt areas are being invaded with an exotic invasive Australian plant species, Acacia melanoxylon, which will not only continue to change the habitat structure but also escalate the fire regimes. Further studies could investigate on the nest success rates in burnt and unburnt areas and the extent of spread and effects of invasive plant species to the biodiversity of this area. Meanwhile, plans for managing the invasive plant species, restoration and rehabilitation of the burnt areas are required.

Key words: Fire Effects on Understory Birds

Scaling of Individual Tree Crowns Drives Overall Forest Structure

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Abstract: Ecological studies try to reveal general rules explaining the functionality of natural communities. The knowledge of the rules and their predictions represent an essential step for managing natural resources. However, the huge diversity of forest ecosystems in terms of species number, productivity, type of disturbances and the intrinsic system "complexity" might suggest that finding general rules can be very difficult or even virtually impossible. Recent advances in our understanding of how trees generally perform and grow, associated with simple principles of maximum use of resources of the whole community, allow us to propose a set of simple allometric principles for predicting the forest structure, regardless of species composition and productivity.Here we present the theoretical framework of the so-called "H-model" and some empirical tests in temperate and tropical forests (Congo Basin and Borneo). The forests were selected in relation to their different degree of disturbance.In several plots (1-4 ha each) we measured the tree DBH of all trees (full inventory) with DBH>1 cm, tree height in a subsample, crown radius and crown length. In agreement with the model expectations the scaling of crown volume was very similar in all species within the same region. The allometric exponent of the crown volume vs. tree height varied from 2.2 (in temperate forests) to 3.3 (in tropical forests) and these exponents drive the structure of the forests.The tree-size distributions, fitted with a power law (in general with r2>0.90), showed that in the most disturbed forest the scaling exponent was lower if compared with the condition of full resource use.We conclude that the potential tree size distribution can be predicted allowing us to quantify the degree of disturbance in different forest communities.

Key words: Allometric Relationships, Disturbance, Tree-Size Distribution, Operationalization

T5-04: Plant Resistance to Drought: From Trait Syntheses at Plant-Scale to Vegetation Models

Aboveground Biomass Production of a Meadow Steppe in Northeast China Is More Sensitive to Spring Drought than Summer Drought

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Abstract: Grassland vegetation composition and productivity are very sensitive to short term climate extremes, such as drought, which is predicted to increase in both frequency and intensity. Effects of the drought intensity on grassland productivity and stability have been extensively studied; however, timing of drought (spring vs summer) is also an important aspect of drought study, which received much less attention. Moreover, drought is likely to interaction with other chronic global change factors, such as N deposition, to enhance its adverse impacts on vegetation composition and ecosystem functions. To assess effects of the timing of drought, as well as interaction with N deposition, on grassland productivity, we conducted a manipulated drought experiment in a meadow steppe in northeast China. We predicted that biomass production in the studied meadow steppe is more sensitivity to spring drought than summer drought and N addition will enhance drought sensitivity. In May 2015, 6 blocks with similar vegetation composition were established within the experimental site. We divided each block in 6 plots (each plot has an area of 5 m ×5 m), and assigned one of the six treatments randomly (control, spring drought, summer drought, nitrogen addition, nitrogen addition and spring drought, nitrogen addition and summer drought). Nitrogen addition treatment (10 g N m−2 year−1) was carried out in 2015 and 2016; whereas drought treatment was only implied in 2016. In each drought plot, the 2 mm corrosion resistant plate was placed around the sub-plot (3 m×3 m) to prevent water from the overland runoff and belowground lateral soil infiltration. The extreme drought event was simulated by installing rainout shelters (3.5 m × 3.5 m) with transparent acrylic roof (>90% light permeability). Spring drought and summer drought was initiated on DOY 133 and 178, respectively, and last for 45 days. We measured soil water content, aboveground and belowground biomass, leaf net assimilation rate during the drought period as well as the beginning and end of grow season. The aboveground biomass productivity of the studied meadow steppe (dominated by Leymus chinensis) was more sensitive to the manipulated spring drought than summer drought, which may attribute to the C3 photosynthetic pathway of the dominant species. Spring is the major growing season for L. chinensis; therefore, spring drought associated water shortage

greatly reduced biomass formation and accumulation of photosynthetic leaf area. The studied meadow steppe had almost reached its peak biomass at the beginning of the summer drought treatment, which explained the less sensitivity in the productivity to the summer drought. The nitrogen addition treatment enhanced both aboveground and belowground biomass production, but reduced root: shoot ratio, which exaggerated drought sensitivity of aboveground biomass production, especially during the spring season. The results of this study suggest that the vulnerability of grassland ecosystem functions to drought depends on the timing of the drought and species-specific traits of the dominant species. The chronic global change factors, such as N deposition, will interact with short-term climate extremes to increase grassland drought sensitivity.

Key words: Drought, Nitrogen Deposition, Grassland, Aboveground Biomass Productivity

Drought Responses of Two Genetically Differentiated Telopea Speciosissima Populations under Elevated [CO_2] and Temperature

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Abstract: Woody plant populations originating from different environments usually show intraspecific variation in response to drought. However, to what extend this pattern would be altered by changes in other climatic variables such as [CO_2] and temperature remains unknown. Here, we investigated the main and interactive effects of elevated [CO_2] (CE) and elevated temperature (TE) on growth and physiological responses to drought of Coastal (warmer and relatively wetter environment) and Upland (cooler and relatively drier environment) genotypes of an Australian woody species Telopea speciosissima. The two genotypes showed similar declines in growth and photosynthesis under drought conditions across [CO_2] and temperature treatments, and did not exhibit differences in response to drought stress. Regardless of genotype, TE negatively affected plant drought resistance by accelerating the process of drought seedlings becoming physiologically stressed, while CE did not influence the capacity of plant drought resistance or alter the sensitivity of photosynthesis to declines in soil water content. Furthermore, CE did not ameliorate the negative effects of TE on drought response. Overall, these results suggest that woody plant populations originating from different environments may not necessarily show intraspecific variation in response to drought under current or predicted future climates. These findings also indicate that temperature is likely to be a stronger determinant than [CO_2] in affecting woody plant response to drought in the context of climate change.

Key words: Drought, Elevated [CO_2], Elevated Temperature, Intraspecific Variation

Understanding Plant Water Use Efficiency: Environmental Dependence of Leaf-Internal CO_2 Concentration in Theory, Data and Simulation

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Abstract: Plant water use efficiency depends on leaf-internal carbon dioxide partial pressure. Variation in this trait is a result of optimal stomata behaviour responding to surrounding environments. But representations of this key trait in Earth System Models (ESMs) are empirical and incomplete, contributing to many uncertainties afflicting projections of terrestrial carbon and water cycles. Here we show that a simple evolutionary optimality hypothesis predicts specific, quantitative responses of χ (the ratio of leaf-internal to ambient carbon dioxide) to growth temperature, vapour pressure deficit and elevation, which also emerge from an independent analysis of empirical χ values derived from a worldwide data set of > 3500 leaf stable carbon isotope measurements. The simulated environmental dependencies of χ and WUE from seven land ecosystem models in TRENDY project show large discrepancies among model-predicted relationships of χ and WUE to temperature and moisture. This suggests that a top-priority task for land ecosystem models should be to reformulate the environmental drivers of χ and WUE relationships to be consistent with observations. Our work also indicates that eco-physiological optimality hypotheses provide a promising route to an improved predictive understanding of terrestrial carbon and water cycling.

Key words: Water Use Efficiency, Stomata, Eco-Physiological Optimality, Leaf Internal CO_2 Partial Pressure

Does the Intensity of Drought Matter During the Drought-Induced Mortality of Tree Seedlings in Subtropical China?

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Abstract: The worldwide forest mortality has been attributed to severe droughts and increasing temperatures. Despite substantial progress in unravelling physiological mechanisms underlying drought-induced tree mortality, details about carbon and water

relations towards tree mortality remain still unresolved. In particular, it is currently poorly understood how the intensity and duration of drought would impact the relative contributions of hydraulic failure and carbon depletion to mortality of subtropical woody species. In the context of global climate change characterizing with changing precipitation patterns, bridging this knowledge gap will help to improve the predictions in forest responses to future climates in the subtropical regions of China. In this study, one year old potted seedlings of three native woody species in south China, i.e. Schima superb (a tree species), Castanopsis chinensis (a tree species) and Syzygium rehderianum (a shrub species), were well watered and fertilized until the commencement of soil drought treatments (i.e. fast drought and slow drought). Water was completely withheld in the fast drought treatment, while 80-90% of the whole plant water loss was rewatered to seedlings in the slow drought treatment. We measured leaf gas exchange, growth, plant hydraulics, non-structural carbohydrates (NSC) as well as rate of mortality regularly until the death of seedlings, enabling to distinguish the responses of carbon and water relations to fast or slow drought. We are also able to compare drought strategies among the three species. Results showed that leaf gas exchange, water potential and xylem hydraulic conductance of the three species exhibited more profoundly declines in the fast drought treatment than slow drought treatment, indicating that fast drought had greater impacts on physiological responses than slow drought. Syzygium rehderianum had greater drought sensitivities in leaf gas exchange, leaf water potential and xylem embolism, associated with less negative P50 (i.e. the xylem potential at which 50% of xylem hydraulic conductance was lost) and turgor loss point, while Schima superb had higher drought tolerance. Organ NSC will also be reported. In combination with NSC data, we are able to determine the relative contribution of hydraulic failure and carbon depletion to seedling mortality and generate a better understanding of effects of drought intensity and duration on carbon and water relations. Furthermore, implications of shifts in forest composition and functioning in subtropical China will be obtained.

Key words: Drought intensity, Plant traits, Water and carbon relations, Subtropical China

Drought Resistance Advantage of Endophyte-Infected over Endophyte-Free Leymus Chinensis Is Reduced by Arbuscular Mycorrhizal Fungi Inoculation

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Abstract: Endophytes are ubiquitous fungi that inhabit healthy cool season grasses

without causing disease. Thus far, the best-studied endophytes are Neotyphodium lolii and Neotyphodium coenophialum, which colonize perennial ryegrass (Lolium perenne) and tall fescue (Lolium arundinaceum), respectively. It has been well documented that endophytes can ameliorate drought stress in perennial ryegrass and tall fescue.

Endophytes not only exist in cultivated grasses such as tall fescue and perennial ryegrass but are also widely distributed in native grasses. In comparison with cultivated grass species, the potential for enhancement of drought resistance provided by endophytes are less constant and more variable in native grasses, spanning the range from mutualism to antagonism. Endophytes not only directly affect the host plant itself but also influence the host plant indirectly via altering the composition and function of the soil microbe community in the host habitat. Can the uncertainty of contribution of endophyte infection on drought resistance of native grasses result from other microbes in the soil such as arbuscular mycorrhizal (AM) fungi. AM fungi colonize host roots and form symbiotic associations with most terrestrial plant species, including a variety of grass species. AM fungi are also proposed to affect drought resistance of host grasses to some extent.

Leymus chinensis is a perennial bunchgrass widely distributed in the Northeast Plain and the east of Inner Mongolian Plateau of China and commonly infected by Epichlo ë endophyte. L. chinensis can be simultaneously colonized by AM fungi. In this study, endophyte-infected (EI) and endophyte-free (EF) L. chinensis were adopted as plant material. We wondered whether endophyte infection can ameliorate drought stress of the L. chinensis and whether the effect of endophyte infection on growth and drought resistance of the host influenced by AM fungi.

We found that endophyte infection significantly increased drought resistance of the host grass. Under drought conditions, EI had higher net photosynthetic rate, greater concentration of proline and total phenolic, and accumulated significantly more biomass when compared with EF plants. Meanwhile, the specific leaf area (SLA) and malondialdehyde (MDA) concentration of EI plants were lower than those of EF plants. AM fungi inoculation reduced drought resistance advantage of EI over EF plants. In mycorrhizal-free (MF) treatment, endophyte infection significantly enhanced drought resistance of the host grass; while in mycorrhizal-inoculation (MI) treatment, no significant difference occurred in the performance between EI and EF plants. The results suggested that endophyte infection could increase drought resistance but drought resistance advantage of EI over EF L. chinensis was reduced by AM fungi inoculation.

Key words: Endophytes, Arbuscular Mycorrhizal Fungi, Leymus Chinensis, Drought

Responses of Populus Euphratica on River Drying in the Lower Reaches of Peacock River，Xijiang

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Abstract: Ecological degradation is a worldwide concern in arid and semiarid regions, especially in the desert riparian ecosystem. In the fragile riparian ecosystem, natural vegetation, as the windbreak for sand fixation, plays an critical role in preventing desertification, and directly determine the pros and cons of the environment. However vegetation function of preventing desertification would be limited by water availability. The Peacock River originates from Boston Lake and flows through the east of the Taklamakan Desert; it has an important ecological function in supplying water and ecological stability to the South Korla and Lop Nor. regions. Owing to climate change, and excessive human exploitation, water availability has become increasingly limited, resulting in severe river drying in the lower reaches of the Peacock River.

Therefore, to evaluate the degree of vegetation degradation and potential restoration probability in the lower reaches of the Peacock River, this study focused on vegetation degradation and the relationship between plant group and environment by analyzing the groundwater, soil salinity, soil nutrients, and vegetation in 2013. The results show that (1) there is an increasing tendency for dying Populus euphratica along the river from Yuli County to Lop Nor. regions. The majorities of surviving Populus euphratica are adult woods, and population pattern of Populus euphratica remains cluster-type. (2) Three plant groups are divided based on CCA ordination, namely deep GD (groundwater depth) - salt tolerance group, deep GD – halophyte group and low GD - euhalophyte group. Of these, the deep GD - salt tolerance group, Populus euphratica being dominant species, live in the environment with good soil nutrient, the low GD - euhalophyte group, Kalidium foliatum and Halostachys caspica being dominant species, occupy the environment with high salinity and poor soil nutrient. (3) Decision-tree Model showed that Populus euphratica is the key factor to prevent desertification occurring, the probability of slight desertification reach 16.7% as coverage of Populus euphratica is less than 1%, then the probability of heavy desertification would be 83.3%.

Key words: Populus euphratica, Peacock River, river drying, Plant group

Revisiting the Soil-Plant-Atmosphere Continuum (SPAC)

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Abstract: A unified theory of plant water relations did not emerge until the 1960s, when Cowan (1965), Phillip (1966) and Slatyer (1967), all working in Australia showed that the flow of water from the soil to the atmosphere could be represented as a resistance analogue wherein water is transferred from regions of relatively high water potential to regions of low water potential through a chain of resistances. They were relying heavily on the cohesion-tension theory of water transport, developed much earlier (Dixon, Joly 1894, Askensay 1895).

We ask the question: to what extent is the theory useful today, and how has it been used in biophysical models such as those forming part of global climate models. If modellers ignore it, and use only an empirical relation between plant growth and water availability, is the predictive power of any model likely to be diminished.

In favour of the theory is the fact that many of the required parameters can now be measured on a continuous basis. Against it, is the observation that ecosystems and soils differ so much from each other that measurement campaigns can never cover the range of behaviors.

We are thus faced with a modeller's dilemma: to be empirical or mechanistic. We examine the dilemma alongside the uncertainty inherent in models of complex systems.

Key words: Drought, Water Transport, Vulnerability, Models

Drought Stress Release Increased Growth Rate but Did Not Affect Levels of Storage Carbohydrates in Scots Pine Trees

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Abstract: For trees, energy storage in the form of non-structural carbohydrates (NSCs) plays an important role for survival and growth, especially during stress events such as drought. It is hypothesized, that tree individuals that experience long-term drought stress use up larger amounts of NSCs than trees that do not experience drought. Consequently, such drought-induced depletion might lead to a decrease in tree vigor and carbon starvation, a mechanism that is subject of intensive debates in recent literature. Hence, if carbon starvation is occurring during drought, drought stress release should again increase NSC concentrations.

A long-term (13 years) irrigation experiment is being conducted in the Pfyn forest, the largest Pinus sylvestris dominated forest in Switzerland, located in the dry inner-Alpine Swiss Rhone valley (average precipitation ~600 mm/year, with frequent dry spells). Water addition (~600 mm/year) is executed every year during the growing season between April and October. Tree height, stem diameter and crown transparency are being measured since 2003. In February, July and October 2015, roots, stem sapwood

and needles were harvested from 30 irrigated and 30 control trees and 5 different crown transparency classes. Shoot length, needle morphology, soluble sugars, starch concentrations, needle δ13C and δ15N were measured.

Shoot and stem growth were higher in irrigated trees than in control trees. Growth decreased with increasing crown transparency in both treatments. Only in July, needle starch levels were higher in irrigated trees than in control trees but there was no treatment effect for wood and root starch concentrations. Tissue starch and sugar levels were negatively correlated with crown transparency, particularly in the roots (>0.001), independent of the treatment. Needle δ13C values were higher in the control trees than in the irrigated trees, where needle δ13C values were positively correlated with increasing transparency (>0.01). Annual shoot growth was positively correlated with starch levels in the roots.

The results show that 13 years of irrigation did lead to increased growth but not to increased NSC levels hence not confirming our initial hypothesis. δ13C levels indicate that control trees experienced more drought stress than irrigated trees. However, we found irrigated trees from high crown transparency classes with similar δ13C levels as for non-irrigated control trees. The release of drought stress has benefited the initially vital trees, whereas the initially inferior trees still show signs of drought stress. The results point to a 'winner takes it all principle', where differences between individuals increase when environment conditions improve. This caused the irrigation treatment not being effective in generally releasing drought stress and NSC depletion in all trees. As increasing crown transparency over both treatments is correlated with decreasing growth and decreasing NSC levels, there are still indications that reduced NSC is related to reduce tree vigor under drought.

Key words: Drought Release, Nonstructural Carbohydrates, Pinus Sylvestris, Climate Change

Response of Tropical Forests to Drought: Current Progress and Future Perspectives

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Abstract: In many parts of the tropics we may expect an increase in the frequency of drought over the coming decades. There is evidence that rain forest trees are often sensitive to drought, and that long-term drought may lead to forest decline. We review the roles hydraulic resistance and changing carbon availability play in influencing patterns of tree mortality at the world's longest running tropical forest drought experiment in the Brazilian Amazon. Drawing on a recent report from this experiment, we show that the remaining droughted forest has sufficient carbon available to maintain non-structural carbohydrate reserves and to increase tree growth rates, indicating that this measure may not signal an elevated risk of mortality. Instead our data suggest that hydraulic vulnerability in the largest trees of drought-sensitive species is likely to trigger higher mortality rates as observed in the drought-treated forest. Variations in hydraulic vulnerability are likely to be related to differences xylem properties, tree size and its taxonomic identity. We discuss knowledge gaps and the notion that a re-examination of plant functional types in terms of hydraulic variables would be useful. We also call for the establishment of a trans-continental network of research sites as a means of identifying unified principles of drought response in rain forests.
Key words: Drought Stress, Plant Traits, Water and Carbon Relations, Tropical Brazil

Effects of Manipulated Drought and Re-Watering on Photosynthesis in C3 and C4 Grasses in a Meadow Steppe of Northeast China

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Abstract: Global change factors, such as variation in precipitation regimes and nitrogen deposition, are likely to occur simultaneously and may have profound impacts on vegetation composition of grasses differed in functional traits, such as C3 and C4 species. To assess resistance and recovery ability differences among C3 and C4 grasses, we conducted a manipulated extreme drought and re-watering experiment. In addition to the water treatment, nitrogen addition treatment (with or without nitrogen addition) was carried out to evaluate whether or not nitrogen availability will alter sensitivity of C3 and C4 grasses to extreme environmental disturbance. A C3 perennial grass (Leymus chinensis) and two C4 grasses (annual: Chloris virgata; perennial: Hemarthria altissima) that co-occur in the Songnen meadow steppe were selected as experimental plants. In May 15th 2015, seedlings of L. chinensis and H. altissima were transplanted in plastic pots (23.5 cm in diameter and 20 cm in height) filled with chernozem soil (8 kg soil pot^{-1}). For C. virgata, plants were germinated from seeds and transplanted into the plastic pots. All species were planted in monoculture (five individuals per pot). Before the initiation of the drought treatment, all the transplanted plants were

well-watered (manually watered every three days). For the nitrogen addition treatment, each pot was fertilized with granular urea with a rate of 10 g N m−2 year−1. During the drought treatment (July 15th - 21st), all the pots were placed under a plastic shed to exclude natural precipitation. All the pots were watered thoroughly during the re-watering period (July 21th - 28st). Leaf gas exchange, leaf enzyme activities, and content of proline, chlorophyll and MDA were measured on Day 1, 3, 5, 7 during the drought period and on Day 7 at the end of the re-watering period. With the progress of drought treatment, leaf net CO_2 assimilation rate (A) in both C3 and C4 grasses showed a trend of gradually decreasing, but differed in the magnitude of reduction. For the no nitrogen treatments, A in both C4 grasses had a greater reduction rate than C3 grass; whereas under nitrogen addition treatment, similar reduction rate in A were observed for the studied C3 and C4 grasses. Compared to the C4 grasses, A in L. chinensis fully recovered at the end of the re-watering period under the no nitrogen addition treatment. The resistance and recovery ability in the studied C4 annual grass was influenced by the nitrogen treatment; whereas C4 perennial H. altissima was not significantly affected by nitrogen addition. Our results suggest C3 grass L. chinensis, compared to the studied C4 grasses, has better adaptation ability to the predicted future precipitation regimes, which are characterized by high frequency and increased intensity in drought. However, this advantage of L. chinensis is likely to diminish if nitrogen deposition is co-occurred with extreme drought.

Key words: C3 And C4 Grasses, Drought, Photosynthesis, Nitrogen Deposition

A Comparative Research on Ecological Adaptability between Alien and Native Woody Plants in Warm Temperate Region

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China

Abstract: Under the background of global change, warm temperate region is becoming drier and drier. In order to compare the ecological adaptability between alien and native woody plants in warm temperate region, via researching water utilization strategy in different time and season, a field experiment was designed in Fanggan Village, where there is an ecological experimental base of Shandong University. In this experiment, Quercus acutissima Carruth. Vitex negundo L. var. heterophylla (Franch.) Rehd. Robinia pseudoacacia L., Rhus Typhina, were chosen as the research objects. This research shows that when the climate becomes drier, different kind of plants has different strategy in ecological adaptability. As arbors, Quercus acutissima Carruth. Grows slower than Robinia pseudoacacia L., but the former is abler to resist the drier envoriment, so in Robinia pseudoacacia L. - Quercus acutissima Carruth. Mingled

forest, with the help of the global change, Quercus acutissima Carruth. May occupy more advantage, and at the end, it may be the only dominant species in the forest. In terms of shrubs, the ability of drought resisting in Vitex negundo L. var. heterophylla (Franch.) Rehd. And Rhus Typhina shares on a fifty-fifty basis. But compared with Vitex negundo L. var. heterophylla (Franch.) Rehd. The ability of metabolism in Rhus Typhina is higher when the weather is a little dry. On the contrary, when it is a little moist, Vitex negundo L. var. heterophylla (Franch.) Rehd. Is better. In the future, Vitex negundo L. var. heterophylla (Franch.) Rehd. - Rhus Typhina mixed shrub may be faced with niche separation, Rhus Typhina may move to the dry place while the other may stay in the wet ground.

Key words: Globe Change, Warm Temperate Region, Ecological Adaptability, Water Utilization Strategy

Competitive Interaction between Mixed-Planting Maize Cultivars Enhanced Yield and Water-Use Efficiency in a Semi-Arid Region

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Abstract: Effects of competitive interaction between two mixed planting maize (Zea mays L.) cultivars on yield and water use efficiency are inevitable and the positive process needs more excavation. Two maize cultivars were mixed planting in two densities to explicit the potential of competitive interaction improving yield and water use efficiency in a semi-arid region over two growing seasons. During grain filling stage firstly, competitive interaction optimized stem to leaf ratio of two maize cultivars, and decreased root to shoot ratio at harvest under the same-high mixed planting density, great competitive intensity caused by high planting density suppressed vegetative growth of maize. Secondly, land equivalent ratio positively increased from 1.02 to 1.14, which signified the advantage of farming land use. Furthermore, positive values of total actual yield loss in the four mixed systems indicated a yield advantage. Over two years, mean yield and water use efficiency increased by 6.5 % and 11.7 % which resulted from the positive performance of two maize cultivars in the mixed systems. Thus, consequences of competitive interaction in the mixed planting systems performed as land use, maize yield and water use efficiency advantages in the dry land farming.

Key words: Maize Cultivars Mixture, Competitive Parameter, Yield and WUE Advantage, Semi-Arid Region

Grass Diversity Increased under Drought in a Savanna Ecosystem, southwest China

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Abstract: Precipitation variety will likely have impact on plant communities. However, how changes in precipitation will affect the plant communities and how dose plant communities or plant groups response to the change remains unclear. In this study, a three-year filed manipulate experiment was conducted with exclude precipitation in a savanna ecosystem of Yunnan, southwest China. Grass species composition, cover, and abundance from the different plant functional groups were analyzed under continuous drought. Drought reduced percentage cover and average height of grass across the different plant functional types. Relative abundance of C_3-plant and legume species tended to increase with increasing of drought stress. Species diversity significantly increased under drought. These results suggest that species richness will vary with drought stress. Precipitation variety is likely to alter community structure and species composition.

Key words: Species Diversity, Drought, Plant Functional Types, Savanna

Combined Stress of High Temperature and Drought on Photosynthesis and Antioxidant Enzyme System of Poplar Seedlings

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Abstract: The objective of this study was to investigate the effects of high temperature stress, drought stress and their combined stress on photosynthetic characteristics, chlorophyll fluorescence and antioxidant enzyme activity of poplar seedlings (Populus × euramericana 'Nanlin 895') through controlled pot experiment. Results demonstrated that with the prolonging of stress (single stress and combined stress) application, net photosynthetic rate (Pn), stomatal conductance (Gs), transpirationrate(Tr), maximal fluorescence(Fm) and optimal/maximal photochemical efficiency of PS II (Fv/Fm) decreased, while the minimal fluorescence (F0) increased. Under moderate drought stress, intercellular CO_2 concentration (Ci) and water use efficiency (WUE) decreased firstly and then increased, whereas the activity of superoxide dismutase and Peroxidase changed in the opposite way. Pn is mainly determined by stomatal and non-stomatal factors together. During late periods of heavy high temperature stress, heavy drought stress and combined stress, the activity of SOD and POD declined significantly and Pn

is mainly determined by non-stomatal factors. Two combined abiotic stress has superimposed effect on Pn and Tr. Compared to single stress, combined stress affected Pn, Gs, Ci, TR, Fv/Fm and SOD activity more. Poplar seedlings experienced more bad damages under the combined stress of high temperature and drought.
Key words: High Temperature, Drought, Poplar, Photosynthetic Characteristics

Contrasting Effects of Different Drought Strength on Soil Respiration in Savanna Ecosystem, southwest of China

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Abstract: To better understanding the effect of the drought on soil respiration (SR), we conducted a drought experiment in south west of China. The results indicated that SR mainly from rainy season which occupied more than half of the annual cumulative soil respiration in all treatments, which significant higher than that in dry season. The sensitivity between soil respiration and soil moisture decreased as drought severity increased. The SRs were significantly correlated to soil temperature (ST) in treatments with a parabolic function, and the SRs decreased when the soil temperature were too high, accompanying with insufficient soil water content, we get an exponential relationship between SR and ST when excluded the soil respiration value when the soil temperature was not too high, which indicated that the SR was controlled by soil temperature and soil moister, and get a better simulation results by the two factors.
Key words: Drought, Soil Respiration

T5-05: Species Diversity Mechanism in Ecosystem and Landscape Restoration

Can Kentucky's Wetland Restorations Meet Functional Goals?

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Abstract: Wetland restoration in the USA became more prevalent after policy changes in the early 1980s. Many early wetland restoration attempts were hampered by inadequate knowledge about the best techniques. Further, we knew it would take decades to evaluate how successful different types of restoration techniques would be. In Kentucky, we evaluated a number of wetland restoration sites for over 20 years to determine how well they meet functional objectives. Although vegetative criteria are often met (wetland plants are present), as long a hydrology is adequately addressed, some ecosystem functions and biodiversity goals have been more elusive. For example, diel oxygen changes in natural wetlands are hard to recreate. Herptofauna and avian diversity may increase, but it may not be similar to natural wetlands. It could be that more decades will be required for these sites to meet functional and biodiversity goals. This could have policy implications, since mitigation wetland restoration acreage is often calculated based partially upon lost regional functions.
Key words: Restoration, Wetland, Biodiversity

The Relationship of the Light Environment and the Forest Floor Vegetation between Monolayered and Multilayered Forests

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Abstract: To restore and maintain natural vegetation on bare land, the rapid and stable establishment of saplings is necessary. The light environment is one of the most important parameters for sapling establishment, but at reforestation sites, reports on their interactions are insufficient. Therefore, in this study, we investigated monolayer and multilayer forests established twenty years ago by two reforestation techniques. The forest floor vegetation and light environments were assessed and the relationship between them was analyzed.

The study took place on a slope in Gifu prefecture, Japan. Six species were planted on the multilayer forest slope (hereinafter called the multilayer slope) using a

mixed-species plantation method. Seven species were introduced on the monolayer forest slope (hereinafter called the monolayer slope) using the seed sowing method.
To measure the light environment, we established 20 plots (each 5 × 5 m) on the multilayer slope and 16 on the monolayer slope. The relative photosynthetic photon flux density (rPPFD) was measured at 1 m height intervals (using the midpoints) from 0 m to 10 m. For the forest floor vegetation survey, we quartered each plot and recorded the coverage of every herbaceous and sapling species below the height of 1.8 m. The number of individuals for each sapling species was also recorded. To check the relationship between the forest floor vegetation and the light environment, we ran a cluster analysis for each using the coverage and rPPFD, and then matched the groups.
From the forest floor vegetation survey, the number of sapling individuals per m2 on the multilayer slope was 0.894, which was larger than the sapling density on the monolayer slope of 0.075 ($P < 0.01$). A difference was also noted in the coverage of herbaceous species ($P < 0.01$): the mean coverage was 68.5% on the multilayer slope and 30.6% on the monolayer slope. From the cluster analysis, six vegetation groups were found on the multilayer slope and five were found on the monolayer slope.
The minimum and maximum rPPFD values were 0.008 and 1.000 for the multilayer slope, and 0.002 and 0.217 for the monolayer slope. A box-plot at each height also demonstrates that the multilayer slope had a wide variety of light environments in both the vertical and horizontal directions, while the monolayer slope was more uniform. From the cluster analysis, the multilayer slope plots were grouped to five light fluctuation types, while the monolayer slope plots were grouped to four types. The mean value at 0 m showed that the amount of light reaching the forest floor in the monolayer forest (0.006 ± 0.0030) was less than that reaching the multilayer forest floor (0.027 ± 0.011, $P<0.01$). It is possible that the low light value was caused by a dominance of herbaceous species, and likely hindered sapling establishment.
In this study, no correlation was found between the light fluctuation type and forest floor vegetation group; however, the multilayer forest had a greater variety of light environments and much better sapling establishment than did the monolayer forest.
Key words: Light Environment, Forest Floor Vegetation, Reforestation

In Search of Candidate Species for Phytostabilization of Copper Mine Tailings Dams in Zambia

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Abstract: Mining activities generate a large amount of waste rocks, overburden materials and tailings, which are one of the main environmental problems in

post-mining landscapes due to their high heavy metal contents. In addition, the waste rocks and tailings are often very unstable, poor in essential plant nutrients and soil physical structure with low soil pH, as a result inactive or abandoned mining sites generally remain un-vegetated for extended period of time. In the absence of adequate closure management, metalliferous mine tailings and overburden materials pose serious hazards to human health and agricultural productivity through surface or groundwater pollution, offsite contamination via aeolian dispersion and water erosion, and uptake by vegetation and bioaccumulation in food chains. Phytostabilization has emerged as a sustainable "green technology" to restore mining wastelands using plant species adapted to metalliferous sites and soil amendment measures to immobilize heavy metals through absorption and accumulation by roots, adsorption onto roots, or precipitation within the rhizosphere. Selection of candidate species is, however, challenging. A survey of autochthonous colonizers of abandoned mine tailings could provide a snapshot of species adapted to the harsh growing conditions of the tailings dams as a basis for further screening. We conducted vegetation survey on decommissioned tailings dams in Zambia, one of the African countries with rich copper deposit and a long history of mining. The preliminary result shows that 30 woody species naturally colonized copper mine tailings dams compared to 55 species in the nearby natural forests; and six species were solely found on tailings dam. Further investigation of these species is on-going to determine their adaptation mechanisms.
Key words: Phytostabilization, Tailing Dams, Candidate Species, Restoration

Evaluation on the Effect of 50 Years' Forest in Main Tree Species of Taishan Mountain

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Abstract: There were 6 kinds of artificial forest for more than 50 years of artificial forest, and the typical sampling method was used to investigate the plant and soil samples, and the samples were set up in the field. 42 were collected from the Tianmu Village Line, the Red Gate Line, the Tianzhufeng Line and the Peach Blossom Spring Line. The results showed that: 1) The tree layer richness index, Shannon-Wiener diversity index and Simpson diversity index of Robinia pseudoacacia plantation were significantly lower than those of the other five plantations ($p < 0.05$); Pinus tabulaeformis plantation and Japanese larch The Shannon-Wiener diversity index and Simpson diversity index of shrub layer were significantly lower than those of the other four plantations ($p < 0.05$), while the Pielou evenness index of Pinus tabulaeformis and Pinus densiflora plantations was significantly lower than that of the other four ($P < 0.05$).

The herbaceous layer richness index of Pinus tabulaeformis plantation and Platycladus orientalis plantation was significantly lower than that of the other four plantations ($p < 0.05$), while the Shannon-Wiener diversity index of Pinus tabulaeformis plantation and Simpson diversity index was significantly lower than the other five plantations ($p < 0.05$). 2) The soil organic matter of Pinus tabulaeformis plantation and Pinus densiflora plantation was significantly lower than that of the other four plantations ($p < 0.05$). The total nitrogen of Pinus densiflora plantation was significantly lower than that of the other five plantations ($p < 0.05$) ($P < 0.05$). The active organic carbon of Pinus densiflora plantations and Pinus armandii plantations was significantly lower than that of the other four plantations ($p < 0.05$). 3) The species richness index, Shannon-Wiener diversity index and Simpson diversity index of tree layer and shrub layer showed Mengshan plantation> Taishan plantation> Yishan plantation, and the species richness index of herb layer, Shannon-Wiener diversity index and Simpson diversity index were the highest in Taishan plantation. The Pielou evenness index of tree layer and shrub layer was the lowest in Taishan plantation.

Key words: Taishan, Plantation, Plant Diversity, Soil

Vertical Gradient Characteristics of Plant Diversity and NPP in Tuoliang National Nature Reserve, China

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Abstract: In this paper, we studied the vertical gradient distribution traits of plant species richness, community diversity including α diversity, β diversity, Shannon-wiener index, Sørensen index, Jaccard index and Cody index in Tuoliang National Nature Reserve, which locates in the central of Taihang montane zone. Features of plant community succession on the altitudinal gradient were analyzed as well, the correlation between plant diversity and vegetation NPP, precipitation and temperature was also discussed respectively, basing on the MODIS data from 2010 to 2014. The results showed that 1) the "double peaks" model was found in the altitudinal distribution of plant diversity in Tuoliang National Nature Reserve, respectively appearing on the altitude of about 900m and 1800m above sea level, 2) distribution of Shannon-wiener index in the plant community appeared "double peaks" model in line with the species richness on vertical scale, 3) research of β diversity distribution pattern indicated that the similarity indexes, such as Sørensen index and Jaccard index, reached their minimum levels on the height of 900m and 1800m, in accordance with the distribution feature of plant species richness, which meaning an increasing of the differences among the plant communities, while the Cody index reached its maximum

level in the corresponding altitude, which meaning an accelerating of community succession rate among the plant communities, and an increasing of plant diversity, 4) the same vertical distribution pattern of the plant species richness and the Net Primary Productivity (NPP) was verified, with a significant positive correlation between the species and NPP confirmed in Tuoliang National Nature Reserve, 5) the major environmental factors which influencing the plant diversity vertical pattern were elevation and temperature in the central of Taihang mountains.
Key words: Plant Species Diversity, Vertical Pattern, NPP, Community Succession

Survivorship Characteristics of Phytoplankton Assembles in Ballast Water: An Implication for Ballast Water Management

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Abstract: Abstract: Phytoplankton species and abundance in ballast water from 26 vessels of Yangshan port was determined from April 2015 to January 2016. In total, 84 species of phytoplankton were identified, belonging to 43 genera and 5 phyla, Bacillariophyta (75.0%, which includes 30 genera and 63 species) was the dominant algae in ballast water. The density ranged between (5.55±9.62)-(1.878±0.872) ×103 cells/L (mean 410.1 cells/L). 9 potentially harmful phytoplankton taxa, Ceratium furca, C. Marcroceros, Leptocylindrus danicus Cleve 1889, Coscinodiscus radiatus, C. granii, Prorocentrum micans, Melosira sulcata, Meuniera membranacea and Skeletonema costatum were detected. The investigation also shows that Microcystis aeruginosa, Ankistrodesmus falcatus and Scenedesmus can still survive in the high-salinity ballast water although they are freshwater species. Moreover, we summarized the common features of surviving phytoplankton and the impacts on the phytoplankton community in the ballast water samples with different water ages, and different ballast water sources. Ballast Water Management Convention will take effect formally in September 2017. For this reason, it's necessary to have a full understanding of the survival organisms in ballast water. The investigation and analysis of the phytoplankton in ballast water aims to provide suggestions and statistical and theoretical support for future researches, in order to improve the ballast water treatment equipment and enhance the inspections in vessels that are going to enter the port.
Key words: Ship'S Ballast Water, Phytoplankton Assembles, Harmful Species, Biological Survey

Vertical Distribution Patterns of Soil Microbial Communities along Soil Profile in the Loess Plateau

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Abstract: This study investigated 5 land uses, including natural shrub, native grassland, artificial forest plantation, artificial shrub plantation and Slope farmland. The distribution pattern of soil microbial communities along 0-10 m at soil profile was investigated. The research methods included Illumina MiSeq 16S rDNA of high-throughput sequencing, vegetation survey, and soil physical and chemical analysis. The results showed significant differences in soil microbial community composition and structure along soil profile. In soil surface, the relative abundance of dominant phylum of soil microbial community expressed as Proteobacteria> Actinobacteria> Acidobacteria. In soil subsurface, the relative abundance of dominant phylum of soil microbial community expressed as Actinobacteria > Proteobacteria > Acidobacteria. There have a significantly correlated relationship between the soil microbial community distribution and environmental factors (Mantel test, $p < 0.01$). Soil nutrient (SOC, C, N, C/N, pH and EC), texture (silt content) and micro-climate (soil temperature) and other environmental factors could significantly affect the distribution of soil microbial communities (RDA analysis, $p < 0.01$). The study indicated that soil profile is important influence factors for the distribution of soil microbial communities.
Key words: Deep Soil Profile, Soil Microbial Community, Diversity, High-Throughput Sequencing

Fish restoration in China

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Abstract: China has more than 20000 living aquatic species in its water and it has a long and successful utilization of fishery resources, which played important role in ensuring food security, employment, indigenous people's subsistence and incomings. Currently, China ranks 1st of fish production, procession, consumption and export in the world. Meanwhile, china faces great fishery resources pressure due to overfishing, habitat destruction and environmental pollution. To conserve the aquatic resources and achieve sustainable fisheries, the Chinese government has initiated a series of measures to confront the challenges, namely, reducing fishing effort, and establishment of conservation zones, fish enhancement and marine ranching. This report will provide an

overview of the efforts with short comments to restore fish resources at the national level in China. Introduce the fish restoration activities in the context of establishment of ecological civilization and present the current state, challenges ahead and moves to be taken in a macro perspective.

Key words: Fish restoration, Fishing effort, Conservation zones, Fish enhancement

Analysis on the Spatial Pattern of Small-Scale Ant Community in Greater Xing'an Mountain

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Abstract: Spatial patterns of soil arthropods are the fundamental parameter to describe the soil community. In this study, taking ants as the research object, 2 subfamilies, 2 genera and 3 species (Tetramorium caespitum, Camponotus japonicas, Camponotus herculeanus) of ant specimens were collected from the habitat of coniferous and broad-leaved mixed forest by trap and sample plot methods in the Nanwenghe Wetland Reserve, Heilongjiang Province, China. We found 867 individuals at 81 uniformly distributed points in two 20 × 20 m2 plots, and the dominant species was Tetramorium caespitum, which accounted for 90.3% of the total number. Then we analyzed the spatial distribution patterns of ant community by geostatistical tools with semivariogram and ordinary kriging. According to the results of semivariograms, the ant community showed measurably clumped distributions in a small scale, revealing exponential or Gaussian models. Moreover，based on the analysis of ordinary kriging, medium - related spatial structures were detected, and the values of (C0 /C0 + C) demonstrated that the spatial differentiations of those ants mainly controlled by both structured and random factors.

Key words: Ant Community, Spatial Patterns, Semivariogram, Ordinary Kriging

A Comparison of Microbial Communities of Natural Seawater and Ballast Water during a Land-Based Experiment by High-Throughput Sequencing

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Abstract: The microorganisms surviving in ballast tank have to face very harsh

conditions: darkness, murky waters, turbulence and a lack of oxygen. After doing simulation experiment at Land-based test facility for one month, pyrosequencing of 16S rRNA genes showed distinct differences between ballast water (test group) and natural water (control group), and developed an understanding of the mechanisms by which bacterial communities might demonstrate temporal variations. A total of 459,978 high-quality sequences and 1,334 singleton operational taxonomic units were obtained. Proteobacteria and Bacteroidetes were the major phyla, but the richness of Proteobacteria in test group (mostly Gammaproteobacteria) was higher than that in control group. Acidobacteria and Chloroflexi were gradually increased on day 15 in test group. At the family level, Flavobacteriaceae became the most abundant taxon on day 5, but gradually decreased thereafter in test group. And the abundance of Pseudoalteromonadaceae gradually increased and it became the dominant taxon from day 10 onwards. The UPGMA analysis showed a tighter clustering of the microbial composition of control group indicating higher similarities in structure as compared to the test group samples which were more dispersed. PCoA and NMDS also reinforced that ballast tank environments have impacted bacterial community structure. In this study, the richness and diversity peaked at the long age (30d) of ballast water, which was dissimilar to previous studies. An appreciable number of unclassified reads were noted at the genus level in test group samples during the later ballasting stage. More bacterial taxa were found in ballast water after long age post-ballasting than were present in natural seawater. This increase demonstrated that conditions inside ballast tanks could support the development of some taxa. It was suggested that ballast tanks may act as incubators under special environments and further emphasizes the risk of species invasion.

Key words: Microorganisms, Ballast Tank, Water Age, Species Invasion

Ecosystem Resilience Characteristics and Mechanism of Closed Mines in the Loess Plateau

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Abstract: This study investigates the ecosystem resilience characteristics and mechanism of closed mines in the Loess Plate. The loess plate serves as an important energy base and a typical fragile eco-regions, has a critical damage in ecology, particularly in the context of the transformation of industry and energy. Facing large amounts of closed mines, it is difficult to take project management due to the limits of cost and technology, thus, the resilience of eco-system become the main approach to restore environment. This research was focused on the characteristics of resilience of

eco-system and its mechanism, (i) establishing a biophysical model to simulate the process of restoration of margin ground fissures and to forecast recovery time , (ii) designing an experiment to test the vitality of seed in the landslide surface. Results show that the ground issues which existed over 25 years would be repaired greatly, it is mostly due to the soil movement caused by the rainfall and water erosion, topsoil was carried by rainwater in ground issue to fill it up. Besides, the vitality of seed in the landslide surface was not damaged by the surface deformation, remaining the ability of revegetating in the feasible condition. Further, we find the vegetation on the landslide surface is dominated by herbaceous plants, with small amount of shrub plants. Our findings suggest the possibility that closed mine eco-systems would restore ground issues and vegetation on landslide surface, as well as reveling the mechanism of ecosystem resilience.

Key words: Loess Plateau, Ecosystem Resilience, Closed Mines, Restoration Mechanism

Early Stage Vegetation Recovery in Forests Damaged by Oak Wilt Disease and Deer Browsing: Effects of Deer-Proof Fencing and Clear-Cutting

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Abstract: Oak wilt disease and deer grazing have damaged secondary broad-leaved forests, such as the Quercus serrata and Quercus variabilis forests in Japan, which used to be coppice forests. The spread of oak wilt disease resulted in mass mortality of oak trees and formed huge gaps in the canopy. Deer browsing prevented regeneration, which should have been promoted by the improved light condition caused by the gap formation. The dominance and expansion of deer-unpalatable species, which might result in the reduction of biodiversity, has been reported (Ito, 2016). Small-scale clear-cutting that enhances rejuvenation by sprouting is recommended as one of the options for the restoration of damaged forests. However, most of the damaged forests are mature-aged stands and it is not clear whether they successfully sprout. Moreover, little is known about the effects of deer-proof fencing on the regeneration process of forests damaged by both oak wilt disease and deer browsing.

In order to determine the appropriate treatment for the restoration of the damaged broad-leaved forests, we established a study site with three different treatments (10 × 30 m each) at a damaged forest in Kyoto City: clear-cut and fenced, removed dead oak trees and fenced, and removed dead oak trees and unfenced sites. The number of individuals and species of seedlings and samplings was investigated for about a year

after cutting. The number of sprouts was also investigated in the clear-cut and fenced sites. Additionally, the relative photosynthetic photon flux density (rPPFD) was measured to determine the light condition at each site.

The number of species and individuals in the samplings showed a tendency to increase in the lower-slope of each site and the dominant species was Ilex pedunculosa, one of the expanding unpalatable species. The largest number of species and individuals were observed at the clear-cut and fenced site and pioneer species such as Mallotus japonicus were found in addition to I. pedunculosa. Only five seedlings of Q. serrata and Q. variabilis were found at each treatment site and no sampling existed. The emergence of Q. serrata and Q. variabilis seedlings was mainly related to their location at the slope (lower or upper) and light condition, and not the treatment. However, many sprouts of Q. serrata and Q. variabilis were observed at the clear-cut and fenced site. Although further monitoring is needed, clear-cutting seemed to be useful to enhance rejuvenation, even for mature-aged Q. serrata and Q. variabilis.

Key words: Oak Wilt Disease, Deer Browsing, Mature-Aged Forest, Rejuvenation

Using the Plant Biodiversity and Nitrogen Application for Increasing the Pastoral Ecosystem Function in Inner Mongolia

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Abstract: Due to the irrational utilization and the restriction by climate and nature condition, the productivity and quality of pasture has gradually decreased, this study has taken the pasture in Hulunbuir of Inner Mongolia as a case study to figure out the mechanism of using biodiversity and fertilizer management for increasing pastoral ecosystem function. The project would using the mixture of grass of legume and gramineae and nitrogen fertilizer management in Hulunbuir pasture area to identify: 1) priority effect of mixture replanting on the productivity and biodiversity of plant community; 2)mixture replanting impact on the nutrient efficiency of pastoral ecosystem; 3) the influence of mixture replanting on the ecosystem stability; 4) the improvement of the nutritional status of pasture ecosystem; 5） the reaction of plant functional community to mixture planting. This field experiment was conducted at Hulunbuir Grassland Ecosystem Observation and Research Station (N 49°19'35", E 119°56'52"), and three species of forages (Medicago sativa, Bromus inermis and Leymus chinensis) were selected within the study. Biodiversity was considered as the main treatment, we arranged three forages monoculture and alfalfa intercropped with two grasses respectively, three levels of nitrogen fertilizer were applied for each treatment. Main results included 1) the stem to leaves ratio is lower in the mixed

cultivation of alfalfa and Leymus chinensis than that of their monoculture respectively. It suggested that mixed planting had the potential to improve grassland quality;2)Intercropped with grasses, the transpiration rate of alfalfa was suppressed due to the niche complementary effect; thereby an increase appeared in alfalfa leaf water use efficiency;3)mixed cultivated with alfalfa, the net photosynthesis rate would increase significantly both Bromus inermis and Leymus chinensis, especially Bromus inermis. Bromus inermis transpiration rate also has increased compared with alfalfa;4)mixture cultivated with two species, the soil respiration rate of alfalfa also increased simultaneously.Based on this we would made a holistic evaluation on the impact of mixture replanting and fertilizer management to the pastoral ecosystem function, and select optimized mixture models, ideal ecological species and fertilizer strategy for increasing the function of pastoral ecosystem, all the results would be a good supplement to the developing the ecosystem restoration strategy.

Key words: Biodiversity, Nitrogen Fertilizer, Ecosystem Function, Hulunbier Pasture

Spatial Characteristics of Cyclobalanopsis in China

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Abstract: Cyclobalanopsis is one of 7 genus which belong to Fagaceae. Its spatial data is gotten from Scientific Database of China Plant Species, Flora Republicae Popularis Sinicae and so on. The data is made and analysed in ArcGIS 9.2, including map and attributes of Cyclobalanopsis in China. The map is composed of counties. The attributes are species of Cyclobalanopsis.

Cyclobalanopsis is mainly distributed in the south of China. It is from the most northern Songxian to the south of the Sanya and from the most eastern Zhoushan to the west of the Nielamu. It spans latitude from 34°20′ to 18°9′N and a large longitude from 122°20′ to 85°27′E. Cyclobalanopsis accounts for 22% of China's counties, 52% of Fagaceae's counties. Cyclobalanopsis has more central places of diversity which are kept separate. These places are Guangxi, northwest of Guangdong, southwest of Hainan, southeast of Yunnan. Cyclobalanopsis scatters from south to west, north and east.

There are 75 species in Cyclobalanopsis. A few species are widely distributed, such as Cyclobalanopsis glauca, C. gracilis, C. oxyodon. Most species are in limited range. C. bella, C. blakei, C. disciformis, C. fleuryi, C. kerrii, etc are distributed around central places of diversity. Some species are in island. C. dongfangensis, C. fuliginosa, C. litoralis, C. subhinoides, C. tiaoloshanica are in Hainan. C. hypophaea, C. longinux and C. morii are in Taiwan. Some species are limited in a place. C. austrocochinchinensis, C. fulvisericeus, C. jinpinensis, C. lamellosa var.nigrinervis, C. motuoensis, C. saravanensis.

Key words: Cyclobalanopsis, China, Species, Distribution

Evaluation on Ecological Security in the Soft Rock Ecological Fragile Area of Ordos Plateau, China

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Abstract: China soft rock area is concentrated distributed in the contiguous area of Jin-Shan-Mong in Ordos's plateau, where the ecological environment is extremely fragile with rare vegetation, desertification and serious water and soil erosion. Taking the soft rock area, a typical ecological fragile area of Ordos plateau as the study area, the ecological security evaluation index system is established from the perspective of the actual ecological environmental problems as soil erosion, ecological water use, biodiversity, production and living. Using the ecological security comprehensive evaluation model and GIS spatial analysis method, the ecological security status and the temporal and spatial distribution of the study area in 1978, 2000 and 2015 three periods are evaluated and analyzed, which can reveal the adverse effects of desertification on ecological security, biodiversity and human life, and provide the basis for the management and recovery of the ecological system in the fragile area of the Ordos plateau.

Key words: Ecological Security, Ecological Fragile Area, Spatial Distribution, Ordos Plateau

Response of Soil Properties and Soil Community in Riparian Wetland to Different Water Level and Land Utilization along the Songhua River of Northeast China

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Chinese Acady Science

Abstract: The biodiversity of soil community riparian wetland is rich and its ecological functions are very important. The biodiversity of riparian wetland in the lower Songhua River is rich and its ecological functions are very important. In recent years, due to the intensive human activities, the natural wetland has degraded severely and the normal developmental process of the wetland soil has been changed. The characteristics of soil microbe and its controlling factors under different hydrological conditions and utilization were investigated to reveal the driving mechanisms of wetland degradation processes and provide the theoretical basis for restoration of

degraded natural wetland.

The soil microbial PLFAs in riparian wetland were mainly branch saturated fatty acids, straight saturated fatty acids and unsaturated fatty acids. Hydroxyl fatty acids, cyclopropane fatty acids and polyunsaturated fatty acids were less. The number of bacteria was dominant, fungi followed, and antinomycetes is the least in soil microbial community, the proportion were 44.75%~52.59%, 5.32%~8.21% and 1.87%~5.56% respectively. Under different hydrological conditions and utilization, both the microbial total PLFA amount and the functional groups showed a significant difference.

In different degraded wetland, there were closely relationships between soil nutrients and soil microbial properties. And there is also significant correlation between the soil water content and soil microbial properties. Microbial biomass carbon, invertase, urease and phosphatase showed a significant difference in different degree.

The main environmental factors on soil microbial community structure and activities were soil water content, total nitrogen, total phosphorus, rapid available phosphorus and Rapid available potassium under different hydrological conditions in the natural wetland, but in different utilization types of the wetland, the main environmental factors on soil microbial community structure were soil water content, organic carbon, rapid available phosphorus and rapid available potassium.

Key words: Soil Community, Riparian Wetland, Land Utilization, Water Level

Leaving Your Ancestral Neighborhood Makes You Leave Your Ancestral Ecosystem Functioning: Decomposition of Oak Litter

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Abstract: Under global change species may leave their conserved, ancestral niches shared with closely related neighbors and colonize novel neighborhoods of distantly related species. Will this change the species' role for ecosystem functioning such as for litter decomposition? We studied decomposition of leaf litter from oaks (Quercus petraea) growing among phylogenetically closely and distantly related neighbors, i.e. under low or high phylogenetic isolation. We used reciprocal transplantation of litter to tease apart the effects of phylogenetic isolation aboveground (PIA, operating via litter quality) from phylogenetic isolation belowground (PIB, operating via decomposer biota) on decomposition of oak litter. Our results showed that PIA did not significantly affect microbial biomass, abundance or diversity of invertebrates, mass loss or nutrient change of oak litters after 8 months, except for carbon change. However, after 14 months, PIA had significantly negative effects on microbial biomass, mass loss and N change, and a positive effect on C change. On the other hand, PIB had negative effects

on microbial biomass and the diversity of all invertebrates for both harvests, but no effect on mass loss or the nutrient change, except for C change. In addition, fungi abundance and diversity might alter the role of phylogenetic isolation in affecting the decomposition of oak litter. Our results suggested that if tree individuals leave the conserved niche and neighborhood of their lineage they might also leave their ancestral role for ecosystem functioning.

Key words: Phylogenetic Isolation, Litter Decomposition, Biodiversity, Niche Conservatism

Patterns of Plant Beta-Diversity along Longitude and Highway Interference in the Alashan Desert of Inner Mongolia, China

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Abstract: Biodiversity pattern and its underlying mechanism have been regarded as hot topics for ecologists and biogeographers. Beta diversity is an important component of biodiversity, which is closely related to ecological and evolutionary processes. In this study, Alashan Desert of Inner Mongolia in the eastern part of the desert region of Asia and Europe was selected to examine the large-scale patterns of longitude beta-diversity of plants including taxonomy beta-diversity, functional beta-diversity and phylogenetic beta-diversity based on systematic investigation of 50 plots placed the vast range from the eastern to western Alashan Desert. The aims of the study were (1) to identify the patterns of plant beta-diversitys with multi-dimensional biodiversity indices, (2) to investigate relationship between beta-diversity and gama-diversity, and (3) to explore relationship between beta-diversity and climate. The results indicated that mechanisms causing patterns of beta diversity may differ between longitude and highway interference gradients and multi-dimensional beta-diversity indices show inconsistent results.

Key words: Taxonomic Beta-Diversity, Functional Beta-Diversity, Phylogenetic Beta-Diversity, Alashan Desert

The Recovery of Plant Diversity in Secondary Forests in China: A Meta-Analysis

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Abstract: Forests recovery from anthropogenic disturbances, either without human

intervention or assisted by ecological restoration, is increasingly occurring worldwide. In China, secondary forests have been the main resource of forests. However, considerable uncertainty remains about the biodiversity recovery of secondary forests. Here we presented a meta-analysis on plant diversity recovery of secondary forests in China, compared with primary forests as references. A total of 122 secondary-primary forest pairing data reported in 53 publications were identified across China. We analyzed the data by region and logging history to look at their influences on secondary forest restoration. Results indicated that (1) the broad geographical regions notably affected the recovery and the average plant richness recovery ratio was 0.94; the richness of secondary forests in Central China reached the complete recovery, whereas the secondary forests in South region recovered less than those in other regions. (2) Moreover, in the secondary forests with periodical cutting, the richness recovery was better than those with clear cutting. (3) Generally, the increasing years after clear cutting elevated the richness recovery, however when it was more than 80 years, the recovery ratio decreased. Our revealed recovery patterns of plant diversity in secondary forests in China could support policies to minimize anthropogenic disturbance in forest regions the poor biodiversity recovery and could promote further analyses on the forest resilience. *Supported by the National Natural Science Foundation of China (NSFC) project (41271194)

Key words: Secondary Forest, Recovery, Richness, Meta-Analysis

Diversity and influencing factors on spontaneous plants distribution in urban park at different spatial scales

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Abstract: Urbanisation has drove the worldwide biodiversity decreasing and homogenisation of urban landscape. With the intensive management practices on the highly cultivated urban vegetation resulting in over-consumption of natural resources and ecological function losing of urban green spaces, interest is growing in urban spontaneous plants for their variety merits. Urban Park as an important constituent of green spaces, making a significant contribution to urban biodiversity, however, is rarely studied with respect to spontaneous plants. Hence, our study was conducted at two fine spatial scales in an urban park to disentangle the diversity and distribution characteristics of spontaneous plants, particularly the relationship between species and environmental factors. We aimed at improving our knowledge of biodiversity and distribution patterns of spontaneous vegetation in urban parks which may benefit sustainable and low-maintenance planting design in future green space.

We took Beijing Olympic Forest Park as an example and set up a comprehensive field survey during late August 2015 at habitat (determined by position in the park related to specific landscape elements) and microhabitat (determined by the planted plants) scale. Firstly, spontaneous species diversity and evenness across different types of habitat and microhabitat were compared. Secondly, the relationship between environmental variables and species diversity, evenness and composition at all scales were examined. Finally, species correlation between planted trees and spontaneous plants were analysed.A total of 102 spontaneous plant species belonging to 79 genera and 28 families were recorded, and the majority of them were herbaceous plants. The two families which include the largest number of species are Compositae and Gramineae. At habitat scale, roadside (RS) and woodland (WL) were the most species-rich habitats, whereas the habitats of between road and building (R-B) and waterside (WS) showed the maximum diversity and evenness indices. At microhabitat scale, it was under-tree (UT）contained the most species number and the two microhabitats with the maximum diversity and evenness indices were waterside bare patch (WBP) and flower bed (FB). Although the habitats and microhabitats share most of the common species, the significance which variation in species diversity and composition differed, with microhabitat affected them more remarkably compared to habitat. Furthermore, Canopy density (CD) and Intensity of disturbance (ID) were remarkable factors influencing spontaneous plants diversity, evenness and composition at both scales, while community structure of planted plants (P-CS) were only influential at habitat scale and slope direction (SD) was influential at microhabitat scale. Additionally, the impact of specific planted trees was not significant, but some associated species between planted trees and spontaneous plants were notable. Our study revealed that both the environmental variables and planted plants influence the diversity, evenness and composition of spontaneous plants in urban park conditions, and species composition showed markedly different patterns at different habitats and microhabitats. Understand these patterns and influencing factors will provide helpful references for future construction of sustainable urban vegetation with low maintenance, high biodiversity and regional characteristics.

Key words: Diversity and Evenness, Environmental Heterogeneity, Canonical Correspondence Analysis, Fine Spatial Scale

Vegetation Restoration Associated with Soil Variability in Open-Pit Mine Areas in the Yunnan Province, southwest China

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Abstract: Open-pit mining causes huge disturbance to the landscape in the Yunnan Province, Southwest China. Vegetation restoration after open-pit mining is essential to improve soil chemical and physical conditions of the post-mined areas. In this study, we investigated the vegetation and environmental characteristics in phosphate rock areas with different restoration years, and compared them with the control area. Canonical correspondence analysis ordination was used to determine the effects of environmental factors on vegetation diversity. The results showed that such soil factors as As, Cd, Pb and Zn had significant effects on vegetation diversity ($P < 0.05$). Additionally, we quantitatively analyzed the effects of these factors on vegetation based on the model of the lowest Akaike Information Criterion. Our results suggested that we should focus on the soil factor that had a significant effect on vegetation diversity, so as to providing a theoretical basis for vegetation restoration in mining areas.
Key words: Ecological Restoration, Species Diversity, Open-Pit Mining, Soil Factors

Comparing the Effects of Species Diversity and Genetic Diversity of Stipa Grandis of Steppe on Community Productivity in Microcosms

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Abstract: Rapid loss of biodiversity attracted attention of the relationship of diversity-ecosystem productivity. Both species diversity and genetic diversity can affect ecosystem productivity, the mechanisms of which are selection effect and complementary effect which may all be related to plant traits, yet the relative importance of the two levels of diversity was unclear till now. An experiment was designed to explore how companion species diversity and genetic diversity of dominant species in Inner Mongolia steppe had an impact on biomass production, and whether the inter-specific and intra-specific trait variation could explain the effect of plant mixture on productivity. We used 12 genotypes of Stipa grandis and 12 companion species to manipulate species diversity (one, three or six species) (SD-d15) and S. grandis genetic diversity (one, three, or six genotypes of S. grandis) (GD-d15). Then we measured plant traits, including plant height, plant width, specific leaf area (SLA), leaf dry matter content (LDMC), aboveground biomass, belowground biomass, root volume, leaf C and N, within each diversity treatment in microcosms of GD-d15 and SD-d15. We also doubled the area of microcosms (SD-d21) for species diversity experiment in order to confirm whether a manipulating experiment was often limited by space and number of species. We found that genetic diversity did not have a significant effect on biomass production in GD-d15, however, in SD-d15 increasing species diversity

significantly affected ANPP (aboveground net primary productivity) which could be driven by complementary effect. Due to lack of resistance and adaptation, and limited collection area, intra-specific trait variation among genotypes of S. grandis were lower than trait variation among multi-species, which lead to no significance of genetic diversity effect. Increased BNPP (belowground net primary productivity) of species reproduce by rhizome in polycultures was offset by reduction of BNPP of other species in SD-d15, so that the diversity effect of BNPP was not significant. Meanwhile, in microcosms of SD-d21, effects of diversity were enhanced, species diversity increased ANPP, BNPP and TNPP mainly due to complementary effect. In conclusion, species diversity may play more important role than genetic diversity in the productivity of steppe community dominated by S. grandis. Lack of genetic diversity effect of S. grandis may explain why its population will decline and gradually be replaced by other species in response to environmental stress or interference. It reminded us to maintain the habitat and function of population of S. grandis of steppe.
Key words: Diversity, Steppe, Productivity, Plant Traits

Plant and Animal Diversity Responding to Different Forest Restoration Schemes in the Qinling Mountains, China

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Abstract: The base of ecosystem restoration is succession. During succession, the plant species and communities keep changing, so for the animal species do keep changing too. Many scientific questions are still remaining unclear in succession and restoration. Commercial logging had been a normal human activity during 70s, 80sand 90s in the Qinling Mountains where is one of the homes of the giant pandas. After a serious flooding in 1998, the logging ban was announced afterwards in China. Forest restoration was implemented in those logging areas through two ways. One is tree planting and one is natural restoring. Our study on biodiversity difference responding to forest restoration schemes was implemented in the Qinling Mountains, China during 2013-2015. We choosed three types of forest to research on both the plant and animal species. Three types of forest are primary forest with no logging, secondary forest with natural restoration after logging and plantation forest with human planting after logging. The purpose of this study is to look at the difference of both plant and animal diversity

with resulted from different ecological restoration. Both secondary and plantation forests are over 25 years. In total 12 slope sites with 24 forest plots, 48 shrub plots and 48 grass-herb plots were surveyed. Our results showed that (1) the secondary forest showed its highest plant diversity, and the plantation forest had approximately 40% of the same tree species as the primary forest. (2) The primary forests were of irreplaceable value as they had the highest unique species, highest DBH and canopy coverage. (3) The numbers of animal species are similar, while the patterns of the animal occurrence are different under three disturbing schemes. The giant panda (Ailuropoda melanoleuca) mostly occurred in the natural forest with bamboo coverage, the golden monkey (Rhinopithecus roxellanae) more in the secondary forest, the golden leopard (Panthera pardus) often in the plantation, and the golden tarkin (Budorcas taxicolor) in all habitats. (4) The species showed their different activity patterns, such as the tarkin with different daily activity patterns while the deer (Elaphodus cephalophus) with the different yearly activity pattern between natural forest and plantation. Conclusively, secondary forest is still in its dynamic success period showing the highest plant diversity but the lowest animal diversity, plantation forest brings new habitat to the animal species, while primary forest has its own unique plant species. We think all forest area requires human protection. (Acknowledgement: Supported by the National Natural Science Foundation of China (NSFC) project (41271194))

Key words: Plant And Animal Diversity, Responding, Forest Restoration, Qinling Mountains

Effects of Different Desertification Grassland Restoration Approaches on Plant Diversity

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Abstract: Grassland is the largest terrestrial ecosystem in China, accounting for 41% of the total land area. It has important ecological functions in biodiversity conservation, sand fixation, water conservation, climate regulation and carbon sequestration. It is also an important renewable resource and animal husbandry base. For a long time, due to the human activities and environmental changes, the degeneration of grassland ecosystem in China has become increasingly prominent, and the biodiversity and productivity have been threatened, which seriously affecting and restricting its ecological service function. The study shows that the implementation of natural enclosure is one of the effective ways to control the degenerated desertification grassland. At the same time, artificial intervention of grassland ecosystem restoration is also a positive measure. After the enclosure of the degraded desertification grassland, the plant community

structure, productivity, and the biodiversity will be improved by natural forces. In the restoration of grassland ecosystem by human intervention, the vegetation disposition pattern and community construction process have direct influence on community composition and structure. Biodiversity, as an important aspect of community structure, plays an important role in the function of ecosystem. In this study, the community biodiversity of different desertification grassland restoration approaches were studied based on the data of continuous multi-year monitoring, in order to provide a scientific evidence of biodiversity conservation and artificial vegetation reconstruction of degraded desertification grassland ecosystem.

Key words: Grassland, Restoration, Biodiversity

Scale-Dependent Effects of Landscape Pattern on Plant Diversity in Hunshandak Sandland

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Abstract: The influence of landscape pattern on plant diversity has strong scale-dependent effects. It is meaningful to select appropriate metrics in assessing the relations between landscape pattern and plant species diversity at different scales. Aiming at explore such scale-dependent effects, we conducted a case study in Hunshandak Sandland, northern China. Principal component analysis (PCA) and Redundancy Analysis (RDA) was used to disentangle the relations between landscape pattern and alpha, beta plant diversity. Our result displayed landscape pattern has an important influence on plant diversity, however, there existed scale effects. Landscape diversity enhanced the alpha diversity, conversely, reduced the beta diversity for all scales. PSSD positively related with alpha diversity whilst negatively related beta diversity on moderate and large spatial scales, same as LPI on moderate scales. Shape complexity of patches can slightly increase both alpha and beta diversity at large scales. Adjustment of landscape pattern base on different spatial scales can enhance plant diversity. It's useful to improve plant diversity conservation in sandy land.

Key words: Landscape Pattern, Plant Diversity, Scale Effect, Sandy Land

T5-06: Invasive Plants and Ecological Restoration of Invaded Ecosystems

Alien Aquatic Plants in Ponds of a Large European City: From Diagnose to Risk Assessment

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Abstract: In natural landscapes, aquatic invasive alien species constitute a major threat to freshwater habitats, to their ecosystem services and especially to their native biodiversity. In heavily modified landscapes, as in urbanized areas, terrestrial alien species are common and abundant, including many invasive species. This is much less documented on aquatic species, even if wetlands are numerous in cities. Ponds are for example extremely frequent in urban parks and domestic gardens, where countless plant introductions occur. Alien and even invasive species are often introduced as they are largely represented in the public market (garden centers, supermarket, and internet). Therefore the urban ponds are likely to host many aquatic alien species and even to potentially constitute a source of propagule toward the natural environment. To investigate this topic, we collected data for 178 ponds in a large European city (Geneva, one-half million inhabitants), characterized by a gradient from a central urban landscape to a surrounding rural (and near natural) landscape. The aquatic plant community appeared to be only partly non-native, with 10% of non- native species (23 species), including nevertheless 5 species representing a high risk (invasion, damages to the environment). A high proportion of the waterbodies (43 %) hosted one or more non-native species. A mapping of the risk evidenced several spots of presence of non-native species that were localized in the urban, but also in the less urbanized areas, even in protected wetlands. Most dispersion areas appeared nevertheless to be of small size. Ponds are mostly hydrologically isolated in the urban matrix, and therefore represent islands presenting a relative low risk for dissemination in the region. The geographical pattern of introduction and dispersion appeared to be unpredictable, as mostly relying on intentional introduction by human. Management should therefore target primarily on the development of a program for the prevention of introduction of non-native species. The spots of non-native species should also be monitored and if necessary eradicated.

Key words: Non-Native Species, Wetlands, Urban Environment, Freshwater Biodiversity

Effects of Soil Nutrient Heterogeneity on the Foraging Behaviour of Invasive and Native Plants

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Abstract: At the establishment stage, invasive plant species are exposed to heterogeneous nutrient conditions and competition with co-occurring native plant species. However, the influence of soil nutrient heterogeneity on exotic plant invasive foraging behaviour is unclear. The objectives of the present study are to investigate the foraging behaviour of invasive and native plants and the effect of nutrient heterogeneity on the competitive ability of invasive plants. We performed a competition experiment using two invasive–native species pairs grown under homogeneous or heterogeneous conditions in a common greenhouse environment. Root activity was assessed by injecting strontium chloride (SrCl2) in the soil and then determining the amount of strontium (Sr) captured by each species at the end of the experiment. The invasive species possessed a greater foraging scale and lower foraging precision, whereas the native species possessed a reduced foraging scale and higher foraging precision. This study confirms that a trade-off occurs between foraging scale and precision with respect to the root length density (RLD). The Sr acquisition values of the invasive species were 3.8 and 5.2 times higher than those of the native species. Competition reduced the acquisition of Sr to a greater extent in the native species than in the invasive species under homogeneous nutrient-rich conditions. The greater competitive ability of the invasive species was more dependent on the foraging scale than the foraging precision. The results of this study suggest that nutrient heterogeneity promotes the invasion of exotic plants and increases the risk of exclusion for native plants.

Key words: Nutrient Heterogeneity, Plant Invasion, Root Foraging

Restoring to What? Challenges of Assembling Native-Dominated Plant Assemblages in Degraded, Drought and Fire-Prone California Landscapes

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Abstract: The widespread presence of invasive plants, in combination with changing environmental conditions together present substantial obstacles to the restoration of degraded ecosystems. In this talk I will contrast restoration efforts that we are

engaged in, within two different types of ecosystems in California with the goal of evaluating how to select species for 'restoration' trials. The two ecosystems are a Mediterranean/chaparral shrubland degraded by repeated fire, and a habitat that is now exotic annual grassland created by decades of tillage for agriculture. Chaparral shrublands in southern California are being degraded by short fire return intervals, severe drought and invasive Mediterranean-basin annual grasses. Short fire return intervals select against native woody species that only regenerate from seed after fire, require fire in order to germinate and take many years to reach reproduction. In these degraded shrublands, the seed supply of native obligate seeding shrubs and of native forbs is depleted. In addition, it is not clear that the assemblages that were present prior to repeated fires would be resilient to future fires. Hence, we focused on creating assemblages of species that are not limited to recruiing after fire, and which can recruit in by seed from outside the burned areas or can recover from a large seedbank that is not as readily depleted by frequent fire. We also selected species that can resprout from root material after fire and that are drought tolerant so as to survive the hotter, and drier conditions that appear to be more prevalent in predicted climates for the region. Preliminary results will be presented from on-going field trials that manipulate soil conditions, seed addition and alien grass competition. The second community where we are conducting restoration trials, and where selection of a target community is challenging is also heavily invaded by Mediterranean annual grasses but its state prior to disturbance is not known. Here we are focusing on restoration for a future, drier climate by including a very diverse array of native grassland and sage scrub species in our seed mixes, and then subjecting different seed mixes to three different rainfall regimes. Our goal is to evaluate how the rainfall regimes select for the trait combinations among the three species mixes, and to evaluate which mix provides the greatest native cover and biomass stability over future years in this highly variable climate regime. Such a trait-based approach should provide information to help managers more closely target seed mixes for changing climate conditions.

Key words: Invasive Grasses, Fire, Species Traits, Restoration

The Effect of Elevated Temperatures on the Interspecies Competition Pattern between Phragmites Australis and Spartina Alterniflora in the Salt Marsh of the Yangtze Estuary, China

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Abstract: The effect of global warming on the invasiveness of invasive plants is now a high spot in the field of global change. Spartina alterniflora, a C4 species, is widely

distributed in the Chinese coastal salt marsh, it put a high pressure to the native Phragmites australis (C3 species). Whereas little is known about the interspecies competition pattern between Phragmites australis and Spartina alterniflora under global warming? In this work, Phragmites australis and Spartina alterniflora in the salt marsh of Yangtze estuary were chosen, then open-top chambers were used for the elevation of temperatures (2 ℃, 4 ℃). We investigated the physiological traits, morphological traits, biomass accumulation, clonal growth and sexual reproduction parameters of these two species under elevated temperatures at monoculture and mixed community. We choose some biomass and reproduction parameters to quantitatively identify the interspecies competition pattern under elevated temperatures. Then physiological and morphological traits under elevated temperature were compared between these two species to understand the mechanisms behind the competition pattern. This work could provide basic data with respects to the population dynamics of Phragmites australis and Spartina alterniflora in the salt marsh of Yangtze Estuary under global warming, and provide scientific basis for the adjustment of present wetland management to adapt to the predicted global warming.

Key words: Elevated Temperature, Phragmites Australis, Spartina Alterniflora, Competition Pattern

Effect of Stellera Chamaejasme L. On Plant Community and Soil Spatial Heterogeneity in a Typical Steppe of Inner Mongolia

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Abstract: Stellera chamaejasme L., a toxic perennial plant, is widely distributed in natural grasslands of China. Generally, overgrazing makes S. chamaejasme become dominant species or main companion species in degraded grasslands, because of the sharp decrease of high quality forage and the great tolerance of S. chamaejasme. Previous studies mainly focused on the allelopathy, chemical composition and the medicinal value of S. chamaejasme. But the effect of this species on plant community and spatial heterogeneity of soil elements has little attention. Thus, two study sites with high-density (HD) and low-density (LD) of S. chamaejasme were selected in the typical steppe of Inner Mongolia. Three 4 m×4 m plots were randomly established in every site. Each plot was further divided in 64 equal-area 0.5m×0.5m grid-cells. Vegetation survey and soil sampling in each grid-cell were both carried out in June, 2015. The number of species per grid-cell was recorded and plant density of every species in the grid-cell was investigated. Three soil cores (3 cm in diameter, 10 cm in depth) were sampled in each grid-cell and were combined into a mixed soil sample to measure the

concentration of soil elements. Semi-variation analyses were conducted to quantify the structural attributes of spatial variation using GS+10.0. The results showed S. chamaejasme had no obvious effect on Shannon-Wiener index. But species richness in HD site was higher than that in LD site. The density of Gramineae species significantly decreased in HD site, and the densities of other families had no significant change. There was no obvious difference in the concentration of soil element between HD and LD site, except that of soil total nitrogen (N). However, high density of S. chamaejasme resulted in the change of the distribution pattern of soil elements. Phosphorus (P), Cu and Fe were a relatively homogeneous distribution pattern, and soil N, Zn, Mg exhibited spatial dependence in LD site, but these changed into the contrary patterns in HD site. In summary, high density of S. chamaejasme has positive effect on species richness. S. chamaejasme plays as refuge for other associated species to stay away from being taken, reduced and trampled by grazing animals. Lower density of Gramineae revealed that S. chamaejasme has stronger negative influence on Gramineae growth. Higher total N concentration suggested that S. chamaejasme might create fertility islands and cause positive improvements on plant growth in N-deficient grassland. The change of soil spatial heterogeneity can provide more opportunities and favorable habitats for colonization of plants with different nutritional requirements.
Key words: Toxic Plant, Plant Community, Soil Nutrients, Spatial Heterogeneity

Community Structure and Composition of Early Spring Herbs in Response to Ambrosia Trifida L.

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Abstract: In this study, the species composition and structure of the invaded and no-invaded communities by Ambrosia trifida L. was compared. Draba nemorosa L.、Taraxacum mongolicum Hand.-Mazz. and Myosoton aquaticum (L.) Moench. were chosen as study subjects. We compared the height、the coverage、the phenological period and the viability of three kinds of native plants before and after the Ambrosia trifida L. invasion. We explored the responses of the species composition of native plant communities and native species to provide guidance for the protection of ecosystem diversity. The results indicate that the species composition of the communities that invaded by Ambrosia trifida L. shows a single trend and the stability of the community decreased. The species is mainly composed of two types of plants, one type is Draba nemorosa L.、 Capsella bursa-pastoris (Linn.) Medic. and Myosoton aquaticum (L.) Moench. their life history is short and does not overlap with the growth period of Ambrosia trifida L. The other type is vines, such as Humulus scandens (Lour.)

Merr. and Convolvulus arvensis L. The response of the native plants to Ambrosia trifida L. was different. The growth and development of Draba nemorosa L. and Taraxacum mongolicum Hand-Mazz. were inhibited; There was no obvious change in Myosoton aquaticum (L.) Moench.

Key words: Biological Invasions, Native Species, Exotic Species, Response

Interaction of Invasive Plant and Rhizosphere Microbiota

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Abstract: The profound threats of invasive plants on global biodiversity substantiates the urgent need to understand their invasion mechanisms. Symbiotic networks of microorganisms with the roots are critical to the adaption and competitiveness for the invasive plants in new introduced region. However, the scope and depth involved in understanding rhizosphere microbiota employed in plant invasion is limited. Given the recent advances in high-throughput DNA sequencing and corresponding bioinformatics tools, it is time to transform the research strategies among the interactions between invasive plants and their associated microbial communities.Funding： This study was partially supported by National Natural Science Foundation of China (31570414,31600326), the Natural Science Foundation of Jiangsu (BK20150503, BK20150504), the China Postdoctoral Science Foundation (2016M590416), the Innovation and Entrepreneurship Training Program for College Students of Jiangsu University (201610299072X), and the College Students Scientific Research Project of Jiangsu University (Y15A142, 15A318)

Key words: Invasion Mechanisms, Invasive Plant, Rhizosphere Microbiota, Microbial Molecular Ecology

Coexistence via Coevolution Driven by Chemical Competition between Invasive and Native Plants

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Abstract: Coevolution between interacting species exists widely in nature, and it can promote the long-term coexistence of two competing species if selection on both species acts to reduce the fitness inequality between competitors (equalizing process)

and/or strengthen negative frequency dependence within each population (stabilizing process). A growing body of research suggests that evolutionary processes may mitigate the negative effects of invasive species on native communities and enhance the fitness of native species in face of invasion. Still, it is unclear whether evolutionary changes in invasive species, native competitors, or both will act to promote coexistence between the species, allowing the exotic invaders to integrate in the new community while maintaining the native species. Here we investigated chronological changes in the competitive relationship between A. petiolata, a prolific invader of forest understories in eastern US, and its native commonly co-occurring competitor P. pumila, with the goal of determining whether evolutionary changes in the invasive and/or native species would tend to promote or inhibit coexistence. The results showed that (1) both species tended to adapt the presence of each other, developing greater tolerance to competition from the other species over invasion history; (2) niche overlap between the species declined with increasing history of co-occurrence, suggesting an increasing likelihood of coexistence promoted more by increases in stabilizing processes relative to equalizing processes; (3) reductions in allelopathic traits in the invader and evolution of tolerance in the native may play an important role in promoting coexistence between the two species. Our results suggest that evolutionary changes in both invasive and native species may lead to non-zero sum dynamics: integration of A. petiolata into forest understory communities of North America may not necessarily come at the expense of (at least some) native species.

Key words: Alliaria Petiolata, Stabilizing Process, Sinigrin, Coexistence

Effects of Environmental Variables on the Distribution of Spartina Alterniflora at Different Spatial Scales

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Abstract: Environmental variables are very important for the distribution of invasive species. However, few studies have explored the effects of environmental variables on species distribution at different scales. In this paper, we established the species distribution model of Spartina alterniflora at global scale, national scale and regional scale based on Maxent software. The effects of elevation, climate and soil properties on the distribution of S. alterniflora and the distribution of suitable habitat of S. alterniflora on Chinese coastal at different were studied at different scales. The results showed that: 1) at the global scale, the climatic factor is the most important environmental type that affects the distribution of Spartina alterniflora, with PC(percent contribution) and PI(permutation importance) of 65.97% and 56.92%. S.alterniflora possess broad

suitable habitat, in coastal areas of China, the suitable habitat of Spartina alterniflora accounts for 54.16% of the entire study area. 2) at the national scale, the relative importance of soil factors reduced the influence of climatic factors on the distribution of Spartina alterniflora, and the suitable habitat of Spartina alterniflora decreased to 12.64% of total study area. However, the interaction between environmental variables has promoted the invasion of Spartina alterniflora, and allows Spartina alterniflora to show a higher relative presence probability. 3) at the regional scale, the regional differences affect the relative importance of environmental variables, leading to great differences in the expansion direction and suitable habitatof Spartina alterniflora on the north(To the north of Hangzhou Bay of Chinese coast) and south (To the south of Hangzhou Bay of Chinese coast)coasts. In northern coast, Precipitation of Driest Month, Soil drainage, Soil organic carbon and Soil PH have a higher importance. The suitable habitat of Spartina alterniflora is mainly distributed in the coast of Jiangsu and Bohai Bay, and its distribution is concentrated and expanded toward the inland; In southern coast, for the distribution of Spartina alterniflora, the elevation is dominant, and influence from the soil factors is low. The suitable habitat of Spartina alterniflora is mainly confined to the narrow coastal area to the south of Hangzhou Bay, and expanded toward the sea alone the coastline. 4) for suitable habitat of Spartina alterniflora on Chinese coast, from the global scale to the national scale, the unchanged suitable habitat is 5.64 km^2, the decreased suitable habitat is 21.77 km^2 (Mainly distributed in the inland of Jiangsu, the west of Bohai Bay and Guangdong and Guangxi regions), the increased suitable habitat is 0.04 km^2; from the national scale to the regional scale, the unchanged suitable habitat is 3.47 km^2, the diseased suitable habitat is 2.20 km^2 (Mainly distributed to the north of Hangzhou Bay), the increased suitable habitat is 0.60km^2. In this paper, the influence of environmental variables on the distribution of Spartina alterniflora and its relative importance were explored, and the suitable habitat of Spartina alterniflora at different scales was predicted, which will be helpful for the risk assessment and early warning of invasive species, and provide appropriate decision-making advice.

Key words: Spartina Alterniflora, Environmental Variables, Maxent, Spatial Scales

Biological Control of the Invasive Weed Xanthium Italicum Morretii

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Abstract: Xanthium italicum Moretti (common name: Italian cocklebur; family Asteraceae) is an herbaceous annual weed that is represented by 25 species distributing throughout Eurasia and America. X. italicum is not indigenous to China; it was first spotted in Beijing, the capital city of China in 1991, and has expanded to six provinces

(Liaoning, Hebei, Xinjiang, Shandong, Guangdong and Guangxi) in the past two decades. X. italicum is a very competitive weed; once established, X. italicum is often found to form dense monocultures as long as light, moisture and nutrition are sufficient, which consequently results in adverse impacts on native plant communities. X. italicum is difficult to control chemically or manually, therefore it was listed on the "People's Republic of China imported plant quarantine pests list" in 2007. The ecological modeling suggests that it has the potential to spread to most regions in China, except areas with extreme environmental conditions. In the past 6 years we have collected several pathogenic fungi from diseased X. italicum plants growing in both agricultural and natural habitats, which have been identified as Curvularia inaequalis, Alternaria alternata and Alternaria tenuissima, respectively, by using ITS gene sequence analysis. Herein we report the isolation and identification procedure of their major active compounds, and their toxicity on the invasive weed X. italicum as well as native plants was also investigated. The potential utilization of these active compounds as environmentally friendly natural pesticides was discussed.

Key words: Biological Invasion, Xanthium Italicum, Biological Control, Environmentally Friendly Pesticide

Establishment of the Invasive Praxelis Clematidea Increases the Chemically Recalcitrant Rather Than Labile Soil Organic Carbon in a Tropical Savanna

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Abstract: Soil organic carbon (SOC) consists of a series of C-contained materials which have different decomposability. Previous studies suggested that plant invasion could substantially promote the total SOC storage, but whether invasion alters different SOC fractions to a comparable extent remains less studied. This study was therefore conducted in southern China to observe the invasion effects of Praxelis clematidea, a short-lived herb native to South America but has invaded widely across tropical and subtropical ecosystems, on SOC fractions which were separated by a chemical oxidization method. Two layers of soil samples, i.e., 0-10 and 10-20 cm, were collected from non-invaded, slightly invaded and severely invaded plots of a tropical savanna in Hainan Province to analyze the total SOC and readily and non-readily oxidizable organic C content. Results showed that although slight invasion did not significantly alter the SOC content, severe P. clematidea invasion significantly increased the SOC content by 47% in the surface soil layer of this tropical savanna. This increase was mainly originated from the accumulation of the non-readily rather than readily

oxidizable organic C content. This change may be in favor of the long-term C storage in the soil because chemical recalcitrance has been frequently considered an important pathway to prevent the SOC from decomposition. Moreover, the invasion induced SOC increment turned greater with further invasion and decreased with soil depth, implying that SOC accumulation derived from plant invasion is a slow and asymptotic process. These results suggest that P. clematidea invasion could facilitate C sequestration in the tropical savannas in a long term.

Key words: Global Change, Biological Invasion, SOC Fractions, C Sequestration

Selection Effect and the Maintenance of Community Productivity and Exotic Resistance

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Abstract: Diverse plant communities are hypothesized to possess stronger stability than species-poor communities. In other words, when facing with environmental changes, such as climate changes, anthropologic disturbances and exotic invasion, the ecological functions of a diverse plant community are less affected. Stronger stability of diverse communities can sometimes be attributed to the occurrence of some specific species or some specific groups of species (i.e. selection effect), which maintains the strong ecological functions even with the loss of other species. Here I present some preliminary evidence for how a specific species or a specific group of species may play important roles in maintaining two important community ecological functions, productivity and invasion resistance. A previous study conducted in grassland ecosystem in north-western USA showed that native grasses were the major contributors to the high productivity and strong resistance to invasion by Bromus tectorum, while the growth performance of native grasses were less affected by environmental changes and Bromus invasion comparing to native forbs. However, as species diversity increased, forbs performed better, which made the advantage of grasses over forbs less prominent. This result indicates that while native grasses can help maintain strong ecological functions alone or through facilitating the performance of native forbs. Another study conducted in the subtropical forest in southern China suggested that there was also a specific group of species that played an important role in impeding exotic invasions in forest. We found that those species with strong allelopathic potential against exotic invaders can greatly enhance community resistance to invasion. Even though increased species diversity also facilitated stronger resistance, the presence of these allelopathic plants played stronger roles. Both the above evidence indicate that there are some key species in a plant community which could

help maintain community stability. This implies that we could make use of these key species to enhance community stability.
Key words: Selection Effect, Productivity, Resistance, Plant Community

The Study on Ecophysiological Responses by Light Quantity of Ambrosia Trifida L., Korean Invasive Species.

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Abstract: We studied ecophysiological responses of Ambrosia trifida, Korean invasive species, under different light quantities. For study, we selected the two spot (T1 and T2) in the University. In each spot, we investigated ecophysiological responses in the more light environment (L) and in the less light environment (S). As a results, the shoot height, No. of leaves, Leaf width and Leaf length were recorded relatively high in the spot of most light quantity and in the spot of least light quantity. In the physiological responses, the more light quantity, the more photosynthetic rate, transpiration rate and stomatal conductance were increased. Fv/Fm, the photochemical efficiency of photosystem II, was recorded the least low in the spot of most light quantity. These results show Ambrosia trifida grow well in the spot of most light quantity and least light quantity but it grown in the shade have the less environmental stress.
Key words: Exotic Species, Compositae, Light Condition

Effects of Submergence Level and Fluctuation Frequency on the Invasive Riparian Plant Alternanthera Philoxeroides

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Abstract: Our study tested the independent and interactive effects of submergence level and fluctuation frequency on a globally important riparian invasive plant, Alternanthera philoxeroides. In the greenhouse experiment, ramets obtained from a wetland in China, were treated with four fluctuation frequencies (0, 3, 6, and 12 cycles over a 96-day experimental period) under three water levels (0, 10, and 30 cm). We found that effects of fluctuation frequency were non-significant, negative, and positive under water levels of 0, 10 and 30 cm, respectively. As fluctuation frequency increased, the effects of increasing water level decreased significantly. When water levels were high, A. philoxeroides allocated greater biomass to shoot production probably in order to elongate and escape from submergence. However, as fluctuation frequency increased,

biomass investment in roots and leaves also increased, probably in order to maximize nutrient absorption and photosynthesis, respectively. These results suggest that water level fluctuation may alleviate the effects of submergence on A. philoxeroides. In addition, A. philoxeroides showed significant phenotypic plasticity, adjusting its functional traits, such as number of nodes and leaves per stem, as well as stem diameter and pith cavity diameter, according to recurrent water level fluctuation. We conclude that A. philoxeroides may perform better in shallow water zones under conditions of disturbance that include recurrent water level fluctuation.

Key words: Plant Invasions, Wetland, Water Level Fluctuation, Submergence

Predicting Alien Herb Invasion with Machine Learning Models: Biogeographical and Life-History Traits Both Matter

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Abstract: Identifying the variables associated with invasiveness is a core task for developing risk assessment models to predict invasion potential. However, quantitative models with both biogeographical and life-history variables for invasion risk assessment in China are limited. We hypothesized that (1) compared to statistical algorithms, some machine learning models could offer a promising quantitative approach with high accuracy for potential invader prediction; (2)native range distribution size, origins and life-history traits co-determine an alien plant's performance in the latter invasion stage. In this study, we used four machine learning models [classification and regression tree (CART), multivariate adaptive regression spline (MARS), random forest (RF) and multiple additive regression tree (MART)] and two traditional statistical algorithms [logistic regression (LR) and linear discriminant analysis (LDA)] to assess the relative importance of biogeographical and trait variables in the naturalized-invasion stage of 150 invasive and 87 non-invasive herb plants in China. Our results showed that good performance was the case for all predictive models (AUROC ranges from 0.68 to 0.87), which had overall mean performance value ranging from 0.66 to 0.82. Compared with traditional statistical algorithms, MART and RF models have a consistently higher accuracy, indicating that these two models could be used as alternative quantitative approaches for risk assessment. Additionally, both biogeographical (native range distribution size) and life-history traits (seed weight) were screened out by the models, suggesting their high correlation with plant invasiveness and important roles in risk assessment.

Key words: Risk Assessment, Invasiveness

Regulation of Reestablishment of Invasive Alien Species Senecio Madagascariensis Poir. Using Bamboo Chips and Other Control Treatments

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Abstract: Senecio madagascariensis Pior. (Fireweed) is an invasive toxic alien plant, with an original habitat in the tropical and subtropical grassland in South Africa and Madagascar. This species has invaded numerous countries such as Australia, parts of the US (Hawaii), Argentina, Brazil, and Japan. In Japan, it has spread rapidly along Osaka Bay, especially in Awaji Island, Western Japan. This species has become dominant and thereby reduce biodiversity in many areas. S. madagascariensis is poisonous to livestock because of its pyrrolizine alkaloid content (McBarron 1976). Stock farming is an important industry in Awaji Island, and expansion of this species to pastures and other sites is a serious problem. In many areas of Japan, this alien species has been controlled, but its seeds continue to rapidly invade areas where the plant has been removed. Controlling re-invasion is important for preventing the expansion of this species and for the ecological restoration of invaded ecosystems. The objective of the present study was to clarify the re-invasion pattern of this invasive alien species after control treatment. Field surveys and experiments were conducted on Awaji Island. The mean annual temperature and precipitation of the study area were 15.6℃ and 1494 mm, respectively. Control treatments (hand weeding, herbicide treatment, and covering with sheets) were applied to the field on November 7, 2010, with additional treatments on November 12, 2012. After removing the plants, the plot surface was covered with bamboo chips (approximately 2 ×3 ×1 cm) to a 5- or 10-cm depth (hand weeding plus 5- or 10-cm depth of bamboo chip mulching, respectively). After treatments, the coverage and height of S. madagascariensis were measured, and the number of inflorescences was counted every 10 days. In the hand-weeded plots, all shoots with fireweed roots were removed, but new seedlings were found on day 15 after the treatment. In the plots with herbicide, all plant shoots had died by day 15 after treatment, but new seedlings were found on day 150 after treatment. In the sheet-covered plots, all plant shoots had died by day 25 after treatment, and new seedlings were not found after the treatment. In the case of additional treatments, all shoots with fireweed roots were removed by hand. In the hand-weeded plots, seedlings were found on day 15 after treatment. In the hand weeding plus 5-cm bamboo chip plots, fireweed seedlings were found on day 136 day after treatment. In the hand weeding plus 10-cm bamboo chip plots, fireweed seedlings were not found up to day 1300 (approximately 3.5 years) after treatment. We considered that mulching with bamboo chips was effective in preventing

the re-invasion of fireweed. The bamboo, Phyllostachys pubescens, (moso bamboo), is also an exotic species, which was introduced to Japan from China. After the abandonment of the management of bamboo forests, they expanded by rhizomes to surrounding areas. It appears that the control of invasive alien species by mulching with alien species contributes to the conservation of biodiversity in Japan.

Key words: Invasive Alien Species, Seedling, Conservation Ecology, Field Experiment

Affection of Invasive Plant (Ambrosia Trifida) on the Performance of an Endangered Plant, Polygonatum Stenophyllum in Korea

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Abstract: The aim of this research is to study the impact of invasive species Ambrosia trifida on the vitality of Polygonatum stenophyllum which is endangered species. We removed the coverage of the invasive species at different levels(C, T1, T2) in the natural habitat where both invasive and endangered species live together and observed ecological responses of P. stenophyllum for two years. C (control) which removed none of Ambrosia trifida, T1 (treatment 1) removed 40~60% coverage of Ambrosia trifida and T2 (treatment 2) removed all Ambrosia trifida. Plant species number, shoot length, aboveground biomass weight, shoot weight, leaf weight, fruit weight, fruit number, seed weight, fruit number, seed number per fruit were higher in the treatments of removed invasive plant cover(T1, T2) than control(C) that didn't remove it both the first year and the second year($p<0.05$). However, death rate and seed weight between the control(C) and treatment (T1, T2) were almost same in the first year but showed difference in second year. This result reveals that the Ambrosia trifida has significant impact on the performance reduction of Polygonatum stenophyllum. In conclusion, removal of more than 40% of invasive species' cover degree is required to conserve the endangered species.

Key words: Field, Treatment, Alien, Endemic

Spatial Distribution of Spartina Alterniflora in the Coastal Areas of China

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Abstract: Spartina alterniflora (S. alterniflora), as an invasive plant, was first

introduced to China in 1979 from the Atlantic Coast of the U.S. for the purpose of ecological engineering. Over the past thirty years, it has widely spread in the coastal area of China and caused different ecological consequences in different places. Mapping the spatial distribution of S. alterniflora is particularly critical for further actions. This research aims to investigate the invasion of S. alterniflora along the coastal areas of China. To achieve this goal, remote sensing and ground surveys were both conducted. Forty-five Landsat OLI images (cloud free and low tide) were chosen and object-oriented classification method was applied to map S. alterniflora, then field survey points were used to access the classification accuracy. The Kappa coefficient and overall accuracy is 0.88 and 92%, respectively, which means the classification results are consistent with those validate points obtained from ground surveys. Areal statistics for the mapped S. alterniflora revealed that there were approximately 570 km^2 of S. alterniflora in the coastal areas of China in 2015. This species was found from Liaoning Province to Guangxi Province, and nearly 92 percent areal extent of S. alterniflora occurred in Jiangsu, Shanghai, Zhejiang and Fujian province. Based on monitoring results derived from the fused Landsat OLI images of 15 m spatial resolution, eight national nature reserves were invaded by S. alterniflora (Jiangsu Yancheng, Shanghai Jiuduansha, Shanghai Chongming Dongtan Wetland, Guangxi Shankou Mangrove, Shandong Yellow River Delta Wetland, Fujian Zhangjiangkou Mangrove, Binzhou Chenier Plain and Wetland, and Hepu Dugong National Nature Reserve), the total area occupied by S. alterniflora reached 181 km^2 in those national nature reserves and the Yancheng National Nature Reserve had the largest areal extent of 125 km^2 of S. alterniflora. It occupied large areas of intertidal mudflat in the coastal area and competed with native species. This study presents the current distribution of S. alterniflora and can aid in providing scientific guidelines on managing or controlling S. alterniflora.

Key words: Remote Sensing, Invasive Species, Spatial Distribution, Spartina Alterniflora

Life History Differences Influence the Impact of a Novel Predator on Two Sympatric Prey

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Abstract: Failure to recognize a novel predator and respond appropriately due to a lack of experience is a well-established mechanism of population decline in newly invaded system, but little is known about how trait variation among native prey communities may disproportionally affect species vulnerability. Here we report on how previously

identified growth rate differences in two native Japanese tadpoles, Pelophylax nigromaculata (PN) and Rachophorus schlegelii (RS)), can influence their vulnerability to a novel predator Procambarus clarkii. We first tested the phenotypic responses (in morphology and behavior) of the tadpoles, when alone or together, to cues of caged P. clarkii. We subsequently conducted a series of outdoor and laboratory predation trials to determine the traits influencing tadpole mortality. None of the tadpoles exhibited morphological defense, but PN became less active, a behavioral defense phenotype, in the presence of fed caged crayfish. RS lowered activity level when associated with PN in predator-environments. The lower activity level recorded in the laboratory did not result in higher survival in the presence of the crayfish in outdoor experiments. Indeed, in mesocosms, PN grew faster, reached larger size quicker, which increased resistance to native dragonfly predators, but these traits amplified predation risk in the presence of P. clarkii. The results indicate that sympatric prey may differentially respond to novel predators. Pattern of selection was reversed and, interestingly, a formerly reliable strategy (e.g., large size for antipredator defense) was no longer adaptive in the presence of the novel predator.

Key words: Invasive Species, Amphibians, Life-History Theory

Exploring Exotic Plant Invasions on a Biogeographic Scale

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Abstract: Much attention has been paid to the ecological impacts of invasive plants in their non-native ranges, but only a few studies have compared these impacts to those in the native ranges of the invaders. This is important because biogeographical differences in species interactions would suggest that evolutionary history might affect community assembly. Many exotic species have become more abundant outside their native ranges and exert greater impacts on native species in those ranges. However, in many cases we do not know whether such behavior is only characteristic for the non-native range, or if they also respond similarly to different ecological variables (e.g. disturbance, competition) in their native range. In addition, it is still not clear how native and non-native populations of invasive species vary.

The fundamental objective of our research was to use a biogeographic approach to study two noxious plant invaders (cheatgrass - Bromus tectorum and giant goldenrod - Solidago gigantea). Cheatgrass originates from Eurasia and causes problems all over North America, while giant goldenrod originates from North America and causes problems all over Europe. We correlated the frequency of cheatgrass and the stem densities of giant goldenrod with associated plant species richness in plots measured over large areas of the Northwestern US and Europe. After testing the effects of the

two invaders on community assembly we tried to identify the reasons for the biogeographic differences. We tested the effect of disturbance on cheatgrass and compared how the similar community composition of introduced species could influence the success of the plant in the non-native range. We compared the performance of giant goldenrod by setting up common gardens in the native and non-native ranges using the same genotypes. In greenhouse experiments, we tested the effects of competition, compensatory growth, and mycorrhizal colonization on native and non-native populations of invaders.

Our results show that increasing frequency and stem density of the invaders correlated with significant decreases in total species diversity and native species diversity in the non-native range, but not in the native range. Disturbance had a significant effect in the spread of cheatgrass in both ranges, however, it was more pronounced in the non-native range. A large number of Eurasian species in North America co-occurring with cheatgrass might impact its invasive success. Our results from the greenhouse experiments suggest that genotypes from different continents and from different habitat conditions show a strong adaptation to their original environment and if they are transplanted to a new environment they generally perform worse. Giant goldenrod from Europe did not exhibit greater competitive ability than North American populations. Plants from the non-native range, however, were more tolerant to herbivory than plants from the native range. Interestingly non-native genotypes contained more arbuscula than native genotypes.

Our results are consistent with a growing body of quantitative results demonstrating a strong biogeographic context to exotic plant invasions. This body of work indicates that the biogeographic origin of species can affect community organization, as well as individual performance in the native and non-native ranges.

Key words: Biological Invasions, Biogeographic Approach, Solidago Gigantea, Bromus Tectorum

Effects of Clonal Integration of Alternanthera Philoxeroides in Fungi Pathogen Resistance

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Abstract: As an invasive clonal weed which caused serious damage in economy and ecological environment, Alternanthera philoxerodies was attacked by few pathogens in the field. And clonal integration plays key roles in the growth of clonal weed A. philoxerodies. However, there are few researches about it. Thus, we conducted experiments to test whether clonal integration plays significant roles in the pathogen

resistance of A. philoxerodies. The result showed that the resistance abilities to fungi pathogen of A. philoxerodies are greatly higher than that of Amaranthus tricolor which is in the same family. Clonal integration significantly promoted the growth of underground part in apical ramet. After fungi pathogen Rhizoctonia solani infected, the content of phenol of apical ramet with clonal integration were increased, and the connected leaf infected area were decreased after the second infection. Our results showed that clonal integration could increase the resistance abilities to pathogen of clonal weed A. philoxerodies. The mechanism that clonal integration improves the resistance abilities of clonal plant still need to be studied deeply.

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Key words: Clonal Integration, Fungi Pathogen, Pathogen Resistance, Invasive Clonal Weed

Invasive Spartina Alterniflora Influences Benthic Food Web by Different Pathways in Different Subhabitats

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Abstract: Invasive plants have wide ecologic niches and much more competitive than the natives, could invade multiple habitats that produced notable ecosystem changes. In the Yangtze River estuarine salt marshes (China), Spartina alterniflora is an exotic perennial grass that can rapidly colonies the intertidal zone include native plant Scirpus mariqueter and Phragmites australis marshes and unvegetated area of tidal creek and bare land.

We examined community distribution pattern of benthic macroinvertebrates associated with Spartina invaded and native habitats of tidal creek, bare land, S. mariqueter and P. australis marshes. Then we documented differences in basal resources of benthic food web in different habitats by nature abundance of stable carbon and nitrogen isotope ratios (δ13C and δ15N) and application of mixing models (Iso-Sources). At last, we conducted isotopic enrichment experiments by providing 13C and 15N-labeled Spartina detritus in the sediment of different subhabitats to gain an understanding of trophic effects of exotic plant detritus.

The result showed the effects of Spartina invasion on benthic food web exhibited differences among habitats. The conversion of tidal creek and bare land to Spartina

meadows, had significant effects on benthic macroinvertebrate communities, and the mainly basic food source were changed from SOM and detritus to detritus only in invaded system. When S. mariqueter and P. australis were replaced by Spartina, benthic community structure have not changed, and the basic food resource were shifted from SOM and/or BMI to detritus in invaded system. Enrichment experiment have proved that Spartina detritus could assimilated by benthos in all habitats.

So, we concluded that Spartina invasion in different habitats will affect the food web by different mechanisms. For tidal creek and bare land, changes in food web following plant invasion were driven in part by bottom-up processes related to consumer feeding habit shift increased use detritus, other part were driven by feeding group changes related to habitat shift from unvegetated to vegetated marshes. However, for S. mariqueter and P. australis marshes, the food web changes were only driven by basal resource shift following Spartina invasion.

Key words: Spartina Alterniflora, Food Web, Benthic Macroinvertebrate, Stable Isotope

Integration of Biological Control and Ecohydrological Assessment in Facilitating Restoration of Riparian Ecosystems Invaded by Tamarix

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Abstract: Many riparian ecosystems of western North America are invaded by Tamarix spp. (tamarisk, saltcedar), a Eurasian shrub that displaces native plants, transpires excessive groundwater, is poor wildlife habitat and promotes wildfire. A beetle, Diorhabda carinulata (Chrysomelidae), from central Asia that feeds only on Tamarix has been imported for biological control (biocontrol) of Tamarix without damaging these sensitive ecosystems by chemical or mechanical control methods. In some locations native plants can recover when Tamarix is suppressed by the biocontrol agent, but in more degraded systems, a restoration planning approach called Ecohydrological Assessment is used to design restoration actions that are cost-effective, with high probability of successful plant establishment and low risk of subsequent flood damage. A case history from the Virgin River in Nevada, USA is presented to illustrate this integration of invasive plant biocontrol and riparian restoration.

Key words: Biological Control, Riparian Restoration, Tamarix, Diorhabda

Ecological Traits of Invasive Plant Hypochaeris Radicata L. - How It Became Successful Invader in Jeju Island.

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Abstract: Hypochaeris radicata L. is one of the most invasive and dominant alien species in Jeju island, where known as for biosphere reserve. The species covers over 10% if Importance Values of vegetation of the island of the research in 2016. However, how it became successful is still unknown, therefore several traits of the species were studied to find out what gives advantage to H. radicata. H. radicata disperses seeds around late May, and 95% of seeds germinate during June. Then, the species can grow during summer and fall season to form rosette that will allow H. radicata to start photosynthesis next early spring. Also this flowering period is quite early compare to other native species that green space management activities such as mowing and transplanting of flowers would not affect H. radicata. Furthermore, H. radicata showed more than 40% of seed productivity even after 3 times of mowing indicating great resistance to mowing. By mowing activity, H. radicata was affected much less compared to other native species because the species only had leaves as rosettes which was very close to ground. Among 30 sites where H. radicata was dominant, 29 sites were observed with frequent mowing while other 34 sites were native species were dominant had only 2 sites with mowing activities. Allelopathy study shows that H. radicata has certain abilities to restrain growth of other species, but the reaction was too species specific. Also as H. radicata grows in Hanla Mountain over 1600m altitude, temperature seems not to be the major factor of its abundance. Therefore, anthropogenic physical disturbance such as mowing is believed to be the major reason of H. radicata invasion.

Key words: Invasive Plant, Mowing, Disturbance

A New Strategy for Controlling Invasive Weeds: selectIng Valuable Legume Forbs to Defeat Them

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Abstract: Invasion by exotic weed species is a serious threat to natural ecosystems and would lead to nitrogen loss of the soil.Replacement control through planting valuable legume forbs could make compensation for the nitrogen loss becausethe symbionts of legumes-rhizobium is an efficient system of biological nitrogen fixation, probably to be a robust and feasible means of preventing the invasive weed Mikania micrantha from

re-growing. We studied the competitive effects of two valuable legume forbs, Desmodium inrtum and Macroptilium atropuypureum, on growth, photosynthetic characteristics and drought resistance of the invasive weed M. micrantha, in pot and field experiments. The results showed that: 1) the soil nitrogen increased significantly after planting legume forbs but decreased significantly after planting M. micrantha; 2) the two legume forbs has stronger competitive ability than M. micrantha and can suppress the growth of M. micrantha when growing with it; 3) compared with D. intortum, M. atropurpureum had a stronger inhibitory competition effect on M. micrantha, which could be ascribed to its stronger allelopathy, shade tolerance and drought resistance; 4) the legume forbs prevented the weed M. micrantha from re-generation in the field and improved the biodiversity of the native community. It was concluded that early, robust establishment and strong allelopathy, efficient photosynthesis and drought resistance of legume forbs, is of great importance in resistance to M. micantha invasions.

Key words: Ecological Restoration, Invasive Weeds, Replacement Control, Photosynthesis

Prefer Plants and Parasitic Site of Invasive Cuscuta Pentagona Engelm

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Abstract: Problems of invasive species are emerging domestically and externally. Cuscuta pentagona Egelm is widely distributed in its distribution range and population size compared to indigenous species, and is a species that damages crops. However, it has difficulty to control because there are few specific ecological information. In order to provide the basic data necessary for effective control and management of C. pentagona, we surveyed that whether C. pentagona appears in 88 point in the Geumgang River system and the campus on Kongju National University. In addition, we surveyed emerging plants at the point where the C. pentagona appeared. So we can know the rate of parasitism of C. pentagona. The survey was conducted for two years from May 2015 to October 2016, based on May as the germination period of the C. pentagona and October as the flowering period. The total plants are 91 family 245 genus 385 species containd Herbaceous plants of 66 family 193 genus 298 species and woody plants of 34 familly 57 genus 87 species. Of these, 39 family 88 genus 107 species were parasitized with C. pentagona. The highest rate among the plants with more than 10 kinds of plant appeared of parasitism family in C. pentagona is polygonaceae (53.33%). Followed by leguminosae (48.39%), compositae (39.53%),

labiatae (36.36%), cyperaceae (27.27%), gramineae (20.75%), rosaceae (17.65%). However, the rate of host plants is compositae (15.89%), gramineae (10.28%), leguminosae (10.28%), polygonaceae (7.48%), others (56.07%). As a result, compositae is the most common parasitism family but the most preferred family in C. pentagona is polygonaceae. The average number of coiling leaves and stems on host plants of C.pentagona is Scrophularia takesimensis Nakai. Species that is only parasitic on the stem are Silene armeria L., Actinostemma lobatum (Maxim.) Maxim. Scirpus radicans Schkuhr, Cyperus microiria. species that is only parasitic on the leaves are Mentha arvensis var. piperascens, Solanum melongena, Capsicum annuum, Oenothera biennis. There was also indirect effect that the rate at which host plants die is caused by insects. The results of this study can be expected to reduce the damage of crops by using as a basic data for effective control and management of C. pentagona.

Key words: Cuscuta Pentagona Engelm, Invasive Plants, Host Plants, Parasitic Site

Effect of Cotyledon Damage on the Early Growth of Sophora Alopecuroides L. Seedling

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Abstract: IN order to explore the effect of injury to cotyledon on the early growth of Sophora alopecuroides L. seedlings, experiments of simulated cotyledon removal were conducted to test the effects of different cotyledon excision (excision of 0.5, 2*0.5, 1, 1.5 and 2 cotyledon，with non excision cotyledon as the control) on the early seedlings growth of S. alopecuroides，a native and malignant invasive species in Ili River Valley of Xinjiang. The results showed that mortality depend on a great extent on the degree of cotyledon excision, 1.5 and 2 cotyledon excision treatments significantly increased seedlings' mortality. There were no significant differences in seedlings' taproot length among cotyledon excised and non-excised treatments. Seedlings' height every cotyledon excision treatments were higher than that of non-excised treatments, and a significant difference at 0.01 level was detected between the lower damage degree (0.5 and 2*0.5 cotyledon) and higher degree (1.5 and 2 cotyledon) of cotyledon excision treatments. There were significant differences at 0.05 or 0.01 level in the amount of seedlings' lateral roots among the higher damage degree (1.5 and 2 cotyledon) and non-excised treatments, but no significant difference in amount of lateral roots was observed among the control and the lower damage degree treatments. And at the same time, cotyledon excision significantly decreased the length of lateral roots. Compared to the control treatment，leaf area significantly decreased with the decreasing of degree of cotyledon excision. It was found that cotyledon excision did not significantly affect

root shoot ratio. Even though the degree of cotyledon excision was only 0.5, 2*0.5 or 1.0, stem biomass, leaf biomass and total biomass of seedling were significantly restrained in different degree. Cotyledon excision had little impact on the biomass allocation ratio of stem. The biomass allocation ratio of roots increased significantly with the increasing of the degree of cotyledon excision, but all cotyledon excision treatments significantly increased the biomass allocation ratio of leaves. Those results indicated that cotyledon damage was the bottlenecks of seedling establishment and population regeneration. Cotyledon damage and excision caused by biotic or abiotic factors, both of them would cause significant inhibitory effects on seedling growth. The results of the research would provide scientific support theoretical evidence for the prevention and control management of S. alopecuroides in upland meadow and farmland ecosystem in Ili river Valley.

Key words: Sophora Alopecuroides L, Cotyledon Damage, Seedling Growth

Interspecies Correlation between Native and Invasive Plants under the Artificial Wetland Forests in the Dianchi Lake Areas, SW China

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Abstract: The issue of plant interspecies correlation in the wetland ecological reconstruction of lake areas has important academic significance and social economic value. Fifty-eight plant species were recorded in 4 sampling plots (1500 m2 each) from the 5-year old artificial wetland forests in the Dianchi lake areas. The interspecific relationship of 23 main species from 160 quadrats (1.0 m2 each) were analyzed by using Spearman rank correlation coefficient index. Results showed that, of the 253 species pairs, 48 were very significant and significant($P \leq 0.01$~0.05) positive correlation (6 invasive species only, 15 native species only, and 27 invasive and native species), 46 were very significant and significant($P \leq 0.01$~0.05) negative correlation (10 invasive species only , 15 native species only,and 21invasive and native species), no significant positive correlation and negative correlation were 60 and 99 respectively, showing the intense interspecific competition in the wetland forests. Clustering analysis by using the Spearman rank correlation coefficient, the 23 species were divided in 5 ecological species groups: newly invasion dominant species (Solidago canadensis,1 species), early invasion dominant species (Ageratina adenophora and Bidens pilosa,2 species), species sharing similar habitats (4 species), species with ecological complementary (5 species) ,and native species scatted in the forests (11 species), showing the exclusivity of the dominant invasive and native species. The dense canopy to a certain extent obstructed the growth of undergrowth species, which

was good for the control of invasive species and reduced the investment for management. In general, the study suggested that artificial forests were beneficial to wetland ecological reconstruction in lake areas

Key words: Interspecific Relationship, Wetland Forest, Invasion Plant

The Interaction between Solidago Canadensis and Root-Associated Bacteria

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Abstract: Although plant-soil feedbacks, host adaptation and co-evolution dynamics, are greatly correlated with microbial communities in plant rhizosphere, it remains unclear how the functional shifts of a changed microbial community affect on the invasion processes of exotic plants. We conducted a field study to explore the relationship between rhizobacteria community and invasive plant Solidago canadensis using metagenomic sequencing. Meanwhile, we conducted microbial culture-dependent experiments to explore relationship between the ability of the relevant bacterial taxa to produce auxinindole-3-acetic acid (IAA) and the different invasion stages of S. canadensis. Metagenomic (16S-rRNA) analysis showed that the bacteria community clustered together according to the plant invasion processes in the root-soil interface, with a significant lower bacterial diversity inside the roots. Furthermore, communities of the relevant bacteria taxa showed enhanced ability to produce IAA under low invasion stages. Our results suggested potential coevolutionary dynamics between invasive plant S. canadensis and its associated rhizobacteria via phytohormone IAA. Exotic plants are often demographically successful in a new introduced range partly due to evolutionary novelty, however, the development of the coevolutionary relationships with rhizobacteria may facilitate the plant invasion process.

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Key words: Function, Microbial Communities, Plant Invasion, Rhizoplane

Effects and Environmental Fate of the Application of Gallant (Haloxyfop) to Control Spartina Alterniflora in the Yangtze Estuary, China

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Abstract: Smooth Cordgrass (Spartina alterniflora) is non-native species in China which occupied the ecological niche of native species and imperil the ecological balance of estuary system, therefore, the control of S. alterniflora is a regional issue of great importance. To date, S. alterniflora management strategies primarily focused on mechanical control in China, but it is costly and inefficient to control scattered S. alterniflora clones. The herbicide Gallant (Haloxyfop) had been proven as an efficient and low toxicity herbicide for controlling S. alterniflora in New Zealand and United States. In the Yangtze Estuary, Gallant has been used to control S. alterniflora, but little information is available regarding the effects and environmental residue associated with the herbicide Gallant applications in this strong tidal estuary. In this study, an intensive field trial was conducted in the Chongming Dongtan wetland, Shanghai, China in August 2016. 0g/ha, 45g/ha, 90g/ha, 180g/ha and 360g/ha Gallant were applied to S. alterniflora community plots (5m×5m) with similar coverage by manual sprayer during the low tide. The density, height and coverage of S. alterniflora were recorded in treated and control (untreated) plots 1d before, 1d, 3d, 7d, 14d, 21d, and 30d after spraying, and sediments were sampled systematically at the same time to test environmental residue by high-performance liquid chromatography (HPLC) analysis and monitor microbenthic communities structure and quantity. The aims of this study were the following: (1) To compare control effects of herbicide Gallant sprayed to S. alterniflora communities with different application concentrations; (2) To monitor the residual content of Gallant in the sediment and assess potential environmental effects to the estuarine, and (3) To evaluate potential impacts of herbicide Gallant on microbenthic communities. The results indicated that application Rodeo of Gallant completely brown the aboveground of S. alterniflora and deteriorated underground parts of S. alterniflora within 30 days with mortality rate higher than 90% but with lower residue risk under 1.8g/ha Gallant treatment. The application of Gallant could be a safe, feasible and time- and cost-effective method to facilitate the control of inaccessible monoclonal stands of S. alterniflora. However, effects of Gallant for control S. alterniflora is weakened by various factors under the tidal conditions inherent to estuaries. Our suggestions are Gallant should be sprayed uniformly during ebb tides in a windless or weak-wind sunny day, and it is necessary to set aside at least 6 hours for application, drying, and absorption by S. alterniflora to assure the control effects.

Key words: Gallant, Herbicide, Spartina Alterniflora, Invasion

Bacteria Diversity in Rhizosphere and Surrounding Bulk Soil of Senecio Vulgaris L. (Asteracea)

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Abstract: A large number of previous studies have shown that rhizosphere microbes have an interactive relationship with plants, and may play an important role in plant invasion mechanism. Senecio vulgaris (Asteraceae), originated in Europe and a widely - distributed weeds in temperate regions, has been listed as one of the invasive plants in China. Studies on microbial diversity in rhizosphere and surrounding bulk soil help to understand the function of soil microorganisms in invasion of plants. By culture-independent, PCR-based methods (sequencing 4V zone of 16S rDNA with Illumina MiSeq high-throughput sequencing technology), we determined the components and relative abundance of the components of bacteria communities in rhizosphere and bulk soil in 7 S. vulgaris populations in Shennongjia, Hubei, China. The results showed that S. vulgaris populations in severely- disturbed habitats contained slightly lower α- diversity of rhizosphere bacteria than the others and the composition of the rhizosphere bacterial communities were different between populations as well. The bacteria communities in rhizosphere and bulk soil had different pattern in relation to α- and β- diversity: there were more abundant bacteria in bulk than in rhizosphere soil; more amount of Proteobacteria, Bacteroidetes and Verrucomicrobia were found in rhizosphere; and more Firmicutes, Chloroflexi, Nitrospirae and Acidobacteria were found in bulk soil. The great different of bacteria diversity between rhizosphere and the surrounding bulk soil indicated that plants may have an important influence on shaping the rhizosphere microbiomes and suggested plants may benefit from this.

Key words: Microbial Ecology, Rhizosphere Microbiomes, Invasive Plants, Culture-Independent Methods

THEME 6

Environmental Stress and Biodiversity Conservation

T6-01: Karst Biodiversity: Understanding Diversity and Threats in Asias Forgotten Ecosystem

Developing Priorities for Karst Conservation

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Abstract: Karsts represent a challenging ecosystem for conservation. With almost unparalleled levels of endemism, and an estimated 90% of cave fauna undesribed in some countries they represent priorities for further research. However growing demand for cement in many regions, and especially parts of Southeast Asia where accelerating cement demand caused China to use 6.6 gigatonnes in just a two year period, exceeding US historical construction and leading to an exponential increase in the demand for cement and consequently the increasing destruction of limestone karsts to meet that cement demand.

Thus to ensure karst diversity is adequately protected, we require both an understanding of hotspots of biodiversity, and how karst landscapes can be effectively managed to maintain karst ecosystems.

Here we review a recently initiated project which sets to do that. By initially developing methods to map karsts, then develop stratified inventories of karst biodiversity, hotspots of endemism and also evaluate how landscape configuration changes the microclimate and species present on karst ecosystems.

We discuss how such stratified approaches can be implemented and scaled across the landscape to generate standardized information on karst biodiversity and understand how to manage karts and develop effective priorities to account for diversity and endemism.

Given the almost unparalleled endemism in these systems it is essential that we rapidly develop priorities that most effectively protect biodiversity in these challenging systems.

Key words: Endemic, Threatened, Limestone, Biodiversity

Disturbance-Responsive Traits in Assigning Conservation Status of Plants: Gesneriaceae of China

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Abstract: Globally widespread conversion of natural ecosystems to agriculture and other land uses, diverse anthropogenic disturbance and climate change pose serious threat to biodiversity conservation. By providing goods and services to human, biodiversity directly benefits humans and maintains ecosystem function. Hence biological conservation is vital to human wellbeing and ecosystem function. Traditionally conservation status of plants and animals is determined by assigning species to one of the five categories: common, rare, threatened, endangered and extinct (CRTEE) based on frequency of occurrence in certain area. Habitat loss and drastic ecosystem disturbance change the frequency of occurrence of some species affecting their conservation status. Although widely used, the frequency-based categorization of plants in CRTEE is somewhat tenuous because it is primarily based on herbarium collections that are neither systematic nor un-biased random. However, systematic or un-biased random sampling of plants is time consuming, labor intensive and expensive, hence not practical. We propose a modified CRTEE categorization by adding disturbance-responsive species traits to the current frequency-based method. Disturbance-responsive functional traits of plants can capture processed-based mechanistic interpretation of species loss in disturbed ecosystems. With increasing availability of quantitative plant traits, one can determine a trait-based cause and effect of species loss in disturbed habitats. Using plants of horticultural significant family Gesneriaceae commonly found in karst and non-karst ecosystems of China we present a three stage approach, i) identification of threat, ii) quantification of vulnerable species traits and iii) habitat restoration, to demonstrate how this enhanced CRTEE categorization can be used effectively by land managers, conservationists, and restoration ecologists.

Key words: Ecosystem disturbance, Biodiversity conservation, Karst, Habitat degradation

Fate of Malaysian Karst and Similar Ecosystems in the Changing Climate: Indicator Models from Smaller Arachnid Orders, Pseudoscorpiones and Harvestmen

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Abstract: The karst and cave ecosystems in Malaysia are home to many elusive arachnids especially the Smaller Arachnid Orders. Distributions of arachnids in Malaysia were poorly documented as arachnological studies in Malaysia started in the

late 19th Century with the first described Smaller Arachnid Order in Malaysia being Uropygi, with two species Thelyphonus anthracinus and Thelyphonus doriae hosei from Sarawak (Malaysian Northwest Borneo). Whereas, the study on Pseudoscorpiones started earlier in 1890 with two species from Cheliferiidae being described by Thorell, whilst the comprehensive work on Harvestmen was that of Suzuki's which truncated in the 1980's. With the small amount of work, distributions of these arachnids were known only to be scattered and scarce in the Malay Penisular dan Malaysian Borneo. In 2012, we made an effort to re-establish a mapping of these Arachnids for geospatial distributions and connectivity by venturing in other localities which has not been documented before. We also include other related ecosystems which arise from earlier geological formations such as quartz ridge and old mountain ranges. Based on mapping of the Smaller Arachnid Orders distribution and spatial surface correlations to average rainfall, average temperature and average relative humidity at 23 locations in Malaysia, we found that all orders were concentrated at localities with either high average rainfall distribution or humidity. The scarcity of these arachnids when mapped against the environmental factors clearly signals the highly risky niche bound distribution and existence of the arachnids - threatening. Except for Pseudoscorpiones that were observed to be resistance on dry environment and were widely distributed, still, were not conclusive as assemblages were few. Meanwhile, even with high diversity of harvestmen, we discovered a large physiological trade off amongst the long legged Phalangids as compared to Sandokanids which indicate a strong relationships between altitude, temperature and humidity, which signals possible threat to these arachnids in the changing climate. With these results, we hypothesized that, due to most of the arachnid orders and families were karst and caves related, or very localized to certain ecosystems, at the event of climate change, the fate of these ecosystems can be predicted by the existence and non-existence of the orders as indicator model. We propose, a high conservation value (HCV) being put in place by local authorities as a policy to protect these ecosystems before further damage and the diminishing of biodiversity were experience at large in these fragile landscape.

Key words: Karst Ecosystems, Geospatial Distribution, Altitudinal Gradient, Physiological Tradeoff

Effect of Different Specifications of Cuttings and Seasons on Rooting of C. Migao Cuttings

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Abstract: Abstract: This thesis studies the effect of different specifications of cuttings and season on Rooting of C. migao cuttings. Methods: from cuttings thickness, length and cutting season on the cutting period of rooting rate (%), Callusing rate (%). Hyponastic root rate (%), rooting number (a), The longest root length (CM) and other indicators. Conclusion: the comparative study of the cuttings should choose the diameter of around 3-4mm branches, cut 10cm long as the best specifications. Different seasons experiment show that in spring March the rooting effect of C. migaois is the best.

Key words: Cuttings Size, Seasons, Cinnamomum Migao H. W. Li

Study on Population Characteristics of Artificial Poplar in Linzhi

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Abstract: The population dynamics of poplar plantation was analyzed from the aspects of population life table, survival analysis and time series forecasting. The population dynamics of poplar plantation were analyzed by using the sample - like method. The results showed that the survival curve of poplar population showed that the survival curve of poplar population was between Deevey-Ⅱ type and Deevey-III, which favored Deevey-III. The results of four survival function analysis showed that the cumulative mortality rate of poplar population decreased monotonically, and the survival rate first dropped from the age of Ⅰ to the age of Ⅴ to the bottom, then fluctuated, and the death density and the risk In addition to the differences in the forms of Ⅴ-Ⅵ ages, the variation curves of the two age groups are close to each other, showing the fluctuation phenomenon.

Key words: Artificial Poplar Forest, Population Structure, Life Table Time, Prediction Model

Genetic Diversity Detected with ISSR Marker in Cinnamomum migao Populations

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Abstract: Studed on genetic diversity of Cinnamomum migao h. w. Li. natural populations and explored population's degradation mechanism. This study can provide theoretical basis for genetic improvement of Cinnamomum migao genetic resources, effective protection and rational utilization. The genetic diversity of 8 natural

populations on Cinnamomum migao was analyzed by using ISSR molecular markers. The genetic diversity of Cinnamomum migao natural populations showed that 8 populations were amplified 167 polymorphic site by 19 primers, and the percentage of polymorphic site was 89.78%. The value of Na, Ne, H, I, PPB was 1.5726, 1.3909, 0.3032, 0.3282, 57.26% respectively. Gst was 0.2636, and the genetic diversity indexes of different natural populations were showed that the indexes of genetic diversity were presented species level > population level on Cinnamomum migao different natural populations, the genetic distance of the 8 populations were not high enough, and the genetic variation among populations were low; the gene flow (Nm) 1.3968> 1, indicated that there is a gene flow between among populations, and the genetic differentiation among the populations is small. Principal coordinates analysis (PCoA)showed that 62 samples of Cinnamomum migao were divided in two ancestry obviously, Ancestry 1 was two populations of Luodian, Ancestry 2 contained Zhenning (ZN), Zhenfeng (ZF), Ceheng (CH), the two populations of Wangmo with genetic information of two ancestry. UPGMA dendrogram showed that Zhenning (ZN) was one class; Luodian 1 (LD1), Luodian 2 (LD2), Wangmo 1 (WM1), Wangmo 2 (WM2) were a class; Ceheng (CH), Libo (LB), Zhenfeng (ZF) were a class in 8 natural populations of Cinnamomum migao, its indicated that geographic distance close to cluster together.According to the rich genetic diversity of Cinnamomum migao, the prospect of its genetic improvement is very broad. This is of great significance to the further research of Cinnamomum migao genetic diversity and germplasm resource's protection and evaluation, the rational development and utilization of natural forests and the cultivation of plantations. According to the rich genetic diversity of Cinnamomum migao, the prospect of its genetic improvement is very broad. This is of great significance to the further research of Cinnamomum migao and germplasm resource's protection and evaluation, the rational development and utilization of natural forests and the cultivation of plantations.

Key words: Cinnamomum migao H. W. Li, Natural population, ISSR marker, Genetic diversity

Response on Biomass and Leaf Microstructure of Blumea Balsamifera L. DC. Seedling to Water Stress

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Abstract: Blumea balsamifera is the Guizhou ethnic characteristics of Chinese herbal medicine, is one of the main sources of extraction of natural borneol. In order to provide some theoretical guidance for large-scale cultivation, improve economic growth pole

for the Guizhou province, contribute to the development of industrialization, in this paper, seeding B. balsamifera. have been researched the adaptability to drought and shade by combining laboratory tests . The tests contain the relative water content, biomass and shoot ratio, leaf microstructure,The results are as follows:1. In the soil moisture of 40% moderate drought stress, whether from B. balsamifera.'s macro or microscopic morphological and biochemical indicators ,the results showed a significant difference between the control group .In the middle experimental of higher temperatures and lower humidity ,the leaf take curl and close stomatal and other ways to deal with drought. Although plants can be grown, plants have significant reductions in height, diameter and biomass. B. balsamifera. is perennial herb and have largerer leaf area , so it is generally worse drought tolerance than other plants.2. The B. balsamifera.'s moisture control throughout the experiment show that B. balsamifera. can not stress drought. The soil moisture content 40% in the growing season, B. balsamifera. shows poor vigor and some died. In 30% the soil moisture have a large scale of death. If extending moderate drought stress time, B. balsamifera. can be grow well. But B. balsamifera. 's biomass is considerated the economic value of herbal medicine.In cultivation and management respects, we should ensure sufficient water needs.

Key words: Biomass, Leaf Microstructure, Blumea Balsamifera L. DC, Drought

Leaf Anatomical Structure and Photosynthetic Physiology Responses of Akebia trifoliatas under Drought Stress

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Abstract: Drought is a common stress during plant growth and development, especially in karst rocky desertification area as a major factor limiting plant growth. In order to understand the effect of drought stress on structure of plant leaf and the response of structure and photosynthesis of plant to drought stress, the response of leaf anatomical structures and photosynthetic indexes to drought stress were studied after continuous drought and pot experiment. The experiment used Akebia trifoliate as materials, a kind of liana with homology of food and medicine, and used the method of Li-6400 photosynthesis system and conventional paraffin sections. The results indicated that the mature leaves of Akebia trifoliate produced a series of changes in structure with decrease of soil moisture such as thinning of the vane thickness ， decrease of moisture， shortening and lessening of palisade tissue and so on. And the change of the leaf structure led to the change of the physiological function. The

nitrogen content，photosynthetic rate(Pn) , stomatal conductance (GS) and transpiration rate (Tr) decreased，while the water use efficiency (WUE) improved .The results showed that Akebia trifoliate could cope with drought through adjusting the leaf structure and photosynthetic physiological characteristics under drought stress, and it had a certain drought resistance from the anatomical Structure and photosynthetic Physiology point of view. Therefore, Acedia trifoliate can be considered as a kind of liana for restoration of rocky desertification of in the karst area.

Key words: Drought Stress, Akebia Trifoliatas, Leaf Anatomy Structure, Photosynthetic Physiology

The Growth and Physiological Characteristics of Cinnamomum Migao Seedling with Different Phosphorus Conditions

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Abstract: Abstract：In order to explore the effect of the growth and phsiological characteristics of Cinnamomum migao seedling with different phosphorus conditions, sand culture of the seedlings were adopted, in which different phosphorus concentrations were set up.The results showed that different levels of phosphorus could significantly affect the growth, biomass accumulation and the allocation of nitrogen and phosphorus in different organ ($P<0.05$). The phosphorus in every organ and biomass of Migao all represented leaf> stem> root, phosphorus increased with the increase of phosphorus level at 0.125~1 and $mmol^{-1}$, but when phosphorus was 2 $mmol^{-1}$, the nitrogen content and root phosphorus content of rhizome and leaf were decreased. In the same period, different phosphorus concentration on physiological and biochemical indexes of Migao have different effects, but no significant difference between the groups，CK group phosphorus most conducive to seedling growth of Migao in the whole growth period.

Key words: Cinnamomum Migao H. W. Li, Phosphorus, Growth and Physiological Characteristics

A Novel Approach for Biodiversity Pattern Research

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Abstract: Numerous studies on biodiversity have been done, and proposed many hypotheses for formation mechanism of biodiversity pattern, but none can explain it

alone. And previous studies mostly focused on single level of species diversity, ignored diversity patterns of higher taxa. Here we analyze family, genus and species diversity patterns of seed plants in China by ArcGIS10.0 and SPSS, and find there is some similarity among them, but not identical exactly, it suggests that factors determined different taxa are not the same. Further study through calculating the flora of seed plants in family genus and species levels respectively. We find that tropical element are dominant component in three levels, and show a latitudinal gradient, decreasing along latitude; while the other elements like cosmopolitan element and temperate element show little deviant among provinces in family level, but in genus level it expresses as geographical differentiation, in species level it shows modern climatic differentiation. Above all, we infer that ancient geology and climate change determined the distribution of family diversity; geographic factors shape the pattern of genus diversity based on family diversity pattern; and on the basis of higher taxa diversity patterns, distribution of species is influenced by modern environment; what's more, there is a certain inclusive nature among three taxa.

Key words: Plant Floristic Geography, Distribution Pattern, Geological Factors, Geographical Factors

Decline of Soil Depth and Water Availability Restrict the Stomatal and Vein Development of Two Mixed Grasses in Karst System

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Abstract: Shallow soil and karst drought are the main limited factors to plant growth, development and reproduction in vulnerable karst regions. Leaf stomatal and vein development may be restricted by resources limitation. Here we investigated whether the decline of soil depth, water availability, or their combination restricted the stomatal and vein development between grasses with different root systems in karst soil. In our paper, Festuca arundinacea (deep-rooted) and Lolium perenne (shallow-rooted), were treated with two soil depths (normal versus shallow), two water treatments (control versus drought) and two planting patterns (monoculture versus mixture) in a full three-way randomized block design. The key results showed that: (1) with the decline of resources, for F. Arundinacea, the ad- and abaxial stomatal density and vein density increased, but stomatal size (area, length and width) and vein distance decreased; However, for L. perenne, those stomatal and vein traits did not change or slightly decreased either in mixture or in monoculture. (2) For F. Arundinacea, the ad- and abaxial stomatal density and vein distance was higher, and stomatal size and vein distance was lower in mixture than in monoculture (consistent with resource use

complementarity). However, they were almost the same in mixture and in monoculture at low resource levels (did not alleviate the stomatal and vein development). In contrast, for L. perenne, whether at high or lower resource level, those stomatal and vein traits had the similar values between monoculture and mixture. The results indicated that the reduction resources limited the stomatal and vein development of both species. Deep rooted plant F. Arundinacea adopted a strategy of "relative progressive", while shallow rooted plant L. perenne remained constant with their already adaptive strategy to keep their water balance in terms of the stomatal and vein size and density.

Key words: Shallow Soil, Karst Drought, Stomatal Density, Vein Density

Nutrient Cycling in Substratevegetation Systems of Rock Slopes

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Abstract: A substrate-vegetation system is the primary functional component of eco-engineering for rock slope protection.Its stable development relies on the state of nutrient cycling. In this study, Cynodon Rich is selected as the trial plant to study the process of nutrient cycling in a substrate-vegetation system of rock slopes with observation tests simulating rock slopes. The results show that nutrient accumulations in the

substrate, which is the main accumulation storage of nutrients, occupy 98 %of the system.The total nutrient accumulations in the system are in the following order: K >N >P >Ca >Mg and that in the bio-subsystem are in the order of K >N >Ca >Mg >P; two years after the establishment of vegetation on slopes, biomass accumulation from decayed material reaches homeostasis, which is the basis of nutrient cycling of systems; Biocycles of nutrient elements in the system are in the following order: K > N > Ca > Mg > P.The nutrient utilization efficiencies of N, Ca and Mg are higher than those of K and P when absorbing nutrients from substrates. The annual returns of each nutrient element are all greater than that of annual retentions, which indicates that slope vegetation has the characteristic of quick cyclic nutrient utilization. Due to favorable and stable characteristics of the substrate and the vegetation cover, the annual input of nutrients in the system is greater than the annual output of nutrients (runoff), which implies a favorable state of nutrient accumulation.The annual input (except K) of nutrients in the substrate (the litter layer is not included) is also greater than the annual output of nutrients .The annual deficit of K is small but persistent. It is, therefore, not necessary, to supply nutrients from external sources to maintain a stable development of vegetation on slopes. It is shown that the nutrient supply is not a major factor, after appropriate artificial deployment, during the later stages of engineering management.

Key words: Substrate-vegetation, Nutrient Cycling, Rock Slope, Eco-engineering

A Preliminary Study on Species Diversity of Sygara Mountain Moss Plant

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Abstract: Tibet Sygara Mountain is located in the northwest side of the Yarlung Zangbo River southeast of Tibet great bend, Nyainqentanglha mountain and Himalaya Range in Linzhi county at the junction, is the Nyainqentanglha mountains, the mountain is located in the E93 degrees 12 minutes to 95 degrees 35 ', 10' N29 degrees to 30 degrees 15 '. The mountain brown soil and acid brown soil are mainly. Sygara Mountain mainly forest ecosystems, is also an important part of bryophyte species. Before Syagara bryophytes have done a systematic investigation, quantitative study of species diversity has not been performed. Through this study, one can understand the species composition and characteristics of Shergyla Mountain bryophyte flora, rich China moss, especially provide the basis for the development of the vegetation ecosystem ecosystem of alpine forest plateau faces. This research mainly discusses Syagara bryophyte species diversity and ecosystem diversity, draws the following conclusion:1) Through a detailed investigation of the bryophytes were collected, 2390 samples, the laboratory identification, has confirmed the Syagara moss plants of 26 families 70 genera and 134 species of liverworts; which only one, push the new Tibet sejilamountain no fur records; Tibet found 37 new records, were moss class, there are 1 varieties of small gourd moss (Pohlia crudoides Broth. var. angustifolia), 1 subspecies of small thorn edge polytric subspecies (pogonatum cirratum Brid.subsp.) original.2) Bryophyte communities in Syagara Mountain is mainly composed of Thuidiaceae, often taking shape a large clumps; green, brown green, yellow green leaves; multi column misheng; basic for native and water storage capacity. Compared with the typical mountain type, diversity of Syagara Mountain bryophytes and unique climate types in Tibet relevant.3) According to the statistical distribution of Syagara mosses, found Magao moss are dominant families Syagara Mountain bryophyte vegetation and its vertical distribution showed a certain degree of correlation.

Key words: Tibet, Sygara, Moss, Specie-Diversity

Effects of Tourism Disturbance on Soil Hydrological and Physical Characteristics of Subtropical Mountain Meadow

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Abstract: The Wugong mountain meadow is a typical representative of subtropical

mountain meadow in Jiangxi province, which is typical and special in the vertical vegetation zone of East China. The hydrological and physical characteristics of soil play an important role in soil quality and ecosystem energy exchange, at present, there are few studies on the soil hydrological characteristics of subtropical mountain meadow. Based on the characteristics of the special ecosystem of Wugong mountain meadow, this paper analyzes of the hydrological and physical properties of meadow soil with different tourism disturbance levels, to explore the main physical factors affecting soil hydrological and physical characteristics, and to provide references for the ecological restoration and sustainable management of degraded meadow in subtropical zone. The results showed that: (1) with the increase of tourism disturbance levels, the comprehensive performance of soil hydrology and physics is degraded, which is CK>LD>MD>SD. (2) the upper and lower layers of the soil bulk density, total porosity, water content, water storage, water holding capacity, capillary water holding capacity in the CK meadow area have a significantly difference (>0.05), there are significant differences(>0.05) between the upper and lower layers of soil non capillary porosity in LD, MD, SD meadow areas , soil moisture and water storage in SD meadow area.（3）Soil bulk density and porosity were the key factors affecting the soil hydrological and physical properties, and have a significantly correlated with soil water content, water holding capacity and permeability (>0.05).

Key words: Tourism Disturbance, Hydrological and Physical Properties, Wugong Mountain

T6-02: Assessing Changes in Asian Ecosystems and Biodiversity with Special Reference to Threats and Restorations through Human Activities

Restoration Potential of Bamboo Plantations under Rehabilitated Coalmine Spoil in a Dry Tropical Region of India: An Implication for Ecological Restoration

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Abstract: Present study was conducted in a dry tropical region of India where mining is one of the serious problem, degrading forests with unprecedented rates. Since, degraded soils have no ability to accumulate more essential nutrients (C, N and P) for vegetation development because soil-plant relationships and nutrient circuit in the soil medium has been damaged. Hence, soil restoration is a really challenging ecological problem; moreover, their recovery by natural succession is very slow. To understand ecology of soil carbon sequestration and restoration potential, a number of parameters like soil organic carbon, accretion, accumulation, soil microbial biomass, soil respiration etc. were monitored from soil component and biomass, growth performance (culm/clump recruitment) standing stock of carbon, cycling of carbon (plant-soil), mineralization (CO_2), turnover (carbon accretion rate, sequestration rate) and several others were monitored from vegetational component.The objective of this study was to quantify biodiversity recruitment, and to estimate biomass, net primary production (NPP), carbon cycling and standing stock under planted plots of bamboo species. Since, bamboo (Dendrocalamus strictus) is a fast growing, hardy in nature, indigenous woody grass species and possessing socio-economic values exhibited many good characters for restoration values and have shown good efficiency for soil carbon sequestration, therefore, plantation of bamboo was established on coal mine habitats to restore the functional attributes of degraded coal mine ecosystem.Results indicated that influence of bamboo plantations on soil sequestration and redevelopment was more pronounced with increasing age of plantation. However, recruitment of biodiversity development beneath bamboo plantation was not so effective due to age because canopy cover provides more shade and cool region under plantation surface which maintain significant level of soil moisture in the rhizospheric zone that provides feasible condition to the microbial flora and fauna. Moreover, contribution of fine and coarse roots biomass provided substantial amount of soil organic matter, after mineralization, contributing more carbon accretion in soil due with

increasing age of plantation. Moreover, accretion of soil organic carbon (SOC) in redeveloping soil was significantly related with soil carbon sequestration with plantation age confirming positive way of soil redevelopment, it further indicates that an equilibrium yet to achieved with increasing time. Furthermore, redevelopment of soil biological fertility (microbial biomass carbon and other nutrients) was strongly integrated with plantation development confirming a strong role of carbon contributed by bamboo plantation showed strong restoration potential for the restoration of damaged ecosystems.

Key words: Soil Carbon Sequestration, Coal mine Spoil, Soil-redevelopment, Biomass

Addressing the Threats to Mammals in Tea Garden Agroforestry System in Assam, India: A Case Study

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Abstract: Assam is located in the eastern Himalaya biodiversity hotspot. 3, 12,210 ha of the area is under tea plantations in Assam. During the British times, large area of forests in Assam were clear-felled to convert them in tea gardens. With the increasing settlement many of these tea gardens are now surrounded with human habitations. This study was undertaken to understand the role of such human-dominated landscapes in the conservation of mammalian diversity and to address their threats. Direct sightings (line transects of 1 km length), indirect sightings (scat, pellets, tracks, pugmarks etc.) and interviews were employed in four tea gardens in Sonitpur district of Assam. A questionnaire survey was conducted with 40 hunters within the tea tribes (10 from each tea garden) to evaluate the threats to the mammals. A total of 26 species of mammals were reported, out of which, according to IUCN Red Data list, endangered (1), vulnerable (5), near threatened (2), Least concern (14) and Not assessed (4). Macaca mulatta, Nycticebus bengalensis and Trachypithecus pileatus were captured to keep them as pets. Felis chaus, Herpestes edwardsi, Vulpes bengalensis, Viverricula indica, Hystrix indica, Viverra zibetha, and Prionailurus viverrinus were hunted for their meat as well as their ethno-zoological uses. Four species were killed as they were pests and the rest (12) were hunted for meat. Conservation awareness programs are required to change the hunters into conservation practitioners. Training in alternative livelihood like animal husbandry, fisheries production, poultry farming, etc. must be given to the tea tribes to reduce the hunting necessity. Policy makers must look into the development and proper implementation of schemes related to health, education and livelihood of the tea tribes.

Key words: Mammal Diversity, Tea Garden Agroforestry System, Conservation,

Threats

Assessing the Ecological and Environmental Security Risk in Xinjiang Production and Construction Corps Based on the PSR Sustainability Framework

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Abstract: Constituting as it does an important part of the Xinjiang Uyghur Autonomous Region, the Xinjiang Production and Construction Corps (XPCC) started from scratch 60 years ago. It has since made strenuous efforts to fulfill faithfully the responsibilities the state has entrusted to it to cultivate and guard the border areas. Over the past 60 years, the XPCC reclaimed farmland and successively built regimental agricultural and stock raising farms in the harsh natural environment of the desolate areas. The economic development of XPCC has made remarkable achievements, the total output value of the XPCC in 2013 was 220 times more than that in 1954 when it was established. However, it is unclear whether is the ecological and environmental situation in XPCC developing synchronously with social economic status. So the objective of this study was to clarify the ecological and environmental situation changing by a set of well-chosen indices based on the conceptual Pressure-State-Response (PSR) sustainability framework. The assessment methods included the incorporating the entropy method and the comprehensive index model. Twenty-four indices were well-chosen in terms of the three PSR criteria: pressure, state, and response. The results showed that the overall ecological effect of XPCC was downtrend in the temporal scale, which the value declined from 0.515(2008) to 0.481(2015); the comprehensive index of ecological effect in northern XPCC was between 0.359-0.600 in the spatial scale, where the ecological situation was better as a whole. Meanwhile, the comprehensive indexes of ecological effects in the eastern and the southern of the XPCC were between 0.226-0.363. The results showed the ecological situations of the southern of the XPCC were degenerated. To improve ecological environmental situation and societal sustainability in XPCC, a suite of remedial and preventative suggestion was proposed to manage ecological security in the regions that are affected by development and utilization of water resources, chemical fertilizers, emissions of industrial wastewater, forest harvesting and other influence process. These findings demonstrate that the conceptual PSR sustainability framework model could provide a simple and reliable approach to evaluate the ecological and environmental security risk in XPCC and may be useful for the planning and management of the local the ecological and environmental situation.

Key words: The Xinjiang Production and Construction Corps, Assessing the Ecological Security Risk, Pressure-state-response (PSR) Framework, Comprehensive Index of the Ecological Effect

Land-use Changes Cause Rapid Loss of Seagrass Resources: Case in Guangxi Province, China

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Abstract: Seagrasses are the flowering plants which have adapted to exist fully submersed in the sea. They play significant roles in providing nurseries and shelters for marine lives, sequestrating carbon, stabilizing sediments, improving water quality, etc. Globally, seagrasses are declining at an accelerating rate mainly due to anthropogenic activities. Here, we present our comprehensive investigation results of seagrass resource in Guangxi, China in 2016. We also accessed the primary causes which induced the losses of Guangxi seagrass resources in the past ~8 years. We used field surveys, combing with Google satellite images interpretations to investigation the area of Guangxi from April to Oct, 2016. Our results show that, total 617.2 hm2 of seagrasses were found along the coast of Guangxi, of which 20.1 hm2 were newly found in 2016. Specifically, seagrasses in Beilunhe Esturary, Western Fangchenggang Bay, Eastern Fangchenggang Bay, Lianzhou Bay, Inner Yingluo Bay, etc., were all recorded for the first time. In the comprehensive survey of 2016, four seagrass species were found, namely Halophila ovalis, Zostera japonica, Halophila beccarii and Ruppia brevipedunculata. Tieshangang and Pearl Bay (Zhenzhugang) were the major seagrass distribution areas in Guangxi, dominated by Halophila ovalis and Zostera japonica, respectively. Total 354 hm2 of seagrasses, accounting for 37.6% of seagrasses area in 2008, were lost as a result of coastal land-use practices, like sea reclamations. These led to -5.5% of annual loss of seagrasses in Guangxi from 2008 to 2016. Besides, the seagrasses Halodule uninervis, Halodule pinifolia and Halophila minor which have been recorded in 2008 in Guangxi, couldn't be found any longer in 2016.

Key words: Coastal Wetland, Aquatic Plant, Sea Reclamation, Anthropogenic Influence

Benefit Assessment on Soil and Water Conservation and Ecological Restoration on the Loess Plateau of China

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Abstract: The Loess Plateau is the most serious area for soil and water loss in the world, and is the key area for soil and water conservation and ecological restoration in China. A series of projects, including the Small Watershed Management Project, Key Soil and Water Conservation Project, Grain for Green Project, Check Dam Construction Project and the Slope Farmland Regulation Project, has been carried out in this area since 1980s. Soil erosion and water loss was under controlled and the ecosystem was restored gradually due to those projects. In order to evaluate the ecological effect for those projects, the dynamics changes of land use and vegetation cover, soil erosion, runoff, sediment transport amounts and social economic structure were analyzed in different scales from plots-small watershed-region based on model building and long-term position monitoring for ecological processes of field stations. The results showed the ecological environment was improved significantly from 1982 to 2013, average NDVI increased from 0.30 to 0.45 reducing the area and intensity of soil erosion and water loss, the annual sediment transport was reduced about 85% in the yellow river in last 15years, of which vegetation restoration made the contribution of 34.9%, sediment wallop dam had the contribution of 22.1%, the changes of rainfall had the effect of 22.1%. Dural the restoration process, the social and economic also developed significantly. On the other hand, serious loss of soil and water still occurred at some plots or areas, the annual erosion rate is till of 4-5 times over allowable value and there is still a long way to continue conduct the ecosystem restoration and management. The strategy were suggested including ecological building, discipline construction, policy management and industrial structure adjustment for the incoming ecological projects.

Key words: Loess Plateau, Soil and Water Conservation, Ecological Restoration, Ecological Benefit

Using Landsat Images to Quantify Different Human Threats to the Shuangtai Estuary Ramsar Site, China

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Abstract: Multiple human activities can impose significant negative effects on wetland ecosystem. This study aimed to identify and quantify the human threats on the Shuangtai Estuary Ramsar site (SERS) by means of detecting wetland landscape changes using Landsat images from 1988 to 2014. Land-cover changes induced by agricultural reclamation, urban expansion, petroleum industry, aquaculture, and the increases in transportation land were identified using an object-oriented classification method and a decision tree. Human-triggered wetland conversions and landscape metrics-characterized wetland changes were documented in order to assess the protection effectiveness after this wetland was listed as a national nature reserve (1988) and a Ramsar site with international importance (2005). Results indicate that wetlands area at this Ramsar site decreased from 127,526 ha in 1988 to 117,805 ha in 2005 and 113,705 ha in 2014 at an annual averaged loss rate of 531.6 ha/yr. The only two vegetated wetland types, Phragmites australis and Suaeda heteroptera, have lost 4788 ha and 12,856 ha, respectively. Aquaculture ponds increased by 9,715 ha, and almost all were transformed from natural wetlands. The landscape metrics used in this study show notable fragmentation trend of wetland as a result of the expansion of transportation lands. Multiple human activities occupied large areas of various wetland types. Comparedto agricultural reclamation and urbanization, wetland changes at the study site were affected primarily by the development of aquaculture and petroleum industry. Obvious wetland loss and fragmentation determined by the analysis of Landsat images suggests that the protection effect has been relatively low in spite of the fact that the SERS is a national natural reserve and Ramsar site. As an internationally critical rest habitat for migration waterfowl, ecological degradation of the SERS and severe human threats create great challenges for ecosystem managements. This study also indicates that the protection effectiveness of other costal wetland should also be assessed using remote sensing to objectively track the conservation or restoration of these areas.

Key words: Remote Sensing, Human Threats, Wetland Loss, Landscape Metrics

Geochemistry of Potentially Toxic Trace Elements in Soils of Mining Area: A Case Study from Zangezur Copper and Molybdenum Combine, Armenia

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Abstract: Pollution of soil with heavy metals to the greatest extent ascribed to human sources, including different anthropogenic activities such as mining, smelting, and various industrial activities. The primary aim of the study was the determination and

evaluation of the impact of mining activity on soil pollution with application of various pollution indices. In this study we Selected 8 zones basing on soil maps and marked 13 points for soil sampling. Soil samples were analyzed for heavy metals using Atomic-absorption spectrometer PG990. During the study 11 metals and nonmetals were analyzed and the greater quantities, as compared with control sample, were observed generally in case of copper and molybdenum. These data were obtained by means of both Contamination factors (Cf) and Geoaccumulation index (I-geo) during the testing of soil contamination level. From studied metals and nonmetals the greater quantities, as compared with control sample, were observed generally in the case of copper and molybdenum. Particularly, in the vicinity of open mine (sample Q-F-11) in horizon A the Cf value in the case of copper was 48.6, in the case of molybdenum 154.0, and in horizon B – 58.4 and 121.8, respectively. The correlation analysis revealed the strongest positive correlation between Cu and Mo and that the high content of these two elements in soil is caused by human activities and the presence of a single pollution source. Contamination assessment based on Degree of contamination (Cd) showed, that the 58.4% of A horizon soil samples referred to a moderate degree of contamination, 8.3% - to a considerable degree and 33.3% - to a very high degree of contamination. From B horizon soils samples 16.7 % had low degree of contamination, 50.0% - moderate and 33.3% - very high degree of contamination. Thus A horizon soil layer is more polluted than soil of B horizon, that is, the high content of studied elements cannot be entirely connected with high content of these elements in soil-forming rocks, but also is conditioned by external factors, in particular by mining activities. Study showed that the soils around Zangezur Copper and Molybdenum Combine were widely and extremely polluted by some heavy metals as a result of long-term industrial activities. Obtained results will be useful for implementation of control measures of pollution and the remediation techniques in the study area.

Key words: Heavy Metals, Soil Contamination, Geoaccumulation Index, Armenia

Assessing Anthropogenic Impact on Deep Water Methane Seep Ecosystem: The South China Sea Case

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Abstract: Deep-sea environment remains the biggest but least known ecosystem in the planet Earth. The recent discovery of rich methane gas-hydrate resources in seep environments of the South and East China Sea provide a potential energy resolution to the neighborhood countries. However, exploring such resources presents not only a great engineering challenge but also possible anthropogenic perturbation which may

result in ecological instability and threaten the deep-sea biological diversity. The study is aimed to investigate biological compositions and trophic relationships of benthic megafauna at the seep and surrounding ecosystems of deep oceans in the South China Sea for further environmental impact assessment. Based on the samples collected during 2013 to 16, we had recognized more than 190 taxa from over 2100 pieces of large benthic animal specimens. The stable isotopic measures (δ13C, δ15N) were taken from tissues of represented samples to elucidate the trophic relationships among major functional groups and eventually result in a novel food web model including seep and nearby bathypelagic fauna. We then apply this model with scenario removal of direct methane-utilizer, the deep mussels, to assess the potential impact on the system and biodiversity. Our simulations suggested the overall system energy, biomass, cycling but not stability indices were affected considerably when >50% of mussel biomass was depleted. Although our preliminary results indicated the isolation nature of deep-water seep ecosystem, the local impact of methane gas-hydrate exploration remains to be carefully assessed and monitored.

Key words: Anthropogenic Impact, Food Web Model, Seep Ecosystem, Trophic Relationships

Effect of Transgenic Insect Resistant Gene Poplar 741 on Arthropod Community Structure and Dynamics

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Abstract: For transgenic Poplars be exploited more and more widely in the production and application of life, the bio-safety issues are much noticed by the public. Therefore, potential bio-safety of arthropod community which caused by transgenic poplars' large-scale planting is becoming increasingly urgent. In order to provide a scientific basis for the ecological safety assessment and rational utilization and extention of transgenic hybrid poplar 741, effect and its rules of the transgenic poplar on arthropod community structure，characteristics and dynamics were studied by the investigation to the community of transgenic BtCry3A and BtCry1Ac gene poplar. The main results are as follows:

1. Effects of transgenic BtCry3A and BtCry1Ac gene poplar 741 on arthropod community structure

The two kinds of transgenic poplar 741 had obvious inhibition on Lepidoptera and Coleopteran insects, reduced the quantity of non-target Hemiptera sucking insects, increased the quantity of predacity natural enemy insects,but the neutral insects had no obvious change.

2. Effects of transgenic BtCry3A and BtCry1Ac gene poplar 741 on nutritional structure of arthropod community

The composition and quantity of the functional groups in transgenic BtCry1Ac gene poplar stand were no difference than that in the control, but less than that in the transgenic BtCry3A gene poplar stand.

3. Effects of transgenic BtCry3A and BtCry1Ac gene poplar 741 on characteristic index of arthropod community

The two kinds of transgenic poplars stand can raise the diversity of arthropod community to a certain extent.

4. Effects of transgenic BtCry3A and BtCry1Ac gene poplar 741 on temporal dynamics of arthropod community

Showing an obvious regularity, the change of arthropod community composition, quantity and diversity in transgenic poplars stand was relatively stable.

5. The principal component analysis and cluster analysis of transgenic BtCry3A and BtCry1Ac gene poplar communities

Cluster analysis showed that the transgenic BtCry1Ac gene poplar community was most similar with control. And the restrictive function of interspecies relation in the two transgenic poplar communities was better than that in the control.

Key Word: transgenic hybrid poplar 741; insect resistant gene; arthropod community; biosecurity

Key words: Transgenic Hybrid Poplar 741, Insect Resistant Gene, Biosecurity, Arthropod Community

Impact of Shifting Cultivation on Biodiversity and Carbon Stock in North-East India

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Abstract: Shifting cultivation is a major driver of tropical deforestation, biodiversity loss and carbon emission. This involves clearing a forest patch using slash-and-burn methods and cropping for a few seasons, after which the farmland is left fallow for vegetation regeneration. Historically, the fallow period lasted for 20-30 years allowing sufficient regeneration of secondary forest. However, due to increasing human population and more demand for farmland, fallow periods have reduced to 2-3 years, leading to incomplete forest regeneration and more frequent clearing. With this marked and increasing contribution of shifting cultivation to forest transformation, it is vital to understand its impact on biodiversity and carbon storage to develop cost-effective mechanism for protecting both biodiversity and carbon without adversely affecting

crop production. Here, we assessed the recovery of biodiversity and carbon stocks following shifting cultivation in Nagaland, North-east India. To do so, we conducted bird point count surveys and measured non-soil carbon stocks in 108 sampling plots across the three main habitat types, i.e. farmland, secondary forest and mature forest, whilst taking variation in age of secondary forest in account. We then used these data to model landscape-level bird diversity and carbon stocks under hypothetical scenarios of changing fallow period to assess the optimum shifting cultivation system for maximising bird diversity and carbon at a regional scale. Results showed that overall bird species diversity and carbon stocks increase across habitats from farmland, secondary forest to mature forest. We also found a progressive increase in both bird species richness and carbon stock with increasing fallow age in regenerating secondary forests. In landscape level, simulation of hypothetical scenarios showed that bird species richness and carbon stock reach similar levels with that of primary forest when a smaller proportion of the total landscape (one sixth of the total area in case of a 30 year cultivation cycle) is farmed intensively and rest of the secondary forests are abandoned for regeneration. Our study depicts that both carbon and biodiversity have a positive relationship with fallow age of secondary forests and therefore, carbon-based payment schemes have the potential to provide co-benefits for both in shifting cultivation dominated landscapes.
Key words: Slash and Burn, Tropical Forest, Biodiversity, Carbon Storage

Water Quality Analyzing at Lake Maninjau, Indonesia

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Abstract: Abstract Indonesia is one of the countries with the highest precipitation in the world. It implies that the actual availability of water is plentiful but water availability is not balanced in terms of place (location) and season (time). Indonesia as a tropical country, the amount of the rainfall is relatively high. In a year, approximately 80% water is available during the rainy season (5 months) otherwise, only 20% of water available in the dry season which relatively longer than rainy season (7 months). Tropical lake is one of the unique ecosystems which are functioning in both ecological and economic services. The objective of this study is to analyze water quality characteristics of tropical lakes in Indonesia, represented by Lake Maninjau. Surveys at Lake Maninjau was conducted in March 2014. The results on the survey in Lake Maninjau showed that the average depth is 105. It covers 13,260 ha of area with a height of 461.5 m above sea level and maximum depth of 165 m. The lake water comes from rainfall, small rivers and the surrounding ground water and one outflow in Batang Antokan River. Next, the percentage value of fish cages at Lake Maninjau was

0.31%. It indicated the potential impact from fish cages to the water quality. In addition, based on water quality profiles (dissolve oxygen/DO, Chl-a and temperature), upwelling caused water quality degradation. In order to maintain the sustainability of the lake, basic ecological information is necessary for the next study.

Key words: Lake Maninjau, Water Quality, Fish Cages, Tropical Lake

Long-Term Changes in Water Quality in Lake Biwa with Special Reference to Organic Matter Dynamics, Microbial Ecology and Diversity

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Abstract: Lake Biwa is the largest and most socially important lake in Japan. About 14 million people who live in Kinki Area use the water of the lake. During 1960' and 1970's due to the large loading of phosphorus and nitrogen, eutrophication in Lake Biwa was serious, leading to phytoplankton blooms since the late 1960's and freshwater red tide since the late 1970's. In 1970's, Japanese Government and Shiga Prefectural Government had started some measures to reduce high phosphorus loading in Lake Biwa. Due to the efforts, the water quality of Lake Biwa has been improved during the last 40 years (for example, N, P and chlorophyll a concentrations have been decreased). Mysteriously, a portion of organic matter expressed by chemical oxygen demand (CODMn) in the lake has been gradually increasing every year. However, chlorophyll a concentration whose high values indicate high production of dissolved organic matter (DOM) have been decreased. Some researchers have reported that the increase in CODMn might be due to the accumulation of refractory and/or semi-labile DOM, and those DOM might be autochthonously produced. We have partly clarified the microbial processes with special reference to production of those DOM in Lake Biwa, especially in the lake's hypolimnion. In the epilimnion of the lake, phytoplankton biomass is produced through primary production, followed by sinking in the hypolimnion. In the hypolimnion, a part of the phytoplankton biomass is converted into humic-like DOM through decomposition by planktonic bacteria. Fluorescence in situ hybridization (FISH) showed that bacterial clade, CL500-11 (phylum Chloroflexi), predominates in the hypolimnion. Further analyses on prokaryotic community composition by high throughput 16S rRNA gene amplicon sequencing demonstrated that ubiquitous tribes in epilimnion can also dominate in the hypolimnion (e.g. bacI-A1 & acI-B1), and that members of Planctomycetes (e.g. CL500-15, CL500-37 & CL500-3), together with CL500-11 exclusively occurred in the hypolimnion. In

addition, FISH on eukaryotes showed that bacterivorous kinetoplastid flagellates are the dominant eukaryotes in the hypolimnion. Furthermore, high throughput 18S rRNA gene amplicon sequencing showed the presence of possibly novel hypolimnion dwelling bacterivorous flagellates (e.g. cercozoans, choanoflagellates and telonemids). So, the results indicate the presence of unique microbial food webs in the hypolimnion of Lake Biwa, where humic-like DOM is produced by the hypolimnion bacterial assemblages, and those bacteria are grazed by the dominant kinetoplastids and other hypolimnion dwelling bacterivorous protists. Thus, the deep waters of Lake Biwa harbor active microbial loop consisting of novel hypolimnion-specific groups, which might play an important role in the production of refractory DOM. This work was funded by JSPS KAKENHI Grant Number 15J00971, by Japan Science and Technology Strategic International Research Cooperative Program project 'Fate of dissolved organic matter in lakes with special reference to loading and pollution' and by the Environment Research and Technology Development Fund [grant number 5-1607] of the Ministry of the Environment, Japan. Indranil Mukherjee was supported by the Monbukagakusho scholarship provided by the Japanese Ministry of Education, Culture, Sports, Science and Technology.

Key words: Eutrophication, Hemical Oxygen Demand, Dissolved Organic Matter, Bacteria

Determining the Impact of Free-Ranging Livestock on Wild Ungulates in Wanglang National Nature Reserve, SW China

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Abstract: During the past two decades, the dramatically increasing livestock that are freely dwelling in and around nature reserves has become to a major threat to protected area management across China. While compared to wild ungulates, domestic animals were in general characterized by larger body size, higher density, less fear in behavior, more consumption of food resources, and more intensive disturbance to the habitat. These free-ranging livestock will compete with wild herbivores for limited space and food resources, and greatly increase the risk of disease transmission. Overabundant livestock may also have negative impacts on seedling recruitment, vegetation regeneration, forest structure, and further alter the ecosystem processes. To examine the influence of free-ranging livestock on wild ungulates, we randomly selected 66 quadrats in Wanglang Alpine Conifer Forest Dynamics Plot, SW China, a natural habitat of the iconic giant panda Ailuropoda melanoleuca, and conducted

infrared-triggered camera-trapping to study the interaction between domestic and wild large herbivores from 2013 to 2016. We recorded five wild ungulates and two livestock species with a sampling effort of 3361 camera-days. Three species with sufficient detections (>100), i.e., domestic cattle Bos Taurus (431 detections), horse Equus caballus (375 detections) and tufted deer Elaphodus cephalophus (195 detections), were included in further analysis. Density estimation was used to evaluate the activity pattern of each species and calculate the temporal overlap between each species pair, and occupancy modelling was used to determine the spatial co-occurrence patterns between domestic and wild animals. The results showed that, livestock had become the dominating herbivores in this forest ecosystem. Tufted deer and horses utilized the plot throughout the year, whereas the cattle occurred in the plot only during growing season (May-September). When livestock, either horses or cattle, were present, the activity pattern of tufted deer will shift accordingly to reduce their temporal overlap. The mean dwelling durations of domestic cattle (305s) and the horse (300s) at specific location were both significantly longer than that of tufted deer (35s). The presence of cattle had a negative impact on both the occupancy rate and detection probability of tufted deer, whereas the presence of horses showed no impact on the spatial occupancy of tufted deer. Our results indicated that, tufted deer might take different strategies, through temporal or spatial niche differentiations, against the much more abundant domestic horses or cattle to reduce the inter-specific competition and therefore facilitate their co-existing. Our study provided preliminary data and insights the complicated interactions of free-ranging livestock and wild ungulates in the forest of SW China. The results will have further implications to the protected area management and wildlife habitat conservation across the region and elsewhere.

Key words: Wild Ungulate, Free-ranging Livestock, Activity Pattern, Spatial Co-occurrence Pattern

Effect of Soybean Cultivation on Soil Collembola Community in Sanjiang Plain Wetland, Northeast China

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Abstract: The Sanjiang plain as one of the largest freshwater wetland ecosystems in China has experienced intensive cultivation over the past 60 years. Most of the marshland were converted to soybean and rice fields. However, since the establishment of the Sanjiang national nature reserve in 1994, a lot of wetland restoration were adopted in agricultural land use areas. Little is known about the dynamic change of soil fauna in this bidirectional succession of wetlands. Therefore, we surveyed the soil

Collembola community of three soybean fields that have been cultivated for differentyears (2, 15, 25 years), two wetlands that have been restored for different years (6, 12 years) and original wetland which represents the habitat without destruction. We also analysed the relationship between the community structure and the environmental factors.

During the wetland reclamation, a total of 36894 soil Collembola, belonging to 30 species, 16 genera and 8 families were captured, but they differed remarkably between original wetland and farmland. Different years of cultivation had a markedly significant difference on densities and species richness（$P<0.01$）, specially, S2>S0>S15>S25. That is to say, short-term cultivation will promote the densities and species richness of soil Collembola, medium-term cultivation will significantly decrease the densities and species richness, and long-term cultivation can partly replenish the diversity of soil Collembola.

During the wetland restoration, a total of 21842 soil Collembola, belonging to 31 species, 16 genera and 8 families were captured. Folsomides sp2, Onychiurus allonychiurus, Onychiurus oligaphorura, Onychiurus protaphorura as the dominant species account for 54.27% of the total collembolan community. Common species including Bourletiella sp1, Desoria sp1, Desoria sp2, Desoria sp4, Entomobrya sp4, Folsomia sp1, Folsomia sp2, Hypogastrura sp1, Hypogastrura sp2, Isotomiella sp1, Orchesellides sp1, accounted for 41.59% of the total collembolan community. Rare species including Desoria sp3 and other 13 species, accounted for 4.14% of the total collembolan community. Different years of restoration had a markedly significant difference on densities and species richness（$P<0.01$）, specially, R12>S0>R6. Those wetland restoration measures can significantly improve the farmland environment and even better than the native wetland.

In conclusion, wetland reclamation and wetland restoration significantly affect the soil Collembola community. We presume that the plant communities and soil traits are key factors that affect the composition, abundance and diversity of the soil Collembola community.

Key words: Sanjiang Plain Wetland, Collembola, Wetland Reclamation, Wetland Restroration

T6-04: Patterns of Freshwater Biodiversity and Ecosystem Management

High-mountain Lakes and Karstic Aquifers – Two Contrasting and Endangered Ecosystems from Slovenia

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Abstract: Slovenia, with an area of 20,000 km^2, is among the smallest countries in Europe but at the same time with the very diverse and rich surface as well as sub-surface biodiversity. About 50% of Slovenia is covered by karst, where 15 high-mountain and several intermittent and permanent surface lakes are known as well as more than 12.000 caves. Both ecosystems have some specific restrictions which make them vulnerable and thus they need specific and complex management.

Intensive investigation of high-mountain lakes in Slovenia started in 1991and was regularly performed each autumn till 2014. Studies included physical and chemical characteristics of water column as well as fauna and flora in the water column and littoral zone. Along unique community of macrophytes a rich fauna of Copepoda, Cladocera and insect larvae was found there. The lakes get endangered after 1991 due to intensive tourist activities as well as introduction of fish. The fish were not present in the lakes before 1990 but after their introduction significant changes in fauna composition as well as in the water quality happened. Additional threats to high mountain lakes ecosystems are also climate changes and long-distance pollution. Decrease of water quality affects water supply for inhabitants in lowlands.

The first scientific investigation of groundwater fauna in Slovenia started about 150 years ago. Today it represents hot-spot of groundwater biodiversity with about 200 known stygobionts (= exclusive groundwater dwellers). Majority of species belong to Mollusca (snails) and Crustacea (crabs) with Copepoda as the most abundant crustacean group. Apart those two groups are some other groups, with very few representatives in groundwater: Hydrozoa, Polychaeta, Cladocera, Calanoida, and Urodela. Rich and diverse groundwater dwelling fauna represents a unique assemblage of genetic pool as a result of specific evolution and also tool for studies of geological/tectonic events. Groundwater fauna is endangered due to pollution, water abstraction and modifications of river beds, thus special attention is needed for protection of unique and endemic groundwater fauna. As majority of drinking water in Slovenia origins from groundwater, a good status of groundwater fauna is guarantee for high-quality drinking water, too.

Key words: High-mountain Lakes, Climate Change, Biodiversity, Pollution

Population Genetics Structure of Daphnia Galeata

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Abstract: Cyclically parthenogenetic Daphnia galeata is widely distributed in four main river catchments and the Tibetan Plateau across China, nuclear and mitochondrial markers are used to investigate population and genetic structure over vast geographic distances under. We observed evidence the contribution of long distance dispersal as well as genetic isolation in the landscape genetic structure of this species. Eight out of the sixty six observed COI haplotypes were shared among populations in all four catchments. Across the whole data set from Tibetan Plateau to East China, isolation by distance is observed for both mitochondrial as well as nuclear markers, but it was highly dependent on the presence of the Tibetan populations, which were highly differentiated from the populations in the other catchments. There was a lack of strong signal of catchment for the distribution of mtDNA haplotypes and genetic structure as derived from microsatellite markers, even though the distances covered were substantial (>3,000 km). Our data suggest that D. galeata can achieve long distance dispersal and some populations with specific haplotypes can colonize habitats from the temperate to the subtropical zones. There was no strong pattern of genetic differentiation in relation to temperature or altitude when the Tibetan populations are removed from the whole dataset. The populations in the Tibetan plateau stand out and are strongly isolated from any of the others. They have the highest genetic diversity, with up to fourteen private haplotypes being found in a single population. Yet, all these haplotypes seem to be derived from one single haplotype, suggesting that these populations are both very old and isolated. Our findings of long distance dispersal in the four catchments combined with high genetic differentiation among populations (mean FST=0.31) are in line with a scenario where population genetic structure is strongly impacted by colonization patterns ("Isolation by colonization"). The landscape genetic structure of D. galeata in China reflects both the importance of long distance dispersal as well as of reduced levels of gene flow, likely caused by priority effects or monopolization.

Key words: Genetic Differentiation, Isolation by Colonization, Monopolization Hypothesis, Tibet

Distribution, Leaf Diversity and Quality of a Chinese Endangered Aquatic Vegetable Brasenia Schreberi

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Abstract: The watershield, Brasenia schreberi, is a floating-leaved macrophyte of the Nymphaeaceae family. It was once a popular aquatic vegetable in east China on the history, but has been diminishing during the past decades and now been listed as a first-class endangered species. The plant is characterized with thick mucilage that covers all of the underwater organs, including underside of leaves, petioles, stems and developing buds. Such mucilage is rich in polysaccharide, and has been considered to have strong anti-bacteria and immune effects. China is trying to recover the watershield populations both for biodiversity protection and for food production, and primary aquacultures of watershield can now be found in Suzhou and Hangzhou of east China as well as Shizhu and Leibo in central China. We didn't find any difference on mucilage contents of B. schreberi from Suzhou, Hangzhou and Shizhu. However, we had verified three different strains with colors of the underside of leaves, a full dark red type (DR-type), a light red type (LR-type) and a green type (G-type). Edible buds of the DR-type watershield contained 47% (w/w) of the mucilage, which was about two times of the contents from LR- and G- types plants. Further chlorophyll and fluorescence research suggested that the DR-type leaves were relative heavier than LR- and G-types leaves (shown as special leaf weight). DR-type leaves also had the highest levels of both chlorophyll and carotenoids contents on a base per unit area, followed by LR-type, and then G-type. Maximun quantum yield (Fv/Fm) of photosynthesis II (PSII) of the three types leaves were all about 0.825, with LR-type leaves slightly higher. However, quantum yield (ψPSII), electron transport rate (ETR) and photochemical quenching (qP) from light induction curves were all lower with LR-type leaves. Such fluorescence indices were proved to be similar between DR- and G- types leaves. The DR-type leaves had the highest non-photochemical quenching (NPQ), followed by LR-type leaves, and G-type leaves being the lowest. Our research suggested that the varied leaf colors of watershield represent diverse leaf function and quality of the vegetable, attentions should be paid on the diversity of the species during restoration.

Key words: Brasenia Schreberi, Endangered Species, Leaf Phenotype, Leaf Function

How Do Fish Communities Respond to Anthropogenic Stressors in Lakes Along the Eastern Route of China's South-to-North Water Diversion Project (SNWDP)?

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Abstract: Fish communities have been commonly described and frequently used to assess the effects of anthropogenic stressors on freshwater ecosystems. This article aimed at testing and understanding the mechanism of fish communities respond to the anthropogenic stressors from China's South-to-North Water Diversion Project (SNWDP). A database of fish compositions in five large lakes (Gaoyou Lake, Hongze Lake, Luoma Lake, Nansi Lake, Dongping Lake) along the eastern route of the SNWDP was compiled from both 1980s and 2010s, which represent the before and after status of the construction of SNWDP. Widely observed effects of hydrological, environmental and ecological variations were identified. Our results indicated that taxonomic diversity of fish communities in each lake decreased considerably over the past 40 years. Moreover, a significant homogenization was found among the fish communities in these 5 lakes. Environmental and hydrological variations related to the SNWDP were the main drivers in structuring the fish communities. Our research will contribute considerably to the ecological assessment of the SNWDP and also the conservation of fish diversity.

Key words: SNWDP, Fish Diversity, Environmental Changes, Anthropogenic Stressors

Periodic Wind Mixing Enhances Cyanobacterial Dominance in Large, Shallow, Eutrophic Lake Taihu, China

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Abstract: Harmful blooms of cyanobacteria (CyanoHABs) have increased globally, creating serious threats to drinking water supplies, ecological and economic sustainability of freshwater ecosystems. Cyanobacterial dominance is controlled not only by nutrient supplies but also by physical processes. Wind waves induce several physical processes in large, shallow lakes, the most important of which are turbulence, turbidity, and release of nutrients from sediment. Using field observations and mesocosm bioassay experiments, we investigated the impact of turbulence generated by wind waves on the phytoplankton community composition (focusing on CyanoHABs) in Lake Taihu, a large, shallow eutrophic lake in China. During summer,

when wind waves were strong in the central lake, diatoms and green algae seemed to dominate while harmful cyanobacteria dominated in more sheltered, highly eutrophic Meiliang Bay. Bioassays showed phytoplankton only grew well within the upper 1 meter of the water column, due to high turbidity. Turbulence-induced bioassays showed that diatoms and green algae were favored by continuous turbulent mixing. However, short-term intermittent turbulence enhanced dominance by cyanobacteria. What depth increase hampered turbulence influence on phytoplankton biomass and composition? Climatic changes have led to warming and lower wind speeds in Taihu basin. Resultant enhanced stratification enhanced dominance by buoyant CyanoHAB species. This study suggests that the duration and intensity of wind events and associated hydrodynamic changes are key factors to understanding cyanobacterial dominance and bloom formation in Taihu.

Key words: Cyanobacterial Bloom, Wind, Turbulence, Lake Taihu

Pattern of Relationship between Feeding Structure and Prey Selectivity in Rotifers: Applicability of Functional Feeding Group (FFG) of Zooplankton Community and Diversity

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Abstract: In terms of environmental assessment using biological community, functional group is useful categorization for understanding function as well as structure. In zooplankton, body size has been considered as one ecologically applicable feature categorizing their function representing prey selectivity. However, in the case of rotifers dominant in eutrophic water bodies, they have characteristic mastax called trophi (a masticatory apparatus composed of hard, sclerotized and articulated segment) which is related to their feeding behavior. Because feeding behavior can represent not only food consumption but also the result of competition and overall environmental condition, it can be one classification key of functional feeding group (FFG) of rotifer. Structure of trophi is species-specific, therefore, trophi can be key-point of taxonomic characteristic. At the same time, different trophi structure can represent their feeding behavior (grasping, grinding, pumping, or suction) and habitat preference. In recent study, we applied six types of FFG to identify the relationship between rotifers community and their environment such as water quality (EC, COD and nutrients) and food assemblages (densities of phytoplankton, heterotrophic nano-flagellates, ciliates, and bacteria), and it has been suggested that composition of rotifer FFG shows different tendency in accordance with various environmental factors. In the present study, we verified applicability of rotifer FFG in zooplankton community based on the data

collected from various water bodies. To identify detailed relationship between FFG and food environment, we collected rotifer species having different trophi as well as different sizes from reservoirs, and tried DNA approach to list up their prey items and estimate their differences. In addition, we analyzed the response patterns of species diversity and functional feeding groups diversity for looking at the potentiality in zooplankton diversity.

Key words: Trophi, Feeding Behavior, Biodiversity, Multivariate Analyses

The Impacts of Saline Mine Drainage from the Talvivaara Mining Complex on Cladoceran and Diatom Communities in Lake Kivijärvi

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Abstract: Mining can have considerable impacts on freshwater ecosystems. Mine water drainage, pond leaching and tailings dam accidents are widely regarded as serious threats to aquatic biota. While effects of acidic mine drainage are relatively well studied, the environmental impacts of saline and metal contaminated, but only lightly acidified (temporarily and locally) mine water are not yet fully assessed. We used an extensive paleolimnological data set (cladoceran remains, diatoms, and elemental concentrations), contemporary water quality data, biological monitoring data, and recorded land use history to assess the environmental history and the ecological impacts of recent mining activities on cladoceran and diatom communities in the rural Lake Kivijärvi, located in the vicinity of the troubled mine Talvivaara, once aiming to become Europe's biggest nickel mine. Fishing activity and forestry are visible in the cladoceran composition and in geochemical sediment record from the early 20th century. Recent mine water pollution has had a strong impact on the cladoceran and diatom communities. Mine pollution is also clearly visible in the sediment elemental concentration trends, in particular in the pronounced rising Ni and Zn after the commencement of mining activities. In addition, saline mine water has caused Lake Kivijärvi to become meromictic. Thus, the circulation of nutrients has ceased and primary production has decreased. A permanent stratification has also removed the possibility of vertical migration and has subsequently exposed Daphnia to intensified fish predation resulting in nearly complete elimination of Daphnia. Elevated concentrations of heavy metals in the sediment and deep water anoxia may hamper cladoceran community recovery due to lowered hatching success from sedimentary resting eggs, even as pollution has recently decreased. Mine water is usually characterized by acidity and accompanying high levels of trace metals. However, in the lake, the effects of mine pollution are drastic even as there is no acidification involved.

Key words: Minewater, Cladocera, Diatoms, Heavy Metals

Temperature Adaption of Daphnia Galeata Based on Life Table Experiments

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Abstract: We conducted 7 clones of Daphnia galeata G. O. Sars 1863 to investigate the influence of temperature (T) on life history through standard life table experiments. D. galeata, a species is classified in D. longispina complex, and it has a wide Holarctic distribution. The used clones included five clones from China (C: Chaishitan Reservoir, Yunnan; E: Erlongshan Reservoir, Haerbin; L: Liuxihe Reservoir, Guangdong; Q: Qiandaohu, Zhejiang; X, Xujiahe Reservoir, Hubei), one from Germany (G: Lake Constance) and one from Czech Republic (R: Rimov Reservoir). No clone was able to have a whole life-cycle at 30℃, it is therefore considered to be at or above CTmax for all clones. All clones grew poorly at 10℃, and they did not produce second generation offspring. So 10℃ was thought to be at or below CTmin. The experiments showed that temperature had a strong effect on the traits of clones. There was significant intraspecific variation in thermal performance curves (TPCs) of three traits (number of newborn, ARF, average of clutch size), but there was no significant intraspecific variation of other life history variables. Life-span, age at first reproduction (AFR) and size at first reproduction (SRF) were decreased linearly with temperature and their temperature performance curves (TPCs) were followed by the same nonlinear regression: log P = b1*log(T)+ b0). The nonlinear regression: P =b3·T3+b2·T2 + b1·T+b0 was employed to fit TPCs of intrinsic rate of population increase (r), net reproductive rate (R0), number of newborn and clutches size. They were convex over the temperature interval, therefore, the optimum T of number of newborn of six clones was 20-25℃, while clone Q was 18-20℃, the optimum T of number of clutches size was also 20-23℃, but the clone E was 25-28℃, the R0 had optimum T between 20 to 23℃, while the r of clone that from subtropical monsoon climate had the highest optimum T (28-30℃) and the clone of C, R and G just between 23 to 25℃, all of three clone from temperate continental climate. All of TPCs accounted for by generalist-specialist type of variation, the clones from subtropical monsoon climate had wider thermal safety margins than those clones from the temperate continental climate, which indicating potential for further adaptation incase of an increase in environmental temperatures.Keywords: temperature, Daphnia. galeata, fitness, life history, TPCs

Key words: Temperature, Daphnia. Galeata, Fitness, Life History

A General Modelling Framework for Metapopulation Dynamics in Size-structured Riverine Networks

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Abstract: Different from other ecological networks, riverine networks that feature particular structural and dynamic characteristics deserve special attention. Yet, the dynamics of species constrained to dispersal within riverine networks are not well captured by existing metapopulation models. We develop a conceptual framework for metapopulation dynamics subject to local colonization-extinction dynamics and regional dispersal process in closed size-structured riverine systems. Interestingly, two-way dispersal is not always an optimal strategy for species persistence relative to one-way dispersal, as both population demographic characteristics and riverine topological structure can greatly alter the two-way dispersal superiority. Increasing hierarchical levels and branchiness generally reduces metapopulation persistence, but species show more vulnerability to hierarchies by comparison, indicating that separating branchiness from hierarchies can better understand the dendritic topological effects on metapopulation viability. Furthermore, while upstream- or downstream-biased dispersal increases species extinction risk, unbiased dispersal maximizes global patch occupancy due to the balance between local demographic and regional dispersal-driven forces among patches at different hierarchical levels. Overall, our theoretical framework that directly considers the hierarchical branching geometries of size-structured networks offers new perspectives for riverine metapopulation dynamics.

Key words: Riverine Networks, Metapopulation Models, Downstream and Upstream Dispersal, Hierarchical Levels

Spatial and Temporal Distribution of Phytoplankton during the Transition Levels between River- and Lake-type in Lake Poyang: A Yangtze-connected Lake

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Abstract: As one of the two lakes that are freely connecting with the Yangtze River, Poyang Lake exhibits highly variable water-level fluctuations every year. In order to fully understand the phytoplankton spatial distribution and its relationship with the environment factors, field investigations were performed in Jul and Oct from 2012 to 2014. Statistical analysis showed that phytoplankton composition of Poyang Lake was

characterized by a pronounced dominance of diatoms, accompanied by cyanobacteria and green algae in periods of transition levels between river- and lake-type. The results of principal components analysis didn't showed a distinct temporal shift in species composition during sampling periods. The biomass was high in the south and east, the lowest in the north, which may be the results from the nutrients increasing and light availability in the southern and eastern area. Multiple analyses showed that light availability is the major factor determining the spatial distribution of phytoplankton; nevertheless，nutrients did not explain much variation in phytoplankton distribution, except south and east Poyang Lake. Light availability, compared with nutrients showed relatively higher explanation power for phytoplankton spatial distribution which was significantly positively correlated with light availability in full lake. The phytoplankton biomass decline gradual in the all sampling periods, while the proportion of cyanobacteria increased stably. These results showed that results of light availability and nutrients increase, cyanobacteria will become the dominant species replacing diatoms in period of transition levels between river- and lake-type.

Key words: Poyang Lake, Phytoplankton Distribution, Light Availability

iTRAQ-based Proteomics Analysis Revealed the Embryo Teratogenic Mechanism of Cyanobacteria Exudates on an Endangered Native Fish

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Abstract: Harmful Cyanobacteria Blooms (HCBs) have been a world-wide aquatic environmental problem for decades, and would be aggravated by global climate changes. One of the consequent risks is the cyanobacterial hazardous secondary metabolisms in freshwater ecosystem. Our former research showed that cyanobacterial exudates from exponential phase cells could strongly induce teratogenic effects in Sinocyclocheilus grahami embryo, but the underlying molecular mechanism are still remained unknown. The iTRAQ-based quantitative proteomics analysis has been applied to identify the differently expressed proteins between the healthy embryo and cyanobacterial-exudates-cultured embryo in hatching stage. We identified 446 high-confidence protein groups ($P<0.05$; ratio≥ 2, up- or down- regulated expression), and some of them are mainly involved in organ development (especially the development of heart), balance regulation of calcium ion and lipid metabolisms etc. These findings help us to elucidate deeply the hazardous mechanisms of cyanobacteria exudates on the co-existing fishes.

Key words: Cyanobacteria, Proteomic, Embryo, Teratogenic Mechanism

Disturbance-induced Phytoplankton Regime Shifts and Recovery of Cyanobacteria Dominance in Two Subtropical Reservoirs

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Abstract: Many countries in the world still suffer from high toxic cyanobacterial blooms in inland waters used for human consumption. Regional climate change and human activities within watersheds exert a complex and diverse influence on aquatic ecosystem structure and function across space and time. However, the degree to which these factors may contribute to the long-term dynamics of plankton communities is still not well understood. Here, we explore the impacts of multiple extreme disturbance events (e.g. human-resettlement, temperature change, rainfall, water level fluctuations), including six combined disturbances, on phytoplankton and cyanobacteria in two subtropical reservoirs over six years. Our data showed that combined environmental disturbances triggered two apparent and abrupt switches between cyanobacteria-dominated state and non-cyanobacterial taxa-dominated state. In late 2010, the combined effect of human-resettlement (emigration) and natural disturbances (e.g. cooling, rainfall, water level fluctuations) lead to a 60-90% decrease in cyanobacteria biomass accompanied by the disappearance of cyanobacterial blooms, in tandem with an abrupt and persistent shift in phytoplankton community. After the summer 2014, however, combined weather and hydrological disturbances (e.g. warming, rainfall, water level fluctuations) occurred leading to an abrupt and marked increase of cyanobacteria biomass, associated with a return to cyanobacteria dominance. These changes or shifts in phytoplankton community were strongly related to the nutrient concentrations and water level fluctuations, as well as water temperature and rainfall. As both extreme weather events and human disturbances are predicted to become more frequent and severe during the twenty-first century, prudent sustainable management will require consideration of the background limnologic conditions and both the frequency and type of disturbance events when assessing the potential impacts on reservoir biodiversity and ecosystem functioning and services.

Key words: Climate Change, Cyanobacterial Bloom, Multiple Disturbances, Watershed Management

Influences of Environmental Factors on Macroinvertebrate Assemblages: Difference between Mountain and Lowland Ecoregions, Wei River, China

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Abstract: Key environmental drivers and their influence mechanisms on stream physicochemical habitat and macroinvertebrate communities may vary among ecoregions. Using Wei River basin's two ecoregion setting, we studied such differences in environmental drivers and their influence mechanisms on stream conditions. We collected macroinvertebrates and measured environmental factors (land use and physicochemical variables) from 48 stream sites from mountain and lowland ecoregions in 2012. We applied generalized linear model to identify key environmental factors influencing macroinvertebrate metrics of taxa richness, Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa, relative abundances of EPT and inlerant individuals, and Shannon-Wiener diversity index. Environmental factors and assemblages significantly differed between mountain and lowland ecoregions. Lowland streams had significantly higher nutrients and percentages of silt substrate resulted from the high amount of agricultural and urban land use at catchment and reach scales. Mountain streams had total taxa richness two times greater than lowland streams. Catchment land use was strongly related to stream macroinvertebrate assemblage. Catchment and riparian agricultural and urban land uses are key drivers influencing physical habitat in the mountain ecoregion, but land uses are main drivers influencing both physical and chemical conditions in the lowland ecoregion. As a result, stream benthic macroinvertebrates metrics are predominantly influenced by land uses and physical habitat in the mountain ecoregion, but such metrics are strongly influenced not only by land use and physical habitat, but also chemical variables in the lowland ecoregion. Our results provide new insights on identifying key environmental drivers and understanding how they constrain physicochemical habitat and biological communities among ecoregions. Our findings help bioassessment and bioriteria establishing for ecoregions with different natural settings and different mechanism in how anthropogenic activities influence stream physicochemical and biological communities.

Key words: Land Use, Spatial Scales, Ecoregion, Generalized Linear Model

Low Dose of Yttrium Enhanced Tolerance of Submerged Macrophyte Potamogeton Crispus L. To Heavy Metal Nickel

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Abstract: As an anthropogenic stressor, heavy metal pollution has become a global aquatic problem because heavy metals are toxic, persist for several decades in limnological environments. Nickel (Ni) is an essential micronutrient for aquatic plants but is toxic to plants at excess levels like enhanced extracellular peroxidase activity. Previous studies have shown that certain amounts of rare earth elements (REEs) can enhance terrestrial plants resistance to environmental stresses, promote their growth and development; little is known about interactive effects of REEs and heavy metals on submerged macrophytes. The present study was designed to explore the potentially amelioratory effect of yttrium on Ni induced toxicity in aquatic macrophyte Potamogeton crispus. P. crispus steriled seedlings were exposed to mixtures of Ni (0, 0.05, 0.10, 0.15, and 0.2 mmol/L) and dissolved yttrium (0 and 2.5 μmol/L) in a full factorial design for 5 days. By physiological and biochemical approaches, the exposed plants were analyzed for oxidation damage, changes in polyamines (PAs) metabolism. In single Ni treated P. crispus as compared to control, higher-concentration Ni significantly ($P>0.05$) increased reactive oxygen intermediates ($O_2^{\cdot}-$ and H_2O_2), lowered spermine, spermidine, polyamine oxidase and diamine oxidase contents, suggesting that heavy metal Ni induced toxicity, as result of enhanced oxidation damage and inhibited plant growth regulation. When co-administered by low-dosed yttrium, $O_2^{\cdot}-$ and H_2O_2 were substantially decreased to the control ($P>0.05$). Additionally, yttrium triggered spermine and spermidine contents even more than the control. Thus, the present study indicates that the Ni toxicity on P. crispus could be substantially ameliorated by yttrium, via activating the antioxidant protection and growth regulation. From an application perspective, that low-dosed yttrium has a potential to be developed as preventive agent against Ni induced toxicity in submerged macrophytes.

Key words: Heavy Metals, Toxic Effects, Polyamines Metabolism, Plant Tolerance

Effect of Water Level Fluctuations on Variations of Anabaena Abundance and Its Heterocyst in Poyang Lake

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Abstract: As one of the only two lakes that retain its free connection with the Yangtze River, Poyang Lake exhibits great annual and interannual water level fluctuations. The biomass, abundance of Anabaena and heterocyst frequency and the corresponding environmental parameters were weekly or bi-weekly monitored during the period June to November in 2013 and 2014. Anabaena was observed throughout the year, and the average relative biomass of Anabaena in the study period was over 40%, being most abundant in summer. Anabaena formed heterocyst and well-adapted to the low nitrogen concentrations in the high water level phase in Poyang Lake, indicated that reflecting nitrogen deficiency in Poyang Lake. The results can provide a theoretical basis for the protection and utilization of Poyang Lake. Relating to this, management objectives should be focused on restricting the external phosphorus loading in order to reduce water column phosphorus concentrations in Poyang Lake.
Key words: Anabaena, Heterocyst, Poyang Lake, Water Level Fluctuation

Warming and Oligotrophication Cause Shifts in Freshwater Phytoplankton Communities

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Abstract: Freshwater ecosystems show rapid responses to anthropogenic pressures such as climate change and eutrophication. Hence they have become model systems to investigate singular and synergistic effects of warming and fertilization in situ as well as in experiments. However, we now see a Europe wide trend of nutrient decrease (re-oligotrophication) in freshwater systems, for which we need predictions on community and functional responses, especially in the context of temperature increase through climate change. Therefore, we used a new experimental indoor mesocosms setup, the Planktotrons, to investigate the interactive effects of nutrient reduction and gradual temperature increase on a natural freshwater phytoplankton community. We found a significant reduction of species richness through increasing temperature stress. Biomass was higher under constant nutrient conditions compared to the treatment with sequential nutrient decrease. We observed an interactive effect of temperature stress and nutrient reduction on phytoplankton diversity, which lead to a hump shaped pattern over time in evenness and biomass production. Given the dependence of ecosystem functions on species diversity, we point out the necessity of careful monitoring such patterns and appropriately adapt management plans. Multiple stressors could lead to unexpected (sudden) regime shifts, with far-ranging consequences for ecosystem services and intended uses.
Key words: Biodiversity, Phytoplankton Community, Oligotrophication, Climate

Change

Formulating a List of Sites of Waterbird Conservation Significance to Contribute to China's Ecological Protection Red Line

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Abstract: China makes a unique and vital contribution to maintaining global and regional waterbird diversity and conservation. Despite considerable historical conservation efforts, the continued loss of waterbird diversity and abundance necessitates a contemporary review of Chinese sites of conservation significance. The Ecological Protection Red Line (EPRL) was proposed by China's Central Government in 2013 to protect areas providing crucial ecosystem services and provides the opportunity for such a review to enhance waterbird conservation in China. By incorporating various sources of data, surveys and information, we identified a suite of sites of waterbird conservation significance in China, following the Ramsar Site Criteria/Important Bird and Biodiversity Area (IBA) Criteria. In total, we identified 422 sites, of which the existing 286 IBA sites formed the basis of the site safeguard network. Altogether, these sites of waterbird conservation significance constitute over 727,000 km^2 (7.6% of China's land surface). Over half of the area of these sites is outside of the China's national nature reserves, which confirms the importance and urgency of including them in EPRL for the effective conservation of waterbird sites. We suggest that this assessment of sites of waterbird importance offer a useful model to apply to other taxa, such as terrestrial birds and mammals.

Key words: Conservation Gaps, Important Bird and Biodiversity Areas, Ramsar Convention, IUCN Red List

Large-Scale Patterns in Microbial Biodiversity in Lakes and Reservoirs across China

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Abstract: G. Evelyn Hutchinson, one of the great freshwater ecologists of the 20th century, wrote at the start of a famous paper published in 1964 that 'The great intellectual fascination of limnology lies in the comparative study of a great number of systems'. We have used samples from over 50 lakes and reservoirs from across China

to investigate large scale patterns in microbial ecology. We compared the taxonomic or functional communities of bacteria, eukaryotic microbes (testate amoebae), and antibiotic resistance genes (ARGs) from these water bodies – from the sub-tropical zone in the south, to the edge of the Steppes in Inner Mongolia to the north. Studies that describe large scale patterns in the biogeography of microorganisms are relatively rare. This study aimed to describe the variation in aquatic microorganisms across China to provide a context for more applied studies on ecosystem management. However, these data also allow large scale questions in microbial ecology to be addressed, as well as more applied questions such as the relationship between human population size in a lakes catchment and the extent of ARGs in the water (as expected we found a positive correlation between these two factors).

In the biogeography of macroscopic organisms it is common to find relationships between species richness and latitude and/or altitude. Indeed the relationship between species richness and latitude is one of the more robust and striking relationships in the large scale ecology of macroscopic organisms. However, in an analysis of testate amoebae from 51 lakes and reservoirs we failed to find any significant relationship with latitude, but there was a decrease in species richness with increased altitude of water body. New methods (e.g. high throughput sequencing) now allow the identification of taxa that are at such low concentrations in the plankton that they would have been invisible to older microscopy-based approaches. Over the last decade this has led to several studies of the so-called rare biosphere, many of which have concentrated on marine systems. For lakes and reservoirs across China we compared the community similarity of bacterioplankton for sites at different geographical distances. For macroscopic organisms one normally expects increasing dissimilarity with increasing distance between sites. We also found this relationship for our full bacterioplankton data set, and also for sub-sets of both common and rare bacteria. This result is of interest given the suggestion that random processes may be much more important for rare microorganism – if this was so it should obscure the distance relationship for the rare biosphere.

Key words: Biogeographical Pattern, Communityassembly, Testate Amoebae, Bacterioplankton

Spatial and temporal distributions of bacterioplankton in a large plateau lake of southwest China

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Abstract: Fuxian Lake, a subtropical and oligotrophic system in southwest China, is

home to ~ 9% of Chinese strategic freshwater resources. However, the water quality of Fuxian continues to deteriorate because of the increasing catchment development and nutrient inputs. Thus, it is needed to evaluate food web structure and ecosystem processes for sustainable catchment management and lake conservation. Bacteria serve as key decomposers and play a central role in nutrient cycling (such as carbon) and energy flow in lake food webs. Uncovering bacteria distribution and the drivers of community organization is crucial for understanding food web dynamics, however, little is known about bacterial communities and its driving mechanisms in Fuxian Lake. Here, we explore the pattern of bacterioplankton distribution and its controlling factors through sampling every two months in 2015 at three sites covering the lake basin. The results of 16S rRNA (V3-V4) MiSeq-pyrosequencing showed that bacterioplankton was composed of Proteobacteria, Cyanobacteria, Bacteroidetes, Firmicute, Planctomycete and Verrucomicrobia, with Proteobacteria being the most abundant. The community distribution showed strong temporal and spatial heterogeneity in this large lake, with the degree of temporal turnover generally greater than that over space. Redundancy and variation partitioning analyses further indicated that water temperature, and nutrient status were among the main environmental factors shaping bacterioplankton community structure and distribution. Overall, our preliminary survey will help expand our understanding of the microbial loop and its role in food web structure of Fuxian Lake.

Key words: Fuxian Lake, Bacterioplankton, Community Distribution, Environmental Factors

Spatial Variation in Fish Otolith Elemental Fingerprints: Implications for Connectivity Assessment and Sustainable Management

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Abstract: Connectivity between fish populations is fundamental to the understanding of population dynamics and the design of sustainable management. Fish otolith microchemistry is a promising tool as it can provide information on the continuous growth of fish otoliths and the environmental effects on otolith composition. Such elemental fingerprints can help distinguish different fish populations or life history stages, identify the origins or nursery areas of fish, and assess fish population structure. In this study, we examined the spatial variation and connectivity of wild and cage-cultured populations of Yellowfin seabream (Acanthopagrus latus) from the coastal waters of Shantou, Yangjiang, and Zhanjiang in China southern province

Guangdong during 2012–2014, based on otolith trace-elemental signatures using multivariate statistical analysis and machine learning approaches. The concentrations of 13 elements (Li, Na, Mg, Fe, Ca, Mn, Co, Ni, Cu, Zn, Sr, Ba, and Pb) in the natal zone of fish otoliths, representing the embryonic and paralarval stages of adult fish, were analyzed using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Stepwise discriminant analysis and random forests were used to distinguish the wild and cultured populations of Yellowfin seabream, and non-metric multidimensional scaling (NMDS) and cluster analysis were used to determine the spatial variation and connectivity of Yellowfin seabream populations. Overall, the wild and cultured populations of Yellowfin seabream could be identified with classification accuracy of 80.7% and 90.2% by using stepwise discriminant analysis and random forests respectively. When we compared site differences between wild and cultured populations (site × population interactions), the classification success was 60.5% for stepwise discriminant analysis and 85.7% for random forests. The misclassification of wild and cultured populations within the three sites suggested the spatial connectivity between populations and among sampling locations. Our findings indicated that the three wild populations of Yellowfin seabream from Guangdong coastal waters can be considered as one stock for sustainable management, and the difference between wild and cultured populations were significant for Yellowfin seabream from Shantou and Yangjiang, but less significant for Yellowfin seabream from Zhanjiang. This study demonstrated that fish otolith elemental fingerprints can help improve our knowledge of the spatial connectivity, population structure, and life history of fish populations, and random forests can be a useful tool for identifying wild and cultured fish populations compared to the traditional stepwise discriminant analysis or using the original otolith elemental signatures. The multiple modeling approaches applied in this study showed the potential value of incorporating spatial variation and connectivity among fish populations when utilizing otolith elemental fingerprints, and such information can help guide sustainable management for ecologically and economically important fish species or in particular geographical areas.

Key words: Fish Otolith Elemental Fingerprints, Population Connectivity Assessment, Population Discrimination, Sustainable Ecosystem Management

Comparison of Two Summer Phytoplankton Metacommunities in Low Land and High Land Lakes: The Roles of Environmental and Spatial Elements

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Abstract: Phytoplankton metacommunities are shaped by environmental and spatial elements, and their organization usually vary in regional scales. To understand the regional variation, we compared summer phytoplankton metacommunities in two regions in China, which represent low (average altitude of 166 m) and high (average altitude of 2756 m) land lakes, respectively. Phytoplankton were classified in three ways: taxonomy in genera, functional groups (coda), morphology based functional groups (MBFG). Compared with low land lakes, temperature and nutrients were significantly lower, coincidentally in high land lakes, the local communities were characterized with lower richness and biomass and higher community dissimilarity between local communities, and more genera with high frequency of occurrence in metacommunity. The environmental and spatial variables explained the variation for biomass of genus and functional group in the high land lakes. In both metacommunities, no significant environmental variable was selected to explain variation of community composition, and spatial effect was only significant in large scale. There is no significant difference in testing the relationship between phytoplankton community and environmental variables between three phytoplankton classification used, i.e., two functional groups and taxonomy in genera. The effect of spatial elements become too weaker for the phytoplankton community classified with functional groups classification. In conclusion, dispersal limitation is not common for phytoplankton in both low and high land lakes; environmental selection plays a major role in assemblage of phytoplankton communities.
Key words: Phytoplankton Assemblage, Spatial Distribution, Environmental Selection

Source-Based Fish Trophic Guilds, Energy Consumption and Indicators along a Large Subtropical River

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Abstract: As the food sources distribute diversely in riverine networks, understanding how they are used by fish consumers along a river's longitudinal gradient remains a challenge for stream ecologists. In this study, basin-scale stomach content analysis (SCA) of fish along the East River was conducted to determine the longitudinal variation in food utilization by fish trophic guilds and widespread species. Eight food categories were identified to cluster 96 fish species in 17 trophic guilds. The guild number increased from 6 in montane headwaters to 15 in downstream urban areas, then decreased sharply to 11 in industrial zones. The joint location where rheophilous (insect and epiphyte) and limnophilic sources (detritus, bivalves and plankton) co-occurred in

SCA implied the highest guild richness. Compared with the predictions in other climate zones, fish trophic guilds along the subtropical East River showed: 1) a downstream decrease in insectivores rather than invertivores. 2) an increase in omnivores and piscivores from headwaters to midstream, which was masked by the dominant detritivores that mainly composed of exotic species in lower reaches. The quantitative food consumption by site-specific fish assemblages showed that the downward insect sources and upward detritus sources were two longitudinally alternating energy pathways. Specially, the midstream food consumption notably differentiated between the types (abundance and biomass) of assemblage composition, with mollusks and hydrophytes contributing more to biomass. Of note, in addition to the significant spatial difference in SCA of six widespread species, our results revealed that the fish trophic structure was influenced by the diet shifts of crucial species that emerged at high abundance or biomass level. Finally, 28 site-specific fish species from different guilds were selected as trophic indicators, with their potential use in ecosystem management explored.

Key words: Stomach Content, Spatiotemporal Changes, River Continuum, Diet Shifts

De Novo Assembly of Transcriptomes Reveals Diverse Responses of Mixotrophic Ochromonas to Toxin-producing and Toxin-free Microcystis

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Abstract: Microcystins are known as highly toxic and hardly degradable secondary metabolites of toxic cyanobacteria, however, mixotrophic flagellates Ochromonas sp. show an efficient removal on microcystins. To explore the genes potentially involved in degradation process, we investigated the transcriptomes of mixotrophic Ochromonas fed on toxin-free Microcystis (NM) and toxin-producing (TM) using illumina RNAseq. In this study, we obtained a total of 143779562 and 164862464 high-quality reads of Ochromonas respectively fed on toxin-free Microcystis and toxin-producing Microcystis, and de novo assembled 116969 contigs, of which 999 genes expressed significantly differently between NM and TM treatments. Functional analysis with KEGG pathway annotation showed these genes strongly associated with ribosome, photosynthesis, starch and sucrose, nitrogen and sphingolipid metabolisms. Additionally, significantly up-regulated transcripts included ones encoding ribosomal proteins, peroxiredoxin, aminopeptidase and glutathione S-transferase, and ones encoding hsp70 and serine/threonine-protein kinase to repair misfolded proteins when Ochromonas fed on toxin-producing Microcystis. Therefore, we concluded that these

parameters highlighted difference between Ochromonas fed on toxin-free and toxin-producing Microcystis, and potentially explained the highly efficient antioxidant activity and repair capacity in response of mixotrophic Ochromonas to toxin-producing Microcystis with transcriptomes.

Key words: Mixotrophic Ochromonas, Toxin-producing Microcystis, Differentially Expressed genes, Transcriptomes

Association between Temporal and Spatial Beta Diversity in Phytoplankton

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Abstract: The rates of temporal and spatial species turnover have been compared in different organisms and scales, revealing that temporal and spatial species turnover rates are not independent but, rather, associated. Process studies differing from the previous snapshot studies to elucidate the correlation between spatial turnover and temporal turnover. Here, we performed two investigations of the phytoplankton composition in the lakes of the Yangtze River catchment in China in the spring and summer of 2012, which varied regional spatial scale and seasonal temporal scale. We compared the variation in the pattern and underlying mechanisms between the seasons and analysed the association between temporal and spatial species turnover. The results showed that (1) the seasonal turnover differed based on the habitat features and their variation levels, and pH was the most important variable negatively affecting the seasonal turnover; (2) the spatial beta diversity of phytoplankton in the fast-growth season (summer) was higher than that in the slow-growth season (spring); (3) the distance decay pattern was significant in summer, but not in spring; (4) the proportion of jointly explained variation of Jaccard dissimilarity by the environment and space was similar in spring and summer, while that of Bray-Curtis dissimilarity increased from ~38% to ~55%, mainly due to the variation in spatially structured environmental variables, such as pH and ion concentrations; (5) the primary variables determining the growth rates and composition of phytoplankton (nitrogen, phosphorus and underwater available light) and broader-scale spatial variables contributed significantly to the variation in spatial turnover, and the spatial variable PCNM1 (the first principal coordinates of neighbor matric), mainly related to pH, was an additional variable presenting a significant contribution in summer; (6) the spatial turnover route of phytoplankton composition in summer was partially predetermined based on the seasonal turnover, and the shifted community compositions were more similar between

the lakes with similar seasonal turnover. These results highlight the need for understanding the temporal variations in spatial beta diversity as well as the underlying assembly mechanisms in phytoplankton.

Key words: Beta Diversity, Phytoplankton, Seasonal Turnover, Variation Partitioning

Congruence of Fish, Macroinvertebrate and Diatom in Streams at Xishuangbanna, Upper Mekong River Basin, China

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Abstract: Understanding the congruence across different taxonomic groups and the importance of environmental variables in shifty scales as drivers are crucial for conservation biologists and environmental managers. Previous studies had divergent result about the presence of among-groups congruence, but generally, researches came to an agreement that it would be enhanced when diverse groups responded similarly to the same factors. However, the major factors at multiple spatial scales constraining community were highly correlated to species body size and diffusivity. In addition, the query that which aspects of trophic effect or similar responses to influence variables have major effects on among-groups congruence is not clear. We sampled 34 sites of fish, benthic diatom and macroinvertebrates in Xishuangbanna, upper Mekong River Basin, China during March and April 2013. We performed variance partitioning to test the congruence among groups in XSBN, then applied Structural Equation Modeling (SEM) with multi-scale environmental variables to evaluate different effect of multi-scale variables on different groups. Mantel test was additionally used to further distinguish the congruence in least disturbed and disturbed sites. Our results showed the significant congruence among three groups, and great correlation between variables of their spatial scales and species body size, with fish mainly shaped by basin scale variables, and benthic macroinvertebrates and diatom mainly controlled by local variables. Basin scale variables indirectly constrained small sized groups through affecting local variables. Our results highlighted the importance of basin scale variables. Moreover, congruence of disturbed sites is greatly higher than that of least disturbed sites. Our results indicated that stress would enhance congruence among organism groups shaped by body-size related constraints, suggesting that the surrogate in water quality bioassessment for degraded waters. However, the least disturbed sites may be required to be evaluated by multiple groups.

Key words: Congruence, Bioassessment, Scale, Disturbance

Seasonal Fluctuations of Phytoplankton Distribution and Environmental Drivers in an Arsenic-Contaminated Large Lake of Southwest China

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Abstract: Abstract: Yangzong Lake is an arsenic-contaminated sub-trophical large lake, which has been of public health, and ecological risk concerns over the last decade. As phytoplankton serve as the base of lacustrine food webs, understanding algal distribution and the drivers of ecosystem structure following arsenic contamination is crucial for Lake Remediation and restoration. Here, phytoplankton surveys of Yangzong were conducted through qualitative and quantitative sampling every two months from April 2015 to February 2016 covering the south, central and north parts of the lake basin, respectively. A total of 43 planktonic genera were identified, among which 34.9% belong to Chlorophyta and 27.9% to Cyanophyta. Cyanophyta was absolutely dominant (> 74.3% of the total biomass) over both time and space. The dominant algae in Yangzong all belong to Cyanophyta, including Pseudoanabaena sp., Planktothrix sp., Aphanizomenon sp., Rhabdogloea sp.. There existed strong seasonal fluctuation in dominant algal taxa and respective biomass, but the spatial variation was not obvious. The results of Redundancy Analysis (RDA) further showed that water temperature (WT), arsenic concentration (As), ammonia nitrogen (NH3.N), nitrate nitrogen (NO3.N), dissolved oxygen (DO), lead (Pb), and conductivity (Cond) accounted for 44.02% of the temporal and spatial variations of phytoplankton community in Lake Yangzong, with WT, NH3.N and as being the most pronounced factors. The total cell abundance and biomass for Cyanobacteria was highest in summer, corresponding to the higher water temperature and nutrient levels. However, diatom cell abundance and biomass was highest in winter, which corresponded to the low water temperature and higher arsenic concentration. Furthermore, seasonal variation in cell abundance and biomass was not significant for other groups of algae. With the increase in arsenic concentrations in Yangzong, the community structure of phytoplankton has shifted accordingly in the context of strong temperature and nutrient fluctuation across seasons. Therefore, the relic effect of arsenic contamination on phytoplankton should be considered for ecological assessment and sustainable restoration of contaminated lakes.

Key words: Phytoplankton, Arsenic Pollution, Spatial and Temporal Scales, Environmental Drivers

Mechanisms of Coexistence in Species Rich Tadpole Communities in Madagascar

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Abstract: One hypothesis about the contribution of competition in community assembly is that closely related species are less likely to coexist. However, in nature, especially in the tropics, many related species have been observed to persist in the same environment with no evidence of exclusion, but the mechanisms mediating their coexistence remain elusive. Madagascar harbors the richest lotic tadpole community in the world, and more than 22 tadpole species belonging to eight morphological clusters could be found within a single stream. Phenotypic divergence is typically thought to promote coexistence in species rich communities, however, since not all species undergo morphological differentiation during character displacement, it is unclear how generalists and specialists can coexist within the same habitat. We tested the hypothesis that environmental filtering, phenotypic divergence, and resource partitioning mediate coexistence in these tadpoles. We studied tadpole communities at the microhabitat level in multiple streams in three habitats along a gradient of disturbance history. We subsequently examined species trophic spaces using gut content and stable isotope analyses. Tadpoles with generalized morphology dominated assemblages and accounted for more half of species in terms of frequency. Community structures differed between the three habitats, and microhabitat environmental features strongly influenced tadpole assemblages. Although tadpoles within a same morphological cluster tended to be determined by similar environmental parameters for specialists, tadpoles with generalized morphology did not follow this pattern and were influenced by distinct environmental axes. Most tadpoles were primary consumers, but interspecific differences in carbon isotope signatures (from –19‰ to –32‰) indicated that the tadpoles feed on a wide variety of resources. Although stable isotope analysis indicated overlaps in trophic space for some species, examination of gut contents revealed dissimilarities in resource use, even in tadpoles with similar mouthparts. Phenotypic divergence mediated resource specialization, but differences in feeding habits also contributed to niche differentiation, ultimately allowing several tadpoles with similar mouthparts to coexist in the same environment. Collectively, the findings found support to the hypothesis that environmental filtering and resource partitioning mediate coexistence in this species rich community.

Key words: Mechanisms of Coexistence, Tadpole Communities, Resource Partitioning, Environmental Filtering

Changes in Inundation Area and Water Quality Drive Declines in Waterbird Abundance and Diversity in Yangtze River Floodplain Wetlands

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Abstract: The Yangtze River floodplain (YRF) supports wetlands of global importance for wintering waterbirds, including several species unique to the area. We compared abundance and diversity of waterbirds, upper food chain indicators of trophic status and biodiversity, at 72 lakes surveyed twice in YRF in 2005 and 2016. We modelled impacts of maximum wetland area, inundation area (difference between maximum flooded and dry season area), total dissolved nitrogen and phosphorus, precipitation and temperature on waterbird abundance, species richness and species diversity in the two-year dataset. Inundation area (positive) and total dissolved nitrogen (negative) were the most important variables contributing to all models predicting waterbird abundance and diversity, while climate and total wetland area did not feature in these models. The results showed significant declines in waterbird abundance and diversity, confirming that water quality and quantity are key drivers of ecosystem change in YRF wetlands. This suggests that continued water abstraction, land claim and deteriorating water quality will continue to have a greater impact on future waterbird diversity in these lakes than effects of climate change. Although the best lakes in the YRF are protected for their biodiversity interest, these results also show such protection cannot safeguard this interest when threatened by extrinsic catchment factors, such as water quality and quantity. This confirms the urgent need for more strategic water planning to safeguard YRF ephemeral lake systems of global biodiversity significance as well as sustaining ecosystem services and the livelihoods of millions of Chinese people.

Key words: Yangtze, Waterbirds, Inundation Area, Water Quality

Environmental DNA Reflects the Spatial and Temporal Distribution of Common Prawn, Palaemon Paucidens, in Lake Biwa

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Abstract: Recently, global biodiversity is threatened by climate change, pollution,

overfishing, invasive species, and habitat loss/alteration. Therefore, in order to protect and manage the biodiversity, the information on the distributions of species is indispensably required. A landlocked population of common shrimp (Palaemon paucidens) in Lake Biwa, which is the largest (~670 km^2) and oldest (>4 Mya) in Japan shows seasonal migration: Adult P. paucidens migrate from littoral habitats to deep water habitats (~90m in depth), where a mass of P. paucidens stayed during the winter in autumn and they back to littoral habitats in spring. However, a few previous studies have reported the presence of some amounts of adult P. paucidens in littoral habitats in winter, suggesting an unidentified ecomorph in the lake. However, conventional monitoring methods to monitor species distribution are often inefficient and environmentally destructive, and require significant person-time and resources. Recently, environmental DNA (eDNA) surveillance has drawn some attention. eDNA via the collection of water samples, that takes advantage of shed cellular material suspended in aquatic environments to detect the presence of organisms including rare taxa. In this study, we developed a species-specific eDNA marker that reliably identifies P. paucidens based on mitochondrial 16S rRNA sequence. We collected water samples from field, and filtered each water samples. After DNA extraction we used real-time PCR to quantify P. Paucidens eDNA. The water samples were collected from lagoons, littoral zone and bottom of Lake Biwa in summer and winter. We captured P. paucidens with conventional fisheries (fixed net) in winter, in the lagoons where eDNA had been detected. For samples from lagoon and littoral zone were positive for P. paucidens DNA in winter. P. paucidens DNA was also detected in lagoon where the living P. paucidens was captured by conventional fisheries. For samples from littoral zone and bottom of Lake Biwa the eDNA concentrations were higher in lagoons and littoral zones than in bottom in summer. Also, the eDNA concentration was higher in the bottom of Lake Biwa than in the lagoon and littoral zone in winter. We captured P. paucidens in the lagoons where eDNA had been detected. it means the detected DNA in lagoon was from non-migrating type of P.paucidens. The eDNA concentrations were higher in lagoons and littoral zones than in bottom in summer. This result is corresponded with the fact that both migrating and non-migrating P. paucidens reproduce in lagoon and littoral zone from spring to summer. In winter most of P. paucidens migrated downward to the bottom of the lake, therefore, the detected DNA in bottom was from migrating P.paucidens.

In this study, we demonstrated that the eDNA surveillance successfully reveals local habitats and seasonal migration of P. paucidens. Therefore, eDNA is a useful tool in detecting shrimp. By such means, the life history of the shrimps can be well recorded by eDNA surve.

Key words: Enviroment DNA (Edna), P. Paucidens, Non-Migrating/Migrating, Lake Biwa

Trophodynamics of Autochthonous and Allochthonous Carbon in a Large Cross-Border River (China): Implications from Resource Availability and Hydrological Regime

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Abstract: Resource availability restricts the amount of energy available to the upper trophic level consumers and thus plays a crucial role in energy mobilization of river food webs. Epilithic-based and terrestrially-derived primary production could subsidize the cross-border rivers in northwest China substantially. Thereby, we evaluated the availability of basal food resources, food web structure (determined by δ13C and δ15N) and relative contributions of autochthonous and allochthonous production to aquatic consumers in the Irtysh River, which spans from China to Kazakhstan. Despite much higher density and biomass, epilithic algae was not the most important carbon source of fish and aquatic invertebrate throughout the study period due to the restriction of flow velocity, turbidity, water depth and water temperature. Aquatic invertebrates specialized in utilization of terrestrial leaf litter throughout the study period, whereas the reliance of fish varied from aquatic plants, riparian plants to terrestrial leaf. Our findings suggest that allochthonous carbon made greater contribution to aquatic food web in contrast with autochthonous carbon. Autochthonous production including epilithic algae and aquatic plants was determined by flow regime and artificial dams, whereas allochthonous carbon sources from riparian plants and forest cover were available all year round.

Key words: Autochthonous and Allochthonous Carbon, River Food Web, Resource Availability, Hydrological Regime

Niche Partitioning of Aquatic Invertebrates on Leaf Litters

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Abstract: Resources partitioning among species plays an important role in the species coexistence and is a mechanism for explaining biodiversity. This study was conducted to understand niche partitioning of aquatic invertebrates on leaf litters of 4 tree species and litter types in a valley. Litter bags (size: 30 x 30 cm, mesh size: 2 x 2 cm) filled with fresh and fallen leaves of the four dominant trees (Quercus mongolica, Robinia pseudoacacia, Prunus serrulata var. pubescens, Pinus densiflora) and gravels were placed at five points in a valley of the Mt. Gwanak, Seoul, Korea in October 2016. Leaf area and dry weight of four tree species were measured. Litter bags were collected after

two weeks and aquatic invertebrates in the litter bags were separated and identified. Aquatic invertebrates of 9 orders 23 family and 28 species were identified. Species diversity (H') of aquatic invertebrates was the highest in litter of R. pseudoacacia and was lowered in order of P. serrulata var. pubescens, Q. mongolica, P. densiflora and gravels. As for the condition of the leaves, species diversity on fresh leaves was higher than that on fallen leaves. Species diversity of aquatic invertebrates showed positive correlation with specific leaf area (SLA). This indicates that diverse species prefer leaves with relatively higher nitrogen contents and lower secondary compounds such as tannin and lignin. There were some species such as Tubificidae, Chironomidae, Mystacides KUa equally distributed on all resource types. Anisocentropus minutus, Tipula KUa and Goerodes KUa appeared at a high rate on fresh leaf of R. pseudoacacia, fallen leaf of Q. mongolica, and fresh leaf of P. serrulata var. pubescens respectively. These show that coexisting aquatic invertebrates have different preferences in leaf species and types. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (No. 2015R1D1A1A01057373) and Korea Ministry of Environment (MOE) as “Public Technology Program based on Environmental Policy” (2016000210003).
Key words: Aquatic Invertebrates, Biodiversity, Leaf Litters, Niche Partitioning

Spatio-temporal Patterns in the Relationship between Productivity and Diatom Diversity in Fuxian Lake, SW China

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Abstract: Abstract: Phytoplankton, one of the most important primary producers on earth, has played a central role in maintaining aquatic ecosystem health. Diatoms are an important group of phytoplankton with clear environmental optima and high sensitivity to environmental changes (such as nutrient level and warming), serving as an excellent indicator for Lake Ecosystem health. Fuxian Lake, a large and deep alpine lake located in Southwest China, is a biodiversity hotspot and home to dozens of endemic species, but it has experienced deterioration of environmental quality due to both warming and catchment development. Therefore, it is urgently needed to identify the drivers for diatom species sorting and to uncover the role of lake productivity in maintaining diatom diversity. Here, we conducted a seasonal survey of diatoms and limnological variables at 16 sampling sites across the lake. Furthermore, we identified temporal and spatial patterns of diatom diversity distribution to explore the relationship between productivity and diversity (PDR). At each of the sampling site, there existed a seasonal community succession with dominant diatoms shifting from Aulacoseira granulata (~

50%) in March to Cyclotella ocellata in other seasons (~ 80%). Over time, the dominant diatom species were similar across sites with little differences in magnitude of the change between the north and the south basin of the lake. Furthermore, the results also showed that diatom α diversity had a significant response to lake productivity ($P < 0.001$) with a significant positive correlation both over time and space. This pattern might reflect that phytoplankton growth in Fuxian is strongly limited by resource availability (e.g. light, nutrients) with a low degree of species competition due to its location at lower end of system productivity. Therefore, the increase of resource supply, through the processes of eutrophication and temperature fluctuation in Fuxian, could directly promoted diatom species diversity and should be highlighted in catchment management and diversity maintenance.

Key words: Fuxian Lake, Diatoms, Biodiversity, Lake Productivity

Effects of Fish Culture on Water Quality and Wild Fish Communities in Urban Lakes

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Abstract: Fish culture in lakes is a very important aquaculture sector in China while its effects on lake ecosystems are rarely studied. The current study was conducted from January 2016 to January 2017 in 7 urban lakes in central China: 5 with while the other 2 without fish culture, to assess the effects of fish culture on lake water quality and wild fish communities. Lakes in the culture group were mainly stocked with Silver carp (Hypophthalmichthys molitrix), Bighead carp (Aristichthys nobilis), Crucian carp (Carassius auratus) and Grass carp (Ctenopharyngodon idellus) for about 600 kg/ha where the first two species contributed to over 80%. We found no significant difference on nutrient concentration in water between the two lake groups ($p>0.05$). Total hardness in the non-culture lakes was significantly higher than the culture lakes in July and November. Turbidity and total suspended solids in the non-culture lakes were significantly lower than the culture lakes in September. Total phosphorus, orthophosphate, turbidity and total suspended solid in September were significantly higher than the other months in the fish culture lakes ($p>0.05$). There was no significant difference on fish diversity index between the lake groups in autumn and winter. In spring, the Margalef diversity index (D) of the non- culture lakes was significantly lower than the culture lakes. Toxabramis swinhonis Gunther was the dominant fish species in all the studied lakes except one culture lake, Lake Zhongshan where Pseudorasbora parva was dominant. Overall, we find no significant effects of fish culture on lake water quality and wild fish communities during the current study period.

More future studies are needed to assess its longer term effects.
Key words: Urban Lakes, Fish Culture, Water Quality, Wild Fish Community

Spatio-temporal Patterns of Fish Diversity in the Three Gorges Reservoir and Implications for Ecosystem-based Fisheries Management

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Abstract: Understanding the effects of large hydraulic project on fish diversity is critically important to conserve and manage aquatic ecosystems. In this study, we examined the spatio-temporal patterns of fish diversity in the Three Gorges Reservoir (TGR) to provide basic knowledge for managing this kind of novel ecosystem. By using multi-mesh gillnets, conventional fishery surveys, and hydroacoustic methods, we sampled fish communities in the TGR between 2012 and 2015 on multiple spatial (i.e. longitudinal axis from head to tail of the reservoir, lateral axis from the mainstream to tributaries, vertical axis along water depth) and temporal (i.e. seasonal and annual) scales. With biodiversity indices, functional trait measurements, and multivariate statistical tools, we described the spatial and temporal variations of fish communities in the TGR, including functional group compositions, species abundance distributions, species diversity, and functional diversity. We also identified key environmental factors and driving processes under different scales, and propose that ecosystem-based fisheries management should be a strategy to regulate human activity towards maintaining long-term system sustainability of the TGR within the range of natural variability.
Key words: Fish Community Dynamics, Ecological Effect Assessment, Environmental Heterogeneity, Ecological Fishery Management

Novel Thoughts on Algal Inhibition Potential of Hydrophyte Allelopathy in Shallow Eutrophic Chaohu Lake

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Abstract: Novel thoughts on algal inhibition potential of hydrophyte allelopathy in shallow eutrophic Chaohu LakeShengpeng Zuo*, Shoubiao Zhou, Jianchun Xie,

Liangtao Ye, Xiaofeng Jiang, Wenxiu Hong(College of Environmental Science and Engineering, Anhui Normal University, Wuhu 241002, P. R. China)**Abstract:** Besides purifying and restoring the polluted water body by metabolizing, stabilizing, and transforming pollutants, aquatic macrophytes will kill harmful algae by producing active allelochemicals including phenols, terpenoids, fatty acids, esters and heterocycle group. Moreover, bio-diversity can promote algal suppression of typical hydrophytes by some formats such as positive interaction of many allelochemicals, the reasonable mixing culture of different ecotypes of macrophytes, and the efficient combination of hydrophytes and predatory zooplankton or benthic fauna. We have verified synergistic interactions among five allelochemicals [coumarin, ρ-hydroxybenzoic acid, protocatechuic acid, stearic acid,ρ-aminobenzene-sulfonic acid] with antialgal effects on bloom-forming Microcystis aeruginosa. Meanwhile, in the watershed of Chaohu Lake, through both field survey and lab experiment, three typical aquatic macrophytes (Alternanthera philoxeroides, Ranunculus sceleratus and Trapa incise) showed combined enhanced-effect on algal suppression. Interestingly, four predatory zooplankton, i.e. Stentor polymorphus Müller, Brachionus calyciflorus Pallas, Acartia spinicauda, and Moina macrocopa will help the macrophytes fighting with the noxious algae. Similar findings also occurred for some dominant zoobenthos such as Limnodrilus hoffmeisteri (oligochaete), Chironomus plumosus (chironomid larva), Palaemonetes sinensis (crustacean), and Corbicula fluminea (mollusk). Especially, the pollution conditions will influence algal inhibition potential by representative hydrophytes. Low level pollution reduced the allelopathic inhibition of microalgae by allelochemicals. However, many challenges need be solved. For example, how shall the exotic invasion of aquatic macrophytes like A. philoxeroides (Mart.) Griseb, Eichhornia crassipes (Mart.) Solms, and, Spartina anglica, etc. affect the interaction between hydrophytes and algae, and ecosystem health and safety. Of course, the development of local travel, wading birds, and human interfering activities such as mowing and agricultural chemicals application also deserve more attentions.

Key words: Algal Suppression, Hydrophyte Allelopathy, Induced or Interfering Factors, Aquatic Biodiversity

Locations in Dendritic Stream Network and Environmental Gradients Determine the Meta-community Structures and Types of Macroinvertebrate and Diatom

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Abstract: Meta-community concept provides new insights in undermining the community assemblage rule. Streams are the typical dendritic networks and of a high

biodiversity. The meta-community structures and types of macroinvertebrate and diatom in Chinese stream networks remain unclear. We collected benthic macroinvertebrates and diatoms samples in a total of113 stream sites of middle Qiantang (43), Irtysh (33), Lancang-Mekong (37) in China. We used a combination of approaches to examine meta-community structures and types: elements of meta-community structure (EMS), variance partitioning (raw data approach), and Mantel test (distance-based approach). The EMS analysis revealed that compartmentalized (Clementsian or quasi-Clementsian) patterns were the predominant best-fit structures, and quasi-Clementsian occurs more frequently for diatom, while nestedness and quasi-nestedness structure occur at the location where more affected by anthropogenic disturbance. Beta-diversity was higher at headwaters mainly driven by species replacement in the meta-community, due to species sorting (SS). In contrast, SS + dispersal-driven model was primarily detected at mainstreams for macroinvertebrates though a less species turnover across space assembly process. Out results highlighted that species sorting prevailing in stream meta-communities, while dispersal-driven assembly determinism for macroinvertebrate meta-community related to the location of local community within stream networks. Our results indicated that enough sample allowed a better disentangling of the best-fit meta-community structure, and under strong anthropogenic interferential filtering meta-community structures of stream organisms were nestedness.

Key words: Species Sorting, Diatoms, Benthic Macroinvertebrates, China

Biogeography and Environmental Structuring of Phytoplankton in Subtropical Alpine Lakes of Southwest China

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Abstract: Freshwater lakes in subtropical China are a vital component of this global biodiversity hotspot and provide important resources for the socio-economic development. However, deterioration of surface water quality and degradation of ecosystem functioning have been increasingly caused by multiple environmental stresses, namely eutrophication, industrial pollution and damming. Therefore, understanding the spatial distribution of key lake biota and their link with environmental filters serve as the basis for lake preservation and biodiversity conservation. The species composition, richness and biomass of phytoplankton, the key primary producers of freshwaters, play a vital role in energy flow of lake food webs and can also reflect the impact of anthropogenic disturbances. In this study, a total of 25 lakes were chosen for algal surveys and regional comparison, comprising of 13 and 12

lakes from the southeast and Northwest of Yunnan, respectively. On the basis of limnological characteristics and algal data, multivariate statistics were applied to reveal the environmental gradients in structuring phytoplankton. A total of 73 genera belonging to seven algal groups were identified and also displayed a regional pattern related to nutrient levels. In southeast Yunnan, common algae include Aphanizomenon and Microcystis belonging to Cyanobacteria that dominated in lakes of Datun and Dianchi. While, Chrysophyta Dinobryon is mainly found in oligotrophic lakes in Northwest Yunnan (such as Cibi and Haixi lakes). In addition, the total biomass in lakes of Southeast Yunnan is significantly higher than those of Northwest Yunnan. The values of algal taxonomic richness, Shannon index and evenness index varied in the range of 18-48, 0.008-3.01 and 0.002-0.78, respectively, showing a clear pattern of regional heterogeneity. The results of CCA further showed that the gradients of altitude, physical features (i.e. lake area, Secchi depth, water temperature), and nutrients (i.e. total nitrogen, total phosphorus) were among the significant factors in driving phytoplankton distribution. Overall, this study can provide background data on phytoplankton biogeography and scientific basis for the biodiversity management and lake restoration.
Key words: Yunnan, Lake Phytoplankton, Biodiversity, Environmental Filters

Community Architecture and Competitive Hierarchies in Lagoon Ecosystems: Body Size Implications

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Abstract: Body size is a fundamental property of organisms affecting many individual traits with cascading influences on community structure and energy use. The relationships between body size, individual energetics, space use behaviour, life cycles and abundance at population and community levels have been extensively studied. Body size dependency of interspecific interactions, competitive performances and coexistence relationships have also been addressed showing body size dependent coexistence conditions based on a suggested competitive advantage of being large. At the community level, body size related coexistence should result in a hierarchical allocation of energy use among species, with a departure from the expected energy equivalence rule

Here, we test these hypotheses on benthic invertebrate detritus feeder guilds of Mediterranean lagoon ecosystems. The study has been carried out in fifteen lagoons of the Eastern Mediterranean, where benthic macroinvertebrate guildshave been studied at different habitats, stations per habitat and seasons. At every sampling occasion, number

of species, number of individuals, individual body mass and main physico-chemical water parameters have been assessed.

Globally the resulting dataset includes 137 taxa and 52.458 individuals covering almost 6 orders of magnitude of body size. The analysis of size spectra and size abundance distributions at every level of spatial and temporal heterogeneity showed triangular distribution of both species number and individual abundance along the body size axis and size abundance distributions characterised by scaling coefficient higher than the -3/4 values expected from the energy equivalence rule. Consistently, a hierarchical energy use allocation among detritus feeder species coexisting in local guilds at the sampling station level have been observed. We have observed a regular pattern of energy use allocation for the three largest species in every guild, with approx. 33% of the overall energy used by the guild allocated to the largest species, same to the second largest when the first largest was artificially removed from the data set and so on up to the third largest. Null model analysis has supported a deterministic basis of the observed patterns. Moreover, more than two thirds of the variance in the energy used by the largest species in the different local guilds was explained by a few relevant abiotic factors; same patterns was not observed for the second and third largest species.

Implications of body size-mediated coexistence relationship suggest a hierarchical allocation of energy use with species body size, which is not expected according to classic metabolic theory. The study data reported shallower scaling exponentson macroinvertebrate guilds/communities in lagoon ecosystems, providing evidence on a hierarchical dominance of the large species.

This finding seem to confirm thatlarge species have an advantage in the interspecific competition in detritus feeder guilds of lagoon ecosystems supporting the hypothesis of body size coexistence mechanisms underlying species diversity and community organization in those aquatic ecosystem types.

The lack of correspondence between optimal body size of detritus feeder species and competitive performances of species in the body size hierarchy requires further analysis of the biodiversity ecosystem functioning relationships in detritus feeder guilds of lagoon ecosystems.

Key words: Energy Use, Body Size, Macroinvertebrate Guilds, Lagoon Ecosystems

Do Hatchery-reared Mandarin Fish Siniperca Chuatsi (Basilewsky) Affect the Growth and Feeding of Wild Congeners?

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Abstract: Artificial stocking of hatchery-reared mandarin fish has become a commercially significant fishery mode in China; however, the ecological effects of

stocking hatchery mandarin fish have received little attention. In this study, the growth and feeding of the hatchery-reared mandarin fish (HMF) and wild mandarin fish (WMF) were compared to evaluate the effects of stocking hatchery mandarin fish on wild congeners in a shallow lake. The results showed that total length and body weight of HMF were significantly lower than those of WMF with the same age at the early stocking stage (before the 12th month), while no significant differences were observed at the late stocking stage (after the 16th months). The specific growth rate of HMF was obviously higher than WMF from the 13th month to the 19th month, which indicated that HMF might have a compensate growth after adapting the environment. The food compositions of HMF and WMF were significantly different. The diversity index (H) and the Levin's standardized niche breadth (Ba) of HMF were lower than WMF. The richness of prey by HMF was lower than that by WMF, with small amount of main prey species. The niche overlap index between HMF and WMF was 0.324, which indicated that there was not significant competition in the diet between HMF and WMF. Our results suggest that hatchery-reared mandarin fish do not significantly affect the growth and feeding of wild congeners in current stocking condition.

Key words: Ecological Effects, Mandarin Fish Stocking, Growth and Feeding, Fisheries Management

Impacts of Invaders: Detrital Processing, Climate Change and Community Impacts

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Abstract: Invasive non-native species can drive community change in freshwater systems through key functional behaviours, such as detrital processing. The degree to which species differ in such behaviours can have community level impacts. In addition to pressures imposed by invasive species, freshwater communities are also subject to pressure from climate change. Despite these impacts, the combined effects of invasive non-native species and climatic warming remain widely understudied. We aimed to quantify the detrital leaf shredding behaviour, a key functional trait, of two UK invasive non-native (Dikerogammarus villosus and Dikerogammarus haemobaphes) and one native (Gammarus pulex) freshwater amphipod species. Detrital breakdown rates were quantified across a three temperatures (8, 14 and 20 ℃) and three leaf species (Quercus robur, Acer pseudoplatanus and Alnus glutinosa). Next, we used field mesocosms to quantify the impacts of the differing detrital shredding rates on community and ecosystem functioning. Previous studies have failed to appropriately account for climatic change and invasive species pressures in freshwater systems. Additionally, few

studies have accounted for multiple detrital leaf species therefore limiting the applicability of their findings. Our study provides novel insight as to the impacts of freshwater species invasions with respect to initial detrital leaf litter shredding and the wider community while considering the effects of temperature and leaf species.
Key words: Invasive, Detritus, Amphipod, Climate Change

Using Resting Eggs in Sediments to Track the Changes of Zooplankton Biodiversity

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Abstract: Long-term monitoring programs are usually not available for most freshwater systems, which has limited our abilities to evaluate the changes of zooplankton biodiversity. Resting eggs are produced by many zooplankton and settled in bottom sediments. They are abundant and well preserved in sediments. They may provide a new means to investigate zooplankton biodiversity.

The single-egg DNA barcoding was developed to identify zooplankton resting eggs in sediments. The sediment samples were suspended in 50% sucrose solution and centrifuged to isolate resting eggs. One egg was picked and its DNA was extracted using the HotSHOT method. A fragment of mitochondrial cytochrome c oxidase subunit 1 (COI) was amplified suing the LCO1490 and HCO2198. The PCR products were sequenced. DNA sequences were blasted against GenBank. A taxonomic level was assigned to the sequence of an egg according to the BLAST similarity.

The changes of zooplankton biodiversity were tracked in two case studies (Dianshan Lake and Chongming Dongtan Wetland) using their resting eggs in sediments. Fifty-eight species were determined for zooplankton resting eggs in the sediments of Dianshan Lake, Shanghai. The dominant taxa were rotifers, cladocerans, and copepods. Zooplankton communities in the past 50 years were reconstructed by counting their resting eggs in a sediment core. Total microcystin concentration was measured with an enzyme linked immunosorbent assay to represent the prevalence of cyanobacterial blooms. Zooplankton communities obviously shifted from the large species to small ones. The microcystin concentration in the sediments was positively correlated with the rotifer 'Lecanidae 2', but negatively correlated with the copepod Sinocalanus tenelus. Both the copepods/rotifers and cladocerans/rotifers ratios declined significantly with the microcystin concentration. These results demonstrated the increasing cyanobacterial blooms in Dianshan Lake contributed to the dominance of small zooplankton species.

Twenty-four species were identified for the resting eggs from the five creeks of

Chongming Dongtan Wetland. Zooplankton communities in the creeks were recovered using their resting eggs. These communities were significantly altered by the human activities. For example, one creek was used as a fish pond, which significantly increased the abundance of resting eggs and shifted the dominant species from copepods to rotifers.

In summary, zooplankton resting eggs in sediments were identified using the single-egg DNA barcoding. These eggs were convenient natural proxies for tracking zooplankton community responses to environmental changes.

Key words: Resting Eggs, Zooplankton, Biodiversity, DNA Barcoding

Diversity in Phytoplankton Communities: A Field Test of the Intermediate Disturbance Hypothesis

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Abstract: The intermediate disturbance hypothesis proposes that the highest diversity is maintained at intermediate scales of disturbance. This hypothesis has been applied to phytoplankton in water. To investigate whether the intermediate disturbance hypothesis is applicable to phytoplankton communities in water with a pollution gradient, we provided a field test in an urban wetland park. We sampled once a month over a span of four seasons. The phytoplankton species were identified, and water quality monitoring was conducted, which included the carbon, nitrogen and phosphorus concentrations. The disturbance in this study consisted of water pollution. We calculated the similarities of phytoplankton species and water quality among the sampling locations and regarded them as indicators of disturbance to study the impacts of water pollution. In a small area, a low similarity between temporally or spatially consecutive samples is the result of a drastic disturbance, whereas a high similarity indicates a stable condition with a low disturbance. The results indicated that: (1) the fitting curves of phytoplankton community diversity and similarity showed unimodal patterns over four seasons, which supported the intermediate disturbance hypothesis; (2) the response of phytoplankton diversity to water quality levels was not clear. When the water quality similarity was plotted against the phytoplankton diversity, there was no unimodal relationship, neither in the particular season nor over an entire year. We concluded that in this water with a gradient of pollution, the intermediate disturbance hypothesis was confirmed by the phytoplankton composition similarity, but water quality failed to be an indicator of a disturbance.

Key words: Intermediate Disturbance Hypothesis, Phytoplankton, Water Pollution, Similarity

Biogeography and Genetic Diversity of an Endemic Copepod Species (Phyllodiaptomus Tunguidus) in China

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Abstract: Abstract Phyllodiaptomus tunguidus, a freshwater calanoid copepod, is Chinese endemic species and mainly distribute in southern China. Two sequences: cytochrome-b and ITS were used to explore the biogeography and population genetic diversity of the species. The population was sampled in southern China from Yunnan Province to Guangdong Province covered one million km2 in the winter of 2016. All of cyt-b and ITS sequences were edited and then identified from NCBI. Maximum Likehood and Bayesian methods were applied to build phylogeny trees of Phyllodiaptomus tunguidus for both cyt-b and ITS sequences. Two clades were found from both Maximum Likelihood and Bayesian trees of P. tunguidus based on cyt-b sequence. The genetic differentiation between the two clades was 8.5％, and 0.06％ and 2.4％ within the two clades, respectively, under Kimura 2-parameter model
Forty four haplotypes were identified in the twenty three populations of P. tunguidus. Two common haplotypes were shared in eighteen populations, indicating a widespread geographical distribution. Six haplotypes have a limited geographical range in the southern of Guangxi Province. The highest genetic diversity was found in the most southern of China, with up to nine haplotypes in a single population. The landscape genetic structure of P. tunguidus in southwest China demonstrates both the importance of long distance dispersal as well as of high levels of genetic differentiation, likely caused by priority effects.
Key words: Phyllodiaptomus Tunguidus, Endemic Species, Phylogeny, Genetic Diversity

Spatial Distribution and Beta Diversity of Phytoplankton in Tibetan Plateau Lakes: Nestedness or Replacement?

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Abstract: Spatial patterns and beta-diversity of phytoplankton community depends on the relative importance of species dispersal capacity, environmental filtering and species sorting. Variation of species composition indicated by differences in species richness (nestedness) and species replacement change with species niche and environmental selection. Tibetan plateau lakes are located in high elevation and constitute harsh ecosystems characterized with low temperature, low available nutrient,

and a strong gradient of salinity. Under these strong environmental selection, only well-adapted species could survive in the harsh conditions with narrow available niches. We assumed that environmental filtering is the main mediating factor for phytoplankton community in Tibetan plateau, then species nestedness largely contributes high β-diversity. The present study implemented a field survey in Tibetan Plateau on 38 lakes with varying salinity during summer of 2012 and 2013. Spatial multivariate analysis shows that environmental variables and broad-scale spatial variables account for variation of phytoplankton community. The phytoplankton communities were shaped by environmental heterogeneity, and they were characterized as low α-diversity, high β-diversity, and spatial distribution pattern emerges on broad scale. In contrast to our assumption, species replacement contributes majority of β-diversity of the communities. Within the narrow range of niches available, environmental filtering of phytoplankton induced by species' gain and loss along environmental gradients based on their ecological traits of different groups.

Key words: Phytoplankton, Spatial Distribution, Beta Diversity

Study on Morphological Variation among Fourteen Population of the Culter Species

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Abstract: This research was investigated morphology divergence of culter species, which was a particular genus in East Asia and widely distributed in China. The morphological variations among fourteen culter population of the four species, Culter alburnus (CA), Culter dabryi (CD), Culter erythropterus (CE), Culter mongolicus (CM), were analyzed with the three multivariation analysis methods based on 42 proportional parameters of liner morphometric characters. The adults culter were collected respectively from Xingkai Lake (LXK), Jingpo Lake (LJP), Weishan Lake (LWS), Yanlong Lake (LYL), Kuilei Lake (LKL), Danjiangkou reservoir (RDJK), Liangzi Lake (LLZ), Dongting Lake (LDT), Poyang Lake (LPY), Biandantang lake (LBDT), Shengjin lake (LSJ), Dongjiang reservoir (RDJ), Xingfengjiang Reservior (RXFJ), Songtao Reservior (RST). Specifically, CA population were cluster in three clades, the first group was the RDJ population alone; the second group included population of LXK, LPY and RDJK; LWS, LKL, LLZ, LSJ, RST and RXFJ clustered as the third group. CD were cluster into two clades, the first group was LLZ, LXK and LKL; the second group was LSJ population separated. CE population were clustered into three clades, LXK, RDJK and LPY clustered into the first group; LBDT and LSJ was clustered into second group; LKL, LDT, LYL and LWS cluster as the third group. CM population were also cluster into three clades, the first group included RDJK, LDT,

LPY, LLZ and LKL; RST, LJP and LXKH clustered as the second group; LSJ clustered into third group independently. Principal component analysis (PCA) showed that the contributions of the head length, pre-orbital length, pre-pectoral length and body height to total CA morphology variance were the most among the 42 proportional parameters liner morphometric characters. Discriminate CD morphology variance mainly according to body height and tail length. The PCA of the CE result indicated that morphology mainly influenced by axis of body height, head length and head height. The CM morphology variance primarily correspond to body height, head height, and caudal peduncle length. Discriminant analysis indicated that the identification accuracy of the discriminant functions of CA populations were 92.1%-100% (P1) and 84.2%-100% (P2), and the total discriminant accuracy was 94.9%. Identification accuracy of the discriminant functions of CD populations were 91.3%-100% (P1) and 79.2%-100% (P2), and the total discriminant accuracy was 91.0%. Identification accuracy of the discriminant functions of CE populations were 90.6%-100% (P1) and 87.5%-100% (P2), and the total discriminant accuracy was 93.4%. Identification accuracy of the discriminant functions of these CM populations were 93.8%-100% (P1) and 81.5%-100% (P2), and the total discriminant accuracy was 93.1%. All result suggested that there were some divergences to a certain extent among the fourteen populations of the four kinds of culter species and the fourteen populations could be identified by using three multivariation analysis methods.

Key words: Culter, Morphology, Divergence, Multivariation Analysis

Watershed Ecology of Eriocheir Sinensis Stock Enhancement Management: Based on the Migration Routes

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Abstract: The migratory routes of Eriocheir sinensis is a special case of seasonal migration of relatively fixed routes, which is a result of adaption to the changes of the ecological conditions of the Yangtze River Basin for a long time. Through the migration route, releasing tagging spawning crabs and then recapturing them are important measurements for evaluation of Eriocheir sinensis enhancement management and impacts. This study took the investigation with a combination of two kinds of Eriocheir sinensis crabs. Through the recapture data of tagged releasing Eriocheir sinensis, the results showed that there was a fork (Nangang Line and North route) in the migratory route of Eriocheir sinensis crabs at the mouth of the Yangtze River in Changxing Island and Hengsha Island. Jiuduansha seperated the Nangang Line in a secondary fork as the South and North trough route. Combined with biological

aggregation evaluation of crabs brood stock and spawning crab, the basic distribution was calculated and inferred in the same longitude of the spawning location results are consistent with the 1980s survey results from other persons out of nearly 30 years, spawning the regional distribution of Eriocheir sinensis crabs that is stable. In the condition of effective recovery of megalopa resources, several advices were put forward: the number of multiplication needed to gradually reduce in the plan and the appropriate releasing size of the released group should be controlled to decrease the contribution rate year by year, at last, a relatively subtle way of releasing activities should be adopted. In addition, with the application of watershed ecology, the systematic and integral research of enhancement planning could serve as a bridge between scientists and managers.

Key words: Eriocheir Sinensis, Migration Routes, Stock Enhancement, Watershed Ecology

Costs and Trade-offs of Grazer-induced Defenses in Scenedesmus

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Abstract: The green alga Scenedesmus can form inducible defensive morphs under zooplankton grazing threat. Costs and trade-offs of inducible defense are expected to accompany the benefits of defense, but are hard to detect for Scenedesmus, which may be due to nutrient-sufficient conditions. Here we review our work on detecting costs and trade-offs of inducible defense in Scenedesmus under various specific conditions.

The defensive colony size of Scenedesmus is not constitutive but increases with grazing pressure, indicating that the trade-offs of producing colonies exist and the amount of cells that forms defensive colonies in the Scenedesmus populations relies on the actual grazing loss they face.

The inducible defense also relies on availability degree of environmental resources. Different essential environmental resources have different effects on the colony formation of Scenedesmus. Light limitation and phosphorous deficiency restricted the defensive colony size. Nitrogen deficiency did not affect the maximum colony size but prolonged the maintaining time. The effect of insufficient availability of two metallic elements, magnesium and calcium, is similar with phosphorous. Decreased growth was detected in inducible defensive Scenedesmus under phosphorous and Mg2+ limitations, which indicated the high fitness costs of producing inducible defense.

When facing both competition pressure and grazing pressure, trade-offs existed between the producing of large sinkable colonies and vulnerable unicells. In the presence of co-existing algae, fast growth and defense were costs to each other. However, under the exposure of allelopathic chemicals released by macrophytes, more

anti-grazer colonies were formed, indicating the different competitive relationships between alga vs. alga and alga vs. macrophytes.

Pollutions and other artificial disturbances also have great effects on the stability of aquatic communities. Low pH values of water, nonlethal concentrations of several herbicides and heavy metals reduced the defensive colonies in Scenedesmus, which also indicated there is a trade-off between inducible anti-grazer defenses and tolerate the stress.

In summary, inducible defense in Scenedesmus alters according to actual grazing pressure, resource availability, water conditions, inter-specific competition, and pollutions. Our work provides evidence supporting the existence of costs and trade-offs of inducible defense in Scenedesmus

Key words: Inducible Defense, Anti-grazing Colony, Trade-offs, Fitness Costs

Comparison of Diatom Diversity and Community Changes in Response to Multiple Stressors in Two Large Plateau Lakes of Southwest China

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Abstract: Surface waters in China have experienced increasing pressure derived from multiple environmental stresses such as eutrophication, water diversion and extreme climate. Despite of intensive measures taken for water protection, a lack of continuous water monitoring has prevented the effective restoration of impacted lakes. Furthermore, Lake Typology (i.e. lake depth, nutrient status, flow regime) can regulate the patterns of environmental processes and biotic responses leading to a heterogeneous pattern of ecosystem dynamics between lakes. This study combined paleolimnological techniques with archived data to quantify the degree of congruence in long-term community changes between lakes of distinct lake typology for the last two centuries. Xingyun, a large and shallow open system, is currently hyper-eutrophic due to deforestation, lake reclamation, fish introduction and industrial development, while Chenghai, a large, deep and closed system, is currently mesotrophic but has shown increased lake productivity recently. Sedimentary records show that primary productivity of both lakes has increased significantly in the past few decades, but there existed clear differences on the timing and the magnitude of enrichment. Sediment grain size data indicated pronounced hydrological fluctuation and extreme climate events for both lakes, implying the significant impact of both climate change and water diversion projects. Multiple regression analysis results showed that diatom diversity indices had significant correlation with lake nutrient level and hydrological changes in

Chenghai, but not in Xingyun. For example, nutrient level accounted for more than half of the changes in diversity indices over time in Chenghai, with Hydrological fluctuation explaining 19-27%. Despite that a similar trend of diatom community shift was found for both lakes, there exist a complex pattern of diatom changes in response to warming and hydrological changes in the shallow and eutrophic system of Xingyun. Our results highlight that lake typology need to considered in assessing freshwater biodiversity and ecosystem structure over time and space.

Key words: Lake Sediment, Diatoms, Biodiversity, Multiple Stressors

Differential Bioaccumulation of Essential Versus Nonessential Heavy Metals in the Food Web of Three Gorges Reservoir (China): Implication from Spatiotemporal Pattern, Affecting Factor and Health Risk Assessment

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Abstract: In this study we compared the concentrations of essential metals (Cu, Fe, Zn) and nonessential metals (Hg, Cd, Pb) in water, seston, and fish species in the main stream of TGR, China. Results showed that all of the six metal concentrations in biota were within safety quality guidelines criteria. Concentrations of these metals in organisms varied widely among functional groups and within the same and closely related Compared with before impoundment of TGR, essential metals concentration were lower while non-essential metals concentration were higher than pre-impoundment, indicating the difference of species' ecology and individual traits in the bioaccumulation of metals. The spatial variation of nonessential elements in fish was generally more consistent with the input level of metal concentrations than essential elements. On the other hand, only nonessential metal (Hg and Cd) of six heavy metals showed significant temporal variation, and the temporal trend was consistent with the water level in different impoundment period, which seen as the “reservoir effect”. Essential metal bio-diluted, while nonessential metal biomagnified along the food web, reflecting that the different metabolic dynamics of essential and non-essential elements in fish species.

Key words: Essential and Nonessential Heavy Metals, Biomagnification, Biodilution, Health Risk Assessment

Responses of Population Dynamics and Life Table of the Rotifer Brachionus Plicatilis Exposed to Phaeocystis Globosa in Pure and Mixed Diets with Green Algae

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Abstract: Phaeocystis globosa is one of the most typical species which can form red tide. Harmful algae blooms have become global environment problems impacting the balance of the marine ecosystem and the economic development in aquaculture and fishing industries. Biomanipulation is suggested to be an effective and environmental-friendly way on the control of harmful algae blooms.

To explore whether Brachionus plicatilis can prey on P. globosa and thus has the ability to control the harmful algal blooms, we cultured rotifer B. plicatilis in three different food treatments at a same dry weight: (1) 100% Chlorella (C); (2) 100% P. globosa (P); (3) a mixture of 50% P. globosa and 50 Chlorella. The present research included two parts, the population dynamics experiment and life history experiment. Results showed that the population of the rotifers exposed to Chlorella had the greatest carrying capacity and showed higher intrinsic rate of population increase (R0) and net reproduction rate (Rm) than those exposed to P. globosa. The reproduction rates in all the three treatments changed with time, i.e. firstly increased to a plateau and then decreased. The trends of reproduction rates were similar but the highest reproduction rates differed in the three treatments. The maximal reproduction rates of rotifers fed on 100% P. globosa were significant lower than the other two treatments. The total offspring also showed a significant decrease in rotifers fed on 100% P. globosa. Rotifers fed on P. globosa had a relatively longer lifespan than those fed on Chlorella. As for the survival time, P. globosa was favored than Chlorella. It took a longer time for the maternal rotifer populations fed on P. globosa to reach 50% mortality. Relatively, rotifers in mixed diets, not only had a higher growth rate and reproduction rate but also had a longer lifespan.

In summary, when P. globosa was offered as the sole food, it also could maintain the rotifers population growth. Chlorella contributes to rotifers breeding, whereas P. globosa can extend lifespan of rotifers. The attempt to control harmful P. globosa red tide by B. plicatilis may be possible.

Key words: Red Tide Species, Phaeocystis Globosa, Chlorella, Brachionus Plicatilis

Allelopathic Effects of Submerged Macrophytes on Phytoplankton

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Abstract: As a survival and resource-competition strategy, submerged macrophytes are supposed to release the secondary metabolites, named allelochemicals, to affect the phytoplankton development. The species-specific inhibition and easy degradation of plant allelochemicals makes it possible to control the algal bloom efficiently and environment-friendly. This paper aims to review the research advances in allelopathy of submerged macrophytes on phytoplankton, which covers the following aspects: species-specific inhibition of submerged macrophytes to phytoplankton, potential allelochemicals, their inhibitory modes, physiological mechanisms, impacts of environmental factors and possibility of application in water management. Research methodology on allelopathy needs to be improved from the viewpoint of ecology. It was proposed to do more comparable bioassays, more joint laboratory and field experiments to find the allelochemicals release and degradation dynamics, and interactions with biotic and abiotic factors, which will be helpful to reveal the allelopathic mechanisms from gene to ecology, and provide scientific guidance for its application in aquatic ecosystem management.

Key words: Submerged Macrophytes, Cyanobacterial Control, Allelochemical, Eco-physiology

Effects of Hydrological Differences on Macrobenthic Fauna in the Three Gorges Reservoir Based on Biomass Size-spectra

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Abstract: In order to study the effects of hydrological differences on macrobenthic fauna in the Three Gorges Reservoir, field investigations and sampling were done in January, April and July 2016, in Longhe River from upstream to downstream, there were five sampling sections, contained natural river reaches in upstream, transition river reaches in midstream and perennially flooded river reaches in downstream. Based on the sampling identification data of macrobenthic fauna, we constructed the biomass size spectra (BSS) and normalized biomass size spectra (NBSS) to describe the features of macrobenthic fauna. The main results were as follows: 1) the patterns of BSS were different in the upper reaches, middle transition reaches and the lower reaches. In the estuary where was perennially flooded caused by the Three Gorges Reservoir impounding, the pattern of BSS showed bimodality, and the first peak arose at grain size of 8-9, comprised Chironomidae larvae. The second peck appeared at grain size of 15-16, comprised Palaemonidae and Odonata. In the Daheba where was between the upper natural reaches and transition river reaches, the pattern of BSS presented three

peaks. And the first peak emerged at grain size of 10-11, consisted of multiple species of insects. At grain size of 13-14, the second peck arose, and consisted of Lamellibranchia and Atyidae. The third peck appeared at grain size of 18-19, consisted of Gastropoda. 2) The slope of NBSS were greater than -1, it indicated that the macrobenthic fauna biomass was increase with the grain size increase in Longhe River. The intercept of NBSS ranged from 4.2814 to 9.6672. In all the sampling sites, maximum intercept value of 9.6672 appeared in Daheba, and the patterns of NBSS had best linear regression. It meant highest level of secondary productivity, stability of the microbenthic fauna community and diversity in this site. In the estuary, contrastively, it had minimum intercept value of 4.2814 and maximum slope value of 0.0702, these revealed that the river reaches affected by the Three Gorges Reservoir impounding had lowest level of secondary productivity and the macrobenthic fauna community structure was instability.Generally speaking, the Three Gorges Reservoir impounding caused hydrological changes and then contributed macrobenthic fauna diversity and community structure stability redused. That warns us that we should pay attention to the impact of the Water Conservancy Project on aquatic ecosystems.

Key words: Biomass Size Spectra, Normalized Biomass Size Spectra, Macrobenthic Fauna, The Three Gorges Reservoir

T6-05: Modern Synthetic Approaches to Taylor's Law and Mean-Variance Scaling, And Applications in Pure and Applied Ecology

Fishing and Life History Traits Effects on the Spatial Mean-variance Relationship in Fish

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Abstract: Fishing is expected to alter the spatial heterogeneity of fishes. As an effective index to quantify spatial heterogeneity, the exponent b in Taylor's power law (V=aMb) measures how spatial variance (V) varies with changes in mean abundance (M) of a population, with larger b indicating higher spatial aggregation (i.e. more heterogeneity). Theory predicts b is related with life history traits, but empirical evidence is lacking. Using 50-year spatiotemporal data from the California Current Ecosystem, we examined fishing and life history effects on Taylor's exponent by comparing spatial distributions of exploited and unexploited fishes living in the same environment. We found that unexploited species with smaller size and generation time exhibit larger b, supporting theoretical prediction. In contrast, this relationship in exploited species is much weaker, as the exponents of large exploited species were higher than unexploited species with similar traits. Our results suggest that fishing may increase spatial aggregation of a species, likely through degrading their size/age structure. Using moments of the frequency distribution of a population, we obtained qualitatively similar results.

Key words: Taylor's Power Law, Spatial Heterogeneity, Fishing Effects, Demographic Process

Effects of Synchrony on Taylor's Law

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Abstract: Taylor's law is a widely observed empirical pattern that relates the variances to the means of groups of non-negative measurements via a power law: variance_g = a × mean_g^b, where g indexes the group of measurements. When each group of measurements is distributed in space, the exponent b of this power law is conjectured to

contain information about aggregation in the spatial distribution. Taylor's law has found practical application in many areas since its initial demonstration for the population density of spatially distributed species. Another widely observed aspect of populations is spatial synchrony, which is the tendency for time series of population densities measured in different locations to be correlated through time. Recent studies showed that patterns of population synchrony are changing, possibly as a consequence of climate change. We use mathematical, numeric, and empirical approaches to connect synchrony and Taylor's law. Greater synchrony typically decreases the exponent b of Taylor's law. Synchrony influenced Taylor's law in essentially all of our analytic, numeric, randomization-based, and empirical examples. Given the near ubiquity of synchrony in nature, it seems likely that synchrony influences the exponent of Taylor's law widely in ecologically and economically important systems.

Key words: Taylor's Law, Synchrony, Aphid, Plankton

When Can We Use Taylor's Law as an Early Warning Signal for Critical Transition?

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Abstract: Regime shifts or critical transitions have been major topic in the study of ecosystem dynamics during the past decades. These concepts are usually applied to ecosystem in which small changes in environmental conditions could trigger rapid switch from one stable state to alternative stable states. Positive feedbacks probably exist in these systems when response of a system to an initial deviation of the system acts to reinforce the change in the direction of the deviation. Some early warning signals have been studies as simple properties that the systems exhibit prior to a critical transition, such as slow recovery from perturbations, increasing variance, increasing autocorrelation. Here, we investigated, theoretically, whether Taylor's power law can be used as one the early warning signals when a system approaching critical transition. Taylor's power law describes an empirical relationship between the mean and variance of population densities in field data, in which the variance varies as a power, b, of the mean. Most studies report values of b varying between 1 and 2. Some studies showed recently that smooth changes in environmental conditions in a model can lead to an abrupt, infinite change in b. To understand what factors can influence the occurrence of an abrupt change in b, we used both mathematical analysis and Monte Carlo samples from a model in which populations of the same species settled on patches, and each population followed independently a stochastic linear birth-and-death process. We investigated how the power relationship responds to a smooth change of population

growth rate, under different sampling strategies, initial population density, and population age. We showed analytically that, if the initial populations differ only in density, and samples are taken from all patches after the same time period following a major invasion event, Taylor's law holds with exponent b = 1, regardless of the population growth rate. If samples are taken at different times from patches that have the same initial population densities, we calculate an abrupt shift of b. The loss of linearity between log variance and log mean is a leading indicator of the abrupt shift. If both initial population densities and population ages vary among patches, estimates of b lie between 1 and 2, as in most empirical studies. But the value of b declines to ~1 as the system approaches a critical point. Our results can inform empirical studies that might be designed to demonstrate an abrupt shift in Taylor's law.

Key words: Regime Shift, Taylor's Law, Critical Transition, Alternative Stable States

Power-Law Size Distribution Predicts Mean-Variance Scaling of Individual Aboveground Mass of Woody Plants in a Tropic Forest

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Abstract: The Power-law relationship between the mean and variance of species population abundance is a widely observed quantitative pattern in ecology. Here, we apply the mean-variance power-law to individual body size, called mass allometry (MA), and confirm it empirically using aboveground mass (AGM) of individual trees in a tropic forest. By classifying trees spatially contiguous blocks, we test MA and interpret its slope using individual size distribution (ISD) of AGM within a block. Our results show that the exponent of a truncated Pareto model of ISD per block analytically predicts the slope of MA when the spatial scale of blocks is large. Success of the prediction largely relies on the constancy of truncated Pareto exponent and minimum individual AGM among blocks, and the variability of maximum individual AGM among blocks. This finding reveals the dominant role of large individuals in regulating fluctuation scaling of traits at the individual level.

Key words: Fluctuation Scaling, Individual Variation, Size Spectrum, Body Mass

Chagas Disease Vector Control and Taylor's Law

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Abstract: The need for improved vector control and elimination cuts across all major human vector-borne diseases. Taylor's law (TL) posits that the logarithm of the sample variance of population size is approximately a linear function of the logarithm of the sample mean of population size in different samples. We show that TL described remarkably well (adjusted R^2 = 0.86-0.98) the counts of four insect vectors of Chagas disease (Triatoma infestans, Triatoma guasayana, Triatoma garciabesi and Triatoma sordida) in 36,318 habitat searches in four diverse districts in the Argentine Chaco region, before and after various types of insecticide spraying. Slopes of TL most often ranged from 1.50 to 1.75, consistent with significant spatial heterogeneity or insect aggregation. Predictions of new models of the effect of vector control measures on TL agreed with field data. TL identifies key habitats with highly heterogeneous infestation, providing a new instrument for disease control and elimination programs.
Key words: Infectious Disease, Chagas Disease, Taylor's Law, Vector Control

Proximate Determinants of Empirical Taylor's Law Slopes

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Abstract: Taylor's law (TL), one of the most common empirical patterns in ecology, describes variances of population densities as a power-law function of mean densities, variance=a*mean^b. Several mechanisms have been shown to produce variation among datasets in the exponent b, but the relative importance of these mechanisms is unknown, and they may not be the only mechanisms operating. Furthermore, most prior studies have focused on either spatial or temporal forms of TL - the nature of possible covariation in spatial and temporal TL exponents is little explored. We first demonstrate variation and covariation of spatial and temporal TL exponents in three large data sets of aphid and plankton population density measures. We then determine, through a combination of modelling and data analysis, statistical properties of population time series that are the major proximate predictors of both spatial and temporal TL exponents, and of covariation between these exponents. A ratio of the skewness of population time series over their coefficient of variation, here denoted J, was the most important predictor; a measure of the correlation through time (synchrony) of time series, denoted Ω, was also important. These quantities are more directly interpretable than TL exponents themselves, and more straightforwardly linked to ecological mechanisms, yet they explain much of the variation in TL exponents. Our results should aid future efforts to understand ecological mechanisms driving variation in TL.
Key words: Spatial Taylor's Law, Temporal Taylor's Law, Skewness, Synchrony

Mean and Variance of Catch per Unit Effort of Fishes Collected Along Texas Coast

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Abstract: Mean and variance of fish and invertebrate species collected over 30 years in eight bays along the Texas coast were investigated. The species included red drum (Sciaenops ocellatus), spotted seatrout (Cynoscion nebulosus), southern flounder (Paralichthys lethostigma), brown shrimp (Farfantepenaeus aztecus), and white shrimp (Litopenaeus setiferus). The three fish species were sampled twice (spring and fall) each year, and the two shrimp species were sampled monthly. The mean and variance over year at each location in each season or each month were calculated, and the natural log of the variance was regressed against the natural log of the mean (hereafter a variance-mean relationship). The results showed that all five species exhibited a linear variance-mean relationship as predicted by the temporal Taylor's Law. The slopes were 1.86 (red drum), 1.23 (spotted seatrout), 1.04 (southern flounder), 1.75 (brown shrimp), and 1.77 (white shrimp). The linear variance-mean relationships were much tighter (small R^2) with the two shrimp species than the three fish species. The shrimp data reflected the abundance of late juvenile and early subadult stages, and they are annual species. According to a previous theoretical study, the tight variance-mean linear relationships suggest they experience compensatory density dependence during a juvenile stage. This is consistent with the current idea that the two shrimp species are regulated by habitat size during an early juvenile stage. The linear variance-mean relationships were less tight (larger R^2) with the three fish species although they were still linear. I speculate that multiple sources of fluctuation in abundance experienced by the three species obscured the relationship. Furthermore, I hypothesize that the slope is affected by the life history and sampled stage of organisms. This hypothesis is currently under investigation by expanding the analysis to include more species sampled from the same bays.

Key words: Taylor's Law, Life History, Mean Variance Relationship, Fish,

A New Target Function for Parameter Estimates Based on the Taylor's Power Law

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Abstract: The Taylor's power law (TPL) describes a scaling relationship between the variance and mean of population densities in space or time. For ordinary least squares

(OLS), we assume homoscedasticity of variance and minimizing the residual sum of squares (RSS) to estimate the parameters. However, evidence shows that the variances of body sizes of plants at different times during the growing season exponentially vary with means. Another example is that the variances of temperature-dependent developmental rates of insects at a specific stage exponentially vary with means of developmental rates at different temperatures. Many biological phenomena along different temporal or environmental gradients exhibits heteroscedasticity, so minimizing the RSS might under- or over-estimate the parameters of the linear and non-linear models. Based on the TPL, a new target function was developed for parameter estimates to unify the variances corresponding to different levels of the predictors.

Key words: Data Fitting, Optimization, Ordinary Least Squares, Sigmoid Equation

Applying Taylor's Power Law to Yield Data in a Long-Term Experiment Reveals Decreasing Crop Yield Stability

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Abstract: Crop yields typically fluctuate from year to year, largely due to differences in weather patterns between years. As weather variability is expected to increase with climate change, stabilizing yields is likely to become increasingly important, e.g. through the use of cultivars or crop species with high yield stability or by adjusting crop management. Central in this task is the availability of reliable and unbiased tools for quantifying yield stability. In particular, measures of stability need to account for potential scaling of the variance with the mean. If x is the logarithm of the mean and y is the logarithm of the corresponding variance in a data set, Taylor's Power Law (TPL) describes the situation that over several pairs of x and y, there is a linear relationship between x and y. Using crop yield data from an agricultural long term experiment in Borgeby (R4-0002; 55 °N, 13 °E), Sweden, we show that TPL is indeed valid, with a significant linear increase of y against x (y= a+bx, with a= 1.14 ±0.12 and b=-0.76 ±0.08, df=138, adjusted R^2= 0.395, P<0.001). Based on this regression, temporal stability of yields can then be calculated as the residuals from the TPL regression line, with positive and negative residuals showing low and high yield stability, respectively. This stability measure, called Power Law Residuals (POLAR), reveals that in pea, sugar beet, oil seed rape, spring barley, and spring wheat, but not in winter wheat, temporal yield stability has substantially and significantly decreased over the time that the experiment has been running (1960 to 2015). We further demonstrate that the decrease in yield stability over time is stronger when using POLAR than when the variance scaling effect

is not taken inaccount.

Key words: Yield Stability, Agronomy, Statistics, Long-Term Experiment

Can Taylor's Power Law Extensions Act as Potential Indicators for Diagnosing Human Microbiome Associated Diseases?

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Abstract: The human microbiomes residing in and/or on our body have far reaching influences on our health and diseases. Searching for quantitative tools that can effectively monitor the microbiome changes, especially the changes associated with diseases (i.e., the so-termed dysbiosis) is therefore of critical biomedical significance. Here we test the applicability of Taylor's power law extensions (PLEs), which achieved the status of law in population ecology (Taylor 1961: Nature) and have been extended to community ecology recently (Ma 2015: Molecular Ecology), for detecting dysbiosis by utilizing 10 cross-sectional and longitudinal studies of the human microbiome-associated diseases. The 10 datasets cover all five major human microbiome sites (oral, lung, gut, skin, and vaginal) as well as human milk and semen microbiomes. Specifically, we investigate whether or not the power law scaling parameter (b) and community critical heterogeneity (τ) of the four PLEs (i.e., Type-I PLE for measuring community spatial heterogeneity, Type-II PLE for community temporal stability, Type-III PLE for mixed-species population spatial heterogeneity, and Type-IV PLE for mixed-species population temporal stability) can be harnessed to distinguish between the healthy and diseased samples. The results, based on rigorous randomization tests of 1000 times of re-sampling from randomly mixed healthy and diseased samples, demonstrated that, the power law scaling parameter (b) and community critical heterogeneity (τ) detected dysbiosis in approximately 11% and 30% respectively. While the results appear to be somewhat disappointing, we conjecture that 30% could be "glass ceiling" for many community-ecology based metrics. For example, in a separate study, Ma and Gotelli et al. (2017) found that community diversity indexes, which have been computed and reported in nearly every human microbiome investigation, performed similarly in distinguishing between the healthy and diseases microbiome samples. Microbiome network analysis, which considers species interactions, may hold a key to raise the power to detect the dysbiosis, and ultimately to improve the diagnosis of the human microbiome associated diseases.

Key words: Taylor's Power Law Extensions, Community Spatial Heterogeneity, Human Microbiome-associated Diseases, Community Critical Heterogeneity

T6-06: Species in a Changing World: The Population Perspective

Regeneration of Oak in Central Himalaya: A Hope for Thriving Future

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Abstract: Present study is focused on population dynamics of regenerating Oak and its carbon stock value in the Lamgara block of Almora district in Uttarakhand state. Our studies showed thriving future of Oak in the region that motivated us to study this in detail. Oak is dominating species at all sites with higher IVI value that varied from 126.96– 165.50 followed by IVI values of Pine 72.82– 128.14. Population structure shows higher presence of Oak seedlings and saplings and young trees that favours the regeneration. Total basal area of sites varied from 17.0 $^{m2ha-1}$ to 46.1 $^{m2ha-1}$ where, Oak contributed 5.5 $^{m2ha-1}$-18.2 $^{m2ha-1}$ and contribution of Pine was found between 6.4 $^{m2ha-1}$ and 26.1 $^{m2ha-1}$. Lower tree density and high basal area indicate the presence of old Pine trees while high tree density and lower basal area shows young population of Oak. Regenerating status of oak was found between good and fair whereas Pine showed poor or not regenerating at some sites. Oak also possess higher carbon stock value than Pine and this will enhance the carbon sequestration capacity in near future. Allometric equations were used to calculate biomass and carbon stock of the sites. Biomass of sites were found between 137.03- 503.27 Mg $^{ha-1}$ and carbon stock varied from 64.40-236.54 Mg $^{ha-1}$; thus these regenerating forests contribute significantly in carbon sequestration. This regeneration of Oak could be influenced by many different factors such as nutrient availability (especially nitrogen), moderate disturbances and past fire. Soil characteristics, leaf litter dynamics, fine root dynamics is being studied to find out the reasons behind the phenomena. Remote sensing is also being used to identify such regions affected with fire in past and their influence on current vegetation.

Key words: Oak, Pine, Population Dynamics, Regeneration, Biomass, Carbon Stock

Using Long-term Demographic Data to Gain Understanding on Species Distribution and to Find High Fitness Areas

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Abstract: The project is an intersection between two ecological tools: ecological niche

modeling and demography. They aim at addressing what determines a species' success in space and time, respectively. Demography works at the population level and the local scale whereas ecological niche modeling works at the species level projecting potential distributions at a larger geographical scale. The main goal in integrating both analyses is getting a deeper understanding of what kind of demographic processes determine species distribution. We develop this idea with 15 years of demographic data from the Mexican cactus Opuntia rastrera. Data come from one locality; consequently we used its temporal climatic variability as a surrogate to the spatial climatic variability to create an ecological niche model. We found that rainfall has a great influence on survival, the demographic parameter that mainly determines the population growth rate. We thus can expect that changes in rainfall will limit this species' geographic distribution. The niche model created by our climate-dependent demographic model presented similarities to the result provided by a commonly used ecological niche algorithm (Maxent); and higher suitability values were significantly correlated to higher values of the population growth rate (λ). We found a significant negative correlation between distance to the ecological niche centroid and λ values thus allowing us to confirm the niche centroid theory.

Key words: Ecological Tools Integration, Higher Fitness Areas, Demography, Ecological Niche Modeling

Phenological Mismatch Undermines Mimetic Relationships in Insect Populations

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Abstract: Global change has the capacity to decouple interspecific interactions through a shift in the spatial or temporal distributions of interacting species. Past work on this "mismatch" has focused on either the link between pollinator and flowering plants, or between the timing of peak prey abundance and predator reproduction. However, phenological mismatch can also play a major role in determining the outcome of mimetic interactions. In Batesian mimicry, some organisms that lack a defence ("mimics") gain a benefit by resembling organisms that possess a defence ("models"), and thereby fooling predators. In this project, I examined historical trends in phenology in a charismatic model-mimic complex: the harmless hoverflies (Diptera: Syrphidae) and the stinging Hymenoptera. Recent shifts under climate change suggest that hoverflies are emerging earlier in the year, and that this shift is more rapid than that of Hymenoptera. By using a computer game with human participants acting as predators, we simulate different phenological scenaros: models occurring first, mimics occurring

first, and models and mimics occurring at random. The results show that the mimics benefit most (experience lowest predation) from a random scenario, followed by models first, and then mimics first. The models benefit most from models first, then random, then mimics first. The predators also perform best when the models arrive first, followed by the random scenario and then the mimics first. Our results provide the first quantitative test of the fitness consequences of phenological mismatch in an eco-evolutionary interaction, supporting the importance of temporal associations in driving the evolution of mimicry.

Key words: Ecology, Evolution, Mimicry, Entomology

The Hidden Impact of Biological Invasions in Ecology and Evolution: a General Model of Hybridization

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Abstract: The dispersal of non-native genes due to hybridization is considered as a cryptic invasion of growing concern in ecology and evolution. This includes the spread of modified genes and antibiotic resistance. We developed a general model describing the main genetic, demographic and ecological consequences of hybridization. It is the first attempt to concurrently consider multiple loci, quantitative and qualitative gene expression, assortative mating, dominance/recessivity inheritance, competition and density-dependent demographic effects. Hybridization may produce novel genotypic architectures that depend on the number of genes involved, their direct and indirect interactions, and on the selective pressures acting on each genotype. By using multiple genes, we show that previous modelling approaches based on a single gene may seriously bias conclusions about the effects of hybridization on biodiversity. We also show that it is essential to consider jointly the influence of both genetic and demographic effects to explore the range of potential phenotypes, because demographic factors may either amplify or at contrary balance the genetic effects. We then illustrate the utility of our approach by investigating how introduced mallards (Anas platyrhynchos), the most widely translocated dabbling duck, can threaten local species through hybridization. We show that invasive species may exclude native taxa not only by direct competition but also indirectly by competition with hybrids. We highlight that the effects of human-induced hybridization on biodiversity are not necessarily negative by driving species loss as it may also increase genetic diversity and the potential of adaptation to changing environmental conditions. Our general model thus represents a powerful tool to assess the effects of hybridization on biodiversity, available for a range of biological and societal questions.

Key words: Hybridization Model, Invasive Species, Anas Platyrhynchos, Biodiversity

Coupling Chronosequences and Short-Term Surveys to Understand Long-term Environmental Change in Population Dynamics

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Abstract: Understanding how long-term environmental change affects the population dynamics of species has been a recurrent question in population ecology. Examples of such changes include climate change, chronic anthropogenic disturbance, and secondary succession. In this latter process, species have been traditionally assigned to either the pioneer or the late-growth categories. In many countries where low-tech agricultural practices prevail, a sequential use and abandonment of cultivated fields allows for the study of populations embedded in secondary succession. By having plots with different ages (i.e., times since abandonment) surveyed on short timescales, we can use a chronosequence approach to determine the long-term population dynamics of a species undergoing this process. Here, we studied the dynamics of a long-lived perennial tree, Acacia cochliacantha, using a decade of demographic data gathered in 13 plots of different ages in a seasonally dry forest in southeast Mexico. We used integral projection modelling, accounting for plot-level variation, to model its dynamics, and inverse modelling to estimate fecundity, as no reproduction was recorded in this study. We also explored the impact on results of the amount of data available in terms of number of individuals, plots and surveyed years. We found that this species behaves as a pioneer as its vital rates increase at the onset of succession, decreasing with time, up to a point when the species becomes absent in old-growth forests. As expected, to gain a clear idea of how population dynamics changes over succession, it is important to cover most of the timespan involved in this process, which for this particular system exceeds one century. This can be achieved in two ways, either by having long surveys of a few plots, or by conducting short-term surveys of numerous plots, with the former approach being more successful than the latter. In turn, the number of individuals plays a lesser role in the correct estimation of vital rates. By coupling short time sequences within a chronosequence, our approach can contribute to understanding the population dynamics of the many species that are presently facing environmental change.

Key words: Inverse Estimation, Integral Projection Model, Structured Population Model, Time Series

Migration plasticity in ungulates: will it translate in resilience to global change?

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Abstract: Migration is an important component of ungulate behavioural tactics that is tightly linked both to population distribution and to the function ungulates exert in ecosystems. The migration rate of several species has been observed to decrease, and climate change and anthropic pressure have been indicated as potential driving causes. The loss of migratory behaviour in ungulates could have paramount consequences on the ecosystems that encompass their seasonal ranges, on the one side, and affect population dynamics on the other.This talk has two main goals: first, to re-establish the link between migratory behaviour and emerging movement patterns, in ungulates; then, to assess the causes – or determinants- of migration by looking at multi-population movement datasets of large herbivores in temperate climates, specifically the European roe deer Capreolus capreolus and red deer Cervus elaphus. The analysis of movement trajectories through different methods allowed us to identify inconsistencies in the classification of migratory behaviour at individual level that we attributed to individual plasticity. We thus acknowledged the emergence of movement patterns other than residence and stereotyped migration, and expressed them through 'indexes of migratoriness'. Finally, we have linked intrinsic factors (sex) and extrinsic conditions (e.g. topography, seasonality, canopy closure, plant productivity/NDVI) to parameters describing migration plasticity, i.e. migration propensity, distance and timing. We have found a strong relation between migration variability and sex-related and species-related life history traits. Thus, climate and landscape change might affect migratory behaviour of populations and species through complex responses. This talk will stimulate the discussion whether new knowledge on ungulate migratory behaviour should suggest management and conservation actions to favour and maintain migration in ungulate populations, or if instead should be used to acknowledge the change in movement patterns as a form of reversible adaptive behaviour, impossible to control.
Key words: Deer, Movement Ecology, Animal Distribution, Habitat

Trait-mediated Demography: How Trait Changes Relate to the Dynamics of Species Abundances

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Abstract: Trait change in one species can influence the population dynamics of another, by modifying the strength of interspecific interactions. For example, inducible defences, such as thorns, toxins and armament, reduce predation rates, allowing prey populations to increase. In turn, population densities can influence trait change. If, for example, predators become rare, prey often allocate more resources to growth rather than to defensive traits. A resulting feedback between species' traits and abundances would permit a wide range of ecological dynamics that would not otherwise be expected. However, despite the theoretical importance of trait-abundance feedbacks, an empirical framework is still required to assess their role in governing population dynamics.

We developed a novel, data driven, approach to link trait and abundance dynamics across species. This approach was applied to observations from an experimental predator-prey-resource system in which we monitored the temporal variation in species' densities and several behavioural and morphological traits.

Key traits driving ecological dynamics were identified and we obtained an understanding of how trait change altered species interactions. We also revealed that trait change was influenced by the abundance of multiple species, producing trait-abundance feedbacks. Finally, we showed that predictions of species' dynamic could be substantially improved by accounting for these feedbacks.

Our findings demonstrate empirically that species' trait and abundance dynamics can be intimately linked. Accounting for trait-abundance feedbacks can improve the predictability of ecological dynamics. At the same time, it can aid our understanding of how trait change depends on species densities and influences species interactions.

Key words: Trait Change, Species Interactions, Ecological Predictability, Data Driven Modelling

Carbon or Nutrient Limitation Can Not Explain Formation of Latitudinal Distribution Range Limit of Woody Species

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Abstract: Understanding the mechanism of determining plant distribution range is crucial for predicting climate-driven range shift, and thus enormously important for biodiversity conservation and forest management under ongoing climate change. At present, several famous hypotheses on the formation mechanisms of tree-line have been proposed, such as the carbon-limit hypothesis and the growth-limit hypothesis. However, less attention has been paid on the formation mechanisms of latitudinal range limit for tree species. In the present study, we investigated the latitudinal variations in carbon and nutrient allocation of Chinese cork oak (Quercus variabilis Blume), a

widely distributed woody species in East Asia, along the north-south transect in China with spanning ~14 latitude degree to explore the formation mechanisms of latitudinal range limit. During the growing season (August, 2014) and dormant period (January, 2015), leaves, branches and fine roots in the two ontogenetic stages (mature and juvenile) of the oak across seven designed sites along the transect were sampled and analyzed. Our results showed that the non-structural carbohydrates concentrations (soluble sugar, starch and sum of soluble sugar and starch, NSC) and nutrient concentrations (nitrogen and phosphorus) across the tissues of both mature and juvenile individuals during the growing season and dormant season, did not decrease with the increase of latitude. Conversely, some detected substances, such as the concentration of root nitrogen and root NSC in the juvenile trees, increased with latitude. Our results suggest that carbon or nutrient limitation may not be the determinant factors driving the formation of latitudinal range limit of the studied species. These results greatly improve our understanding of the formation mechanism of latitudinal range limit, and further studies should be conducted for more woody species with multi-year observations, combining with other factors, e.g., regeneration, competition or disturbance. This work was funded by the National Natural Science Foundation of China (No. 41371075).
Key words: Latitudinal Distribution Range, Non-structural Carbohydrate, Nutrient, Quercus Variabilis

No Response to Climate Change Induces Potential Risk of Mistiming for Russian Barnacle Geese

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Abstract: The phenology of vegetation has varied heterogeneously due to the uneven global climate change. Migratory geese have to fine-tune their migration schedule to follow the shift of green wave, so as to acquire enough energy accumulation for breeding. Mismatch between the migration time and optimal food resources might lead to decrease in reproduction success and population decline. Since mid-1990s, barnacle geese, Branta leucopsis, breeding on the Arctic coast of Russia gradually divided for two groups: One small portion arrive at the southern spring stopover site Baltic Sea early, and the majority arrive late, although both depart to the northern stopover site White Sea at the same time. Here we use GIMMS AVHRR NDVI during 1982-2013 to analyse the change of the green wave in Europe and associate the change of the migration timing of early- and late-arrival geese with the change of the green wave at the southern and northern stopover sites. We find that there is a significant advancement of the green wave in Europe as well as at two stopover sites over the 30 years, with a

more dramatic variation and advancement in south than in north Europe. At the southern stopover site, the arrival time of early-arrival geese from 1982 to 2004 shows no remarkable shift and late-arrival geese displays significant delay, whereas the green wave has significantly advanced during this period. At the northern stopover site, no significant change trend is observed for geese arrival time from 1989 to 2006, as well as the green wave over this shorter period. Furthermore, the arrival time of geese is not related to the time of green wave at both southern and northern stopover sites. Geese did not change their spring migration time to adapt to the shift of green wave. Prolonged stay of the late-arrival geese at the wintering site might be caused by the sharp increase of population and a higher predation risk at the southern stopover site. Under the current climate change, geese still can utilize local high quality food to accumulate energy at the wintering and southern stopover site, and arrive at the northern stopover site on time. However, if the green wave continues to advance and geese fail to fine-tune their migration adequately, the migration time of geese might mismatch with the food availability, resulting in low breeding success and population decline.

Key words: Climate Change, Green Wave, Spring Migration Phenology, Mismatch

Effects of Climatic Oscillations on the Phylogeography of Moustache Toads (Anura: Megophryidae: Leptobrachium) in Southern China

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Abstract: Deciphering the spatial distribution of the genetic structure of populations and interpreting the underlying historical processes are major tasks of phylogeography. Southern China, which is characterized by a complex paleoclimate and topography, is still less understood. Herein, we chose three species of moustache toad (Leptobrachium boringii, L. liui and L. leishanensis) to elucidate the effects of climatic oscillations and geological processes on the phylogeographical patterns in southern China. The species were chosen because of their long evolutionary history, low vagility and sensitivity to changes in climate. Molecular results based on two mitochondrial DNA fragments and eight microsatellite loci suggested a deep genetic variation between populations of each species. Genetic divergence within L. boringii and L. liui matrilines were estimated to occur during the Pliocene. Such simultaneous divergences within different species highlight the primary roles of general climate oscillations (Pliocene warming period and subsequent Northern Hemisphere glaciations), instead of regional geologic events. Furthermore, mismatch distribution analyses revealed interglacial expansions in L. boringii and L. leishanensis. Bayesian skyline plot and species distribution models

(SDMs) indicated that species in higher mountain regions survived in several refugia (the Yunnan-Guizhou Plateau and Nanling Mountains), whereas matrilines in lower mountain regions displayed diverse demographics during the last glacial maximum, which may be associated regional climatic characteristics. These findings highlight the important roles of the Pliocene climate shifts on phylogeographic patterns in southern China, which was less valued previously. The findings also contribute to the general understanding of the phylogeography in this biodiversity hotspot.

Key words: Phylogeography, Genetic Divergence, Pliocene Warm Period, Demographics

Water Depth Affects Reproductive Allocation and Reproductive Allometry in the Submerged Macrophyte Vallisneria natans

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Abstract: 1. The relationship between size and reproductive output is a fundamental aspect of a plant's reproductive strategy: the conversion of growth in fitness. Differences among populations in the reproductive allometry have been attributed to environmental conditions. However, the causes of variation in reproductive allocation are still debated (i.e. due to fixed patterns of development, or plasticity in the developmental trajectory of vegetative and reproductive allocation). 2. Using a mesocosm experiment, we investigated variation in reproductive allocation of a semelparous submerged macrophyte Vallisneria natans, one of the dominant species in Poyang Lake (China). To test the hypothesis that allometric trajectories of reproductive allocation are highly plastic in V. natans, we grew plants at three levels (shallow, intermediate and deep) of water depth and measured them after 26 weeks of growth. The allometric relationships between reproductive (R) and vegetative (V) biomass among treatments were compared. 3. In deep water treatment, total plant biomass decreased, average height increased and individuals started flowering in smaller size when compared to the two shallower water treatments. Deep water affected the biomass and number of fruits produced per plant leading to less sexual reproduction. Plants in deep water (the more stressful treatment) had relatively high allocation to reproduction, though they were quite small. The log R vs. log V slope in deep water treatment was much lower than those in more favourable treatments, and shallow water plants exhibited a very different log R-log V relationship than intermediate water plants. A possible explanation is that the environmental limits on size in deep water should favour a relatively large reproductive allocation at smaller sizes and a smaller investment in reproduction per additional unit of biomass accumulated. 4. Our results

demonstrated that water depth affects the observed pattern of reproductive allometry among experimental V. natans populations, and this has important implications for the fitness of macrophytes exposed to significant variations in water depth over time and space due to anthropogenic disturbance (e.g. dam building) and climate change (e.g. changes in local patterns of precipitation). Environmental stress in deep water tends to favor reproduction at relatively small sizes, associated with lower slopes of the log R-log V relationship, supporting that reproductive allometry can be interpreted as an adaptive strategy of plant growth and allocation, rather than as the product of fixed developmental constrains.

Key words: Adaptive Strategy, Reproductive Allometry, Resource Allocation, Submerged Plant

The Significance of Using a Video Recording Method in Assessing Crab Populations: Outlooks from a Tropical Region

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Abstract: The patchy distribution of crabs in mangroves have been the subject of intense examination by ecologists working in the field, generally attributed to spatial complexity, temporal heterogeneity, and increasingly influential disturbances from human activities. The significance of crabs as ecosystem engineers in mangroves is among the main drivers prompting research efforts including the study on the impact of disturbances on crab population. Important roles played by crab species are often lost when mortality occurs, often leading to decline in crab population size and species diversity. Without a prompt and thorough assessment, decline of mangrove crabs may go undetected. However, most of the methods used in assessing population size and diversity of mangrove crab are intrusive to this very sensitive and complex macrofauna, thus affecting the reliability of observations on mangrove crabs. There are various factors that may have confounding effects on assessing crab assemblages, including the sampling method used. Various sampling methods have been conducted with different levels of invasiveness, ranging from destructive practices such as burrow excavation, to least invasive methods such as visual observation. Therefore, it is very crucial to identify the best method that can provide reliable data that can truly represent patterns of crab population size in mangroves. This study compared intrusive hand catches with video recording which were essentially modified forms of visual observation. Data was collected over a year in six sites in two tropical mangrove forests located in the North West of Peninsular Malaysia. To date, this study is among the first in Malaysia attempting the use of video recording method in assessing crab population size across

multiple spatial and temporal scales in mangroves. Patterns found revealed abundance of crabs in video recordings was greater than the abundance of crabs sampled using the hand catch method. Based on the hand catch method, crab abundance did not vary among six study sites. However, based on the video recording method, crab abundance in two out of the six study sites was significantly greater than the other four sites ($p<0.05$). This indicated that use of hand catch method might lead to under sampling of mangrove crabs, skewing representations of crab population size and species richness in mangroves. Video recordings may minimize biases that were unavoidable when using the hand catch method, for example inconsistent efforts, different levels of concentration and skill from different individual samplers. Therefore, the use of less intrusive video recordings in assessing population size of mangrove crab is a viable solution for the conservation of these mangrove ecosystem engineers in this fast-changing tropical habitat.

Key words: Mangrove Crab, Video Recording, Hand Catch, Spatial Temporal

Spider Distribution and Influence of Some Ecological Factors

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Abstract: A twelve months study was carried out in four different habitats within Awka, the capital city of Anambra state in the southeastern Nigeria. While pitfall trap was the only sampling method used at the forest habitat, sweepnet, knockdown and pitfall trap were used on the remaining three habitats; farmland, fallow and marshy sites. 781 individuals in nineteen families were recorded. There were records of spider collection in all the twelve months of the study with December recording the highest abundance with 118 individuals. February with 104 came second while August with 18 individuals was the least in abundance. Fifteen of the nineteen families were found in the fallow site making it the richest in both diversity and abundance. Farmland and marshy with twelve and ten families came second and third respectively. Forest had the least number of families (4) which were also found in almost all the other sites. Lycosidae was the family with highest abundance, species diversity and distribution within and across habitats. Nesticidae was the only new record to Nigeria out of the nineteen families recorded. A Duncan test showed that there was a significant difference between pitfall trap effort and the other methods in both abundance and species richness. There was a significant relationship between efforts of sweep net and knockdown methods, and temperature in the fallow habitat. Correlation coefficient showed a positive significant relationship between efforts of pitfall traps in the forest and sweep net in the farmland and Relative humidity, while it was a negative significant relationship at the marshy habitat. There was a negative significant relationship between pitfall trap effort at the

fallow site, pitfall and knockdown at the marshy with rainfall. Though there was no clear seasonal distribution pattern shown, however, temperature, relative humidity and rainfall slightly affected abundance and distribution of spider both within and across the habitats and months.

Key words: Spider, Habitat, Lycosidae, Abundance

Effects of Human-mediated Mutualism Disruption on the Population Dynamics of a Tropical Tree

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Abstract: Maintaining species interactions is fundamental to the conservation of biological diversity. Chronic anthropogenic disturbance by disrupting beneficial species interactions can directly limit species coexistence and reduce biodiversity. Our understanding of the population level consequences of such mutualism disruption is limited because we often fail to model the response of plants across ontogeny. In West Africa, weaver ants (Oecophylla longinoda) defend African mahogany (Khaya senegalensis) trees from shoot borers (Hypsipyla robusta), and they receive in return habitat (leaves to make their nests) and honeydew from scale insects found on new branches. Heavy and frequent branch and foliage pruning of African mahogany by indigenous Fulani people has led to the disruption of such mutualistic relationships. I use four years of demographic data on African mahogany trees and their associated weaver ants to parameterize an integral projection model which incorporates the number of dead and alive weaver ant nests at the individual-tree level. This model allows for an in-depth analysis of the whole life cycle impact of the reduction in the number of weaver ants nests on the demography and the population dynamics of African mahogany. This model also allows understanding the indirect effect of non-lethal tree harvesting by indigenous people on mahogany productivity and dynamics beyond the direct reduction of photosynthesizing foliage.

Key words: Integral Projection Model, Tropical Ecology, Population and Community Dynamics, Non-timber Forest Products Harvest

Evolutionary Rescue

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Abstract: Evolutionary rescueQuan-Guo Zhang (Beijing Normal University,

zhangqg@bnu.edu.cn)A biological population in decline due to environmental deterioration can recover in abundance if genotypes tolerant of the environmental change increase in frequency and restore population growth sufficiently quickly. This phenomenon is known as evolutionary rescue. Much theoretical and experimental evolution research has been attracted to understanding the conditions to promote or impede evolutionary rescue. I will in this talk address several major questions in this area. Particularly, we found that temporary environmental amelioration may act both as an ecological refuge to promote short-term population growth and an evolutionary trap to decrease the chance of adaption to future deteriorating environment. We also found that antagonistic coevolution between species may decrease the chance to evolutionary adapt to abiotic environmental stress. The later finding has important implications for control of microbes that have high potential of drug resistance evolution.

Key words: Adaptation, Environmental Deterioration, Experimental Evolution

Effects of Field Biases on Our Understanding of Animal and Plant Demography Worldwide

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Abstract: Ecology has come of age. The ecological research being done worldwide is question-driven, highly experimental, and recently has started to take a global angle in order to find global generalities in how organisms interact with each other and with the environment. As a consequence of the momentum, hundreds of peer-review publications appear in ecological journals on a weekly bases containing precious ecological data. In the case of population ecology, two of the most widely used methods are matrix population models and integral projection models, which together produce an average of 5 publications per week. With such a vast, exponentially increasing volume of demographic information, population ecologists are now in a privileged position to address pressing questions in the light of climate change and re-assess findings from several decades ago that were done on a handful of data points. However, strong biases exist in our understanding of how populations may respond to a changing world. Here I introduce the latest versions of the COMPADRE Plant Matrix Database and COMADRE Animal Matrix Database, as well as two new on-going efforts to digitise integral projection models for plants (the PADRINO database) and animals (the MADRINA database). Together, these four resources archive precious demographic information of over 3,000 organisms, but the data are not free of biases. I introduce the results of a gap analyses highlighting the taxonomic groups and biogeographic areas that deserve further exploration, with a special focus on the species living in areas with

harshest changes in climate and human pressures.

Key words: Integral Projection Models, Population Matrix Models, Big Data, Senescence

Stochastic Population Dynamics: Methodological Insights from a Long-Lived Perennial Herb

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Abstract: Population growth rate and the importance of variation in vital rates for population dynamics are widely used to assess population status and the potential effects of environmental change. However, estimates of these population parameters and, consequently, conclusions about stochastic population dynamics may be affected by methodological artefacts such as the length of the observation period or matrix dimension. Here, we investigated the spatial and temporal robustness of population parameters (i.e., population growth rates, the relative contributions of vital rates and transient dynamics) using 27 years of demographic data from a long-lived perennial herb, Astragalus scaphoides. We found that the stochastic population growth rate, as well as the relative importance of vital rates and transient dynamics, varied among four study populations, indicating that responses to environmental variation cannot be necessarily generalized across populations of the same plant species. Considering the observed environmental sequence of vital rates resulted in lower estimates of population growth rate and smaller transient contributions to population growth than simulations based on random environmental variation. The precision and often also the accuracy of population parameters increased with the length of the observation period, with precise and accurate estimates requiring demographic data from 15-20 years. Moreover, larger matrices tended to produce lower estimates of population growth rates than smaller matrices. While matrix dimension had a minor impact on the relative contribution of vital rates, the relative contribution of transient dynamics to population growth rate increased with increasing matrix dimension in randomly varying environments. Overall, these findings indicate that the assessment of stochastic population dynamics and sources for variability of population growth rate based on a few years of demographic data may lead to both quantitatively and qualitatively erroneous conclusions about population responses to environmental variation.

Key words: Demography, Environmental Stochasticity, Population Dynamics, Population Growth Rate

University of TurkuSynergistic Effects of Temperature Variation and Density on the Life History Traits of Aedes Aegypti

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Serampore Collge and University Of Calcutta, India

Abstract: Temperature is one of the most widely studied and physiologically influential environmental factors that plays a key role in determining the mosquito and parasite life history traits. Temperature dependent changes in the life history traits of Aedes aegypti suggest that an optimum temperature range is required during larval development for attaining optimum fitness in terms of nutrient reserve, body size, longevity and fecundity. Deviations from the optimal conditions of expression of life history traits can be used as predictor of density dependent and density independent effects. Density reflects the level of competition of among developing larvae and the outcome can be measured through individual survival, development, size, longevity, reproduction and competence for parasites and pathogens. Entomological surveys from different geographical regions suggest that the density of Aedes mosquito differ with the larval habitats. This variation in immature density may act as a predictor to determine the effects on adult features and population characteristics of Aedes mosquitoes. Using temperature and density as factors, variations in the life history traits of Aedes aegypti was assessed in the present study to highlight possible consequences at the individual and population level fitness. Since fitness of a mosquito determines its capability of disease transmission, evaluating the temperature and density optima for the larval development and subsequent changes in selected life history traits such as age at pupation, pupal weight, longevity, adult weight, and wing length will enable predicting the population characteristics and possibilities of disease incidence. This proposition is based on the assumption that Aedes larval habitats are not food resource limited though the water content may vary as has been noted in many instances in course of entomological survey of Kolkata and adjoining areas. Such conditions reflect that during congenial temperature conditions, density of developing larvae is a primary factor determining the fate of adult mosquito. Thus, individual and interactive effects of temperature and density on life history traits will allow assessment of the fitness of the individual mosquitoes with higher precision. The results revealed that larval development of Aedes aegypti varied with the initial rearing density and temperature. As a consequence the history traits varied as a function of rearing temperature and density of both sexes. The impact of temperature and density treatments on the life history traits for both sexes was significant as revealed in the 3-way factorial ANOVA. The post hoc Tukey test showed significant variation between temperature pairs for each of the life history traits. Irrespective of density, both males and females showed a correlated response to temperature with regards to the life history traits. The differences

in life history traits of male and female Ae. aegypti can be assumed to be sex specific adaptations and strategies to maximize the fitness values, since the reaction norms differ between sexes of mosquitoes. Therefore it is apparent that a combination of density and temperature at which optimal development of Ae. aegypti occurs is important for disease transmission and population dynamics.

Key words: Aedes Aegypti, Intraspecific Competition, Temperature, Life History Traits

Utilizing Population Patterns and Behavioural Ecology in Assessing Uca Population in a Tropical Mangrove

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Abstract: Uca crabs from the family Ocypodidae are ubiquitous and vibrant, colourful additions to an otherwise monotonous landscape of sediment in a mangrove ecosystem. The bold displays by the males are used for defending, retreating, and attracting females. Other behaviours such as burrow construction have significant implications to mangrove ecosystem function. However, in Malaysia, behavioural studies on Uca populations have not been explored in detail. There is inherent hazards due to lack of this information, as the mangroves in Malaysia are currently under threat from human activities, potentially causing negative impacts on the diversity of Uca crabs. Previous studies have involved research on abundance and species richness, however these two components may not provide a detailed understanding of population patterns in increasingly modified mangrove habitats. When considering the complexity of mangroves and Uca populations, the use of multidimensional approach is more suitable. Behavioural studies have been done, involving territorial, courtship and spawning behaviour of Uca which combines usual practices of abundance and diversity studies with behavioural ecology. In this study, crabs were sampled using observations made via in-situ 15 minutes video recording which were then recorded in data sheets. Abundance data was taken in each sampling quadrat, but there was no significant difference observed. In comparison, based on behavioural observations, territorial and courtship behaviour varied significantly across sampling time, characterized by higher amounts of activity across sampling time. Only courtship behaviour correlated with light intensity and soil temperature. In addition, distinct features of Uca sp. was also used as marker to determine zonation and territories of different species in different sediment types. For example from 4 Uca species found, 3 (Uca annulipes, Uca forcipata and Uca tetragonon) were generally found preferring sandy zones, while Uca paradussumieri were found in soft-muddy zones. Findings from this study suggests

using behavioural studies in addition to usual methods is more appropriate and sufficient.

Key words: Tropical Mangroves, Uca Behaviour, Video, Observation

Theoretical Analysis of Population Projection in Random Matrix Models

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Abstract: Projection matrix models are known to be a mathematical model to provide us with plenty of population statistics, such as population growth rate, steady size-class distribution, and sensitivity and elasticity for population growth rate. Hundreds of academic papers using the model have been published these last forty years and a database on many of their matrices is now available on the internet (COMPADRE and COMADRE), which contains the demographic data on more than a thousand species. Franco and Silvertown (2004) published a famous paper, where they mapped elasticity vectors of survival, growth and fecundity for 102 plant species in a triangle simplex and found that they are located in a specific region. The same trend is found on the map for 1307 plant populations in the above plant database. To understand and clarify why they are located in a specific region, we constructed five types of random matrices. 4 by 4 random matrices were composed of two parts: fecundity and transition probabilities from a stage to another. The distribution of fecundities followed a Poisson distribution. The transition probabilities range from zero to one, whose row sums are less than 1. The elasticities for survival, growth and fecundities were calculated using 3000 random matrices and the elasticity vectors were plotted in the triangle map. The five types of matrices were as follows: (1) random matrices with no zero-element, (2) random matrices with no zero-element and the survival probabilities increase as individuals grow, (3) random matrices which have non-zero elements only on diagonal and sub-diagonal positions, (4) random matrices which have non-zero elements only on diagonal and sub-diagonal positions and the survival probabilities increase as individuals grow, (5) random matrices in semelparous species. The results are: (a) the distribution of the elasticity vectors moves to upper-left region of the triangle map as average of fecundity increases. (b) In the third and fourth types of random matrices, the distribution is located on a line. The slope can be described by a function of matrix size, n. When the matrix size is 4, it is equal to 46 degrees. The angler anges from 30 to 60 degrees with n= 2 to infinity. (c) In semelparous species, the distribution moves to the upper left along the 46-degree line. (d)There are no elasticity vectors in the bottom half of the triangle map.

Key words: Population Matrix Model, Random Matrix, Elasticity Analysis

The Distribution Pattern Shift of the Yangtze Finless Porpoise in the Yangtze River between 2006 and 2012: Implications for Reserve Managemen

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Abstract: Species distribution patterns provide a baseline that is essential for conservation planning. Species distribution could shrink and appear in a more fragmented pattern with habitat degradation and fragmentation. Therefore, conservation planning should take fully in account such shifts of species distribution. In this study, we compared the shifts of distribution patterns of the Yangtze finless porpoise in the Yangtze River between 2006 and 2012. We set the statistical unit as 1km, and applied the moving average method to calculate porpoise relative abundance (C-Encounter rates) of every unit in the main stem of the Yangtze River. The C-Encounter rates were calculated based on both visual and acoustic information from surveys in 2006 and 2012 respectively. The average C-Encounter rates were 0.29 porpoise km^{-1} and 0.12 porpoise km^{-1} in 2006 and 2012, respectively. The highest C-Encounter rates (>1.5-1.6 porpoises km^{-1}) in 2006 were more than twice of that in 2012 ($\leq$ 0.7 porpoises km^{-1}). However, the locations of the highest C-Encounter rates were 882km and 870km downstream from Yichang in 2006 and 2012 respectively, which were close enough (~10km) to consider as the same region. This outcome implied this region is the most suitable habitat in both years. The area with the lowest density (C-Encounter rates between 0 and 0.1 porpoises km^{-1}) covered 375 km (22.75% of the survey area in 2006) and 535 km (32.46% of the survey area in 2012) respectively. The percentage of low density area (C-Encounter rates between 0 and 0.2 porpoises km^{-1}) in total survey area was approximately 50% (814km, 49.39%) in 2006, while this number increased to almost 80% (1312 km, 79.61%) in 2012. The C-Encounter rates were decline in most of the statistical units, but increased in some sections mainly located from Anqing to Tongling. These results revealed that the distribution pattern of the porpoise was further fragmented in 2012. The previous recommendation based on the porpoise distribution in 2006 was to construct new reserves in areas with high porpoise densities. However, we found most of such areas with high densities were isolated to some extent, which may potentially contribute to the fragmentation process of the porpoise distribution. We suggested that a ~540km reserve zone should be constructed in priority from 829km (Hukou) to 1367km (Zhenjiang), since our results showed the distribution of the porpoise in this region was continuous and the

population densities is relatively high. The 46.66% of this region is non-reserved, which could be integrated into the current four reserves or considered as candidates for new reserves. Our study for identifying conservation priorities may provide insights into reserves design and conservation management, especially for the riverine systems.
Key words: Yangtze Finless Porpoise, Conservation Planning, Fragmentation, Reserve Zone

T6-07: Role of Ecological Non-Monotonocity in Regulating Stability and Persistence of Ecosystems

Stability of a Two-species System Having Both Intra- and Inter-Specific Non-Monotonic Functions

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Abstract: Although either interspecific or intraspecific non-monotonic functions have been found to influence stability of community and ecological networks, population models considering both interspecific and intraspecific non-monotonic functions have not been investigated. In this study, by using graphic stability analysis, we found a two-species model with both intra- and inter-specific non-monotonic functions could produce multiple equilibria; the probability of producing stable equilibrium points was larger than the models with only intraspecific non-monotonic functions, but lower than the models with only interspecific non-monotonic functions. Our results further confirmed that bell-shaped interspecific non-monotonic function was a stabilizing force, while bell-shaped intraspecific non-monotonic function was a destabilizing force; the former should be more favored by natural Selection than the latter. We appeal for more efforts in studying the ecological non-monotonicity in both theoretical and empirical studies.

The Convexity of Density Dependence and Regulation of Large Herbivore Populations

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Abstract: Population dynamics are nonlinear and stochastic. Strength of density-dependent regulation of animal populations may vary with population growth. Large-sized vertebrate populations may experience no or weaker density dependence at lower density but stronger density dependence at higher population density. Such nonlinear effects of density dependence (i.e., a convex relationship between population grow rate and density, viewing from above) can be represented by the theta-logistic population models with the parameter theta being above 1.0. Nevertheless, stochasticity (e.g., measurement error and environmental variability) of population dynamics often imposes challenges to estimation of nonlinear population models.

Nonlinear state space population models can estimate the parameters of nonlinear models accounting for measurement error and environmental stochasticity. This study implemented hidden Markov models and Bayesian nonlinear state space models to fit the theta logistic population models to 20 long-term population time series of large herbivores from Europe and North America. The findings of this study demonstrate that hidden Markov models are a promising, effective tool for estimation of the parameters of nonlinear state space population models. The convexity of density dependence increased with increasing body size of larger herbivores, suggesting larger animals were subjected to stronger density dependence. Stronger nonlinear density dependence may stabilize population dynamics of large herbivores.
Key words: Hidden Markov Models, Nonlinear Density Dependence, Population Regulation, State Space Models

Cultivated Walnut Trees Showed Earlier but Not Final Advantage over Its Wild Relatives in Competing for Seed Dispersers

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Abstract: Little is known about seeding regeneration of cultivated trees compared to wild relatives in areas where seed dispersers are sharedThat cultivated trees affect seeding regeneration of their wild relatives that share similar seed dispersers of animals has not been well investigated. Here, we investigated the differences in seed fates of cultivated walnut (Juglans regia) and wild Manchurian walnut (Juglans mandshurica) trees under rodent predation and dispersal. J. regia seeds have higher nutritional value (large size, mass and kernel mass) and lower mechanical defensiveness (thin endocarp) than J. mandshurica seeds. We tracked seeds of J. regia and J. mandshurica under both enclosure and field conditions to assess differences in competing for seed dispersers of the 2 two co-occurring tree species of the same genus. We found that rodents preferred to harvest, eat and scatter-hoard seeds of J. regia as compared to those of J. mandshurica. Seeds of J. regia were removed and scatter-hoarded faster than those of J. mandshurica. Caches of J. regia were more likely to be rediscovered by rodents than those of J. mandshurica. These results suggest that J. regia showed earlier dispersal fitness but not the ultimate dispersal fitness over J. mandshurica in seeding regeneration under rodent mediation, implying that J. regia has little effect on seeding regeneration of J. mandshurica in the field. The effects of seed traits on seed dispersal fitness may vary at different dispersal stages under animal mediation.
Key words: Cultivation, Plant-rodent Mutualism, Seed Dispersal, Stage-dependent Dispersal

The Effects of Variability on Species Interactions and Single Species Dynamics

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Abstract: The effects of Jensen's inequality, whereby variability in an input variable leads to a change in the values of a function are quite well known. Variation in the input can either increase or decrease the average values output by the function. While there is a good literature on how nonlinearity enters predator-prey interactions and single species population dynamics, there is much less information for plant-insect interactions. We start by reviewing the mechanisms by which nonlinearity enters species interactions and single species dynamics. We then relate this to variation by discussing mechanisms that alter how organisms react to variation through behavior, traits and population dynamics. Given that variation entering nonlinear functions is expected to alter average abundance of organisms we use the literature on trophic control to discuss the consequences for stability through the effect on the ability of organisms to persist. Viewed through trophic control, we discuss some next steps in modeling the effects of nonlinearity on the stability of trophic modules and communities.

Key words: Nonlinearity, Jensen's Inequality, Species Interactions, Persistence

Evaluating the Reversibility of Abrupt State Shifts: An Experimental Approach in a Coral Reef Community

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Abstract: Non-linear transitions in ecosystem state not only can be challenging to predict, they also can be difficult to reverse. Reversibility of an abrupt state shift depends on whether the underlying driver-response relationship has changed following the state transition. When hysteresis exists in that relationship, return to the original community state will be hindered as the driver reverts to its earlier condition. This lag in recovery arises because hysteresis produces a region of driver parameter space where more than one community state theoretically can be stable due to different sets of reinforcing feedbacks. Hysteresis and bistability have been well explored theoretically. By contrast, identifying hysteresis and evaluating its significance in natural systems have been challenging, despite the tremendous ecological and societal implications of lags in the recovery of degraded ecosystems. We addressed these issues empirically

using the coral reefs of Moorea, French Polynesia, as a model system. A growing number of coral reefs worldwide have undergone persistent phase shifts from a community dominated by coral to one dominated by seaweeds (macroalgae). Shifts to macroalgae can occur when herbivores fail to keep them under control. A critical but unresolved issue concerns the degree of reversibility of a shift to macroalgae back to coral. Our goals were to: 1) identify whether hysteresis is present in the herbivory–macroalgae relationship, 2) evaluate the nature of hysteresis, and 3) test explicitly whether macroalgae can represent an alternative stable state. We used long-term field experiments to address these issues; the first two goals were explored via small-scale discontinuity experiments, while the third was assessed using larger-scale pulse manipulations. Both types of experiments were done in the two coral habitats of Moorea: the outer fore reef slope and the lagoon. The discontinuity experiments revealed the presence of hysteresis in both habitats, although the region of potential bistability was much broader and closer to ambient herbivory in the lagoon than on the fore reef. Pulse manipulations revealed that seaweeds were unable to persist on the fore reef; by contrast, macroalgae was an alternative, self-replenishing community state in the lagoon. These results illustrate the utility of this approach, which could be used widely to quantify potential lags in the recovery of degraded natural communities, and to inform managers of specific feedbacks that need to be interrupted to restore a system.

Key words: Non-Linear Community Dynamics, Abrupt State Shifts, Hysteresis, Coral – algae Phase Shifts

Non-linear Dynamics of Coral Reef Communities: An Experimental Approach to Assessing Tipping Points

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Abstract: Many natural communities have exhibited sudden, unexpected transitions between ecosystem states. These abrupt shifts suggest that communities can respond in a highly non-linear manner to gradually changing environmental conditions, resulting in a rapid state transition when a critical threshold (‘tipping point’) has been passed. General understanding of abrupt state shifts has been advanced well by theory, but the development of useful empirical tools has lagged considerably. We present an experimental approach for assessing tipping points using coral reefs as a model system. Coral reefs can switch abruptly from a coral-dominated community to one where seaweeds (macroalgae) are a major space holder, which degrades the ecosystem services provided by the reef. Developing effective means to prevent such a state shift

can benefit by knowledge of three issues: (1) whether the amount of seaweeds present is a linear or non-linear function of herbivory (i.e., is there a tipping point?); (2) how much herbivory is needed to prevent the widespread establishment of macroalgae (i.e., where the threshold lies along the non-linear herbivory-macroalgae relationship); and (3) where ambient herbivory lies in relation to the minimum amount needed to retain control. We developed an experimental approach to answer those questions and applied it to coral reefs surrounding Moorea, French Polynesia. Our design created a gradient in herbivory, which broadly mimicked the effect of variation in fishing intensity on herbivorous fishes. A multi-year field experiment revealed that the shape of the herbivory-macroalgae relationship was highly non-linear, with a sharp herbivory threshold below which seaweeds escaped control. Further, the intensity of ambient herbivory in relation to the tipping point varied among reefs; herbivory at some reefs was far above the threshold while at others it was not. Our approach can identify vulnerable coral reef systems in urgent need of management action to both forestall shifts to macroalgae and preserve properties essential for resilience. More broadly, this empirical approach can be applied to other ecosystems, and as such, it can provide a powerful tool to understand non-linear community dynamics as well as to inform resilience-based management strategies.

Key words: Non-Linear Community Dynamics, Tipping Points, Coral-Algae Phase Shifts, Resilience

Feasibility of Integrated Multi-trophic Aquaculture (IMTA) in Ge Heyan Reservoir, China

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Abstract: Intensive cage aquaculture in lakes and reservoirs has been drawing increasing attention from researchers, industry and policy makers as a large amount of nutrients releasing in the environment in the course of aquaculture. To reduce the nutrient wastes from the cages, we compared the environmental theoretical influence of traditional cage aquaculture and integrated multi-trophic aquaculture (IMTA) which combine fed aquaculture species (e.g. black carp) with filter-feeders (e.g. bighead carp) and inorganic extractive plants (calamus). The cage fish aquaculture include six fish species for IMTA and five fish species for original mode in 20 cages. Of the total nutrients input, 62.84 % N and 57.46 % P were released into the environment by IMTA, while 71.3 % N and 68.66 % P were discharged by the original way. Approximately 1960 kg N and 297.9 kg P from IMTA and 2174 kg N and 345.3 kg P from traditional cage culture were annually discharged, with a fish production of about 42986 kg and

32777 kg, respectively. The total biomass of harvested calamus (Acorus calamus L) were 3783.6 kg, equivalent to 87.8 kg N and 15.5 kg P. The mean food conversion ratios of the two farming ways were 1.32 (IMTA) and 2.06. IMTA can reach an economic benefits of 558606.5 rmb, nearly 2000000 rmb greater than original ways. The comparison result of IMTA and mono-cage culture on environmental expense and economic benefits indicated that IMTA can be adopted to replace formal mode as a feasible and sustainable means of intensive cage culture in reservoir.

Key words: Cage Aquaculture, Integrated Multi-trophic Aquaculture (IMTA), Nutrients Discharge, Feed Conversion Ratio (FCR)

The Ecological Thresholds of Salt-marsh Vegetation in the Yangtze Estuary, China

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Abstract: Ecological threshold is closely related to the regime shifts phenomenon which will occur when the disturbance intensity of the ecosystem exceeds the ecological threshold, leading to degradation of the ecosystem service function. Ecological threshold has become the focus and hotspot of the ecological researches in recent years. However, the quantitative analysis of the ecological threshold of environmental factors in coastal wetland ecosystem and the study of multi-factor interactions are still in their infancy. In this study, taking S. mariqueter, S. alterniflora and P. Australis three different salt-marsh species in the Yangtze Estuary as study objects, we aim to: (1) Simulating different tidal flats elevation by different height of PVC piles which transplanted S. mariqueter, S. alterniflora and P. Australis, respectively. The survivals of different species were monitored monthly to determine elevation thresholds. (2) Simulating the interaction of different salinities and inundation by water tank control experiment to determine salinity and inundation thresholds for S. mariqueter and S. Alterniflora. The results showed that there were ecological thresholds of different salt-marsh species in the Yangtze estuary, the specific results are as follows: (1) The elevation thresholds of S. mariqueter, S. alterniflora and P. Australis communities in the Yangtze estuary were 2.32m, 2.54m and 2.64m respectively, and the corresponding daily flooding duration of three salt-marsh species were 9.8h, 8.9h and 8.2h, respectively; (2)The salinity thresholds of S. Mariqueter and S. alterniflora were 19.4‰ and 33.5‰ respectively. We also observed a combination of thresholds line in salinity and inundation depth for slat-marsh species to survive. The results from this study could enrich the mechanism of regime shift researches, and also provide data supports for the early warning of ecosystem regime shift and the scientific

supports for the ecological restoration project, which has meaning for theoretical and practical.

Key words: Ecological Threshold, Salt-marsh, Quantitative Analysis, Multi-factor Interaction

The Interaction Effect in Linear Models

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Abstract: The interaction effect is very common in linear models. It means, in the model Y = X1 + X2, the changes of X1 would change the association between Y and X2, and vice versa. The existence of the interaction effect reflects the complexity of the models. I use examples to demonstrate the interaction effect in ANOVA (mixed points), ANCOVA (non-parallel lines), multiple regression (twisted surface), and mixed effect models (correlated lines). In general linear models and generalized linear models, the interaction effect can be easily checked and its contribution (e.g. explained variance) can be easily quantified; as such, the presence of the interaction effect is clear. In complex machine learning models such as random forest, the the interaction effect can be taken in account yet its presence is usually unknown. Due to the fact that the interaction effect is often ignored, I suggest researchers should always check the effect of the interaction effect in linear models.

Key words: Model Evaluation, General Linear Model, Generalized Linear Model, Statistics

How Does Ecological Non-Monotonicity Attribute to the High Uncertainty and Complexity of Ecosystems?

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Abstract: As compared to physical world, ecosystems are well known to be less predictable due to its high uncertainty and complexity. In most traditional models of ecological networks, the ecological effects were often assumed to be linear, which result in the famous biodiversity paradox: more complex ecosystem would become less stable or persistent. Besides, linear systems are additive and predictable. Recent studies indicate that the ecological effects are often non-monotonic, i.e. the signs of ecological interaction are not fixed, but changeable among positive, negative and neutral instead. Introducing non-monotonic functions in the ecological networks would significantly

promote persistence of ecosystems, but the population behaviors become less predictable. This presentation will report recent progresses in the ecological non-monotonicity at various scales, from behavioral response, population dynamics, species interaction, ecosystem to global change. I want to highlight the significance of ecological non-monotonicity in causing stability and persistence of complex ecosystems.

Key words: Non-monotonicity

T6-08: Conservation of Tropical Plant Diversity and Ecosystem Functions

Biodiversity and Species Interactions in the Forest Canopy: Achievements and Horizons

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Abstract: Canopy science is an active subdiscipline, yet this stratum remains one of the least studied within global forest biomes. The conservation and proper management of canopies have become a central focus for research and policy. Understanding forest canopies is required to ameliorate global warming and enhance rural livelihoods. Recent development and deployment of new technologies (metagenomics and remote sensing) and expansion of infrastructure (across latitudes canopy crane network) have opened up new horizons, affording opportunities to address key knowledge gaps. Canopy science is undergoing a radical change of approach from descriptive studies to experimental manipulation. Here we examine recent progress in canopy science, with particular emphasis on canopy biodiversity and species interactions. We explore how new technologies and global canopy networks can be incorporated in multilateral, collaborative efforts.

Key words: Forest Canopy, Biodiversity, Food Webs, Climate Change

Plant Richness and the Environment in the Páramo Ecoregion

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Abstract: Modern macroecology requires more research on patterns of plant diversity in the tropical mountain areas of the world. In this study, we focus on the páramo ecoregion, which includes the ecosystems above the tree line in the humid northern Andes and is characterized by its unique biodiversity and ecological fragility. We aimed at understanding the spatial patterns and environmental drivers of plant richness in the páramo by addressing the following questions: (1) Can we identify a spatial structure, including altitudinal and latitudinal gradients, in plant richness across the páramo? (2) Is the environment, in the form of energy, climatic stability and climate harshness, a good predictor or richness variation? (3) When predicting species richness across the

entire ecoregion, can we identify particularly phytodiverse areas? We answered these questions using data from the VegPáramo database. First, we conducted an Ordinary Least Squares regression model where richness was modeled as a function of spatial predictors. We found significant spatial autocorrelation, including a small but significant decrease in richness with increasing latitude and elevation. Second, we built multiple General Least Squares (GLS) regression models representing different levels of complexity by combining energetic, climatic stability and climate harshness environmental variables. We found that the best environmental model included a significant effect of energy, and particularly relied on predictors related to water availability. We also revealed the importance of local environments, compared to macroclimatic trends, in driving variation of species richness in the páramo. Finally, we used a combination of GLS and Kriging modelling techniques to predict local species richness in unsampled páramo areas. The resulting predictions showed that there are potential phytodiversity hotspots in several areas of the ecoregion, mostly in the southern Ecuadorian and Peruvian páramos. We suggest further scientific focus on these páramos in order to propose them as priority areas for conservation.

Key words: High Andes, Plant Diversity, Environmental Drivers, Spatial Patterns

Nitrogen Demanding and Fixation Abilities Lead to the Spatial Distribution Pattern and Neighbor Species Richness of Legumes

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Abstract: Understanding how legumes adjust their biological nitrogen fixation abilities (BNF) and demanding to adapt different soil habitats and influence the neighbor species richness are critical to explaining extra sources of nitrogen in the tropics and how legumes coexist with neighbors. However, scant evidences are available to incorporate them together. Here, we assessed their interactions using the database from a 60 ha stem-mapping plot in a tropical forest in Jianfengling, Hainan Island, China. Results showed that legumes partition across the soil available nitrogen gradient and display stronger BNF in nitrogen-rich soils, reflecting species differences in nitrogen requirements and nitrogen use efficiency. This may explain how legumes contribute in maintaining high level of soil nitrogen. Furthermore, neighboring communities surrounding the focal legumes associated with nitrogen rich habitats were more diverse compared to those associated with lower nitrogen habitats, which inferred that legumes influenced the neighbor species richness depending on their nitrogen requirement.

Key words: Habitat Preference, Legumes, Nitrogen Fixation Ability, Spatial Distribution Pattern

Elevation Is a Stronger Driver of Plant Taxonomic, Phylogenetic, and Functional Diversities than Asymmetric Competition and Succession in Hainan Tropical Forests

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Abstract: It is unclear how inter-specific competition and environmental filtering influence variation in three measures of plant species diversity: taxonomic, phylogenetic, and functional diversity. Here, we hypothesize that intensified competition and environmental extremes may reduce species diversity considerably due to competition exclusion and environmental filtering. In this study, we assessed the relative importance of tree size, abiotic conditions, and the local biotic neighborhood in driving patterns of tree survival in an old-growth tropical forest in China's Hainan island at three organizational levels of species: taxonomic, functional and phylogenetic. We found that the Hainan tropical forest community's taxonomic and phylogenetic diversity was largely determined by elevation ($p= 0.001$) and Total Actual Evapotranspiration (Total_ae). Low elevation meant a harsh environmental screening effect due to high temperature and humidity, which contributed to the taxonomic and phylogenetic diversity change in this study. A significantly different phylogenetic signal was detected in diameter at breast height (DBH) in seven sites ($p<0.05$). Both mean pairwise trait distance (Dpw) and mean nearest phylogenetic neighbor distance (Dnn) differ significantly ($p<0.001$). This result proved that environmental filtering played more important roles in shaping the plant taxonomic, phylogenetic, and functional diversity in the tropical forest communities of Diaoluo Mountain in Hainan Island.

Key words: Tropical Forest, Phylogenetic Diversity, Functional Diversity

Functional Traits of Epiphytic Bryophytes and Their Responses to Simulated N Deposition

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Abstract: To investigate the N use strategies of epiphytic bryophytes, and to interpret mechanisms and determine their threshold for N deposition in a subtropical montane forest, here we measured functional traits of three dominant species and their responses to simulated N treatments. The results indicate that bole epiphytic bryophytes located in the dry air lost most of their free water within one hour, as well as the high dependence of net photosynthesis rates on water content, implying that the switch from hydrated photosynthetically-active state to the dry inactive state is quick. They exhibited distinctive features of shade-adapted plants, e.g., low gas exchange rates (<;0.6 μmol m–2 s–1), low light saturation points (101.9~113.1 μmol m–2 s–1) and compensation points (3.6~4.7 μmol m–2 s–1), and extremely low photosynthetic efficiency coefficient (3~4). All species showed significant down regulation of net photosynthesis under high light conditions (>300 μmol m–2 s–1). Their unique functional traits, such as high SLA, Chl, Chl/N, and low Chla/b, PNUE were critically important for enhancing the ability of trapping photons at low light levels. In this way, a strategy of adapting to shade tolerance in the understory was geared for high resource retention rather than high resource gain. Epiphytic bryophytes obtained more N from air deposition than from the bark, but the contribution of N from the bark was non-negligible. Glycine accounted for 28.4% to 44.5% of the total N, which implies that organic N might serve as an important N source. This study thus provides sound evidence that epiphytic bryophytes could take up N from the bark and wet deposition in both organic and inorganic N forms. Our results indicate that the process of carbon metabolism and the chemical stability of epiphytic bryophytes are strongly influenced by N deposition levels, and presenting strong correlations with the bryophytes loss. Imbalanced carbon metabolism, including photosynthesis inhibition and consequent chlorophyll degradation, due to leakage of magnesium and potassium and downstream effects, is suggested as the key mechanism driving the decline of epiphytic bryophytes, providing a novel insight in the bryophyte-pollution ecology. In addition, we found a significant decrease in species richness and cover of bryophyte communities at an N deposition rate of 7.4–12.2 kg ha–1 yr–1, which is consistent with declines in the biomass production, net photosynthetic rates and chlorophyll concentration responses of the two dominant bryophyte species. Considering the background N deposition rate is ca. 7 kg N ha–1 yr–1, a critical load of N deposition is thus suggested as 14.4 kg N ha–1 yr–1. A general decline in community heterogeneity and biomass production of bryophytes induced by increasing N deposition can be expected, which will probably alter the C and N cycles in subtropical forest ecosystems.

Key words: Bryophyte, Carbon Metabolism, Nitrogen Economy, Subtropical Montane Forest

Relative Importance of Tree Diversity, Size and Competition in the Short and Long Term Growth in a Primary Tropical Forest

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Abstract: Tree growth is of central interest both to foresters and ecologists. In forest management, understanding tree growth processes is essential for formulating silvicultural measures and forest policies. Forest ecologists need to know the factors influencing tree growth because of its key role in determining forest structure, biomass, carbon storage and stand dynamics. However, the relative importance of biotic factors influencing individual tree growth has been rarely studied, and such studies are practically missing from tropical forests despite their global significance. Using two 1-ha permanent plots in Brunei five times censused within 20-year interval, we applied individual-level neighbourhood analysis to explore the relative importance of tree diversity, size and competition in both short- and long-term growth in a primary species-rich tropical forest. We found the tree size to be the strongest, positive, predictor of both short- and long-term growth, compared to competition for nutrients, asymmetric competition for light and other factors. Competition with all neighbours negatively affected individual growth in both plots both in 5 and 20 years period. Surprisingly, diversity had significant negative effect on 5-year tree growth in the plot 1 whereas neither 5-year growth in the plot 2 nor 20-year growth in both plots were affected by it. While the effect of diversity on long-term growth was not detected most probably due to the lack of diversity gradient, our results highlighted the importance of large trees in undisturbed tropical forests. In the present study, large trees were the strongest competitors and grow fastest both over the short and long time interval. Our results thus underline the importance of conservation initiatives aimed at keeping the last fragments of primary Bornean forests untouched because removal of large trees by selective logging may significantly affect ecological functioning of tropical forests.
Key words: Tree Growth, Diversity, Tree Size, Borneo

A Study of Cryptocarya (Lauraceae) in Southeast Asia Based on Morphology and Phylogeny

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Abstract: The genus Cryptocarya within the Lauraceae family is widely distributed throughout the tropic forests including the Southeast Asian region. The total number of Cryptocarya is estimated between 200 and 250. However Cryptocarya has not been

fully studied and still remains difficult to identify. Thus we are carrying on a series field survey of plant biodiversity in Southeast Asia, including Cambodia, Indonesia, Laos, Malaysia, Myanmar, Thailand, and Vietnam. We used both plots survey and general specimen collecting methods at different elevations of the tropical mountains. In addition, we applied the both morphology observation and phylogenetic analysis based on DNA barcode ITS to identify the Cryptocarya species. As a result, within 83 Cryptocarya samples, 20 species were identified and 9 species are not identified including 3 new candidate species, which are Cryptocarya bokorensis sp. nov., Cryptocarya kaengkrachanensis sp. nov., and Cryptocarya honbaensis sp. nov..

Key words: Cryptocarya, Lauraceae, Phylogeny, Southeast Asia

Complex Interactions between Host Plant and Multiple Fungal Guilds in a Subtropical Forest

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Abstract: Fungal functional guilds, especially plant pathogens, mycorrhizal fungi, and saprotrophs are critical to ecosystem functioning and the maintenance of species diversity in terrestrial ecosystems. The importance of pathogens has gained considerable empirical support in regulating species abundance in tropical and subtropical forests by inducing negative density dependence. In addition, plant species may become locally dominant because they can take up both organic and inorganic nitrogen in soil by forming root symbioses with ectomycorrhizal fungi. However, a comprehensive study of how theses fungal guilds are related to their host abundance and how they are interacted in a framework of network is still lacking. Here, we collected 529 root tip samples from 45 plant species which cover a wide range of relative abundance (ranging from 0.1% to 10%) and phylogenetic relatedness in a subtropical forest dynamic plot in southern China. The fungal communities in root tips were assessed by massive parallel pyrosequencing and the taxa were assigned to two major guilds including plant pathogens (latency stage) and ectomycorrhizal fungi.

We found that the abundance of latent pathogens is significantly negatively correlated with their host abundance, indicating that rare plant species are under higher risk of disease than abundant species. Thus, latent pathogens may regulate species abundance by inducing a trade-off between plant defense and resource uptake ability. Consistent with this expectation, analyses of ectomycorrhizal fungi showed that their richness and abundance are significantly higher in abundant species than that in rare species. Moreover, the network structures of plant–ectomycorrhizal fungi symbioses showed that abundant plant species and rare species exhibited different levels of interaction

specialization and nestedness, which illustrated an architecturally diverse ecological network in our system. Collectively, our work highlights the profound importance of belowground fungal functional guilds in regulating the diversity and composition of aboveground plant communities.

Key words: Ectomycorrhizal Fungi, Plant Pathogen, Subtropical Forest, Above-ground and Below-ground Interaction

Variation in Woody Plant Functional Traits of the Karst Hills, Guilin, Southwest China

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Abstract: Understanding how plant traits vary across disparate spatial, temporal and and biological scales is one of the central questions in ecology and evolution. However, the relative contribution of variation in a given trait vary across different ecological scales remains poorly known, which prevents us from qualitatively assessing potential scale-dependent aspects of trait variation. To address this question, we used a variance decompostion from linear mixed models to quantified and analysed the relative importance of four nested ecological scales (plot, species, tree and leaf) Variability in four key functional traits (LMA: leaf mass per area, LDMC: leaf dry matter content, LNC: leaf nitrogen concentration and LCC: leaf carbon concentration) on all woody plants were sampled in 40 10×10 m plots in Karst Hills of Guilin, Southwest China (110˚02′–110˚15′E, 24˚48′–25˚03′N).We found that the ranges of explained variance for LMA, LDMC, LNC and LCC were 0.09–0.16, 0.17–0.25, 0.35–0.69, and 0–0.07 for the individuals, intraspecies, interspecies and community levels, respectively. This indicate that the relative contribution of the four traits are similar, that was interspecies > intraspecies > individuals > community.The lowest even the lack of variance at the community level highlight the idea that trait-based environmental filtering could playing a central role in plant community assembly. These results show that variation of functional traits over all species mainly came from interspecies, but data also showed a large variation in functional traits within species. Thus, intraspecific variation of functional traits should be taken in account if we want completely understanding of assembly rules in plant communities.

Key words: Woody Plants, Plant Functional Traits, Ecological Scales, Trait Variation

Non-dominant Tree Species Are Indispensable for Conserving Epiphytic Lichens in Subtropical Forests

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Abstract: Host specie has important influences on the distribution of epiphytic lichens in forest ecosystems. However, the importance of non-dominant trees for conserving lichen species has been poorly detected due to their relative rare individuals, when compared to dominant trees. We determined the relative importance of dominant and non-dominant trees for epiphytic lichens in co- and mono-dominant forests in subtropical southwestern China. The stand-level numbers for total and exclusive lichen species were considerably lower on dominant trees than on non-dominant trees in the primary dwarf mossy forest, primary Lithocarpus forest, old-aged oak secondary forest and Pinus yunnanensis secondary forest, while four other forests showed the contrasting trend. The occurrence of non-dominant trees enhanced epiphytic lichen diversity in all forests. At plot-level, the two tree groups supported significantly different lichen communities amongst and among forest types. Ordination analyses further showed clear separation of lichen assemblages between them within most forests. Our study therefore reinforced the importance of non-dominant trees for conserving epiphytic lichens in subtropical forests, as well as highlighted lichen species assemblages were shaped by both dominant and non-dominant trees. We suggested that non-dominant tree species are indispensable for epiphytes and cannot be ignored in forest conservation and management.

Key words: Diversity Conservation, Dominant Tree, Rare Tree Species, Epiphyte

Recovery of Logged-over and Dioxin Affected Forest in Dong Nai Biosphere Reserve, Vietnam

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Abstract: About 71,000 ha of evergreen natural forest in the core area of Dong Nai Biosphere Reserve have been seriously disturbed in the pass mainly due to selected logging and Agent Orange spraying. This research investigated the recovery of these forests after about 20 years of logging ban and being managed as a conservation area. Data collected from 200 inventory plots of 1000 m2 each on different forest and disturbance types, in a range from 20 – 35 years abandoned after logging, were analysed and compared with data collected from 24 plots (as reference) of the same forest type in the core area of Cat Tien National Park nearby (20 – 40 km) which were

not disturbed in the pass. Results show that, for recovery of forest stock, after 20 – 35 years the volume of the selected logging and logger-over forest type is still much lower than the un-logged forest, 80.9 and 46 vs. 384.1 $^{m3\ ha-1}$ in average, respectively, while it is only 30.7 $^{m3\ ha-1}$ in the dioxin affected forests. Forests have been applied assisted natural regeneration has higher volume, 94.4 $^{m3\ ha-1}$. There is not a clear relationship between volume and years of abandon. The species richness and diversity indices in the selected logging and logged-over forests are also lower than the un-logged forests. Simpson and Shannon index were 0.9 and 2.72 vs. 0.93 and 2.89, respectively, while they are only 0.83 and 2.1 in the dioxin affected forests. The forests were seriously logged and affected by dioxin agent, so the recovery process was slow. Silviculture intervention such as assisted natural regeneration and enrichment planting would help the recovery process faster.

Key words: Evergreen Dipterocarp Forest, Forest Succession, Agent Orange

Exploring the Functional Trait Relationships Across Intraspecific, Interspecific and Community Levels in Tropical Cloud Forests

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Abstract: 1. Allometric relationships among functional traits reflect trade-offs in how plants adapt to environments through resource allocation. Such relationships among species are well studied. However, these trade-offs also exist at the within species and community levels. Analyses across intraspecific, interspecifc and community levels are less common and consequently, our understanding of how trade-offs may be influenced by the choice of scale, remains incomplete.

2. We measured leaf mass per area (LMA), leaf chlorophyll content (Chl), plant height (H) and wood density (WD) for 4,116 individual trees with DBH ≥ 5 cm, as well as soil conditions including organic matter, total phosphorous, total nitrogen, available phosphorous and available nitrogen in three tropical cloud forests. We then tested bivariate relationships between these traits, and explored the effects of soil conditions on these trait relationships across the within-species, among-species, and community levels.

3. LMA-Chl, LMA-H, LMA-WD and Chl-WD had positive and allometric relationships, suggesting a plant strategy related to balancing the tolerance of environmental stresses with the goal of achieving rapid growth. The slopes of LMA-H and LMA-WD relationships did not differ across within-species, among-species, and

community levels. The consistent relationships between LMA-H, and LMA-WD suggest that these two trait pairs capture primary dimensions of functional variation, and thus are core strategies for plant adaptation in tropical cloud forests.

4. Soil phosphorus had a significant effect on the LMA-H and LMA-WD relationships across the within-species, among-species, and community levels, suggesting that soil nutrients, as expected, can shape the stable trait trade-offs across the three levels in tropical cloud forests.

5. In most cases, the shape of trait trade-offs differed depending on whether analysis was intraspecific, interspecific, community-wide, and were correlated with differing environments. This finding reflects the importance of decisions pertaining to scale as well as abiotic features in the understanding trait trade-offs.

Key words: Bivariate Relationship, Plant Strategy, Scale-dependent, Scale-independent

Dormancy and Germination of Firmiana Danxiaensis

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Abstract: Firmiana danxiaensis H. H. Hsue & H. S. Kiu (Family Malvaceae, formerly Sterculiaceae) was listed as a Second Class Key Protected Wild Plant of China in 1999 and in the Conservation Program for Plants with Extremely Small Populations in China in 2012. Its distribution is restricted to Danxia landform, including Danxiashan National Nature Reserve (DX) and Cangshizai County Nature Reserve (NX) at Shaoguan City, South China. F. danxiaensis grows on red cliffs which formed by sandy conglomerates and shallow soil layers. In order to conserve this species, we studied its germination methods. We collected ripe seeds of F. danxiaensis from DX and NX on August, 2016. The seeds were globose and yellowish-brown, ca. 6.23mm (NX) to 6.89mm (DX) in diameter, 92.28g (NX) to 141.79g (DX) in 1000-grain weight, 4.92% (DX) to 8.44% (NX) in the percentage of empty seeds, 11.01% (NX) to 11.36% (DX) in water content, and 58.44% (NX) to 82.89% (DX) in seed viability. Germination test was carried out with total 12 treatments, including four temperatures (25, 25/35, 15/25 and 10/20℃ (night / day)), and three photoperiods (24h light, 24h dark, 12h light /12h dark). The highest average germination rate was 1.48% at 25/35℃, which was significantly lower than the seed viability (58.44%-82.89%). According to this result, we deduced that the seed was dormant. The results also indicated that illumination had no effect on seed germination and 25/35℃ treatment was the suitable germination condition with the shortest germination time lag and the fastest growth rate. The water absorption rate (WAR) of CK (intact seed) was about 20% when it achieved constant weight in 48h. The WAR of ZK (puncture the seed hole) reached 120%

(DX)-140% (NX) in 96h and saturation has not yet reached. The WAR of QK (shuck the seed coat) was about 130% (DX)-170% (NX) in 48h. These results suggested that the seed coat was a physical obstacle on water absorption, and resulted in seed dormancy. To break dormancy, six treatments were conducted, including 1) soak the seeds in 98% H2SO4 for 1h; 2) hot and cold water alternation (90℃/5min transfer to 0℃/5min); 3) 4℃ storage for 7 days; 4) soak the seeds into 500mg/L GA3 and 500mg/L 6-BA for 24h at 50℃, respectively; 5) soak into water at 50℃; 6) CK. The 98% H2SO4 treatment turned out to be an effective way to break the dormancy of the seeds. Those germination methods are helpful for the conservation of this species.

Key words: Dormancy, Germination, Conservation, Firmiana Danxiaensis

Responses of Plant Functional Traits and Soil Environmental Factors to Slope Aspect in Karst Hills of Guilin, China

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Abstract: Plant traits link environmental factors, as plants responsse and adapt to the environment. The analyses on plant functional traits and soil factors and their relationships with slope (shady-sunny) aspects gradient are able to respond and adapt to changes in quality of the spatial pattern of landscape and microhabitat. We explored how shrub plant functional traits respond to environmental factors and examined their relationship changes at (shady-sunny) slope gradient.The results shows that the specific leaf area at shady slope was greater than sunny slope while leaf dry matter content and leaf thickness at sunny slope was greater than shady slope. Soil water content, organic matter content, organic carbon content and available nitrogen content at shady slope were greater than sunny slope, soil temperature and soil total nitrogen content at the sunny slope were greater than the shady slope. Multiple regression analysis demonstrated that environmental factors driving functional traits at the community level varied at (shady-sunny) slope gradient. The key environmental factors at shady aspect were soil available nitrogen, soil temperature and soil organic carbon content while soil water content, soil pH, soil total nitrogen, soil temperature and soil total phosphorus at sunny slope. Our results indicate that at different slop aspect (shady-sunny) gradient, the same functional traits respond to different environmental factors, enabling adaptation to specific environmental conditions.

Key words: Aspect, Soil Environmental Factors, Karst Mountain, Plant Functional Traits

Flexibility in Daily Time Budget of Assamese Macaques Inhabiting Karst Forest of Guangxi, China

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Abstract: Flexibility in daily activity time budget is important for primates to survive various habitats. We collected data on flexibility in daily time budget of a troop of Assamese macaques (Macaca assamensis) habiting limestone forest Southwestern Guangxi, China from September 2012 to August 2013. Our results showed that Assamese macaques devoted the most time to feeding, followed by resting, moving, grooming, playing and other activities, respectively. Macaques spent less time moving but more time resting in thedry season than rainy season did. The daily activity time budgets were affected by food resource, which indicating positive correlations among moving and food availabilities. Moreover, time engaged in playing was a function of fruit abundance. The combination of resting and grooming was decreased with the increasing of fruits abundance. In summary, variation in daily time budget of the Assamese macaques in limestone forest could be primarily linked to the food abundance and displayed a low-cost-low-yield behavioral strategy when coping with fruit scarcity. The flexibility in daily activity time budgets allows Assamese macaques living in limestone forest.

Key words: Daily Time Budget, Assamese Macaques, Karst Forest

T6-09: Species Interaction and Community Structure in Severe Environment

From Inferior to Superior: Plasticity in Root Vertical Distribution of a Bunch Grass in Arid Vegetation Patches

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Abstract: In arid and semi-arid areas, plants commonly aggregate and form vegetation patches to cope with severe living conditions, e.g. high solar radiation, high temperature, lack of water and nutrients. To reveal belowground adaptative strategies of plants in the arid, we chose a bunch grass species Achnatherum splendens as our focus, and studied its root vertical distribution patterns in three types of spatially adjacent communities, namely tree-grass, shrub-grass and forb-grass, in the arid northwest China. In tree-grass community, tree species Elaeagnus angustifolia is the dominant pattern-controlling species, Achnatherum mainly grows under tree canopies. In shrub-grass community, shrub species Nitraria tangutorum is the pattern-controlling species, Achnatherum mainly distributes on the mounds created by Nitraria. However, in a later successional stage, Achnatherum turns to dominate the mounds, Nitraria retreats to the edge of mounds. In grass-forb community, Achnatherum becomes the dominant pattern-controlling species, perennial forb species Sophora alopecuroides with a lignified-root system mainly appears within the base area of the grass. Field sampling was conducted in the late summer, without rain event for more than half a month. In each community, five patches were chosen. Within each patch, a 150 cm deep soil profile with a coverage of 100 cm × 100 cm was excavated. Roots and soil samples were collected in sequential soil layers (0-10 cm, 10-30 cm, 30-60 cm, 60-100 cm and 100-150 cm). Root biomass, soil water content and soil organic matter were measured. Root biomass density and cumulative root fraction were then calculated. We found that in all communities, sub-shallow layers, especially the 10-30 cm layer, always had significantly higher soil water content than shallower layers and higher soil organic matter than deeper layers. In the patches of tree-grass and forb-grass communities which are in stable status, the roots of Achnatherum and the fine roots of its neighbours showed a distinguished vertical segregation pattern. Superior species dominated sub-shallow layers, especially the 10-30 cm layer; while inferior species allocated more roots to either shallower or deeper layers. On the other hand, in the patches of shrub-grass community with unstable status, the vertical distribution patterns of Achnatherum's roots and Nitraria's fine roots highly overlapped. They all preferred the

10-30 cm layer. From a pure inferior to a pure superior, as the role of Achnatherum shifted from tree-grass to forb-grass communities, it rooted increasingly deeper. This was mainly due to its belowground competitive efforts in the 10-30 cm layer shifted from weak to strong.Therefore, we conclude that belowground segregation together with aboveground aggregation stabilize patchy community structures in arid environments. Within a patch, superior species dominate most comfortable soil layer, while inferior species seek for other layers.

Key words: Root Segregation, Vegetation Patch, Belowground Interaction, Arid Environment

Soil Characteristics and Zonation of Phragmites Latifolius and Phragmites Australis Communities at Tidal Marsh

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Abstract: Phacelus latifolius is classified as halophyte and mainly occurs at estuaries in East Asia and has similar growth form to Phragmites australis (common reed) at early growing season. In tidal channels, P. latifolius and P. australis communities show adjacent zoned distribution pattern. However, major factor affecting the zonation of these communities has not been distinguished. To investigate soil factors that affect vegetation zonation of two adjacent emergent macrophyte species, vegetation survey and soil analyses were conducted at a tidal channel in Korea. Quadrat survey and soil sampling were conducted in P. latifolius dominant or P. australis dominant communities. Quadrats were classified mainly in [P. latifolius and Suaeda japonica] community and other communities with P. australis under TWINSPAN. In redundancy analysis (RDA), soil electric conductivity, pH, Na SO_4^{2-}K PO^{4-}P, Ca^{2+}clay content mainly contributed to the separation among classified communities. Generalized additive model (GAM) on coverage of P. latifolius and P. australis were constructed using soil factors with higher coefficient. 52.1% of deviance of P. latifolius coverage could be explained in the model with soil PO^{4-}P, Ca^{2+} and organic matter content. 53.0% of deviance of P. australis coverage could be explained with soil $Ca^{2+}$$Na^{+}$ content and electric conductivity. Soil Ca^{2+} content was the most significant factor to coverage of both P. latifolius ($p = 0.03$) and P. australis ($p = 0.02$) in GAM. In smooth function of each soil factor, P. austalis has relatively narrower soil Ca^{2+} content range than P. latifolius. Therefore, soil calcium content seemed to mainly attribute the zonation of these two communities.

Key words: Emergent Macrohytes, Estuaries, GAM, Salt Marsh

Effects of Nitrogen Deposition on the Biomass of Stipa Krylovii and Allium Polyrhizum

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Abstract: Abstract: Nitrogen deposition is one of the major problems of global environmental change in recent decades. It has affected ecological system at all levels. In this study, the effect of nitrogen deposition on the dominated species of Stipa krylovii and Allium polyrhizum in typical grassland in Hulun Buir grassland. Pot control method with simulated nitrogen deposition was used in this experiment, the nitrogen rate was 0 and 10g/m2/year. We measured the aboveground biomass, belowground biomass, total biomass and the contents of carbon(C), Nitrogen (N), phosphorus (P) in leaves. The results showed that nitrogen addition had a significant effect on the growth of the two species. With the addition of nitrogen, the aboveground biomass, belowground biomass and total biomass increased significantly. The response of S. krylovii was more obvious than A. polyrhizum. The biomass allocation was significantly affected by nitrogen addition for S. krylovii population. The S. krylovii allocated more resources to the underground part, and the biomass allocation of A. polyrhizum population had the same trend but it was not significant. The N content of plant leaves increased obviously after nitrogen addition. It showed that nitrogen deposition caused the accumulation of nitrogen in the leaves of S. krylovii and A. polyrhizum. There was no significant effect of nitrogen deposition on C and P in two species. The N/P of S. krylovii and A. polyrhizum were lower than 14, the growth of two species was mainly limited by nitrogen.

Key words: Nitrogen Additon, Aboveground Biomass, Belowground Biomass, Biomass Allocation

Richness of Bacteria and Hazard Quotients of Human Health of Various Heavy Metals in Soil

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Abstract: Soil pollution is becoming more serious in recent years. In this study, we want to analyze the effect of various metals to the richness of bacteria. The soil samples were collected in November 2015 from Qihe, Lanling, Boshan, Zhaoyuan, Wulian in Shandong province where the abnormal values of heavy metals in soils were observed. We measured the content of heavy metals, non-metallic elements, and soil properties to analyze the variation of the soil microbial species richness. The detected soil elements

include As, Cd, Cr, Cu, Ge, Hg, Mn, Ni, Pb, C, N, P, S, B, F, Se. The soil properties include pH, organic matter, electric conductivity and particle size. The DNA from soil was extracted and the 16S rRNA gene was analyzed. The As, Cd, Cr, Ni, Hg, N, S, F and pH were found significantly correlated with the richness of microbial species by RDA analysis. Through the partial RDA analysis, we found the heavy metals, non-metallic elements and soil properties together affect the bacteria richness. The detected species include Mycobacterium celatum, Amycolatopsis coloradensis, Arthrobacter oxydans, Streptomyces espinosus, Bacillus aryabhattai, Actinoplanes digitatis, Lysobacter solibelonging from Firmicutes, Nitrospirae, Proteobacteria and Actinobacteria. The contaminated land exposure assessment model was also used to investigate the relation between human health and the hazard quotients of heavy metals in soil. Finally we discussed the impact of pollution on human health at the nervous system level and how to control the pollution.

Key words: Heavy Metals, Bacterial Richness, Hazard Quotients, 16S Rrna Gene

Spatial Variation in Food Web Structure of Floodplain Wetlands in Lake Poyang

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Abstract: Spatial variation within food web structure is recognized to be importance for understanding the function of ecosystems, but this information has often been overlooked, especially at a landscape scale. During the dry period, numerous small floodplain wetlands emerge and are disconnected in Lake Poyang. We compared the trophic structure of basal production sources and consumers of these four wetlands (Dahuchi, Shahu, Zhonghuchi and Meixihu) using stable isotope analysis. Isotopic signatures of basal food resources and fishes exhibited clearly distinct among these wetlands. Meanwhile, the estimated trophic position of fishes also showed significant differences among these wetlands except for omnivorous consumers. The results from Bayesian mixing models revealed that benthic algae accounted for a large fraction of fish biomass in all studied wetlands, while Dahuchi and Meixihu was mainly supported by carbon sources from terrestrial vegetation and seston, respectively. These findings suggested that spatial variation in food web structures of floodplain wetlands in Lake Poyang was largely associated with the basal carbon sources utilized by consumers.

Key words: Floodplain Wetlands, Food Web, Lake Poyang, Stable Isotope

Differences in Physicochemical Soil Characteristics of Phragmites Japonica and Phragmites Australis Habitats

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Abstract: To compare the distribution and soil characteristics of two morphologically similar macrophytes, Phragmites japonica and Phragmites australis, 26 sites were surveyed along a single urban river system. Vegetation survey of P. japonica or P. australis communities was conducted, and soil samples were collected at each site for physicochemical analysis. Mean values of water content, organic matter content, PO_4-P, NH_4-N, K+ and Ca_2+ content in soil were significantly different between two communities. Canonical correspondence analysis showed that the strongest factor for the density of two species was the content of NH_4-N, and K_+, organic matter content were followed. The density of *P. australis* and *P. japonica* could be predicted by following general linear models with soil NH_4-N and K_+; contents: D_{PJ} = 97.471-0.052CNH_4-N-0.185CK, DPA = 7.533+0.135 CNH_4-N +0.032CK (DPJ = Density of P. japonica, DPA = Density of P. australis, CNH_4-N = Content of NH_4-N, CK = Content of K+). The relationship between two soil components and two species density is considered as a combined result of the nutrients in soil and hydrological, geological structure of stream. In conclusion, the distribution of P. japonica and P. australis in shore vegetation was mostly separated, and soil characteristics of two species' habitats were different, especially, NH_4-N and K+ contents were much high in P. australis habitats. Also, those two soil components could be used to anticipate P. japoinica and P. australis density.

Key words: Ammonium, Macrophyte, Potassium, Shore Vegetation

Predation Risk Affects Growth and Reproduction of an Invasive Snail Pomacea Canaliculata and Its Lethal Effect Depends on Prey Size

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Abstract: The behavior of invasive species under predation risk has been studied extensively, but their growth and reproductive responses have rarely been investigated. We conducted experiments using juveniles and adults of the invasive freshwater snail Pomacea canaliculata, and observed the changes in growth and reproduction in response to the risk situation from a caged predator (Trachemys scripta elegans). Compared with the control group (no risk), the egg masses of P. canaliculata were produced earlier in the presence of predators and injured conspecifics, although the

total number of the egg masses was exceeded by that of the controls after two weeks. Egg hatching success noticeably decreased under the predation risk, and the incubation period was significantly prolonged, but the oviposition height of the snails was not affected. A lethal effect of predation risk was detected in juvenile snails but not in adults. The growth of juvenile and adult P. canaliculata was inhibited under the predation risk. Females exhibited a greater reduction in growth than males, probably due to the earlier investment in egg laying relative to controls. These results indicate that P. canaliculata snails under the predation risk make a trade-off between the predator avoidance, growth and reproduction, and the lethal effect of the predation risk is linked to the size of the preys.

Key words: Pomacea Canaliculata, Biological Invasion, Predation Risk, Anti-predator Responses

The Different Responses of Microcystis Aeruginosa and Scenedesmus Quadricauda to Antibiotics Pollutants

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Abstract: As one of the most serious problems in the worldwide freshwater shallow lakes, eutrophication usually results in imbalance of ecosystems and leads to cyanobacterial bloom, green algae bloom or diatom bloom, depending on the competition results among phytoplankton species. The outcome of competition would be affected by biotic and abiotic factors owing to the different responses of varied species to them. The constantly input pollutants, including antibiotics, become the problems that cannot be neglected. However, it has not received enough attention yet. In order to investigate the difference of response between cyanobacteria and green algae to typical antibiotics stress, we employed Microcystis aeruginosa (the common species of cyanobacteria) and Scenedesmus quadricauda (the common species of green algae) to compare the growth condition, chlorophyll-a/soluble protein contents and superoxide onion activity under antibiotic stress. Norfloxacin (NFLX) and fluconazole (FCZ) were chosen to represent the common antibacterial and antifungal pollutants respectively. We found that: (1) Cyanobacteria was obviously more sensitive to NFLX than green algae. The growth inhibition of M. aeruginosa (based on OD663 value) was 78.4% under 50μg/L NFLX treatment compared to control, while growth of S. quadricauda (based on OD680) was not influenced even the concentration of NFLX reached to 5000μg/L; (2) Green algae was obviously more sensitive to FCZ than cyanobacteria. The growth inhibition of S. quadricauda was 49% under 500μg/L FCZ treatment compared to control, while growth inhibiton of M. aeruginosa was just 15.5%

when the concentration of FCZ increasing to 10000μg/L; (3) The main physiological responses of two kinds phytoplankton to antibiotic pollutants are similar, such as decreasing of soluble protein and Chla content, increasing of superoxide onion activity; (4) The different responses between cyanobacteria and green algae under different antibiotic pollutants would responsible for the phytoplankton community changes in freshwater bodies.

Key words: Cyanobacteria, Green Algae, Antibiotics, Sensitivity Difference

Effects of Salt Stress, Storaged Time, Seed Mass on Seed Germination Rate and Germination Vigor of Leymus Chinensis

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Abstract: Background/Question/Methods

The seed bank in soil is an important part of the potential for the regeneration of vegetation. Some seeds would germinated in a short time after scattered in the soil, while others would going in the dormant state due to various factors such as salt stress, storage term and seed mass in salt-alkali soils. Leymus chinensis is the dominant species in Songnen salt-alkali grassland, Northern China. However, little attention has been paid to the combined effects of the salt concentration, storaged time and seed mass on seed germination. Here we conducted a full factorial experiment with three factors: salt stress (Na2CO3: 0,10, 20, 50,100mmol·L-1), seed storaged time(long-term storaged: 6 years; short-term storaged: 2 years), and seed mass (long-term storage: small seeds <0.28mg, large seeds ≧0.28mg,short-term storage: small seeds <3.0mg, large seeds≧3.0mg) for a total of 12 combination treatments. Three replications per combination of treatments were designed.

Results/Conclusion

Both of the germination rate and germination vigor are greater under a lower salty concentrations (10mmol L-1) than under control, indicating that a lower concentration of salty could promote the germination of Leymus chinensis. Large seeds tend to have higher germination and germination vigor when compared to small seeds under the same salt stress condition and storaged time. Germination rate and germination vigor of short-term storage seeds are higher than that of long-term storaged seeds in the condition of the same salt stress and mass. Although germination rate and germination vigor all decreased with increased salt stress, the germination rate and germination vigor of short-term storage seeds were much higher than long time storage seeds under the same salt stress condition. And large seeds obviously higher than small seeds. Consequently, the larger and/or short-term storage seeds would have more chance to

germinate and establish than smaller and/or long-term storage seeds under a salt-alkali environmental conditions. In conclusion, larger mass seeds with short-term storage have greater germination rate and germination vigor regardless salt stress.
Key words: Seed Storaged Time, Seed Mass, Seed Germination, Salt Stress

Peinobiomes: Ecological and Evolutionary Community Assembly under High Nutrient Stress

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Abstract: Peinobiomes are biotic communities developing in nutrient-deprived landscapes. Low status of available phosphorus, nitrogen and other vital resources for plants create a highly-stressful soils supporting azonal vegetation and are driving the patterns and dynamics of the ecological community assembly short-term. Many landscapes of the Southern Hemisphere dominated by peinobiomes are characterized by lack of tectonic rejuvenation (hence retarded replenishment of soil nutrients and hence producing nutrient-poor regolith), relative climatic stability (in terms of increased levels of predictability of the climate dynamics), and large-scale, long-term predictable disturbance (involving recurrent fire having a regenerative agent in providing short-term nutrient-supply, and at the same time acting as disruptor of local populations creating opportunities for isolation and later re-union and hence opening possibilities for genetic restructuring, that in turn would underpin speciation processes. The spatial coincidence of peinobiomes and these Old Stable landscapes is the major source of survival of palaeo-geographically old habitat complexes, supporting both ancient plant relict lineages as well as evolutionary young lineages resulting from local rapid radiations. These evolutionary processes as well as plethora of ecological adaptations to low nutrients lead to high gamma diversity (very rich floras) and unprecedented species turnover across habitats in these landscapes. The importance of evolutionary assembly (underpinned by in-situ preservation of old lineages and the rapid radiations) in structuring species-rich scrub communities in the mediterranean-type ecosystems such as Fynbos of South Africa and kwongan of Western Australia (both examples of the flagship vegetation of these global biodiversity hotspots) is discussed.
Key words: Fynbos, Kwongan, Old Stable Landscapes, Phosphorus-Deprived Soils

Comparing Plant Species Diversity of Forests at the 1910 and 1977-78 Eruption Sites on Mount Usu

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Abstract: The intermediate disturbance hypothesis (IDH) states that diversity is higher in areas where mosaic communities develop due to medium-level disturbances unregular in scale and intensity. Volcanic eruptions do not comply with the IDH as they often completely destroy the vegetation in large areas, prompting primary succession processes. However, looking at long time periods, is there an observable trend in plant species diversity at post-eruption areas? To answer this question, the present study examined the changes of plant species diversity on Mt. Usu (Hokkaido, Japan, 42°32'N, 140°50'E) after the 1910 and 1977-78 eruptions. As the 1910 area was not damaged significantly by the 1977-78 eruptions, vegetation changes could be compared between the two sites. Field surveys were carried out during 2015-2016 June-September and plant species diversity was evaluated using true diversity, Shannon and Gini-Simpson indeces. Plots were selected via stratified random two-stage sampling, where understorey plots were randomly selected from larger tree plots. In the 1910 sites three forest communities were recognized: broadleaf forest, artificial Abies forest and mixed forest. At the 1977-78 sites four communities were established: open broadleaf forest, closed broadleaf forest, semi-artificial Betula-Sorbus forest and artificial Picea forest. Comparing the two eruption sites, tree diversity indices were slightly higher for the 1910 area, while understorey vegetation had higher indices for the 1977-78 area. Although the 1977-78 area had more patchy communities, this did not increase its species diversity significantly. Thus, there was no clearly observable trend in plant species diversity comparing the two eruption sites. Looking at artificially planted communities, Betula-Sorbus forest had higher indices than Picea and Abies forest. These results indicated that plant species diversity did not decrease significantly compared to early succession stages in the cases of volcanic disturbance. The findings contribute to the understanding of future developments of primary succession processes and to develop best management practices at large-scale disturbance areas, represented by volcanic areas.

Key words: Species Diversity, Disturbance, Succession, Volcanic Eruption

Temperature Constraints on High Elevation Bee Communities in Response to Functional Trait Diversity

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Abstract: Along an elevation gradient bees and flies occupy different niche space; where bees dominate at low elevations and flies dominate at high elevations. The causes of this shift is still poorly documented. This study looked at functional trait differences between bees and flies that would allow them of occupy different β niche space (i.e. climate niche) along an elevation gradient. Using body darkness and body volume as proxies to measure adaptations to cool temperature habitats, we are able to determine if this shift is a temperature response. We assessed this β niche response in 125 species and 639 individuals of bees and flies. We found 4 major results 1) Bees showed a response to habitat filtering at the highest elevation for both body volume and body darkness. 2) Greater body darkness occurred more in the meadow habitat type. 3) Large body size occurred more in the forest habitat type. Finally, 4) flies provided a null expectation where they showed no differences along the gradient in body volume or body darkness compared than what was expected by chance. Bees at higher elevations possessed traits that allow for adaptations at cooler temperatures, both within species and among species. Flies however showed no change in their traits that allow them to occupy different elevations.
Key words: High Elevation Ecosytems, Functional Traits, Bees, Flies

Experience of Inundation or Drought Alters the Responses of Plants to Subsequent Water Conditions

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Abstract: The availability of water is often highly variable over the life of a plant in nature, and most plants experience episodic extremes in water scarcity and abundance. The importance of plant plasticity in coping with such experiences is widely recognized, but little is known about how plastic responses to current conditions are affected by prior environmental experiences. Our objectives were to investigate the effects of early inundation or drought on the subsequent responses of plant species to the same, opposite or more favourable conditions. To address these questions, we subjected four invasive and four native herbaceous perennial species from different habitats (xeric, mesic, hydric) to two rounds of hydrological treatments (drought, moderate water, inundation) and analysed the effects of the early treatments on survival and performance (total biomass and relative growth) of individuals in the later treatments. In general, (i) early drought reduced the performance of more species than did early inundation, and decreased the final total mass of all species; (ii) early inundation and early drought did not lead to lower survival immediately or later, but improved the relative growth of survivors across all late conditions; (iii) late drought resulted in the

highest mortality and lowest performance after any early treatment. With respect to habitat of origin: (i) early inundation was more beneficial for species from wet habitats than for other species; (ii) species from xeric habitats had the strongest drought tolerance after early drought; (iii) mesic species were more likely to suffer reduced later growth after either inundation or drought experience. Invasive species benefitted more from early inundation than did native species, but native species grew better after experiencing early drought. Results indicate that early exposure to inundation or drought conditions alters how plants respond to later conditions and suggest that exposure to extreme events can induce physiological or morphological changes that improve tolerance for either extreme conditions later. This increased tolerance can be at the cost of poorer performance under more benign conditions. Early inundation or drought experience may be harmful immediately, but can be beneficial for the later growth of plants. The ability of species to utilize early hydrological experiences was associated with the water range of their habitats and whether the species is invasive or native. The ability to modulate future plastic responses may be as important as short-term plasticity in adapting to temporal environmental heterogeneity. Such 'metaplasticity' can optimize current performance, while avoiding the potential costs of maintaining a high degree of plasticity throughout life.

Key words: Extreme Experience, Metaplasticity, Habitat Range, Invasiveness

Trophic and Non-trophic Connections and Their Role in the Stability of Food Webs: An Antarctic Example

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Abstract: The study of food web structure and complexity are central to ecosystem functioning. Recent improvements in data collection and resolution have challenged consistent patterns thought to be present among ecological networks. Here we describe the first and highly detailed food web for the Potter Cove marine ecosystem (Antarctica) and analyzed ten properties related to network complexity: linkage density, connectance and omnivory degree are lower than other marine food webs, suggesting vulnerability of the ecosystem to extinctions. Characteristic path length (average shortest connected distance between pairs of nodes) and clustering coefficient (average fraction of pairs of nodes connected to the same node that are also connected to each other) results showed a weak small-world behavior. Degree distribution analysis, using maximum likelihood and corrected Akaike Criterion, and connectance of species of Potter Cove web do not follow the topology-complexity relationship stated for food

webs. Competition overlap graph, a tool scarcely used in food web assessments, reflects high interaction between demersal fish and niche specialization according to feeding strategies in amphipods. Furthermore, prey overlap graph shows multiple energy pathways suggesting that carbon flow in benthic fauna is complex in Potter Cove ecosystem. In order to understand more deeply the relationships between complexity and stability, we reconstructed the web including non-trophic and indirect connections; so mutualism, commensalism, and indirect benefits or damages were included. This procedure reveals an underlying network that plays a very important role in maintaining the stability of the ecosystem against disturbances. The food web theory should be improved integrating trophic and non-trophic relations and other biologically relevant information such as biomass, metabolic rate, or spatial distribution of species.
Key words: Food Web, Connectivity, Indirect Interactions, Complexity

Competition Ability of Dominant Species under Grazing Intensity Gradient in the Inner Mongolia Typical Steppe: A Review

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Abstract: Glassland is the important consist of terrestrial ecosystem,which has significant ecosystem services and functions.Overgrazing leads to decrase of grassland biological diversity and decline of productivity and ecosystem function.Grassland degeneration is seriously influencial of production capacity and ecological security of grassland.competition is one of the main factor of vegetation succession and community change.This literature hope explain the course of glassland degeneration by that studies competitive capactity of dominant plant species under grazing intensity gradient for the Inner Mongolia typical grassland.Based on the research at domestic and foreign, we summarizes the research progress of plant competition and theory support and the reasonable method to solve the problem.Further through the field in situ test,we analysis performance and competitive capactity of dominant plant species under grazing intensity gradient and analysis the different functional properties and physiological characteristics of plant competition ability and the effects of grazing change environment how to affect plant competition; Indoor control test,we further analysis the relationship between plant functional properties and physiological characteristics and competitive performance.And we also analysis the change of the competitive ability key resources factor, thus analytical grazing the causes of grassland degradation.
Key words: Graze, Competiton, Succession, Inner Mongolia Typical Steppe

胡杨群落空间分布格局与土壤盐分关系的研究

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Abstract: 胡杨（Populus euphratica）是干旱区荒漠河岸林中唯一可建群的高大落叶乔木，以胡杨为优势种的绿洲河岸生态系统是干旱区最重要的生态保障。干旱、高盐是干旱区植物生长的两大威胁，然而前期的研究中多以水分为主要环境因子，土壤盐分对胡杨群落结构和空间分布格局影响的研究较少，本文以土壤盐分为主要环境因子，研究其对胡杨群落分布格局的影响。研究方法：额济纳河流域是我国胡杨林分布较为典型的区域，在额济纳河下游做一个 100m×100m 的永久样方，用相邻格子法将样方划分为 100 个 10m×10m 的小样方进行操作，并测量小样方交叉点土壤的 EC 值；测量样方内所有胡杨的树高，由于树高是以 2m 为界限的双峰型分布，因此将树高 H≤2m 的胡杨划为幼苗，将树高 H＞2m 的树划为林冠木；测量样地所有灌木和草本的种类和覆盖度；用 SADIE 分析盐分、胡杨和林下植被的空间分布格局和它们的相关关系（P＜0.05）。研究结果如下：（1）样地内土壤 EC 值的分布范围从 0.681mS/cm-68.4mS/cm，且大部分地段盐分小于 6mS/cm；（2）样地内总共发现 5 种林下植被，分别为柽柳（Tamarix chinensis），苦豆子（Sophora alopecuroides），骆驼蓬（Peganum harmala），花花柴（Karelinia caspia）和沙蒿（Artemisia desertorum），其中花花柴的盖度最小，为 0.38%，苦豆子的盖度最大，为 37.88%。（3）林冠木（Ia=2.066）、幼苗（Ia=1.484）、苦豆子（Ia=2.227）、沙蒿（Ia=3.269）与土壤 EC（Ia=2.025）一样都为聚集分布，但是幼苗没有明显的斑块（斑块指数 vi=1.226，P＞0.05）；（4）幼苗、柽柳和花花柴与土壤 EC 显著正相关（P＜0.05），蒿草与盐分显著负相关（P＜0.05）。胡杨的幼苗与盐分一样呈聚集分布，而且幼苗又与盐分显著相关，说明胡杨的萌发是需要一定的盐分的，并非盐分越少越好，随着环境的变动原先盐分较多的地方发生变化盐分变少，因此林冠木与盐分变得不相关，但呈聚集分布。柽柳、花花柴与盐分显著相关，说明这两种植物也是喜盐植物。野艾蒿与盐分显著负相关，并且它的斑块和孔隙正好与盐分相反，说明在这里蒿草是最不耐盐的植。由此可见，在干旱区盐分也深刻影响着胡杨群落的空间分布格局。

Key words: 土壤盐分, 胡杨群落空间格局, 土壤 EC 值

How Small Habitats Environment Changes Can Alter the Phenotypic Plasticity of Grasshopper?

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Abstract: Recently, Oedaleus asiaticus frequently outbreaks in Inner Mongolia steppe

due to the habitat changes by heavy livestock grazing. Grasshopper population fitness can be reflected by phenotypic plasticity (PP) in life history. We reared O. asiaticus in 16 habitats differed in dominant plant species and plant height gradient. O. asiaticus showed different degree of performance (size, mass, development rate, survival) across all habitats. Both female body length and body mass were negatively correlated with plant density. Grasshopper development time was negatively correlated with plant diversity (Shannon-Weiner index). Our results suggest that: Habitat strongly influences grasshopper performance and PP. Stress, performance, and PP are interrelated. O. asiaticus are highly susceptible to PP, the effects are pervasive, affecting manifold traits. PP can manifest over surprisingly small geographical/spatial scales, and relatively minor habitat differences can induce PP. These also indicated that plant architecture and plant biodiversity may play an important role to develop phenotypic plasticity of insect herbivore. The findings of this study enrich our understanding on the morphological events involved in habitat adaption, which give us more implications on habitats conservation and ecological management of pests on grassland.

Key words: Environment Change, Phenotypic Plasticity, Stress and Habitats Adaptation, Pest Ecological Management

Physiological Response of Two Xerophytic Plants (Artemisia Ordosica and Salix Psammophila) to Prolonged Summer Drought

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Abstract: Climate changes that trigger prolonged summer droughts are predicted to increase in northern China; however, the physiological response of native species (Artemisia ordosica) and artificial species (Salix psammophila) in this area (a transitional zone) was neglected. We lack an understanding of how these two species respond to the prolonged summer drought and decreasing soil water content (SWC). Here, we studied the impacts of prolonged summer drought (60 days) as well as post-stress recovery in A. ordosica and S. psammophila in field. We measured the following parameters: maximum and actual photochemical efficiency of PSII (Fv/Fm and ΦPSII), photosynthetic rates (Pn), transpiration (E), stomatal conductance (gs), water use efficiency (WUE) and nitrogen use efficiency (NUE). Artificial plant S. psammophila showed a strong decrease in Pn, E and gs, coinciding with a reduction of Fv/Fm and ΦPSII, but differences was observed in A. ordosica. The result also showed that the artificial plant presented a critical levels of SWC in ~0.058 m3 m-3, depending on the measured Fv/Fm and ΦPSII decreased, whereas native plant A. ordosica changed little in Fv/Fm and ΦPSII with decreasing SWC. Besides, the gas exchange

parameters in native species were relative higher than artificial, such as Pn, gs, E and NUE, except WUE. Our results suggest that under water stress, S. psammophila could be more injured than A. ordosica and that the lack of control in the carbon loss and energy dissipation under prolonged periods of drought could be limiting for its survival. Moreover, we found that slopes and intercepts of diurnal ΦPSII-PAR regression responded very strongly to variation in SWC. This suggests that the slopes and intercepts may be used as a proxy of physiological status in xerophytic plants. Understanding these physiological processes and threshold value in transitional zone shrubs is crucial for assessing further climate change impacts on ecosystemic functions and services.

Key words: Photosynthetic Properties, Chlorophyll Fluorescence Characteristics, Summer Drought, Recovery

Plant Community Shifts under Soil Acidification in a Semiarid Grassland on the Loess Plateau

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Abstract: Soil acidification is one of the most important consequences of dramatic increases in anthropogenic acid deposition, and has been a major problem in Chinese grassland. It can lead to changes in plant communities mediated by effects on below-ground biota and soil properties. To investigate the effects of soil acidification on plant communities and the potential mechanisms, we collected data of plant communities and soil properties in a field experiment with five levels of acid addition rate in a semiarid grassland on the Loess Plateau. We found that the changes of soil properties mainly occurred in the soil layer of 0-10cm. Soil moisture, soil NO¯3--N, N mineralization rate, available phosphorus and extractable cations (Al3+, Ca2+ and Mg2+) were positively correlated with soil acidification. With the reduction in soil pH, the total above-biomass of Gramineae and Cyperaceae decreased gradually, while the biomass of Compositae did not change. Meanwhile, the biomass of some non-dominant species was significantly increased with the decrease of dominant species ($P<0.05$). The species richness, Shannon wiener and Simpson index decreased significantly with the increase of soil acidification ($P<0.01$). The sensitivity of plants to acid addition was different. Typically, the occurrence probability of rare species was higher in moderate acidification than in lower or higher acidification levels. These findings can help us to understand the changes of plant community on the Loess Plateau, especially in the

context of anthropogenic acid deposition.

Key words: Soil Acidification, Plant Communities, Soil Properties, Loess Plateau

A Rough Detection on Extracellular Metabolome of Cyanobacteria Microcystis Aeruginosa

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Abstract: Harmful algae blooms (HABs) has become a worldwide severer issue and allelopathic effects (related to allochemicals, which are also regarded as Secondary Metabolites) showed the very important reason for bloom-forming species to dominate. In this study, Liquid chromatography-tandem mass spectrometry (LC-MS/MS) was performed to roughly visualize the extracellular metabolome (metabolic profile) of bloom-forming cyanobacteria, Microcystis aeruginosa, in their exponential phase (6 days) conducted vacuum freeze-drying method with a concentration of 10-folds of the samples. Results showed a potent capacity of M. aeruginosa in secretion efficiency bioactive metabolites. We found 20 kinds of fatty acids and fatty acid derivatives, 12 steroids including plant sterols and steroids which were thought to be animal derived, 9 kinds of terpenes, 8 kinds of lactones which referred to highly antimicrobial activities and some vitamins. The principle metabolites of M. aeruginosa in exponential phase in consideration of the amount of each compound present as fatty acid amide, fatty acids, terpenes, steroids, and organosulfurs, in which several compounds were previously published to be toxicant or teratogenic, e.g. beta-ionone which may involve in the biocondensation and 13-Cis-Acitretin derived from vitamin A. Most of the metabolites mentioned above occurred naturally as antibacterial, antifungal or toxicant agent. Although pretest in current study we made, these qualitatively ensured metabolites partially described how the secondary metabolite play a remarkable role in the competition processes of M. aeruginosa to others.

Key words: Microcystis Aeruginosa, Secondary Metabolites, Bioactive Products

THEME 7

Industrial Ecology and Green Economy

T7-01: Industrial Ecology for Sustainable Industrial and Urban Development Transition

The Relationship between Regional Industrial Organizing Levels and Ecological Economic Efficiency

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Abstract: This paper investigated the roles of industrial organizing levels, economic resource endowments, and natural resource endowments in the development of economic ecological efficiency using data from China during the past decade. Besides an original assessing method for industrial organizing levels was developed, this paper investigated resource usage efficiency and pollution emission efficiency to determine the economic ecological efficiency. And this relationship was defined by the artificial neural network based regression method. In general, China's industrial organizational levels and ecological economic efficiency increased in the past decade, and had a positive relationship between them. However, resource endowments had a negative correlation with the ecological economic efficiency. Moreover, no obvious quantitative relationship was found between the organizational levels and the efficiency of water usage. After a deep discussion, policy suggestions were offered such as enhancing the marketization of waste dealing businesses, more publicity regarding preserving resource-rich regions, and increasing industrial organization levels.

Key words: Industrial Organizing, Ecological Economic Efficiency, Industrial Diversity, Industrial Advance

External Factors on Product End-Of-Life Strategies beyond the Product Itself

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Abstract: Theoretically, product reuse is always considered a higher level strategy than materials and energy recovery in the waste hierarchy, which also applies to Waste Electrical and Electronic Equipment (WEEE). However, in China, reuse has not been considered one of the mainstream end-of-life options in the WEEE management policy and formal recycling plants for WEEE. To promote reuse strategy for WEEE, the

policies and practices in reuse of WEEE in China were compared with those of the EU. It was found that although there are already some guidelines and standards in China, the reuse policies need to be made more systematic and more practical. However, to make the policy more practical in the future, there are still basic questions on reuse to be solved. One of these questions is that based on different policy contexts and products types, whether reuse is more prior to other End-of-Life (EoL) strategies including recycling.

Therefore, Life Cycle Assessment (LCA) is applied to evaluate the environmental impacts of typical EoL strategies for laptop PC and refrigerator in China, including product level reuse, components level reuse and materials recovery. The LCA results showed that the EoL strategies hierarchy is reasonable for laptop PC, which is relatively slow in energy efficiency improvement. But LCA results of refrigerator is more complicated. Because of fast and evident energy consumption efficiency improvement in the recent years in China, when the obsoleted refrigerator is reused for 2 years, the life cycle impact is smaller than the result of materials recycling scenario. But if the obsoleted refrigerator is reused for 3 years, the opposite result is obtained. In conclusion, it is important to take the advanced product technology in consideration, when the EoL strategies of obsolete products are determined.

Key words: Product Reuse, End-of-life, Life Cycle Sustainability Assessment, Circular Economy

Effectiveness of Cross-boundary Environmental Policy in Beijing-Tianjin-Hebei Region

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Abstract: Regional environmental pollution has been severe in China. However, the effects of cross-boundary environmental treatment is not significant due to lacking of appropriate evaluation methods. It is imperative to assess the policy effectiveness. This research proposes that the mechanisms of collaborative governance should be embedded in policy assessment. This research intends to build up a theoretical framework for cross-boundary environmental policy assessment. Subsequently, the measurement model will be established through integrating the advanced data envelopment analysis and spatial correlation analysis and then applied to empirical case study. The main research content includes the following parts: 1) theoretical research on cross-boundary environmental collaborative governance; 2) the application of data envelopment analysis to regional environmental policy assessment. Beijing-Tianjin-Hebei region will be taken for empirical research to analyze the

effectiveness of cross-boundary environmental policies. We will mainly employ super-efficiency model, slacks-based model and Malmquist-Luenberger index. The weights of the major cities in this region will be also calculated and then used in the data envelopment analysis models. This project will deepen the theoretical foundation of cross-boundary environmental governance and enrich the evaluation methods of collaborative governance policies. The results will reveal the approach to improve regional environmental governance and present policy recommendations for solving the current regional pollution issues.

Key words: Environmental Policy Assessment, Collaborative Governance, Data Envelopment Analysis, Beijing-Tianjin-Hebei Region

Taking the Stock of Industrial Ecologists

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Abstract: The discipline of industrial ecology (IE) has experienced a great success since its advent in the 1990s. When we are taking the stock of IE knowledge, our IE society is also coming of age. The purpose of this poster is to investigate the stock of industrial ecologists across the world and their characteristics (e.g., current title, affiliation, background, country of residence, information of PhD degree (year, university, and discipline)). We count "industrial ecologists" from three sources: (i) All the current members of International Society for Industrial Ecology (ISIE); (ii) all the (co-)authors who have published at least one paper in Journal of Industrial Ecology; and (iii) all those who have participated at least once in the biannual ISIE conferences. We aim to provide an inventory of the current industrial ecologists, a statistical analysis of their characteristics, and thus a better understanding of fundamental questions such as "who we are", "where we came from", and "where we will go".

Key words: Industrial Ecology, Industrial Ecologists

Life Cycle Assessment of Polyester-Cotton Product

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Abstract: Abstract: This research conducted a life cycle assessment of polyester-cotton (T/C) product through its whole life cycle including planting, spinning, printing and dyeing as well as waste final disposal. The results indicated that: rank the environmental impact in degree, main environmental impact categories including

Marine Aquatic Ecotoxicity Pot(MAETP), Global Warming Potential(GWP 100 years), Abiotic Depletion(ADP), Freshwater Aquatic Ecotoxicity Pot(FAETP), Acidification Potential(AP), Photochem. Ozone Creation Potential(POCP) and Eutrophication Potential(EP); on the other hand, the results also showed that the most important production process was desizing, besides, mercerizing, cotton planting stage and spinning also had a greater environmental impact potential. Based on the results, water reuse, heat energy recovery, mercerizing alkali recovery, organic cotton planting, boiler renovation and adopting water membrane dust collector were proposed to reduce environmental impact potential in this study. Through the evaluation, an obvious improvement effect were shown in each optimization measure above.

Keywords: polyester-cotton (T/C), LCA, optimization measures

Key words: Polyester-cotton (T/C), LCA, Optimization Measures

Challenges and Opportunity of Life Cycle Analysis in a Fast Economy Transition

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Abstract: This paper makes a review of LCA practice in the past 30 years to identify the driving forces of LCA tools at each turning point. It shows that the LCA is quite efficient in the processing level or institution level to help the stakeholders to identify the environmental performance of product system within the whole life cycle, to help industries to improve the material and energy efficiency and to minimize the environmental impacts based on the product function unit. However at the macro level like society, it is still weak to illustrate the interaction of products system and natural system, as well as the social system.LCA should put much focus on the impacts of product system on earth system or society. The world economy is facing a fast transition from products-oriented to service-oriented, which will lead to a tremendous changes of materials flow related to raw resources or wastes. it is a challenge for LCA to model the interaction between products system and economic system. It is clear that the new economy restructuring needs and can minimizing the material acquisition from natural system and the environmental emissions to ecosystem based on the new technology like the Internet of Things.

Based on some preliminary LCA study results, it proposes that the LCA in future should develop the new application trends in the emerging new economy. LCA should put much focus on the use phase and EoL strategies instead of manufacturing process mainly. On the one hand, it will mainly develop the high quality of life cycle inventory dataset, specially related to use, reuse, remanufacture, as well as the recycling at the

national level or local level. The new decentralized energy supple network also need to be considered to improve the energy mix dataset. On the other hand, more and more service-oriented LCA will be expand to new economic models such as the mobility-sharing system including car-sharing, bicycle sharing, working space or public space sharing system. The leasing system of society is also a good target for LCA studies. Additionally, the infrastructure changes due to technology innovation, such as electric vehicles substitution for fuel vehicle. In a conclusion, LCA should be a helpful system tool to reduce the product volume for the whole society and to improve the service quality for all people.

Key words: Life Cycle Analysis, Economy Transition, Sharing System, Serviced-oriented LCA

CO_2 Emission Patterns of Chinese Urban Household

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Abstract: The major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production. In the past, environmental policy was mainly directed at the supply side. With the increasing income and living level improvement, the demand side is being given more and more attention by decision makers.

In this paper, a bottom-up process life cycle assessment (PLCA) method was used to evaluate the CO_2 emission pattern of Chinese urban household. The emission patterns and the critical driving factors were analyzed.

First, the PLCA framework was built, the function unit, system boundaries and process units were described. The functional unit is the product groups purchased by an average household during 2014 to meet the consumption need. Six categories of final product groups were covered, clothing, food, residence, transport, household facilities, and education and culture. Mining/farming, raw materials preparation, products production and use stage were included in the system boundaries. The LCA model of Chinese household consumption was created in the professional LCA software SimaPro.

Our results show that the average CO_2 emission of per urban household in 2014 was 5.26t $CO^{2\text{-eq}}$. Among the six categories of final consumption, residence consumption produced 32.3% of the total CO_2 emission, followed by food consumption and household facilities consumption, which accounted for 27.5% and 20.2% of the total emission respectively. The share of CO_2 emission from transportation consumption took account only 10% for average Chinese urban household, which is a bit smaller than that in developed countries. This large difference in transportation arises primarily from the distinct gap in vehicle ownership between China and developed countries,

although China has encountered the highest growth rate of vehicle ownership globally. It is notable that, the role of transportation can be much more significant in the future.
Key words: Industrial Ecology, Sustainable Consumption, CO_2 Emission

"The Tragedy of the Planet"? – Characterizing Climate Change as a Tragedy of the Commons Type of Challenge

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Abstract: "The tragedy of the commons" relates to problems where individual optimization of shared resources is conflicted with common optimization. E.g. fishing in the ocean and the most used example grazing on shared land. We believe that global warming is a tragedy of the commons situation.If one country/region should optimize their energy use, based on monetary value, that region would use fossil fuel because of cheaper production cost and because the negative effect of greenhouse gasses is shared with the entire world. Which means that the region get all the benefits and only part of the disadvantages.

This presentation will build upon a core graph that shows an inventory of the proved reserves of fossil fuels (oil, gas and coal) and their production costs, where the production cost of alternative green fuels and the 1.5 and 2.0 ℃ increase of global temperature is inserted for comparison see Figure 1.

We aim to discuss three main questions:

First, which proved fossil fuel reserves should stay in the ground from a socioeconomic point of view, to limit the global temperature increase to 1.5 and 2.0 ℃?

Second, how much fossil fuels would be used, if alternative fuels such as electro fuels (electro fuels are fuels made by reacting hydrogen from electrolysiswith some carbon stock e.g. pure carbon dioxide or methane) would compete with fossil fuels on pure market terms? What will the consequence of the temperature increase be on pure market terms, and what can we do (e.g., CO_2 quota price or CO_2 tax) to limit the use of fossil fuels if the use on pure market terms exceed the 1.5 and 2.0 ℃ limit?

Third, what are the role and scale of electro fuels in the described scenarios, including what it costs to replace fossil fuels with electro fuels?

Figure 1 shows a preliminary mapping of all three main types of fossil fuels, i.e., gas (yellow part of x-axis), oil (purple part of x-axis), and coal (black part of x-axis), and the cost of producing them dependent on the country of origin. The preliminary cost presented here for each fuel type is based partly on some relatively trustworthy sources, but also on our own estimates. The cost is divided in capital cost (CAPEX) of extraction/mining, extraction/mining production cost (OPEX), transportation cost

(CAPEX+OPEX), and refining cost (CAPEX+OPEX). On top of the cost, we have put three CO_2 quota prices to illustrate the effect and the relative difference between the fuels. The low price is set to US$50/ton CO_2, medium to US$100/ton CO_2, and high to US$150/ton CO_2.

Key words: "Tragedy of The Commons", Global Warming, Socioeconomic, Electrolysis

Understanding Industrial Ecosystem Complexity

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Abstract: Industrial ecosystems are complex engineering systems composed of many as well as different types of industrial products and processes. Traditional industrial metabolism methods and tools, such as material flow analysis and substance flow analysis, can present us an overall picture and rough flow patterns of materials through social-economic systems. However, many of the details have been neglected in this data aggregation process. With the help of complex networks, we can uncover some structural complexity and functional complexity embodied in industrial ecosystems. We establish an integrated framework to understand complexity of industrial systems by embracing some key concepts including metabolism, network, order and transition. With this framework, we aim to uncover some static and dynamic characteristics of industrial systems by combining metabolism and network theories and methods. We carried out some case studies at industrial parks and urban levels, and tried to refine some metabolism patterns in eco-industrial parks and circular economy implementation. We also try to generalize metabolism patterns at provincial and national scale in China by applying data mining and pattern identification methods. We hope to contribute to develop a methodology towards uncovering metabolism complexity of industrial systems.

Key words: Industrial Ecosystems, Complexity, Complex network, Industrial ecology

An Assessment Method of Material Flow Analysis of Urban Household

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Abstract: Material Flow Analysis (MFA) is a tool of quantitative analysis on the material metabolism in economic process. By tracking the input, output and stock of

certain substance or activity in economic-environmental system, MFA assesses the relationship between the material flow in a certain system and resource use and environmental effects. MFA has been widely acknowledged as a tool of macro-scale research as national, regional and sector, while less applied to micro scale as household. As the fundamental unit of final consumption, household uses great deal of goods and services to maintain its operation, leading to severe environmental impacts on the natural ecological system. Therefore, we select urban household as the research object and MFA as method due to its normativity and comparability. From the perspective of bottom-up, this research proposes the accounting framework of urban household material flow, which provides a new thought on household-scale material flow analysis. With 74 products, 7 kinds of residential energy and water included, we calculate the specific consumption condition of an average urban household in 2014.

Results show that the direct material input (DMI) of an average urban household in 2014 is 84.746 tons (including water metabolism), and the material output 82.865tons, thereby the net additions to stock (NAS) 1.881 tons per household. From the perspective of material input per capita, it achieves to 2.46 tons (exclusive of water), which correspond to the foreign research results of the range between 0.4 to 4.3 tons per capita. For water metabolism, its 77.613 tons input for an average urban household, of which 63.457tons is discarded as domestic wastewater. For energy metabolism, it takes 290.73kg fossil fuels and 1522.52kwh electricity to meet the requirements for the urban house. Food, housing and household facility are the major energy-consuming sources. For material category, mineral has a huge proportion in material input, mainly used in residential buildings; biomass follows secondly, coming from food mostly. In terms of consumption category, housing, food and transport are the main sources of material input. The main conclusion obtained from this study is that the household material flow accounting can provide data support and policy proposal for sustainable consumption, thus encouraging to optimize household consumption patterns and achieving green household consumption.

Key words: Urban Household, Material Flow Analysis, Household Metabolism, Sustainable Consumption

Exploring the Potential of Urban Planning to Reduce Household GHG Emissions—a Case Study of Xiamen City

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Abstract: Cities are the principle emitters of greenhouse gas (GHG), and simultaneous occurrence of rapid urbanization and significant climate change are already putting

cities to the frontier where mitigation needs to be weighted adequate priorities. Previous studies revealed that GHG emission is closely related with urban spatial form, however there is little scientific understanding of magnitude of the emission reduction from urban spatial planning. In this study, we identified the key urban form indicators affecting GHG emissions through the ridge regression method, and we designed land use scenarios to examine the potential of urban planning to reduce GHG emissions based on the CA-Markov model in Xiamen City. Results showed that impact of urban spatial form on household GHG of energy consumption is not significant; however, population density, green open space, land use-mix and connectivity show significant impact on GHG emission of residential transportation, with standardized coefficient of -0.31, 0.15, -0.19 and -0.17, respectively, dominated by population density. Urban planning under mitigation scenario—land use considers GHG mitigation—can reduce 13.98%, 15.80% of residential transportation GHG by 2020 and 2030 respectively, compared with that of business as usual (BAU) scenario. Quantitative results of this study have important policy implications for better urban planning to achieve mitigation goal in the context of climate change and urbanization.
Key words: Household GHG, Mitigation, Urban Spatial Form, Urban Planning

China's Regional Ammonia Emissions: Characteristics, Interregional Transfer and Mitigation Policies

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Abstract: Anthropogenic ammonia (NH3) has both direct and indirect impacts on human health and ecosystems, including acid deposition, regional fine particles and eutrophication. China, as the world's largest NH3 emitter, hasn't been given enough attention in the regional policies and actions for addressing NH3 related environmental problem. Estimation of anthropogenic ammonia emissions of this prominent country, from both production side and consumption side, will help us understand mitigation potentials and emission responsibilities. This paper combines a bottom-up estimation, material flow analysis (MFA), and an up-bottom method, multi-regional input-output (MRIO). Our results show that China's total anthropogenic NH3 emissions in 2010 are estimated at 25.5 Tg, contributed for 29% of the global NH3 emissions. About half of the national total emissions from domestic production are consumed within the province where products are produced originally. Besides, up to 11% of emissions are exported outside China. The top three domestic virtual NH3 trade fluxes are from Hebei, Shangdong, Guizhou to Shanghai, Shanghai and Guangdong, respectively. At the same time, the top three international virtual NH3 trade fluxes are from Jiangsu,

Shangdong, Henan all to America. Understanding internal and external effects of trade, as well as interdependencies between economic sectors, will facilitate regional ammonia mitigation strategy.

Key words: Ammonia, Trade, China, MRIO

Environmental Impacts of Shifting to Healthy Diet: Case of China

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Abstract: Diets in China is not only correlated with malnutrition issues but also leading to significant environmental consequences on greenhouse gas (GHG) emissions, water consumption and land use. To identify potential win-win opportunities as well as trade-offs in improving public health and reducing environmental impact simultaneously, knowledge is required on whether a healthy diet would result in less environmental impact. Existing studies fall short in including socio-economic heterogeneity of individual dietary choices, and their performance of multiple types of environmental impacts. In this paper, we evaluate nutritional quality of Chinese diets using an individual-level dataset, China Health and Nutrition Survey (CHNS). With the identified malnutrition issues, we estimate the change of GHG emissions, water consumption and land appropriation of shifting to healthy diet. Our findings enrich understandings on the food-nutrition-environment nexus, and provide policy implications on food-related environmental regulations.

Key words: Nutritional Quality, GHG Emission, Water Footprint, Land Use

Integrating Input–Output Analysis Carbon Footprint: The past, Present, and Future

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Abstract: Over the past decades, how to mitigate and adapt to climate change has received worldwide attention. Substantial evidence shows that exponentially increasing greenhouse gas (GHG) emissions are the main cause of global warming. The Paris Agreement reached in December 2015 has therefore set an ambitious goal of dominating the increase in the global average temperature to well below 2 ℃ above pre-industrial levels and even pursuing to limit the temperature increase to 1.5 ℃.The carbon footprint has been broadly recognized as an effective tool for responding to

climate change concerns. By measuring and assessing the direct and indirect GHG emissions associated with human activities, carbon footprint analysis aims to allocate the 'common but differentiated responsibility' for global warming to a variety of entities (e.g., product, organization, or nation) from a life cycle perspective.Carbon footprint accounting can be based on different methodological foundations, mainly including the Intergovernmental Panel on Climate Change (IPCC) approach, life cycle assessment (LCA), and input–output analysis (IOA). While each of these has own pros and cons, there is a notably growing number of studies that account for carbon footprint by means of IOA that translates complex economic relationships between sectors or regions in physical flows.PAST: IOA was raised by Leontief in 1936, with its initial purpose of quantifying the need of iron in the USA. Afterwards, it had grown in interest and popularity over the years. Many updated versions had been developed to improve the scientific robustness and accuracy of the method, such as those of the single-regional input–output (SRIO) and multi-regional input–output (MRIO) models.PRESENT: The ever-improving IOA opens the way to tracking emission flows using economic datasets. While IOA is primarily appropriate for use in carbon footprint accounting at the macro scale, it has been gradually extended to the meso and micro scales, such as processes, organizations, consumers, etc. Nowadays IOA-based carbon footprint studies are often conducted in combination with additional methods such as structure decomposition analysis and scenario analysis, allowing policy makers to better understand the driving force behind and to anticipate the possible trends of anthropogenic GHG emissions in support of the transition towards a low carbon economy.FUTURE: Despite the indispensable role of IOA in carbon footprint accounting, researchers are increasingly facing the challenges of dealing with data uncertainty, promoting the economy and efficiency of input–output tables, and extending the applicability of the method to the micro scale. In response to these challenges, there is a need for a new paradigm aimed at making use of various methods and integrating them into carbon footprint analysis through continuous methodological developments and synergies. The booming of hybrid approaches that take advantage of both IOA and LCA is one example, and the emergence of multi-scale multi-regional input–output (MSMRIO) models is probably another.

Key words: Carbon Footprint, Input–output Analysis, MRIO, SWOT Analysis

Determinants of GHG Emissions from China's Electricity Industry

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Abstract: The electricity generation contributes around 43% of China's CO_2 emissions. Thus, reducing CO_2 emissions from China's electricity industry is an important

component of its CO_2 mitigation. Existing studies mostly focus on the impacts of electricity generation on CO_2 emissions in China (i.e., the production side), but ignored the impacts of electricity consumption on CO_2 emissions (i.e., the consumption side). This study fills in this gap by using the structural decomposition analysis (SDA) to investigate how the changes in China's electricity generation and consumption behaviors influence the changes in its CO_2 emissions. We first construct an electricity input-output (IO) model to track the electricity supply chain at the province scale including electricity generation, electricity allocation, and electricity consumption. We then calculate CO_2 emissions from China's electricity generation in each province, and treat the calculated CO_2 emissions as the satellite account of the electricity IO model. By combining the SDA and electricity IO model, we can investigate the relative contributions of electricity production and consumption behaviors (e.g., energy input structure, energy efficiency, electricity transmission structure, and electricity usage efficiency) to the changes in CO_2 emissions from China's electricity industry. Results in this study can provide hotspots for the CO_2 mitigation in China's electricity industry.

Key words: China, Greenhouse Gases, Input-output Analysis, Power Sector

How the Transitions in Iron and Steel and Construction Material Industry Impact on CO_2 Emissions in China? Analysis from an Inter-Sectoral Linked Perspective

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Abstract: With rapid economic development during the last decades, China experienced a soaring CO_2 emissions growth, and suffered growing pressures for CO_2 emissions mitigation. Sectoral approach is taken as an important tool to realize CO_2 emissions reduction target. Efforts through transitions in iron and steel industry (ISI) and construction material industry (CMI), which are carbon intensive industries and the key nodes with close inter-sectoral linkages in the whole economic system, are particularly important for China.

With implementation of series CO_2 emissions mitigation polices, great transitions happened for iron and steel and construction material industry, including the improvement of technology level, and the changes in both supply and demand structures. Exploring how these transitions in the two important industries impact on CO_2 emissions is great essential to decide if the these transitions are effective for China's CO_2 emissions mitigation, and provide more detailed and targeted directions to improve the current transition actions.

In this study, we investigated CO_2 emissions effects of transitions in ISI and CMI from

an inter-sectoral linked perspective based on Input – output analysis. Results show that both ISI and CMI had significant higher backward and forward linkages than average level with a consideration of CO_2 emission effects. From a view of backward linkage, both the total CO_2 intensity (covering direct CO_2 intensity and indirect CO_2 intensity from supply chains) of ISI and CMI enjoyed an over 50% reduction during the 1992 to 2012 period, and the CO_2 intensity reduction in the production process of the two industries and electricity industry are the largest contributors for the total intensity reduction. Considering the final demand structure, investment is the largest driver for the CO_2 emissions in the two industries, followed by export and household consumption. From a view of forward linkage, construction sector was the largest driver for the CO_2 emissions growth in the two industries, and generated 75.7% (959.3 Mt) and 51.9% (858.0 Mt) of total CO_2 emissions from CMI and ISI in 2012, separately. Moreover, machinery and transport equipment manufacturing, which are highly promoted by government, further contributed 21.5% and 10.9% of total CO_2 emissions of the two industries, respectively. And from a view of industrial chain, most CO_2¬ emission important paths go through ISI and CMI. Structural decomposition analysis shows that CO_2 intensity improvement is the sole driver curbing the CO_2 emissions growth of the two industries, while economic growth and production structure change resulted in remarkable CO_2 emissions growth during the given period.

Key words: CO_2 Emissions, Iron and Steel Industry, Construction Material Industry, Intersectoral Linkage Analysis

Assessment of Promoting Industrial Symbiosis for Chemical Industrial Park: A Case Study of Puyang

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Abstract: Industrial symbiosis (IS) is an important innovative tool to promote the sustainable development. Due to the feature of various material and energy flows, chemical industrial park is regarded as one of the key fields to promote industrial symbiosis in China. In order to investigate the co-benefits of eco-industrial transformation in China's chemical industrial park, this study focused on an industrial symbiosis case of Puyang Economic and Technical Development Zone (PETD) in which solid wastes recycling, waste energy utilization and water resource reuse were involved in this typical petro-chemical industrial park. In this study, the material flow analysis combined with scenario analysis was used to design an integrated eco-industrial network for PETD, with linkages between industrial entities through material exchanges and energy cascade utilization. Subsequently, a quantitatively

evaluation on the economic and environmental benefits of IS activities were further conducted, including the benefits of resource and energy conservation, the benefits of pollution abatement and the benefits of eco-connectance among enterprises. Results showed that a lot of resource saving and air pollution emission abatement can be achieved by IS activities in PETD. Finally, several recommendations on IS promotion in PETD were proposed, such as extending industry chain, improving the IS-related technologies, and promoting the energy cascade utilization.

Key words: Industrial Symbiosis, Chemical Industrial Park, Economic and Environmental Assessment

Phosphorus Sustainability of Food Consumption in China's Urbanization

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Abstract: China’s unprecedented urbanization greatly influence the quantity and structure of Chinese food consumption, causing food security challenge and calling for sustainable phosphorus management. We quantified Chinese phosphorus footprint (PF) through food consumption during 1990 - 2009 and predicted PF in 2020 and 2030 based on scenario analysis. The results showed that PF increased from 4.74 kg P capita^{-1} yr^{-1} (1990) to 5.40 kg P capita^{-1} yr^{-1} (2009) and will grow to 5.79 kg P capita^{-1} yr^{-1} (2020) and 6.20 kg P capita^{-1} yr^{-1} (2030). The increase (amount and proportion) of animal food consumption was the key reason for PF growth. However, the scenario analysis based on income implied that PF inflection point will appear between 2020 and 2030, which means that PF will decrease by 2030. We also estimated that the total amount of phosphorus ore used for producing food would be no less than 9.30 Tg in 2030. These results demonstrate that a balanced diet is an important component of the phosphorus sustainability in China’s urbanization. A dynamic view on the demand of phosphorus ore resource should be approached both on short-term environmental management and long-term resource availability in the process of urbanization.

Key words: Phosphorus Footprint, Food Consumption, Scenario Analysis, Urbanization

A Material Flow Analysis of Distributed Photovoltaic Application in Beijing with a Bottom-up Approach

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Abstract: As the problems of energy shortage and environmental pollution becoming increasingly serious, quite a lot of scholars have examined the feasibility of radical energy transformation, where all energy is provided by wind, water and solar power. The material basis which support energy transformation has also been widely discussed and predicted. Photovoltaic (PV) solar energy technology is being extensively applied, but most of the previous researches use the top-down estimation method to carry out the Material Flow Analysis and Life Cycle Environmental Impact Assessment of solar PV materials. However, the distributed PV application in China has not been adopted on a large scale. So, the top-down method used in calculating the proportion of PV market is somewhat subjective. Through our previous empirical study in a suburb community in Beijing, we have found that different types of users (industrial and residential) have obvious difference in electricity consumption patterns in daily life and the acceptance of PV application. Thus, this research starts with specific PV adoption decision makers, and takes the uncertainty of PV applications at the individual level in account: Will they choose distributed PV technology? Under what conditions (which determines the penetration of PV technology in the market) they will adopt? If they accept distributed PV power generation system, which type of technology will be selected? And how the MFA and LCA results change in different conditions?This research investigates the main factors which influence users' acceptance and choice of distributed PV in a community level by means of household survey, and then constructs a selection model. According to this model, Agent-based Method is used to simulate the proportion of PV application in the whole city, up-scaled from the community level. Based on the results, material flow analysis and life cycle assessment are carried out, focusing on the rare metals and heavy metals in photovoltaic cells. In addition, according to the change of influencing factors in the selection model, we carry out different scenarios to observe the change of material flow. The results show that the material flow analysis by bottom-up method is different with it by top-down method. By adjusting the renewable energy subsidies, reducing PV product costs or changing other factors can affect the flow of key metals.

Key words: Material Flow Analysis, Distributed Photovoltaic Application, Bottom-up Approach

Changing Nitrogen Cascade in Urban Food System under Rapid Urbanization

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Abstract: As the most important source of anthropogenic reactive nitrogen (Nr),

nitrogen (N) cascade and management in food system has become a focus of global research and policy debates. For China that consumes 1/3 of the global N fertilizer, to secure domestic food supply while mitigating adverse environmental impacts from Nr remains a great challenge. Particularly, China is experiencing a significant transition of socioeconomic structure brought by rapid urbanization. What are the influences of growth of urban population, shift of diet pattern, change of lifestyle, as well as shrink of peri-urban arable land (due to urban sprawl) on N cycling of urban food system? Where are the opportunities for sustainable N management of urban food system in the context of rapid urbanization? Questions as such are gaining increasing concern.

Taking Xiamen, a rapidly urbanizing city in China, as an example, this research develops an N cascade model of urban food system by using substance flow analysis. The cascade model consists of four major sub-systems, namely crop production, animal production, household consumption and waste disposal. Nr fluxes and N use efficiencies (NUEs) were calculated to reveal N metabolic characteristics of urban food system, and data from 1993 to 2014 were collected to support a dynamic study. In addition, changing N cascade was coupled with socioeconomic dynamics in Xiamen city to elucidate empirically the impact of urbanization on N cycling of urban food system.

The results show that the total N input in the urban food system decreases from 29.36 Gg in 1993 to 24.10 Gg in 2014, with the applied N for local food production declining from 29.36 to 16.05 Gg while the net imported food N soaring from -0.74 to 8.05 Gg. During the same period, the total recycled N decreases from 7.34 to 4.84 Gg, and the recycling rate descends from 19.92% to 16.42%. Other than the scaling down of local agriculture, breakdown of nutrient recycling route caused by urbanized lifestyle is another reason behind. The total Nr losses into the environment decrease from 19.18 to 15.95 Gg, with roughly 32% into the atmosphere, 50% into surface water and 18% into land. It is noteworthy that Nr losses from production stage reduce from 15.92 to 9.40 Gg, whereas losses from consumption stage increase from 3.27 to 6.55 Gg, indicating transfer of pollution load from production to consumption end during urbanization process. The NUE of the whole food system in Xiamen (excluding food import) exhibits slightly downward trend during the study period, ranging between 14.77% and 27.50%. Besides conventional approach to improving NUE and decreasing Nr losses in agroecosystem, several recommendations are proposed for sustainable N management in urbanizing societies. These include improving nutrient recycling rate through promotion of urban agriculture and kitchen waste composting, reducing food waste, enhancing N-removal of sewage treatment, and constructing treatment system for rural household sewage.

Key words: Nitrogen Cascade, Food System, Rapid Urbanization, Substance Flow Analysis

Linking Industrial Ecology and Urban Ecology to Make Cities More Sustainable

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Abstract: Given that currently more than 50% of global population lives in cities and the world is becoming more and more urbanized, cities are now playing a key role in sustaining modern life styles and in resulting in sustainability challenges. Industrial ecology (IE) is the study of material and energy metabolism in anthropogenic systems such as industrial parks, cities, and countries. It is a young but growing multi-disciplinary field of research that combines aspects of natural sciences, engineering, economics, sociology, and policy making to make modern societies more sustainable. Traditional IE methods such as material flow analysis (MFA), input-output analysis (IOA), life cycle assessment (LCA), and urban metabolism (UM) have been widely performed to create new understandings of human-nature interactions and physical dimensions of socio-economic activities in city scales. Novel approaches, such as spatial analysis, big data and complex network, are being integrated with existing methods to make the studies with higher spatial/temporal resolution, more robust, and more powerful. Although there have been many methodological advancements, studies which can strongly demonstrate how IE research might provide explicit policy implications or engineering schemes for cities are far from enough. A promising method is to link industrial ecology with urban ecology, so as to promote the integration of traditional and novel IE tools in urban sustainability studies, and to explore their potentials in facilitating sustainable urban planning, design and transformation. The following steps are of special significance: (1) the development and integration of different tools of industrial ecology in city sustainability studies; (2) the application of IE studies to facilitate and guide sustainable transition of cities, including theoretical framework and case studies; and (3) the potential of extending IE tools to address new schemes of city development, such as urban mining, circular economy and sharing economy.

Key words: Industrial Ecology, Urban Ecology, Sustainability Science

Progress in Policies and Research of Life Cycle Assessment for Green Development in China

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Abstract: Humans have been pursing economic growth and creating wealth in an unsustainable way since the onset of the Industrial Revolution. Transition to a sustainable future requires sound stewardship of ecosystem services (e.g. the provision of natural resources and the regulation of pollutant emissions); in return posing the challenge of a shift in economic mindsets and pertinent social aspects to many emerging economies which are confronted with serious resource and environmental problems whilst experiencing fast economic growth. The past 16 years in China, as the world's largest emerging economy, witness its elevating attention to cultivate a resource-conserving and environmentally friendly society by setting up 10 binding resource-environment indicators, and promotion of green development as the third of the Five Major Development Concepts in its most current 13th Five-Year Plan.

The greening of the economy (i.e. production and consumption activities), as suggested by China's environmental minister, is expected to be a path to green development. This requires a holistic understanding of how utilising products/services and associated activities impact the ecosphere, and further, some scientific analytic method that can quantify the impacts. Life cycle assessment (LCA) is such a method and has a standardised framework in the ISO 14040 series. In the past two decades or so, LCA has been incorporated in a dozen of environmental management policies in developed economies, e.g. the most recent European Product Environmental Footprint Pilot Programme, and has been a rapidly developing direction in the research field of Industrial Ecology/Sustainability Science as shown by the increasing number of English-language publications. The potential of LCA in supporting green development in China is worthy of investigation. Few studies so far have reviewed the English-language publications of LCA case studies in China; insufficient attention has been paid to the research of LCA databases/tools/impact assessment methods. No study has addressed the policy development of LCA in China. The purpose of this study is to make the R&D potential of LCA in supporting green development in China understood by a broader audience by providing an overview of the progress in pertinent policies and research activities.

The following contents will be presented during the conference: 1) detailed LCA-related policy documents released by the CPC Central Committee, the State Council, the Ministry of Industrial and Information Technology (MIIT) and other ministries and commissions; 2) encouragement policies such as the green-design pilot enterprise programme and the green-design product programme initiated by the MIIT, and the special fund for green manufacturing system integration provided by the Ministry of Finance and the MIIT; 3) progress of Chinese LCA databases, desktop/web-based software, and a tailored impact assessment method for energy conservation and emission reduction; and 4) the gap in LCA studies in many

sectors/products and a proposal to establish a Chinese LCA platform for business opportunities.

Key words: Life Cycle Assessment, Green Development, Policy, China

Co-evolution of Policies of Circular Economy and Eco-industrial Parks in China

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Abstract: The iconic example of Kalundborg has triggered abundant policy actions worldwide to facilitate the development of industrial symbiosis, which has become a highly relevant policy topic. In this regard, China is a proactive country, characterized by the co-evolution of the policies of Circular Economy (CE) and Eco-industrial Park (EIP) within existing contexts. The co-evolution of policies increases the complexity of public policy that challenges our understanding of the dynamics of policy facilitation of industrial symbiosis. The study concentrates on how the policies of CE and EIP co-evolved over time and the effects of the co-evolution on the overall development of industrial symbiosis in China. The results show that the tensions between the key policy actors emerged when the two policies started to show overlapping interests in facilitating industrial symbiosis at industrial park level. The tensions were reduced as a result of the intervention of the external powerful policy actor. And the intervention also resulted in a symbiotic relation of the co-evolving policy processes that mutually reinforced their durable policy development and continuous diffusions in industrial parks. The symbiotic relation, meanwhile, was accompanied with a strategy of differentiation that enabled the mutual survival of the two policies. Overall, the co-evolution and the differentiation led to the diffusion of industrial symbiosis in wide locations and diverse types of industrial parks. The results indicate that co-evolution is seemingly more important in the earlier periods of the policy process when policy actors strive to create the fitness of the policy with the broad environment and the coupling policy processes.

Key words: Industrial Symbiosis, Co-evolution of Policies, Circular Economy, Eco-Industrial Parks

Study on Suitable Scale for Sustainable Development by Coupling Energy Science and Economic Science with Material Scarcity as Pivot

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Abstract: Truly understanding sustainable development requires a broad understanding of natural sciences and social sciences. Although some scholars have offered some kinds of syntheses such as 'triple bottom line', how to synthesize them is still confused, which is evidenced in continual debates (e.g. about 'environment Plimsoll line') between two camps (scientists in natural science, ecological economics and industrial ecology vs. scientists in dominant neoclassic economics, environmental and resource economics). In fact, the economic science of Robbins that based dominant neoclassical economics on subjective relativity of scarcity excessively disparaged the studies of use value and absolute scale, which is a critical obstacle to sustainable development. Now, a new value-free economic science that integrates ecological economics with study of use value within objective operations management has emerged. For better sustainable development, we need study suitable scale of a system in a level further by studying the interaction among flows of materials, energy and value with integration of use value and exchange value. This article is to expound how to study suitable scale for sustainable development by using rational metaphor. Firstly, it reviews predicament of the embodied energy theories of value of Odum and Costanza, the predicament of the biophysical value research initiated by Georgescu-Roegen, an underdeveloped biophysical analogy value research of Patterson, and our biophysical metaphor value research based on two monetary value flow laws similar to two laws of thermodynamics. Secondly, based on modern complexity theory, it expounds reasons for insisting on this biophysical metaphor approach by pondering formal and substantive analogies between non-equilibrium thermodynamics and evolutionary ecological economics & industrial ecology focusing on self-organization and dissipative structure. Thirdly, key divergences in economics history, from total utility to marginal utility and from absolute value to relative value, are repaired in a comprehensive economic science concerning scarce means in society and in nature. Fourthly, a resource productivity theory of value is put forward as a counterpart to theory of exchanges focusing on utility by integrating value-free study of product service systems with Smith's study of specialization and integrating general monetary value flow models with Keynes's monetary production economy. This value theory and existing economic science constitute the comprehensive economic science for better sustainable development. Fifthly, a coupling framework of natural science and economic science with material scarcity as the only pivot is proposed, in which important laws and related models in natural science, not only about energy or material flows, but also about life system with additional law concerning dissipative structure and sustainability, are contrasted to laws and related models in the comprehensive economic science. Finally, a coupling relationship between natural/market price of the comprehensive economic science and accounting of energy/exergy/emergy science is expounded by focusing on irreversibility and path-dependent structure in both

disciplines. This study focusing on the coupling relationship throughout micro- and macro- scopes gives a new rational perspective for considering suitable scale for sustainable development.

Key words: Energy Science, Economic Science, Material Scarcity, Sustainable Development

Carbon Footprint of Residential Buildings in Xiamen City: A Household Survey Based Approach

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Abstract: With China's rapid urbanization process, massive and extensive construction materials are aggregated as stock in urban areas. Understanding carbon footprint of residential buildings is crucial for low-carbon cities. In this study, to reveal the emission characteristics carbon footprint of residential buildings, a stratified random sampling and the face-to-face questionnaire were conducted to obtain the imperative information on residential buildings and socio-economic status of 1016 families from 46 communities in Xiamen City, China. Thus the community buildings' structure were identified, and carbon emission from residential buildings were quantified based on whole building life cycle analysis. The whole building life cycle could be divided in six stages as material production, transportation, construction, operation, decommissioning and recycling. The results showed that the structure of wood, wood-brick, masonry-concrete, steel-concrete is 0.2%, 3.05%, 42.91%, 53.84%, respectively. The average carbon footprint of per household and per capita at community-wide was 4.30 t/Year and 1.48 t/Year. The carbon footprint of per household ranged from 1.38 t/Year (Xiayang community) to 10.39 t/Year (Xindian community), the carbon footprint of per capita ranged from 0.69 t/Year (Xiayang community) to 4.49 t/Year (Xiangping community). The carbon emissions of residential building from material production and operation stages are the main sources of whole life cycles, represented 22.8%, 75.8%, respectively. The results of this study could be helpful in the assessment and reduction of the carbon emissions typically associated with buildings.

Key words: Residential Buildings, Low-carbon Cities, Life Cycle Assessment, Xiamen

The Evolution of Industrial Symbiosis Reexamined in the Network of Industry Space

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Abstract: Industrial symbiosis (IS) has been regarded as an effective method to reduce environmental pollution and resource consumption, which is especially important in developing countries. However, few IS researches have noticed the rapid industrialization process in developing countries, or the deindustrialization in developed countries. The potential of IS should be reexamined based on the fact that industrial structure is evolving and companies enter or exit a region from time to time. In this study, we first considered the co-existence probability of different industries in the same region by calculating a proximity metric, transformed the relationship to a complex network named "industry space" (Fig. 1), and identified the complexity of each industry and each region with the network. We used China Industrial Enterprises Database (1998-2009) as our data source, which includes 200000-400000 largest enterprises from 525 industries in China each year. It was found that industrial structure became more complex in most regions during 1998-2009 in China, and the evolution was generally path-dependent: a region would probably develop a new industry proximate to its current industries in the network of industry space. We further examined some famous cases of eco-industrial parks published in journals and summarized about 120 typical IS relations (Fig. 2) between different industries, which concentrated in several communities (especially the energy-intensive ones) in the network of industry space. Different developing paths lead to great differences in the number, stability and effects of IS relations, which are revealed by both historical data and our simulations. It was shown that China's 108 demonstration eco-industrial parks had a significantly higher number of typical IS than other regions, and the number of IS had a significantly higher increasing speed during 1998-2009, owing to their increasing regional complexity. However, the regions with a fragmented landscape or in the fringe of industry space could hardly maintain a high IS potential. Our simulations also indicated the IS network of a region might collapse in the future if some keystone yet less complex industries (such as cement) were expelled during the industrial structure transformation. The results suggest that policy makers should consider the evolution of industrial structure while planning or facilitating IS development, and the industry space method may become a useful decision-support tool for its tracking and predicting potential.

Key words: Industrial Symbiosis, Complex Network, Industry Space, Evolution

Industrial Diversity and Its Relationship with Industrial Metabolism in China – a Preliminary Result

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Abstract: Industrial diversity is an important frontier of industrial ecology research and can uncover some relationship between different indicators. Among them, one of potential interesting points would be the relationship between industrial diversity and metabolism, just like the natural ecologist colleagues have done. However, few work have been reported in industrial ecology circle. In this research, we aim to explore this interesting topic.

Industrial diversity is a quite dynamic concept and has variety of indicators. Thus, we firstly summarized the measurement methods of industrial diversity and made detailed analysis of the characteristics of these indices about the advantage and disadvantage of each index. Then, we calculated the industrial ecosystem diversity based on the annual survey of industrial firms in China at the county level. Based on these results, we described the spatial pattern of industrial diversity, and then used the exploratory spatial data analysis (ESDA) to examine the spatial autocorrelation among different counties in China. Then we plan to calculate some industrial metabolism indictors by following the urban material flows analysis framework, in order to find the correlation between industrial metabolism and diversity

We have already finished the case study of Shandong Province in East China, about the correlation between industrial metabolism and diversity. Some interesting results have been observed. For example, the calculations of these industrial diversity indices had a significant correlation among each other, and the sorting results about the rank of counties in Shandong province were nearly consistent. The industrial diversity among counties had a significantly positive spatial autocorrelation with geographically concentrated pattern, and was mainly high-high aggregation distribution pattern. Exploratory spatial data analysis reveals the existence of hot spots at Qingdao and Zibo, cold spots at Binzhou at the prefecture level in Shandong Province. We also found that the industrial metabolism gradually increased and then decreased with the increased industrial diversity, such that a significant single-peak curve appeared.

Finally, we expect more interesting results by carrying out analysis of industrial diversity and its relationship with industrial metabolism in China.

Key words: Industrial Diversity, Industrial Metabolism, China, Spatial Distribution Pattern

Research on Key Material Flow Analysis on Chinese Typical Industrial Park — a Case Study of Tianjin Economic-Technological Development Area

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Abstract: The industrial park's circular reconstruction is an important task in the 13th Five-Year Plan in China. It is also a chief component of circular development at the industrial-park level. As the primary analytical method of industry ecology, material flow analysis (MFA) is an effective analysis tool in the resource and environment management field. In this paper, we outline MFA's developmental process and summarize several defects: MFA placed more weight on quantity than influence; its black-box process is unsuited to quantitative study; its applicability is weak in small-scale analyses; and the hidden flow caused deviations. Based on massive investigative practice, three domains were extracted to perform the industrial park's circularization reform, which were a cleaner production in enterprise; promotion of industrial symbiosis within and among industrial parks; enhancement of the park's infrastructure construction. The enterprises in the industrial park were sorted in three types: manufacturing, reproductive, and resource-environment infrastructure. A new concept, key flow, was suggested and its recognition method was developed. After constructing the method frame of material flow path classification and evaluation, eight kinds of typical material flow paths were summarized and speculated to enhance the management level of material flow. Simultaneously, we choose Tianjin Economic-Technological Development Area (TEDA) as a typical case study. Furthermore, TEDA located in the lower reaches of the Haihe River, its water resource is an important factor in its economic and social development. On the one hand, its demand for water resources is growing rapidly. On the other hand, local available water resource is very limited: Its partial groundwater is overdraft; the competition among domestic water, industrial water, and irrigation water is really severe; its reliance on foreign water - water transferred from other region- will be more serious. Therefore, the allocation and utilization of water resources will play an important role in TEDA's economic and social development. This research analyzes TEDA' water resources allocation and utilization in the based 2012 from 5 aspects of water source, water intake, water production, water consumption and drainage. According to the forecast results, the typical path of water recycling key material flow in TEDA was selected, which provides a scientific basis for the realization of the high level material flow management. Finally, the prospect of Chinese industrial park's circularization reform using material flow analysis was anticipated.

Key words: Industrial Park, Material Flow Analysis, Material Flow Path Classification,

Water Recycling

Research and Application of Ountain Area Highway Landscape Aesthetics

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Abstract: The construction of highway will bring great influence to the ecological environment, especially in the mountainous area in southern China.How to make the highway effective fusion in a natural environment is the problem.The main objectives for this paper is to try to solve this problem and show the driver effective make the landscape more beautiful. In this paper, the research in the perspective of the driver, monitor eye movement, under the combination of landscape impact assessment factors monitoring factor, in the highway, on the basis of 3-D modeling, quantitative evaluation of degree of aesthetics of line selection, and gives the circuit concrete Suggestions such as excitement, for mountain area highway landscape aesthetics provides effective mathematical simulation.

Key words: Mountain Area, Highway, Landscape Aesthetics

THEME 8

Molecular Ecology and Evolution

T8-01: Plant Clonality in Changing Environments: Responses and Effects

Ramet Size Determines Benefits of Clonal Integration in Homogeneous Environments: Evidence from a N-Based Model

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Abstract: Occurrence of clonal integration is driven by the disequilibrium in resource supply between connected ramets in clonal species. The adaptive significance of clonal integration has been always highlighted in heterogeneous environments (or under contrasting levels of external resource supply), but little is known in homogeneous environments. Here, we attempted to manipulate the size of young and old ramets in a N-based model of clonal integration to examine how the nutrient uptake capacity (or internal resource supply) caused by ramet size can alter the magnitude of clonal integration for clonal species grown in homogeneous environments. The benefits of clonal integration at ramet and whole-clone levels were evaluated in four simulated scenarios, including (1) when the young ramets had the 20% mass of older ramets; (2) when the young ramets had the 80% mass of older ramets; (3) when the aboveground part of young ramets had the 80% mass of the corresponding part of older ramets, and the belowground part of young ramets had the 20% of the corresponding part of older ramets ; (4) when the aboveground part of young ramets had the 1.2 times mass of the corresponding part of older ramets, and the belowground part of young ramets had 10% mass of older ramets. The results suggested that the resource sharing between connected ramets could always exist in all simulated scenarios, but the benefits of clonal integration at the whole-clone level only occurred in the latter two scenarios. Therefore, only the optimal allocation in ramet size (or the optimal division of labour) between connected ramets can lead to an increased fitness of whole clone in homogeneous environments.

Key words: Clonal Integration, Division of Labour, Homogeneous Environments, Ramet Size

The Effects of Clonal Division of Labour and Hormonal Promotion on the Invasion of Alien Clonal Plants

Daolin Du, Wenhua You, Shanshan Qi, Zhicong Dai, Daoguo Xi

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Abstract: Clonal traits and hormone promotion have been considered to be attributes that could contribute to the growth and invasion of plant invaders. To test how the key clonal traits and hormone affect the performance of alien clonal plants, we investigated the effects of clonal division of labour and gibberellins (GAs) on the growth, clonal propagation and thus invasion of the invasive clonal plants. Under different resource-distribution conditions, we found that all the clones of Alternanthera philoxeroides with heterogeneous and homogeneous resource supply developed a division of labour at both morphological and physiological levels. The clones in homogeneous high soil nutrient showed a greater division of labour (developmentally-programmed) and better performance that in homogeneous low soil nutrient, and the clones with older ramets in high nutrient and low light treatment developed a greater division of labour (environmentally-induced) and greater growth than clones with younger ramets in the same treatment. Moreover, under different levels of endogenous GAs, we found that GAs accelerated the rapid clonal growth of the alien plant Wedelia trilobata, more than that of its native congener W. chinensis, illustrating the relationship between plant hormones and the clonal growth of invasive plants. Despite that, we also found that, through the physiological integration, A. philoxeroides can use endogenous hormone (GAs and PACs) to promote ramet growth and facilitate its invasion. These findings deepen our understanding of the importance of clonal division of labour and hormonal promotion in the invasion of alien invasive plants, suggesting that the clonal traits and hormonal promotion may be closely related to the invasiveness of plant invaders.
Key words: Clonal Integration, Plant Invasion, Gibberellins, Division of Labour

The Conservation Dilemma of Sterile Clonal Species: Examples from South-Eastern Australia

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Abstract: Conservation research and management has focussed on sexually reproducing species. In contrast the phenomenon of clonality in plant conservation is a topic that has received less attention. In threatened species legislation, the ability to interbreed often forms part of the definition of a species but some clonal species are also effectively sterile. Clonally reproductive species range from rare species threatened by extinction to highly invasive plants that threaten the viability of sympatric species. This reproductive resilience underlies the persistence of many but not all clonal species (Vallejo-Marin et al. 2010) because a higher than average

incidence of clonality has been observed in rare and threatened species (Silvertown 2008). Environmental conditions can influence a shift to asexual reproduction in some plants. The contribution of clonal species to evolutionary processes is expected to be minimal if reproduction is rarely sexual, so where does that leave them in the conservation debate?

Clonal reproduction can be considered a conservative strategy when compared to sexual reproduction Pandit & Babu 2003) because it provides replicates of genotypes already successful under existing habitat conditions whereas the novel products of sexual reproduction are untested. However, under today's rapidly changing environmental conditions, the habitat may no longer be optimal for long-lived genets. Compromised sexual reproduction may limit species both in their capacity to disperse to more favourable environments (Cunze 2013), and their ability to adapt to new conditions (Dorken et al. 2004). Therefore, loss of reproductive capacity is considered a threatening process for survival.

While limited seed production is a familiar feature of clonal plant populations (Barrett 2015), Silvertown (2008) stated that obligate clonality is rare presumably because the advantages of maintaining genetic diversity outweigh the costs of sex although individual clones can live for extended periods. Genet longevity provides greater opportunity for mostly neutral sterility mutations to accumulate when associated with enhanced vegetative growth (Dorken et al. 2004). Somatic mutation is recognised as a contributor to measurable genetic variation in long-lived species and has been linked to both disrupted sexual fertility and improved fitness (Gross et al. 2012).

Australian examples are provided where the capacity for clonal growth has been linked to persistence of species or populations with apparently dysfunctional breeding systems. Fire frequency has been implicated in the reproductive contribution of clonality in some species, and clonal reproduction has facilitated the persistence of relict species in marginal environments. The assumption that clonality enables local persistence when sexual reproduction is suppressed has been borne out by empirical studies.

Key words: Clonality, Conservation Priority, Evolutionary Prospects, Sterility

Adaptive Plasticity of the Riparian Plant Polygonum Hydropiper to Flooding

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Abstract: Phenotypic plasticity of plants is a ubiquitous phenomenon in natural ecosystems, while it does not necessarily imply that plasticity is adaptive. Adaptive plasticity refers to the phenotypic plasticity which can greatly improve species fitness.

Up till now, there have been very few studies on adaptive plasticity of plants to environmental stress, which still needs to be greatly advanced. Flooding is one of the most important factors limiting survival and evolution of riparian plants. However, flood-tolerant plants always possess high phenotypic plasticity, whether it is adaptive is not clear, upon flooding. The plasticity variations of the typical riparian plant Polygonum hydropiper within and between populations upon flooding and the related eco-physiological mechanisms were studied. The correlations between phenotypic plasticity and environmental factors of mother plants were analyzed. The costs and benefits of phenotypic plasticity of different genotypes to heterogeneous flooding stress were investigated. The adaptive plasticity of riparian plants to flooding will be elicited and this study will further advance the researches on the basic theory of adaptive evolution of riparian plants and re-vegetation in degraded riparian areas.
Key words: Plasticity, Fitness, Riparian Plant, Flooding

Accumulated Parental Effects on Clonal Offspring Performance: Experimental and Simulation Evidence

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Abstract: Parental environments have been frequently shown to have carry-over effects on fitness of sexual offspring, but such parental effects on clonal (vegetative) offspring fitness have received less attention. Parental effects may depend on the intrinsic growth rate of plants and on whether one considers a individual offspring or all offspring jointly, but these aspects have not been tested yet. By combining a greenhouse experiment and computer simulations, we tested effects of nutrient environments experienced by the parental clonal generation on performance of individual clonal offspring and all clonal offspring of a parent jointly in the stoloniferous herb Alternanthera philoxeroides. We used simulations to test how parental effects depend on intrinsic growth rate of the plants. Both the experiment and the simulations showed that the positive effects of high-nutrient availability on biomass and ramet production were stronger for clonal offspring from high-nutrient parents than for those from low-nutrient parents. Such context-dependent parental effects were more pronounced when all offspring of a parent were considered jointly than when a single offspring was considered. Also context-depend parent effects were detected only at intermediate growth rates (0.016 and 0.024 mg day^{-1}) when individual ramets were considered, but such effects existed at both slow and fast growth rates (0.008-0.040 mg day^{-1}) when all offspring were considered jointly. We conclude that the parental environmental effects can persist across vegetative generations, the magnitude of parental effects strongly

depends upon both the favorability of offspring environments and hierarchal levels of offspring, and intrinsic growth rates affect the occurrence of context-dependent parental effects.

Key words: Clonal Plant, Parental Effect, Intrinsic Growth Rate, Vegetative Offspring

Habitat Selection and DNA Methylation of Clonal Plants

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Abstract: Habitat heterogeneity is a very common phenomenon in natural ecosystems. Resource availability in natural communities can vary widely both in space and over time. A number of studies have shown that clonal plants can increase resource capture through morphological changes, physiological adjustments, and genetic variation, in order to adapt to patchy resource distribution and different total amount of resources. However, the adaptive strategy about 'Preference of clonal plants for high-quality patches' still needs the supports of sufficient evidence. The design of heterogeneous habitats should include more types of resource distribution and more gradients of resource availability. Moreover, until now there are relatively few reports of DNA methylation of clonal plants. The experimental treatments included water, soil mixture and nitrogen addition. Three clonal species, Leymus chinensis (Trin.) Tzvel., Hierochloe glabra Trin. and Carex duriuscula C. A. Mey. were selected as the experimental subjects to analyze spatial extension and foraging responses of clonal plants in multi-patch heterogeneous environments, to compare the levels of DNA cytosine methylation at CCGG sites in leaf-tissue and root-tissue of the ramets, and to discuss the mechanism of clonal plants adapting to habitat heterogeneity. The main conclusions are as follows,

(1)In the presence of multi-patch environmental heterogeneity, L. chinensis and H. glabra showed selective allocation of offspring ramets to preferential patches, and exhibited the higher capacity for rhizome extension within preferential patches. The highest and lowest resource availability would inhibit rhizome extension of clonal plants.

(2)In the field experiment with two levels of nitrogen gradient difference, high gradient difference could promote high-nutrient patch preference by L. Chinensis, H. Glabra, and C. Duriuscula. Gradient difference of habitat patches might be the main external drive improving spatial extension of clonal plants.

(3)Cytosine methylation level in both roots and leaves changed with the increase of nutrient level in mixed soil. Compared to the control, nitrogen addition resulted in the decrease of DNA methylation in H. Glabra. Clonal plants could improve asexual reproduction and further adapt to heterogeneous habitats by epigenetic regulation.

In summary, clonal plants prefer 'suitable' patches over 'high-quality' ones in heterogeneous environments. 'Preference slection' of clonal plants foraging responses is reversible over the long run. Environmental heterogeneity could promote cytosine methylation level of clonal plants. Our results could provide the valuable experimental supports for exploring the molecular mechanisms in adapting to patchy habitats.

Key words: Clonal Plants, Habitat Selection, DNA Methylation, Adaptative Mechanisms

Root-Sprouting After Disturbance: Characteristics and Ecological Significance

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Abstract: Disturbance is a factor damaging or even removing plant biomass. Due to their modular body, the majority of injured plants is able to survive and restore biomass by resprouting. The probability that an injured plant individual survives and successfully regrows is directly related to disturbance severity and the availability of a bud bank. The bud bank is a pool of dormant meristems from which new shoots regrow and removed biomass can be restored. It is composed of all axillary and adventitious buds formed by a plant. Axillary buds are restricted to the leaf axils of stems, which is a type of bud bank universal to plants. Adventitious buds may be formed on roots. This type of bud bank is possessed by only 10% of vascular plants in the Central European flora.

Although we can consider all buds occurring on a plant belong to the bud bank, buds which are somehow protected from disturbance or hidden out of its reach are the most important ones for plant resprouting. In the temperate zone, location of the bud bank belowground is the most common bud protection, since possible disturbance forces mostly act aboveground. As roots are always deeper than belowground stems, we hypothesized that the bud bank on roots is also protected better from severe disturbance than the stem bud bank and that plants possessing a bud bank on their roots are better adapted to severe disturbance than plants possessing belowground stem bud bank. Using Central European data, we confirmed this hypothesis and found that root-sprouting species occur in more severely disturbed habitats than species without this ability.

To elucidate the impact of severe disturbance on plant fitness, we performed a pot experiment with two short-lived root-sprouting Barbarea congeners to test to which extent root-sprouting is an advantageous strategy under severe disturbance. Whole-life seed production – fitness – was compared among resprouting root fragments, uninjured

individuals and individuals regenerating from the seed bank. The fitness of enforced ramets, i.e. root fragments, was higher than the fitness of both uninjured plants and plants germinating from the seed bank at the time of disturbance. This supports the idea that populations of root-sprouting species are not dependent on a seed bank and also that enforced clonality caused by disturbance might even be beneficial from the point of view of seed production.

Root-sprouting after injury is an advantageous strategy in disturbed habitats, since injured individuals survive and thus their populations are not seed-bank dependent and the stored carbohydrate reserves are not lost. Root-sprouting species might therefore have competitive and evolutionary advantages over species relying exclusively on generative regeneration or on a bud bank located on the stem.

Key words: Disturbance, Bud Bank, Resprouting, Fitness

Differential Effects of Ammonium and Nitrate on Growth Performance of Stoloniferous Herb Glechomalongituba Suffering from Heterogeneous Cd Stress

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Abstract: Water, minerals, nutrients, etc.,can be shared by physiological integration among inter-connected ramets of clonal plants. Nitrogen plays an important role in alleviating cadmium (Cd) stress for plants.But how different forms of nitrogen affect growth performance of plants subjected to Cd stress still remains poorly understood.In this study, parent ones of Glechomalongitubafragments with two successive rametswere respectively supplied withmodified Hoagland solution containing 7.5 mM ammonium,7.5 mM nitrate or the same volume of nutrient solution without nitrogen. Different concentrations of Cd (0, 0.1 or 2.0 mM) were applied to offspring rametsof the clonal fragments. We aimed to investigate the differential effects of ammonium and nitrate on growth performance of Glechomalongitubasuffering from heterogeneous Cd stress.Compared with control (N-free), nitrogen application to parent ramets, especially ammonium, significantly improved antioxidant capacity (GSH, Pro, POD, SOD and CAT), chlorophyll fluorescence parameters (Fv/Fmand ΦPSII), chlorophyll content and biomass accumulation of offspring rametssuffering from Cd stress.In addition, negative effects of nitrate on growth performance of Glechomalongitubawere observed whenits clonal fragment suffering from heterogeneous Cd stress with high concentration (2.0 mM).It was concluded that the transport or sharing of nitrogen, especially ammonium, could improvegrowth performance of clonal plants suffering from heterogeneous Cd stress.Physiological integration might be an important

ecological strategy for clonal plants adapting to heterogeneous environment stress conditions

Key words: Clonal Plant, Ecological Strategy, Nitrogen Form

Clonal Growth in the Deep-Time Fossil Record: Evidence from a 410-Million-Year Lycopsid Plant and Its Roles in the Earth System

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Abstract: The colonization of terrestrial environments by vascular plants since the mid-Paleozoic, ca. 430 million years ago, was a key event, as life moved from the water to land. Clonal growth, as an important strategy of plant vegetative reproduction, has been well established in the early phase of vascular plant evolution, as evidenced from a ca. 410-million-year lycopsid preserved in the Early Devonian paleosols (fossil soils) of Yunnan, China. Belowground rhizomes of the basal lycopsid Drepanophycus is well preserved in early soils. The rhizomes produced large clones and helped the plant survive frequent sediment burial in well-drained soils within a seasonal wet-dry climate zone. Rhizome networks contributed to the accumulation and pedogenesis of floodplain sediments and increased the soil stabilizing effects of this small, herbaceous plant. The existence of clonal growth similar to that of Drepanophycus is widespread in the deep-time fossil record: clonal growth is known to have occurred among the Early Devonian zosterophyllopsids, rhyniopsids, early euphyllophytes, and other groups; large woody rhizomes of aneurophytalean progymnosperms have been found in the Middle Devonian of New York, USA, alongside cladoxylopsid and lycopsid trees; and rhizomes characterized many Late Devonian plants, including fern-like clades. The study of clonal growth of Drepanophycus in early soils presents strong, direct evidence for plant-soil interactions at an early stage of vascular plant radiation. Soil stabilization by complex rhizome systems was apparently widespread, and contributed to landscape modification at an earlier time than had been appreciated.

Key words: Rhizome, Paleosol, Clonal Growth, Devonian

Do Clonal Growth Organs Differ by Their Ecology?

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Abstract: Belowground plant organs can serve in overwintering, clonal growth and regeneration after disturbance, as they bear buds and store carbohydrates which enable

plants to build aboveground parts. Although there is a large diversity of belowground bud-bearing organs (stolons, rhizomes, bulbs, tubers, etc.), we only have anecdotal evidence on whether and how they differ in ecology, i.e. whether they differ in ability to overwinter, resprout and growth clonally, and how this is reflected in their distribution along environmental gradients. We therefore examined whether different morphological types of belowground organs are characterized by particular clonal and bud bank traits. Moreover, we asked whether the morphological types are good predictors of the response of a species to environmental gradients, and compared their predictive power with individual plant traits (bud bank depth, bud bank size, clonality, lateral spread). We found that particular plant traits are better predictors of the ecological niche of a plant than the morphological type of the bud-bearing organ. However, differences between the morphological types in their distribution along environmental gradients were still significant. Therefore morphologically determined bud-bearing organs represent phylogenetical constraints on plant body plans, which are compensated by variability of their functional traits.

Key words: Clonality, Functional Traits, Environmental Gradients

Poa Alpina, a Seed- and Bulbil- Producing Apomictic Plant with High Adaptive Potential

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Abstract: Poa alpina, one of the most common fodder grasses at high elevation and widespread across the Northern hemisphere, reproduces either by seeds or clonally by bulbils. In many populations, both seed- and bulbil-producing individuals occur together. Seed-producing plants are apomicts, but the frequency of seeds occurring by meiosis was found to be high. Molecular diversity in grassland sites across the Swiss Alps indicated considerable genetic diversity among populations increasing with geographic distance. Populations of Poa alpina were differentiated molecularly among land use types, and among sexually and vegetatively reproducing populations. The occurrence of seed-producing individuals decreased, and that of bulbil producing individuals increased with elevation, in line with the hypotheses of an adaptive advantage of clonal reproduction in harsher environments. Allocation to reproductive biomass was found to be higher in plants from grazed compared to mown sites, indicating an adaptive advantage of reproduction in pastures and of competitive strength in mown grassland. Reciprocal transplantation indicated that genetic differentiation and adaptive phenotypic plasticity play a complementary role for adjustment of P. alpina to environmental heterogeneity. By its seed- and bulbil

reproducing capacity and by adjusting genetically and plastically to variable conditions, Poa alpina is able to occupy sites across a large elevational and ecological range. The prevailing occurrence of bulbil-producing plants at high elevation is probably due to an advantage of bulbils at cold sites with poor soil and short growing seasons.

Key words: Local Adaptation, Genetic Diversity, Phenotypic Plasticity, Regeneration Niche

Spatial Expansion Strategy of Leymus Chinensis in Response to Grazing and Saline-Alkali Stress in Songnen Grassland

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Abstract: Leymus chinensis root system spatial expansion is a complex and important process for plant clonal growth and spatial resource exploration, which is mainly controlled by morphological integration. However, most previous studies of L. chinensis morphological integration focus on the response mechanisms of resources heterogenity in environments. The spatial expansion strategy of L. chinensis response to grazing and saline-alkali stresses remains largely unknown. Here, we address how biotic (grazing or clipping) and abiotic (saline-alkaline soil) factors interact to affect the foraging behavior of clonal plant to show optimality integration strategy when responding to over-grazing and saline-alkaline stresses in Songnen grassland.

Results from this study provided direct evidence that L. chinensis was able to alter the morphological integration patterns through rhizome spatial expansion and biomass allocation among different function organs above- and below-ground. We proposed a concept model to understand the response of L. chinensis to the interaction of herbivore grazing and salt-alkali limiting, it is complex and can be difficult to interpret by single stress factor. This interactions will generate a positive stimulate on clonal plant performance including the improved capability of daughter plant and rhizome growth to tolerance (or resistance) the damage by hebivores grazing.

Our study has potential importance in greatly enhancing our knowledge of quantify the spatial expansion ability of L. chinensis. Furthermore, a spatially explicit framework of optimality with respect to L. chinensis spatial expansion can provide novel insights to the root foraging behavior of plants. This study not only makes sense in understanding L. chinensis spatial expansion and clonal integration strategy, but also has the practical value in maintaining rationally utilizing grassland resources, and optimize grazing management towards improve forage regrowth in grassland.

Key words: Foraging Behavior, Spatial Expansion Strategy, Clonal Integration,

Saline-Alkaline Stress

Spatial Distribution of Dwarf Bamboo Shoots in an Abandoned Coppice Forest at Early Successional Stages

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Abstract: Dwarf bamboo, *Pleioblastus chino* (Franch. et Sav.) Makino, spreads over forest floors of abandoned coppice forests that scatter in the suburbs of Tokyo and their dominant trees are replaced from deciduous to evergreen *Quercus* trees. In this process, bamboo shoots often form dense stands and the stands are considered to reduce light availability and in consequence decrease species richness of other understorey plants. We predicted that bamboo shoots emerged and increased their densities at sites with high light availability. Consequently, species richness of forest floor plants would decease along with increases in bamboo shoot densities because of their shading. In order to test this hypothesis, we investigated spatial distribution of trees, bamboo shoots, woody saplings or seedlings and herbaceous plants in Matsugihinagta forest (35°37′N 139°22′E) in Tokyo Metropolitan University. We established the study plots that included edges of dense stands of *P. chino*. We also measured canopy openness from hemispherical photos to estimate light availabilities at 1.3 m in height. The forest dominated by *Q. myrsinifolia* and Q. serrate with an area of about 13 square hectares was a coppice forest but understorey plants have not been mowed over 30 years in traditional ways. Thus, many saplings or seedlings of *Aucuba japonica*, *Eurya japonica* and *Q. myrsinifolia* existed as understorey. Canopy openness was 6.3% in average and ranged from 3.3% to 14% in winter. Dwarf bamboo shoots increased their numbers along with canopy openness and were more distributed under deciduous trees. Moreover, numbers of understorey plants also increased with shoot numbers of dwarf bamboo, which was inconsistent with our prediction. Our current results suggest that the elimination process of understorey plants under the existence of *P. chino* shoots would not be very straightforward as expected at least at early successional stages. We like to propose a probable scenario that *P. chino* would have more tolerance to the shading of overlayer trees in comparison with other understorey plants possibly because of its clonality.

Key words: Sasa, Pleioblastus Chino, Species Richness, Abandoned Coppice Forest

Environmental and Phylogenetic Analysis of Distribution Pattern of Clonal Plants in China

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Abstract: Clonality is a plant strategy for adapting to environmental challenges, which enables clonal plants are distributed widely. However, little is known about distribution patterns in clonality. Here, we use clonality data for 4 015 vascular plant species in 545 terrestrial communities across China to provide the latitudinal gradient of clonality. We also investigated 4 climatic variables (mean annual temperature, temperature seasonality, mean annual precipitation, precipitation seasonality) and 3 taxonomic levels (class, order and family) to determine which factors underlie the clonality pattern. We found that species with clonal strategy increased along the latitudinal gradient towards cold, dry or very wet environments, but there were only some weak patterns. Clonality of woody and herbaceous species had opposite responses to climatic variables. Woody clonality showed higher frequency in wet or climatically stable environments, while herbaceous clonality preferred cold, dry or climatically instable environments. We also revealed clear clonality-climate relationships of the taxonomic levels, and the relationships differed predictively in shape and strength between the different clades. These different relationships canceled out one another when all lineages at a certain taxonomic level were pooled. Variation in clonality is suggested to be driven by different phylogenetic lineages having fundamental differences in functional traits other than clonality determining their climate response.

Key words: Clonality, Phylogenetic Analysis, Clonal Plant, Geographic Pattern

Clonal Integration and Plant Invasions: The Case of Carpobrotus Edulis

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Abstract: Clonal growth is characterized by the production of genetically identical offspring (named ramets) that may remain connected by stolon or rhizome internodes. One of the most remarkable traits associated with clonal growth is the capacity for clonal integration (resource sharing between connected members of the clonal system). This capacity for clonal integration has been repeatedly documented and allows clones to behave as cooperative systems, enabling ramets to colonize and survive in unfavourable patches. What makes a plant a successful invader is one of the most interesting questions in modern ecology. Some plant characteristics might explain the

success of invasive species better than others and traits associates with clonal growth have been suggested as a characteristic that could increase plant invasiveness. This idea is based in the rationality that many of the most successful invasive plant species show clonal propagation. In this presentation, I will describe different experiments testing the importance of clonal integration in the expansion of the stoloniferous invader C. edulis. In particular, I will discuss the differences in clonal integration between exotic non-invasive and invasive congeners of the genus Carpobrotus. Comparative studies including congeners differing in invasiveness are a straightforward approach to detect potential traits explaining invasions. Also, I will describe the differences between populations of C. edulis from native and invaded range, in order to determine the presence of adaptive evolution of clonal traits during the invasion process. Understanding the influence of clonal life-history traits in plant invasions seems key for predicting future invasion scenarios and for devising efficient strategies of control and restoration of invaded areas. Also this information will be important on its own right for better understanding on how plants respond and evolve in new environments.

Key words: Clonal Integration, Plant Invasions, Carpobrotus Edulis

The Effects of Climate Change on Growth Response and Ecological Niche Breadth of Hibiscus Hamabo Endangered Plant

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Abstract: We conducted this study dividing control (field) and treatment (elevated CO^{2+}temperature) in the greenhouse. Light, moisture and nutrient gradients were treated within control and treatment. We measured shoot length and number of leaves. Unlike control, Hibiscus hamabo all died on L1 and L2 in treatment. Unlike treatment, that all died on N1and N4in control. Shoot length is longer on M1and M4 in control than treatment. Leaves number is higher on N3 in treatment than control. The ecological niche breath is arranged in order of light (0.91) > moisture (0.78) > nutrient (0.47) in control and moisture (0.93) > nutrient (0.87) > light (0.48) in treatment. In treatment, it is narrower as 30.1% in light gradients but wider as 8.6% in moisture gradients and 30% in nutrient gradients. It means that tolerance of Hibiscus hamabo increases about moisture and nutrient but it decreases about light when climate change is proceeded. In the conclusion, when the climate change is proceeded by elevated CO_2 concentration and temperature, light works on limited factor on growth of Hibiscus hamabo.

Acknowledgment: This work was supported by the Korea Foundation for the Advancement of Science & Creativity (KOFAC) grant funded by Ministry of

Education (MOE).
Key words: Climate Change, Ecological Niche Breadth, Hibiscus Hamabo, Endangered Plant

Effects of Clonal Growth on Plant Sexual Reproduction

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Abstract: Mixed reproductive strategy of both sexual and clonal growth is widespread among angiosperm species. The common view is that clonal growth may impact negatively on certain aspects of sexual reproduction. Here, we will explain that clonal growth may have positive effects on sexual reproduction based on the comparisons between clonal and non-clonal individuals with the same amount of resource investment in floral displays and advances in somatic mutation hypothesis. First, using experimental studies of bumblebees foraging on artificial flowers and through computer simulations, we found that bumblebees often skipped inflorescences on plants with multiple inflorescences and hence visited fewer total flowers and this visitation behavior caused less geitonogamy in simulations with all flowers receiving and donating pollen. Our field studies in Aconitum kusnezoffii confirmed that bumblebee visitation patterns mainly occurred between flowers within a ramet. In Delphinium glaucum, we constructed large inflorescences by tying together two racemes from clones with two flowering ramets and found that the outcrossing rate for these large inflorescences was higher than for clones in which the ramets were not tied together and thus functioned independently. These results suggested that clonality can promote pollination quality without increasing geitonogamy when flowers simultaneously receiving and donating pollen. Second, the somatic mutation hypothesis predicted that the number of different mutation carried by gametes will increase with the growth distance and number of mitotic cell divisions from the ancestral tissue from which flowers used in autogamous and geitonogamous pollination originated. As a results, inbred offspring from autogamous pollinations should exhibit greater inbreeding depression than progeny from geitonogamous pollinations and older clones should exhibit reduction in male fertility. The results from Aconitum kusnezoffii were totally in consistent with the above predictions, which suggest that clonal growth can decrease the cost of autogamous inbreeding. Taken together, the evidence from the two lines indicated that clonal growth may have potential positive effects on sexual reproduction, which is in contrast of the previous predictions.
Key words: Clonal Growth, Geitonogamy, Plant Mating, Somatic Mutation Hypothesis

The Clonality and Invasiveness of Solidago Canadensis under Experimental Warming and Nitrogen Addition

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Abstract: Increasing evidence suggests that clonality of exotic plants may play an important role in driving their invasion success. Of all key factors determining plant clonality, temperature and soil nitrogen (N) are commonly viewed as an important condition and resource, respectively. Thus, the importance of plant clonality in invasions should be addressed in the context of altered temperatures and N availability. To assess the joint effects of climate warming and N deposition, I conducted a five-year microcosm experiment with an invasive plant species Solidago canadensis, which was subjected to four combinations of temperature and N, and focused on two key traits (i.e. ramet numbers and its height). The individual and combined effects of experimental warming (i.e., an increase of 2℃ over the ambient air temperature) and N addition (i.e. an addition of 5 g $N^{m-2\ yr-1}$) on the numbers of ramets and their height were non-significant statistically. Nor was a significant tradeoff between ramet numbers and its height detected. These results suggest that the projected climate warming and N deposition may not enhance the invasiveness of S. canadensis through increasing its clonality, and also highlight that ramet production and height growth may be two mutually independent processes. Undoubtedly, these recognitions need to be further tested in suits of field experiments with multiple clonal plant invaders.

Key words: Global Change, Invasiveness, Plant Clonality, Plant Invasion

Divergent C: N Stoichiometry between Diploid and Tetraploid Stoloniferous Plants of Fragaria across China

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Abstract: Leaf carbon (C) to nitrogen (N) stoichiometry is one of aspects of plant strategies adapting to heterogeneous environments, which shows clear biogeographic patterns in multiple species across broad scales. As the single most important mode of speciation in plants and a main driver of the adaptation and range expansion, little has been known about the ecological roles of polyploidization contribute to plant strategy, such as leaf stoichiometry. Stoloniferous clonal Fragaria species including diploid and tetraploid are widely distributed throughout northern and southwestern China. Thus, we analyzed leaf C: N stoichiometry and stable isotope ratio of diploid and tetraploid

plants of 8 Fragaria species from 203 field sampling plots across China. Primarily, C, N concentration, C: N, δ13C and δ15N shown significant variation along geographic gradient. Diploid species had significantly higher carbon concentration, δ13C and variation of δ15N than tetraploid species. Our results highlight that divergent C: N stoichiometry between diploid and tetraploid stoloniferous plants of Fragaria across China, which suggests difference in ploidy level would cause divergent plant chemical responses to the fast changing planet.

Key words: Polyploidy, Stoichiometry, Fragaria, Clonal Plant

THEME 9

Landscape Pattern, Process and Sustainability

T9-01: Landscape Ecology and Biodiversity Conservation

Latrine-Site Use of Small-Clawed Otters (Aonyx Cinereus) in Tropical Rice Fields: Effects of Landscape and Local Environmental Factors

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Abstract: Rice fields are known to serve as important habitats for aquatic and semi-aquatic wildlife. Owing to promotion of increased food production via agricultural modernisation, changes in land use or farming practices have led to losses of aquatic and semi-aquatic organisms that use rice fields as foraging or refuge sites. The small-clawed otter (Aonyx cinereus) is an IUCN threatened species that uses rice fields as latrine sites and foraging habitats in South-east Asia. Thus, tropical rice field landscapes provide an opportunity to investigate how land-use and local environmental factors influence latrine-site use of this charismatic wildlife. Based on a year weekly field-survey and landscape analyses, we investigated latrine-site use by small-clawed otters in rice-field landscapes in West Sumatra, Indonesia. Using land-use and/or local environmental variables as predictors, we performed generalized linear model (GLM) or generalized linear mixed model (GLMM) analyses to explain the spatial patterns of latrine-site occurrence and spatial-temporal patterns of otter visitation to latrine sites. GLM analysis incorporating spatial patterns of latrine-site use revealed that a medium number of rice field huts was the single important factor explaining the occurrence of latrine sites in rice fields. Another GLM analysis incorporating spatial patterns of latrine-site use indicated that latrine sites that were adjacent to deep-water rice fields, distant from a settlement and close to river experienced the highest visitation by small-clawed otters. GLMM analysis incorporating temporal patterns of latrine-site use revealed that latrine sites that were adjacent to vegetative stage of rice fields with abundant golden-apple snails (Pomacea canaliculata), a food item for otters, experienced the highest visitation by small-clawed otters. Based on these results, we formulate the following management implications of Indonesian rice fields with particular reference to conservation of small-clawed otters. First, given that a landscape containing an intermediate number of rice field huts was the important latrine site for small-clawed otters, a moderate level of rice farming activities are encouraged. Second, although the System of Rice Intensification (SRI), in which less water is used during rice cultivation, is being promoted in Indonesia to conserve water and maximize rice yield, such shallow-flooding practices may have detrimental effects on small-clawed

otters; otter-friendly farming should be urgently designed and implemented in areas where SRI is promoted. Third, asynchronous farming practice may be encouraged to maintain landscape heterogeneity and consistent supply of foraging habitats for small-clawed otters.

Key words: Rice Paddy Field, Scent Marking, Satoyama, Habitat Preference

Interdisciplinary Collaboration in a Landscape Ecological Approach to the Development of an Urban Ecological Network for a Compact City

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Abstract: The declaration of 2011 to 2020 as the "Decade on Biodiversity" by the United Nations has opened up opportunities for cities to participate in biodiversity conservation. Although many cities may have stated conservation objectives as part of their land use policies, there is a lack of examples of how principles from conservation science has informed and guided urban biodiversity programs. An ecological network approach is thus proposed for urban biodiversity management, because it enables the integration of a bottom-up, species-based approach often favoured by conservation managers, with the top-down remote sensing approach employed by land use planners in identifying natural areas for protection. This integrated approach is underpinned by theoretical concepts and methods from landscape ecology which studies the relationship between spatial patterns and ecological processes, and urban ecology which includes the social determinants of cities as an urban ecosystem. An ecological network framework, which links population ecology via a series of “cohesion” indices to the ecosystem and landscape scales of biodiversity, was used to link physical connectivity of vegetation cover over Singapore derived using landscape metrics, with the functional connectivity of the derived vegetation cover. Functional connectivity was determined by modelling the habitat suitability for ten focal species from two taxonomic classes, and the cost of their dispersal from a key source patch to various parks and natural areas throughout the city. The focal species were proposed by various experts in the field of conservation science and ecology via a structured interview process. Integrating the physical connectivity and functional connectivity maps leads to a map of Ecological Network Index (ENI). This forms the basis for the planning and design of sites that has been zoned for development and yet situated within the derived ecological network. To test the application of the modeled ecological network onto landscape planning and design, a secondary forest in Singapore that has been planned for a future new town consisting mainly of public housing was chosen. Stakeholders are

involved in discussing the results of analysing different master plans using evaluative and predictive methods, with the objective of developing planning and design guidelines for the development of such sites. The results, challenges and limitations of such an approach will be shared in the conference presentation.

Key words: Ecological Network, Landscape Ecology, Urban Biodiversity Conservation, Landscape Planning

Farmers' Contributions to the Conservation of Tree Diversity in the Groundnut Basin, Senegal

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Abstract: Tree diversity in West Africa is threatened by intensified land uses and salinization, and farmers' role in conservation of tree species is unclear. We hypothesized that farmers contribute to conservation of tree diversity through protection of trees in their agroforestry landscapes and compared the diversity and structure of the tree vegetation across landscape classes. Inventories were carried out in three villages in the Groundnut Basin in Senegal, assessing tree diversity, density and crown cover. Tree diversity as assessed by species accumulation curves was high in forests, but cultivated landscapes had comparable or almost comparable diversity, especially in the cases where the forest was planted or was affected by charcoal production. However, the occurrence of exotic species was higher in cultivated parts of the landscape, and although many species were in common, ordination plots indicated that forests and cultivated landscapes to some degree had different species composition. Salinity had a strong influence on vegetation, not only in the tans (salt marshes) but also across the other landscape classes. In conclusion, agroforestry landscapes in the three villages harbor considerable tree diversity, but insufficient to fully conserve the tree species. We argue that informing and including farmers in tree management in the region will contribute to overall conservation of tree genetic resources.

Key words: Tree Diversity, Conservation, Landscape Classes, Environmental Factors

The Geographic Patterns of Alpine Flora in China in Relate to the Environmental and Spatial Factors

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Abstract: Alpine is a global biome with extreme environments and distinct boundaries.

Studies on the geography of alpine flora help to understand the forming of flora in the extremely cold and segregated environment, as well as the floristic communication between mountains. This research integrated the alpine flora data of fourteen main mountain ranges in China, measured floristic similarity with Jaccard index, and explored the percentage composition of areal-types of seed plants, the effects of geographical distance and environmental variation on flora similarities, mainly through correlation analyses and Mantel tests. Results indicated that China alpine zone harbors a flora of high species richness, with 3659 species (including 338 subspecies units) belonging to 489 genera and 64 families recorded in the alpine zone of fourteen main mountain ranges in China. These genera are mainly constituted by areal-types of North Temperate and the sub-types, Cosmopolitan, Old World Temperate, East Asia and Sino-Himalayan, while the Sino-Japanese type is absent. The Endemic-to-China type reveals a distinct presence in the alpine flora (5.2%). Based on the data from 14 alpine zones, the geographical patterns of alpine floristic composition is characterized by a significantly latitudinal decrease of tropic and East Asia areal-types, and the increase of northern temperate types; along the longitudinal gradient, the percentages of Mediterranean types decrease while the northern temperate types increase, and the East Asian elements maximize in the middle position. The alpine floras of 14 mountains are significantly correlated in terms of geographical element composition measured at genus level, revealing two groups of higher floristic correlation, i.e. mountains surrounding the Qinghai-Tibet Plateau and separated northern mountains, respectively. The alpine flora of Taiwan Island is more closely related with that of the northern mountains rather than that of the mountains in Southwest China, which have more comparable latitudes. We found the geographic distance as the primary factor for deviation between alpine floras, the physiognomy of alpine zones also influence floristic composition, while the maximum temperature of warmest month (MTWM) is a critical climate factor for geographical deviation of alpine flora composition in China, implying the potential stress effect of global warming to the alpine flora.

Key words: Alpine Flora, Geographical Differentiation, Spatial Distance, Composition Similarity

Using Population Genomics to Assess the Biodiversity Dynamics of an Endemic Ant Radiation in Fiji

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Abstract: Pheidole are a hyper-diverse ant genus found in most temperate and tropical biomes that are particularly dominant in tropical regions. Despite their global ubiquity

they appear to possess relatively low inter-regional dispersal rates that have promoted a repeated pattern of localised endemic radiations across different regions of the planet. In the isolated archipelago of Fiji which comprises 300+ islands of varying sizes, a single endemic radiation initiating approximately 15 Ma. now comprises around 15 species residing alongside a handful of additional species featuring long-term endemics, regionally widespread natives, and human-mediated colonists. Within the endemic radiation are two monophyletic species groups possessing distinctive morphologies and life-history traits. The knowlesi group are morphologically simple, and typically occupy marginal coastal habitats and exhibit simple nest building behaviours. Alternatively, the roosevelti group have pronounced spinescent morphological structures, inhabit high-altitude pristine habitats and construct complex nests. Like many island endemic species, some Fijian Pheidole are extremely rare and likely face immediate extinction threats from habitat loss and invasive species. Our recent work has used next-generation sequencing technologies (RADseq) to investigate the contemporary diversity patterns and conservation status of Fijian Pheidole, with particular reference to diversification dynamics, demographic histories, population structure and trans-archipelagic gene-flow. With these analyses we are attempting to understand numerous features of conservation importance such as: (i) whether small islands have conservation value due to endemism or genetically differentiated populations; (ii) endemism and population connectivity levels in threatened habitats; (iii) signatures of demographic decline (e.g. endemics) versus expansion (e.g. invasives); and (iv) signatures of diversity creation (e.g. within or among islands).

Key words: Ant, Pheidole, Radseq, Population Genomics

Impacts of Urban Expansion on Biodiversity Ecosystem Services in Jinghong County, China, from the 1970s to 2030

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Abstract: Jinghong County is located in the seasonal tropical rainforest biodiversity conservation ecological function area of Xishuangbanna Autonomous Prefecture in the Southwestern China. Jinghong is also the primary urbanization area within the region. Urban and agroforestry expansion surrounding the city brought disturbances in the protection of regional biodiversity. This research aims at analyzing urban expansion in Jinghong and its impact on the regional biodiversity ecosystem services. The PANDORA 3.0 landscape evolution model was applied for the assessment of ecosystem services for biodiversity conservation. Three land use maps from the 1970s to 2010 and a city planning map in 2030 were generated and analyzed, respectively.

Results showed that urban expanded rapidly, while shrub decreased during the past 40 years. The southwestern city proper showed the most significant and fastest urban expansion rate. In response to rapid urban expansion, land use types outside urban areas changed dramatically. Urban areas were usually surrounded by arable land, shrub and permanent crops in the 1970s, while most regions were dominated by permanent crops (mainly rubber) by 2010. Urban expansion apparently reduced the biodiversity ecosystem services. The expansion of built-up areas in the city proper contributed to a net loss of ecosystem services by 0.3 million USD during the 1970s–2010. Besides, the sprawling urban structure aggravated the loss of ecosystem services, as the agroforestry surrounding urban sprawl expanded and invaded the original vegetation. The 2030's city planning shows a larger city proper with a compact structure. The more compact structure provides potential solutions for reducing the peripheral expansion by the agroforestry, this is a more rational development planning than before for the biodiversity ecosystem services.
Key words: Urbanization, Ecosystem Service Value, PANDORA Model

The Effect of Grazing Intensities on Red-Footed Falcon Invertebrate Prey Abundance

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Abstract: The Red-footed Falcon (Falco vespertinus) is a highly conservation dependent, strictly protected species that inhabits open grasslands and semi-arable regions. These birds mainly prey on small vertebrates and insects typically Orthoptera and Coleoptera species. Prey accessibility (i.e. Vegetation structure and height) is an important factor shaping foraging habitat selection of this species, typically optimizing for areas with short vegetation. In this thesis I examined how alternative grazing regimes help shape vegetation and thus, prey availability for Red-footed falcons and how it simultaneously effects orthopteran prey abundance.

This study was carried out in the grasslands of the Bükk National Park in southern part of Heves County, Hungary. The focal area is a 360 ha primary grassland where Hungarian grey cattle were used for habitat management as a part of an ongoing international project. In 2013, we carried out a baseline assessment of prey accessibility and prey abundance prior to any grazing activity. Grazing commenced in 2014 and continued through to 2016. The effects of grazing was measured in 2015 and 2016. Altogether 3 grazing intensities were compared; under grazing (0.25 livestock units/ha), medium grazing (0.5 livestock units/ha) and over grazing (1.5 livestock units/ha). Since a single cattle herd was available for habitat management, we controlled grazing

intensities through the extent of grazed areas. The cattle were rotated daily between the three experimental fields, thus ensuring realistic reproduction of grazing intensities. We used 9 soil traps and 9x3 transect surveys in each experimental field to measure Orthoptera abundance, while prey accessibility was assessed by measuring total and lower vegetation height at 9x3 randomly chosen quadrats around soil traps. Sampling was carried out in the breeding season of Red-footed Falcons (June-August) on a bi-weekly basis.

Our results show that prey accessibility was significantly and positively affected by grazing, however medium and over grazing significantly decreased Orthopera abundance. We conclude that the optimal grazing intensity in the study site is both over- and under grazing. This increases the overall abundance of the Orthopteran prey, while opens the habitat structure sufficiently for foraging falcons to potentially access their prey.

Key words: Red-footed Falcon, Habitat Management, Grassland, Grazing

Limits to Biodiversity Conservation in Alpine Tundra Are Rooted in Theoretical Landscape Ecology

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Abstract: Understanding the consequences of global change for biodiversity depends on understanding the maintenance of biodiversity. The intersection of the theory of island biogeography (TIB) is the starting point. With its corollary, extinction debt, TIB can be extended beyond equilibria. The landscape ecology paradigm has been shaped around a pattern-process feedback in which pattern is patch-corridor-matrix. Strictly, TIB addresses islands patches (or vice-versa), but this limit has been lifted somewhat by the landscape ecology paradigm. The challenge arises where and when the landscape elements of patch-corridor-matrix are in flux and extinction debt expectations become volatile. Then simple models of diversity become untenable and background (equilibrium, without global change) turnover rates cannot be established. Nonequilibrium expectations, based on prior work on beta-diversity, are illustrated with data and metrics of alpha-diversity for alpine tundra in the Rocky Mountains, USA. While microbial community composition data is lacking, other predictors explain little of the variance. Too little is known for empirically-based mitigation.**Key words:** alpha-diversity, alpine, beta-diversity, climate change, island biogeography, plant community, Rocky Mountains, tundra

Key words: Biodiversity, Climate Change, Plant Community, Rocky Mountains

Spatial and Temporal Linkage of Stream-Riparian Food Webs by Seasonal Migration of Aquatic Insects

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Abstract: Stream environments are spatially and temporally heterogeneous. Mainstem Rivers are often wide, sunlit, warm and productive, while tributaries are shaded by riparian trees, unproductive, and remain cool in summer. Within Mainstem Rivers themselves there is substantial spatial heterogeneity in habitat structure and physical conditions, such as water temperature. River environments also change dramatically with season. Organisms that live in the riverine environment respond to and take advantage of such heterogeneous environments by moving between microhabitats or shifting their phenology. Such movements and/or phenology of organisms in the heterogeneous world can link communities that are distant in space and time, which sometimes play important roles in supporting local ecosystems. I discovered that a riverine mayfly, Ephemerella maculata (Ephemerellidae), in a northern California migrates between mainstems and tributaries of rivers during its life cycle, thereby linking food webs in these two habitats, and enhancing predator growth in unproductive tributaries. The resource subsidy from productive but warm rivers to cool, unproductive tributaries associated with the mayfly migration increase the growth of stenothermic predators like juvenile salmonids in otherwise food-limited, cool thermal refuges, and increase their resilience to future warming. Furthermore, I examined the resilience of E. maculata to changes in water temperature using field surveys and lab rearing experiments. I discovered that different life stages of E. maculata have different thermal responses, and they shift their phenology depending on the water temperature, allowing each life stage to occur in the most desirable thermal condition. Therefore, as long as the natural seasonal pattern of the water temperature is sustained, E. maculata can resist temperature changes by shifting their phenology. Finally, I have shown that thermal spatial heterogeneity of rivers desynchronizes mayfly emergence timing, prolonging the subsidy period to riparian predators, and changing the predators' responses to this subsidy.

Key words: Spatial Heterogeneity, Ecosystem Linkages, Movement, Subsidy

Conservation beyond Protected Areas: Case Study for Sarawak, Malaysia

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Abstract: Sarawak, a Malaysian state in Borneo, is rich in plant and animal diversity, and forms part of the global biodiversity hotspots. However, the extent of totally protected area is less than 6% of its land mass, many of which occur in isolation and small sizes. They are surrounded by various other land uses, mostly production forests mean for timber production. Thus, the conservation of wildlife and ecosystems cannot hinge solely on the roles of protected areas but more importantly, the surrounding landscapes. There is a need to influence how well the forests outside of protected areas are managed. In addition, it is important to identify where key wildlife habitats and ecosystems are so that policy intervention can be advocated, and other stakeholders can be engaged to adopt sustainable practices for long term conservation of species, habitat and the ecosystems. This paper provides an insight in the approach used to identify key areas for terrestrial conservation in Sarawak, through a systematic approach of conservation planning.
Key words: Conservation, Sustainable, Planning, Protected Areas

Historical Continuous Cover Dynamics of Sagebrush Steppe in the Western United States from 1984–2015: Pattern, Drivers, and Impacts

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Abstract: Understanding the causes and consequences of changes in continuous cover of sagebrush steppe landscapes is important to managers of rangeland ecosystems in the western United States. Assessments of climate, disturbance, and management impacts on sagebrush steppe ecosystems may be improved by including historical change information on the pattern, fragmentation, and structure as extracted from multi-year remote sensing times-series data. We mapped six continuous cover component changes (annual herbaceous, herbaceous, bare ground, litter, sage, and shrub) in sagebrush steppe ecosystems, and investigated the relationship between these components and various drivers of change to improve our understanding of land use (wildlife, livestock grazing). We utilized Landsat imagery, field data, and regression tree models to produce fractional cover dynamic data layers for the six rangeland components from 1984 to 2015 and analyzed the changes in pattern, driving forces, and impacts. Our results illustrate the untapped potential of remote sensing time-series data to provide detailed descriptions of sagebrush steppe cover changes at variable spatial and temporal scales. The sagebrush steppe ecosystem in the western United States has undergone many changes over the past 30 years, driven by climate, disturbance, and management. Adaptive management strategies based on changes in continuous cover

are needed to curb degradation of sagebrush steppe landscapes and promote sustainability.

Key words: Continuous Cover, Rangeland, Ecosystem Dynamics, Change Pattern

Spatial Variation of Biodiversity in the Bailongjiang Watershed of Southern Gansu Based on InVEST Model and Landscape Pattern Index

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Abstract: It is urgent to strengthen biodiversity conservation and protection due to biodiversity loss has become one of the huge global environmental problems facing us now. Identifying and understanding the spatial variation of biodiversity in the regional scale is urgent needed for the formulation and implementation of biodiversity protection scheme and policy. Bailongjiang Watershed of Gansu Province (BLJW), one of the most abundant biodiversity areas in China, located in the transitional ecotone along the Tibet Plateau, Loess Plateau and Qinba Mountains, is selected to analyze the spatial heterogeneity of biodiversity. Based on remote sensing and GIS technology, this paper constructed an evaluation method of the spatial pattern of regional biodiversity with the combination of InVEST model, NPP and landscape pattern index, to analyze quantitatively the spatial distribution of biodiversity in the raster cell scale of BLJW. The Biodiversity Index of the BLJW increased slightly from 1990a to 2002a, and the mean value increased from 0.189 to 0.211, and the middle and high value areas showed a increase trend, but the maximum and minimum values tended to decrease, which indicated that, despite a slight increase in the biodiversity of the watershed, the biodiversity is declining in some subareas, especially in where biodiversity is low. During the period from 2002a to 2010a, the biodiversity index continued to increase, and the area of the high biodiversity degree increased obviously, which indicated that the habitat quality of the BLJW improved and the landscape pattern tended to be stabilized. As to the whole study period, the biodiversity degree of BLJW increased and polarized gradually. The area with high biodiversity index increased obviously, and the area proportion of low biodiversity value tends to decrease, but still more than 56.7%, which indicated that the biodiversity restoration work in BLJ watershed is still very serious. Spatially, the high biodiversity index area is mainly concentrated in the nature reserves areas, the middle and subalpine forest areas, to Baishuijiang National Nature Reserve and the Nature Reserve of Dala and Axia in Diebu. The results are useful for the policy-making on biodiversity conservation, governance of human activity and natural resource exploitation for the disaster-impacted mountainous areas.

Key words: Biodiversity Conservation, Spatial Variation, Landscape Pattern, Invest Model

Population Changes of Bufo Bufo Gargarizans in the Wetland of Nearby Seomjin River in Korea and Its Habitats Conservation

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Abstract: In order to make conservation and management of the wetland habitat for Bufo bufo gargarizans, we surveyed the population size and environmental conditions in 14 wetland sites within Akyang-myeon, Hadong-gun around Seomjin River from 2014 to 2016. Bufo bufo gargarizans population was found in 6 wetlands among 14 sites, such as Salix-dominated wetland, Nelumbo nucifera planted wetland, Ipseoksang reservoir, Nojeon reservoir, Shinheungha reservoir and Jeongseo reservoir.

Bufo bufo gargarizans did not spawn in wetlands that varied, or have low amounts of water or have fish predators that eat Bufo bufo gargarizans. The population was experienced in road kill during the spawning season between February and March, and adult migration in May. Potential predators were Lutra lutra, Felis bengalensis euptilura, Nyctereutes procyonoides in mamals and herons, ducks, crow and ravens in aves and Rhabdophis tigrinus, Geoclemys reevesii, Trionyx sinensis in reptiles and species belong to Pentatomidae in inverterbrates.

In Oder to conserve the habitat of Bufo bufo gargarizans, it is urgently need as follows; firstly reservoir should be conserved and managed the water depth to be 30cm in the breeding season, secondly safe eco-pathway should be prepared in breeding and migration season.

Key words: Reservoir, Asian Toad, Conservation, Habitat

The Impact of Future Urban Expansion on Natural Reserves in China

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Abstract: Natural reserves are essential for preserving biodiversity and habitats. China's rapid urban growth in the past has caused significant impacts on natural reserves. These impacts has been extensively studied. However, in order to develop sound management plans, we need not only a good understanding of the past but also reasonable predictions of the influence due to future urban expansion. In this study we simulated the future risk of downsizing, fragment, and downgrading for nearly 1800

natural reserves in China caused by future urban expansion between 2010 and 2100 under four RCP scenarios (RCP 8.5, RCP 6.0, RCP 4.5, and RCP2.6). We find that the future urban expansion will result in downsizing and fragment of a small number of natural reserves in China, especially for some inland wetlands and marine offshores in or near built-up areas. Most natural reserves will be downgraded in different degrees. Although rapid urbanization in China is inevitable, if rational urban planning, effective policies, and management plans are in place, the loss and degradation of nature reserves in China can be minimized.

Key words: Natural Reserves, Urban Expansion, Downsizing and Degradation, Management Plans

Landscape Changes in Coastal Areas after the 2011 Tsunami and Subsequent Restoration Construction

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Abstract: The Great East Japan Earthquake of 11th March 2011 and subsequent huge tsunami caused widespread damage along the Pacific Ocean coast of northeastern Japan. In the alluvial plain areas the tsunami penetrated several kilometers inland. The earthquake was followed by widespread land subsidence, as much as 1 m in some areas. Because of this, many areas remained submerged even after the tsunami had retreated. This research utilizes multi-resolution remote sensing images to clarify the impact on landscapes caused by this disaster, and also to monitor the subsequent survival and recovery process in the Sendai Bay region. MODIS data (250 m resolution) were employed to map the overall extent of inundation and damage on the regional landscape scale. The major damage caused by the tsunami, destruction of coastal pine forests and inundation or rice paddies on the plain, was identified at this level. Progressively finer scale analyses were then implemented using SPOT/HRG-2 (10 m resolution) data; GeoEye-1 fine resolution data (0.5 m) and very fine resolution aerial photographs (10 cm) and LiDAR. These results demonstrated the minute details of the damage and recovery process. The discussion also presents a discussion of strategies for restoring the landscape.The study area features a wide variety of natural habitats and land uses, including shallow offshore waters, outer beaches, inner beaches sand dunes, canals, lagoons and marshes, as well as residential districts and cultivated lands such as rice paddies. Pine trees (Pinus thunbergii and P. densiflora) were planted widely in the coastal areas. Farmsteads on the flat alluvial plain are surrounded by groves called Igune, consisting primarily of conifers such as Sugi cedar (Cryptomeria japonica). This

earthquake and tsunami resulted in immense ecological damage, caused by the enormous physical impact of the tsunami, as well as the physiological impact of inundation by seawater. On the outer beaches the tsunami did little more than disturb the surface layers of sediment, but in other areas many pine trees were snapped or uprooted. Many of the conifers in the Igune groves were inundated and subsequently wilted. The pine woods along the coast were mostly destroyed, with the exception of some stands located on higher ground. The remaining stands are now isolated, and the coastal pine woods have lost their function as a continuous ecological corridor. Restoration work should focus on rebuilding a mosaic style landscape, and especially emphasize connectivity among the coastal pine woods and other remaining forest patches for conserving biodiversity.

Key words: Landscape, Earthquake, Tsunami, Remote Sensing

Effects of Vegetation Management to Exterminate Invasive Alien Species Rudbeckia Laciniata in the Semi-Natural Grassland on the Kirigamine Heights, Japan

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Abstract: The purpose of this study is to know the effect of vegetation management to exterminate invasive alien species Rudbeckia laciniata in the semi-natural grassland on the Kirigamine Heights. In Japan, the semi-natural grasslands are a very important native herbaceous plant habitat (Okubo et al., 2010). Formerly, the semi-naturel grasslands has been managed by mowing, grazing and burning to use as the plant resources. Nevertheless, after the 1950s, the semi-natural grassland was not managed to lose productive functions. As a result of the plant succession has been proceeded, rare native herbaceous plants were decreasing rapidly. The Kirigamine Heights are famous as the most typical semi-natural grassland in central Japan. Because this area belongs to form the upper of the temperate deciduous forest zone to the lower part of the subalpine coniferous forest, the natural vegetation is the forest. However, the semi-natural grassland has been established by human activities as described above and severe meteorological and topographic environmental conditions in this area. Because recently, also in this area the succession of semi-natural grassland has been proceeded, the reopening of some kind of management is necessary. On the other hand, the expansion of the distribution and dominance of many naturalized plant has become a serious problem in the semi-natural grassland on the Kirigamine Heights. And the invasive alien species Rudbeckia laciniata (Cutleaf coneflower) becomes the problem most in that. Rudbeckia laciniata is a perennial herb of the Compositae native of North America

and is a high plant of the ability to regenerate. Therefore, we assessed the effects of vegetation management to exterminate invasive alien species Rudbeckia laciniata in the semi-natural grassland communities on this area for 2 years from 2014 to 2016. We set experimental and control plots at Rudbeckia laciniata dominance communities. Experimental plots had been dug up only Rudbeckia laciniata except other plants in from June to August. And control plots had been unconducted. We carried out a vegetation survey by method of plant sociological survey (Braun-Blanquet, 1964) to clarify community of species composition and structure. Further, we measured relative photon flux density and moisture content of soil at all plots to know environmental conditions of community. As a result, almost the dominance of Rudbeckia laciniata was lower in the experimental plots than in the control plots. Furthermore, the dominance of the native plants of the hygrophyte such as Angelica pubescens or Persicaria sieboldi increased, too. However, the vegetation propagation and the germination of the Rudbeckia laciniata were confirmed. In addition, new other alien species such as Erigeron annuus or Erigeron strigosus appeared. It was thought that it was necessary to reduce disturbance of the soil at the time of the work to enhance an effect of the extermination.

Key words: Invasive Alien Species, Semi-Natural Grassland, Kirigamine, Rudbeckia Laciniata

Plant Functional Traits and Species Distribution at Snowfields and Periglacial Patterned Ground at Glacier National Park, Montana, USA

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Abstract: The retreating snowfields and glaciers of Glacier National Park present alpine plants with changes in habitat and hydrology since these plants live along their edges and rely on melted snow. Adjacent to the current snowfields and glaciers, there are extensive areas of periglacial ground patterned with stripes formed by the green, vegetation-covered risers and sparsely vegetated rocky brown treads of solifluction terraces. We established geo-referenced transects for long-term monitoring of plant functional traits and species at the Siyeh Pass, Piegan Pass and the Clements Mountain snowfields and patterned ground. Leaf measurements, field observations and taxonomy provided data for community weighted trait means (CWTM) of quantitative traits and for the relative percent cover (RPC) of qualitative traits.

The CWTM of specific leaf area (SLA, mm2/mg dry weight) decreased significantly with distance from some snowfields, suggesting xeromorphy. The mechanisms of

clonality differed significantly, as the RPC of adventitious-rooted species was lower and the RPC of rhizomatous species was higher near the snow. This suggests that rhizomes colonize land exposed at the edge of retreating snowfields and adventitious roots anchor plants farther from the snowfields.

On the patterned ground, species richness and distribution varied significantly between the brown treads and green risers. Twelve species, including the rare arctic-alpine Aquilegia jonesii, Draba macounii and Papaver pygmaeum grew only on the treads, but the rare arctic-alpine Erigeron lanatus grew on treads and risers. The RPC of species with taproots, caudices, or branched rootcrowns was significantly higher on the treads. The risers were co-dominated by the adventitiously rooted dwarf shrubs Salix arctica and the N-fixing Dryas octopetala, which likely influences nitrogen dynamics.

Long-term monitoring of snowfield-edge plant functional traits and species distribution can be used in conservation of rare arctic-alpine plants and to determine and predict the responses of plants to changes in habitat and hydrology wrought by vanishing glaciers and snowfields in response to climate change.

Key words: Plants, Snowfields, Periglacial, Traits

An Ecological Effectiveness of Different Forest Management Regimes in Bangladesh-A Solution for Biodiversity Conservation

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Abstract: Countless studies and numerous conceptual models have been developed on the landscape patterns of diversity in tropics. However, widespread loss of old growth tropical forest is being continued. Therefore, recently, ecological researches focusing increasingly on the consequences of management regimes on quality of ecosystems. Bangladesh, burdened with huge population, is consistently changing the management regimes to conserve its last remaining natural forest ecosystems. However, ecological analyses of different management regimes are rare. Therefore, the aim of this study was to assess the ecological effectiveness of different management regimes. Ground level ecological measures of forest health quality e.g. species richness, abundance, basal area, canopy cover, regeneration, disturbances were collected. We used GIS technology for sampling across different management regimes and R-statistical program for data analysis. Most of the ecological measures were found significantly satisfactory in co-managed (participatory) areas of forests. Moreover, co-managed areas attributed with lower number of anthropogenic disturbances. This assessed relationship will be helpful to design a proper conservation and management plan.

Key words: Forest Management, Co-Management, Biodiversity, Forest Health

Effects of Urban Land Cover Types and Characteristics on Avian Species Richness and Occupancy in a Subtropical Urbanized Landscape in Asia

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Abstract: Numerous studies have investigated how urbanization affects avian diversity; however, most of these studies have focused on variations in the degree of urbanization and woody vegetation cover. Other environmental features in an urbanized landscape, e.g., different urban land-use types such as commercial or residential areas, building heights, and noise levels, are less considered. In addition, relatively little attention has been given to small/medium-sized cities in subtropical/tropical regions of Asia, where open green space covered with non-woody vegetation, e.g., a small farming area, is a part of urban land cover. Here, we considered all of these features and examined relationships between avian species (richness and occupancy) and environmental variations within a subtropical urbanized landscape in southern China. We established 58 sample points across the city of Nanning, Guangxi. We performed bird surveys three times at each point during December 2015-January 2016. The number of people observed within a 50m-radius area and noise level were also recorded as measures of human disturbance. During March-April 2016, we surveyed local scale environmental features including heights and urban land-use types (commercial or residential) of buildings within a 200m-radius area. Woody vegetation, non-woody vegetation (mostly vegetable crops at small farming areas and herbaceous vegetation at open areas), and open water were also delineated at the local scale and the landscape sale (a 500m-radius area around the sample point). We used a Bayesian multi-species occupancy model with five principal components (PC1~5), which summarized variations in human disturbance and the amount of different local and landscape scale features, as environmental covariates. As built-up structure (PC1) increased, species richness decreased and occupancy of all 26 species tended to decline. On the other hand, increasing non-woody vegetation cover (PC2) or woody vegetation cover (PC3) with deceasing building height and human disturbance influenced species richness positively. Occupancy by 11 species that showed weak or strong responses to PC2 was high in the areas where non woody-vegetation and 1-2 story buildings were dominant land cover types. Of 13 species associated with PC3, only 2 species showed negative responses. Urban land-use type (PC4) and amount of open water (PC5) did not significantly influence on avian species richness and occupancy. While our results

support the finding of previous studies, i.e., the importance of woody vegetation cover for biodiversity conservation in urbanized landscapes, our study further suggests that building height, which is related to human disturbance, can be one of the urban environmental features affecting avian species. Our results also indicate that open green space such as small patches of crops often observed in small/medium-sized cities in Asia, can play a positive role in the conservation of avian diversity.

Key words: Greenery Cover, Hierarchical Modeling Framework, Imperfect Detection, Urban Land-Use Type

Effect of Slope Gradient and Vegetation Cover on Sediment Yielding Characteristics of the Riparian Slope

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Abstract: Slope gradient and vegetation cover are important factors affecting slope soil erosion process, thus exploring the response of sediment yielding characteristics to slope gradient and vegetation cover is of great significance to prediction of sediment yielding in soil erosion process. In this study, based on the field runoff scouring experiments on riparian slope of the lower reaches of the Yellow River, changing process of runoff coefficient, sediment yielding, runoff sediment concentration, and sediment particle size composition under different slope gradients (5 °, 10 °, 15 °, 20 °) and vegetation covers (0%, 15%, 30%) were analyzed, and the response of sediment yielding characteristics to interaction effect of slope gradients and vegetation covers on riparian slope were revealed by using the double factor variance analysis and the relative contribution index. The results showed that, runoff coefficient under different vegetation covers increased with duration of scouring time, therein, it increased quickly during the first 5 min, and then became slowing and leveling off in the later scouring time. With regard to the runoff sediment concentration, it showed decreasing trend with duration of scouring time, and then became slowing and leveling off in the later scouring time. On the slope of less than 15 °, the differences of runoff coefficient and runoff sediment concentration between different vegetation covers were obvious, while they gradually became unobvious on the slope of more than 15 °. The sediment yielding increased with duration of scouring time and slope gradient, and on the same slope gradient, the lower vegetation cover was closely related to the greater sediment yielding. The main enriched particle size of the eroded sediment showed a trend of first increasing and then decreasing with the increasing slope gradient, and accounting for 10%, 50%, and 90% of the total volume of sediment particles mainly were made up of silt, coarse powder grains and very fine sand, and very fine sand and fine sand,

respectively. Result of the double factor variance analysis showed that the slope gradient exhibited the extremely significant effect on the runoff coefficient, sediment yielding, and runoff sediment concentration on the riparian slope ($P<0.001$), and then the vegetation coverage exhibited the extremely significant effect on the slope erosion sediment yield and flow runoff coefficient within the prescribed time ($P<0.001$). However, the interaction between slope gradient and vegetation cover showed the significant effect only on the runoff coefficient within the prescribed time ($P<0.01$). Meanwhile, the relative contribution index showed that, in the interaction of slope gradient and vegetation cover, the effect of vegetation cover weakened gradually with increasing slope gradient, while the role of slope gradient in their interaction enhanced gradually and became the dominant factor influencing soil and water loss.

Key words: Riparian Slope, Slope Gradient, Vegetation Cover, Soil Erosion and Sediment Yielding

Plant Diversity of Indian Hot Desert Landscape: Ecosystem Abridging Livelihood Support and Sustainability

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Abstract: Deserts (also known as dry/arid lands) is constituting one-fifth of the Earth's total surface area (approximately 33.7 × 106 km^2) and the Indian Thar desert being the seventh largest in the world is the main hot sand desert occupies nearly 385,000km^2 and about 9% of the area of the country and the most populous in the world (human density of around 84 persons per km^2). More than 80% of the people live in villages or scattered settlements called dhanis but urbanisation is increasing. It harbours several species likely the flora of 682 species (63 introduced species) belonging to 352 genera and 87 families. The degree of endemism of plant species in the Thar desert is 6.4 percent, which is relatively higher than the degree of endemism in the Sahara desert which is very significant for the conservationist to envisage. It is characterised by varied geomorphic forms and landscapes such as dunes, magras, dhands and bhakars, each with a distinct ecology of its own. Three types of major terrestrial habitats likely sandy, hills & rocky outcrops and ruderal are recognised in relation to flora and fauna. Very specifically the available plant genetic resources (PGR) assumes great significance in view of its adaptability and support to livelihood security of the aboriginals, local dwellers and farming communities. The agro-biodiversity of the region is dominated by pearl millet (Pennisetum glaucum), moth bean (Vigna aconitifolia), horse gram (Macrotyloma uniflorum), cowpea (Vigna unguiculata) and cluster bean (Cyamopsis tetragonoloba). The endemic grasses (Lasiurus sindicus, Cenchrus ciliaris, Cenchrus

setigerus, Panicum antidotale, P. turgidum, Dichanthium annulatum), tree species (Tecomella undulata, Prosopis cineraria, Acacia nilotica, Acacia senegal, Salvadora oleoides, Salvadora persica,) shrubs (Commiphora wightii, Capparis decidua, cordia myxa, Ziziphus nummularia, Z. mauritiana, Calligonum polygonoides, Haloxylon salicornicum, Calotropis procera) and large number of medicinal and underutilized plant species dominating the hot arid region also play significant role in livelihood support to the farming communities particularly the tribals, and small, marginal and landless farmers. It has been revealed that 20–25% of their income is derived from the underutilized, medicinal and multipurpose plants species. Thus, considering the arid ecological complexity, types and forms of the PGR available within institutional repository (nearly 1821 types) and in nature, their sustainable utilization under natural ecosystems for livelihood support, the policy needs to be addressed at the local, regional and national level relating its importance in climate change mitigation, carbon accumulation, conservation and providing the ecosystem services. Therefore, this paper entails the wider dimension of biological diversity, its utilization ensuring sustainability in addressing the cutting edge research areas like biodiversity informatics, cybertaxonomy etc. relating to plant diversity monitoring cum conservation in general and specifically on agro-biodiversity mainstreaming with an emphasis on participatory mapping, monitoring and in situ conservation of PGR rich areas with incentives to the rural communities, awareness and capacity building through institutional support, and organised production and utilization with benefit sharing to the local communities.

Key words: Plant Diversity, Biodiversity Informatics, Livelihood, Sustainability,

Dead Wood as a Keystone Structure for Conservation of Forest Biodiversity

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Abstract: The habitat-amount hypothesis challenges traditional concepts that explain species richness within habitats, such as the habitat-patch hypothesis, where species number is a function of patch size and patch isolation. It posits that effects of patch size and patch isolation are driven by effects of sample area, and thus that the number of species at a site is basically a function of the total habitat amount surrounding this site. We tested the habitat-amount hypothesis for saproxylic beetles and their habitat of dead wood by using an experiment comprising 190 plots with manipulated patch sizes situated in a forested region with a high variation in habitat amount (i.e., density of dead trees in the surrounding landscape). Patch size was manipulated by adding various amounts of downed dead wood to the plots (~800 m^3 in total); dead trees in the

surrounding landscape (~240 km²) were identified using airborne laser scanning (LiDAR). Additionally, we manipulated local habitat heterogeneity by adding different combinations of logs and branches of different tree species creating independent gradients of local dead-wood amount and dead-wood diversity.

Over three years, 477 saproxylic beetle species (101,416 individuals) were recorded. Both patch size and habitat amount in the local landscapes independently affected species numbers without a significant interaction effect, hence refuting the island effect. Moreover, we found that local habitat heterogeneity positively affected species richness consistent with the habitat-heterogeneity hypothesis.

Our study highlights the importance of dead wood as a keystone structure for biodiversity in forest ecosystems. Based on our results we recommend that to protect saproxylic beetle biodiversity in forested regions, conservation should primarily focus on maintaining high amounts of dead wood without considering the spatial distribution. Moreover, dead wood diversity should be high, i.e., it should comprise the full range of wood diameter classes and tree species, to promote a broad range of saproxylic assemblages.

Key words: dead wood, island effect, forest biodiversity, habitat heterogeneity,

Landscape Change and Multi-Scale Landscape Connectivity Alteration Associated with Dam Construction

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Abstract: Dam construction could be a major threat to terrestrial ecological processes. The ecological connectivity, as an effective indicator of species movements at large scales, varies greatly before and after dam construction and exhibits spatial variations upstream and downstream due to landscape change. In this case study in Manwan dam, the equivalent connected area (ECA) index was applied to analyze the spatial and temporal changes in the overall forest landscape connectivity for the dispersal abilities of different species due to dam construction. Our results showed that forest connectivity decreased overall after dam construction. The forest connectivity upstream was much greater than that downstream before dam construction but was lower than that downstream before dam construction. The importance of connectivity increased with increasing species dispersal distances and about 10% of forest patches of small area exhibited changes. Most of the large habitat patches remained stable for landscape connectivity. The Betweenness Centrality indicated that some habitat patches near Manwan Dam acted as stepping stones in maintaining the forest connectivity of the networks.

Key words: forest landscape connectivity, patch prioritization, patch prioritization, Manwan dam,

Fire Affects a Globally Endangered Bird in Differrent Ways across Its Range

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Abstract: Fire is a disturbance process which shapes ecosystems globally. Many species evolved in the context of specific fire-regimes. Modern changes to these regimes are driving biodiversity declines. Conservation managers face the challenge of using fire to promote biodiversity. To do this we must understand how fire affects species and their habitat.

I investigated how fire affects the globally endangered mallee emu-wren Stipiturus mallee. The mallee emu-wren is a fire sensitive habitat specialist restricted to three National Parks in semi-arid south eastern Australia. It is dependent on large clumps of the hummock grass Triodia scariosa which is a fire successional species. Triodia is reported to peak in cover 30 years after fire in this ecosystem.

I surveyed emu-wrens and vegetation at 234 sites across the species range. Sites varied in fire-age from 30 to 100 years since fire. I found that in the west of its range, the mallee emu-wren declines after 30 years since fire, whereas in the east it increases from 30 to 100 years since fire. This differential response to fire-age occurs because fire affects mallee emu-wren's habitat (Triodia) differently depending on geographic location.

I found that the fire-age preference of the mallee emu-wren depends on location. Therefore, fire management for conservation should be tailored to location.

Key words: Patch Dynamics, Fire, Succession, Bird Conservation

Biodiversity, Exotic Invasion, and Landscape Settings

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Abstract: Biodiversity plays a key role in ecosystem integrity, including the resistance to the invasion of exotic species. However, the effectiveness of biotic resistance to invasion varies across different regions, likely due to the variability of landscape settings at different scales. It is unclear how scale dependence and cross-scale interactions contributing to the emergence of macroscale invasion patterns, as complex

nonlinear interactions are difficult to comprehend. Here, using data from about 120,000 field plots across the continental United States, we studied the emergence of macroscale invasion patterns and their relationships to biodiversity and landscape settings. We found (1) large regional difference exists in invasion patterns, where eastern U.S. had higher mean invasion richness and prevalence than western U.S.; (2) native tree biomass and evolutionary diversity, but not species richness, to be negatively associated with invader establishment and dominance; and (3) landscape settings (roads, fragmentation) have a non-linear effect on biotic resistance. Our results suggest that both propagule pressure, which greatly influence by landscape settings and habitat invisibility, which determined by biodiversity contribute to macroscale patterns of plant invasions in a non-linear fashion.
Key words: Biotic resistance, Biodiversity, Fragmentation

A Study on the Characteristics of Breeding Ecology of Oriental Scops Owl (Otus sunia) in South Korea

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Abstract: This study was carried out in order to reveal the characteristics of breeding ecology of Oriental Scops Owl (Otus sunia stictonotus) inhabiting in South Korea according to the nest types from March 2011 to October 2012. Oriental Scops Owls nested in woodpecker's nest hole (46.1%), natural tree hole (38.5%), and artificial wood box (15.4%) that these nests are located in trees, Zelkova serrata, Paulownia coreana, Celtis sinensis, Salix chaenomeloides, Salix babylonica, Fraxinus rhynchophylla, Robinia pseudoacacia and Platanus occidentalis. The hatching success was 91.4%, fledging success was 83.0%, and breeding success was 75.9%. The breeding failure factors were unhatched (7.1%), abandon (28.6%), falling (57.1%), and others with unknown cause of death (7.1%). According to nest types, the fledging success (69.2%) of woodpecker's nest hole was low and the hatching success (79.2%) of natural tree holes was also low due to unhatching and abandoning. However, hatching success, fledging success, breeding success was high in the artificial nests as all the eggs hatched and succeeded in fledging. Therefore, it is determined that artificial nests can cover the weaknesses of natural nests as well as increasing the breeding success. But, long-term research on installation place, height, and holes size of the artificial nest is required in order to clearly reveal the effect it has on the breeding success of Oriental Scops Owls.
Key words: Hatching Success, Fledging Success, Breeding Failure Factors, Artificial Wood Box

Pedodiversity and Its Controlling Factors in Mountainous Area: A Case Study of Taihang Mountain, China

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Abstract: Abstract: The knowledge of pedodiversity is crucial for the management and protection of soil resources. However, the controlling factors of pedodiversity are little known, especially in mountainous area with a highly heterogeneous environment. The purposes of this paper were to study the pedodiversity (soil taxa diversity) and to analyze its influencing factors in Taihang Mountain area, China. The richness (S), Menhinick's index (M), Shannon index (H), the maximum Shannon index (Hmax) and evenness index (E) were calculated to describe the pedodiversity. The influence of natural factors (including elevation, slope gradient, precipitation, and temperature) and human factors (including population density and percentage of farmland) was analyzed with correlation analysis and canonical correspondence analysis (CCA) method. The results showed that among the 101 counties in Taihang Mountain, the average H and E were 1.69 and 0.58, respectively. The object abundance model was logarithmic normal distribution, indicating intermediate abundance soil types were most common. The richness-area relationship was best fitted by a logarithmic function. The richness increases significantly when the area was smaller than 1000 km^2, but increases slowly when the area became larger. This suggested that the effect of area on pedodiversity could be ignored when the area larger than 1000 km^2.The CCA showed that the influencing factors had a decreasing order of elevation > percentage of farmland > slope gradient > population density > precipitation, indicating that elevation and tillage maybe the controlling factors of pedodiversity. Such results provide further insight of pedodiversity in mountainous area and would also be helpful in the protection of soil resource and pedodiversity.

Key words: Soil diversity, environmental factors, human factors, Shannon index,

A GIS-based Mapping and Estimation the Current Forest Landscape State and Dynamics

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Abstract: Development of methods of assessment of the current forest cover state and successional dynamics is an ecological research priority. Accomplishing this task using ecological theory and knowledge of vegetation community interactions with forest

growth conditions will permit to assess and predict effects of external factors on ecosystems. This task can be approached based on a forest vegetation classification, taking in account forest growth conditions and the associated vegetation types. The study covered central Siberian taiga forest ecosystems. Vegetation communities were classified as regeneration series based not on changing external characteristics (i.e.species composition), but on similarity of forest growth conditions, genesis, and succession trends.

GIS technologies were applied to create an ecological database and multilevel maps of potential forest growth conditions and forest regeneration dynamics. An algorithm of building computer maps based on Landsat-5 TM and Landsat-8 OLI image analysis, a digital relief model (Shuttle Radar Topography Mission (SRTM)), and ground observation data was developed and tested in the field. The forest dynamics maps show the distribution of forest regeneration series and stages, and, as a part of the GIS database, allow estimating current forest landscape state and their dynamics in different ecological conditions. Regeneration stages and series reflect ecosystem diversity resulting from both natural and human influences.

The approach described allows to inventory and monitor forest ecosystem diversity and predict biodiversity recovery rates during forest succession in a range of forest growth conditions. Estimating biodiversity changes at different forest succession stages provides insights into the mechanisms controlling development of sustainable forest landscapes. Our results are useful for developing sustainable forest management principles, monitoring forest cover and improving methods of forest inventory and mapping.

Key words: Forest Vegetation Mapping, Digital Elevation Model (DEM), GIS-Technologies, Remote Sensing Data (RSD)

Changes in Habitat Suitability for Cervidae in the Lesser Xing'an Mountains, Northeastern China

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Abstract: Species abundance and habitat distribution are two important aspects of species conservation studies and both are affected by similar environmental factors. Forest resource inventory data were used to evaluate patterns of habitat for species of Cervidae in six typical forestry bureaus of the Yichun forest areas in the Lesser Xing'an Mountains of northeastern China. A habitat suitability index (HSI) model was used based on elevation, slope, aspect, vegetation and age of tree. These five environmental factors were selected by boosted regression tree (BRT) analysis from 14 environmental

variables collected in the field. Changes in habitat caused by anthropogenic activities involving settlement and road factors were also considered. The results identified 1780.49 km^2 and 1770.70 km^2 of the most–suitable and unsuitable habitat areas under natural conditions, covering 16.38% and 16.29% of the entire study area, respectively. Anthropogenic disturbance turned some potential habitats in unsuitable ones. The area of most–suitable habitat was reduced by 4.86% because of human interference, whereas the unsuitable habitat area increased by 11.3%. Landscape metrics calculated using FRAGSTATS 4.1 indicated that average patch area declined while patch density and edge density increased. This suggests that as habitat becomes fragmented and its quality becomes degraded by human activities, cervid populations will be threatened with extirpation in the near future.

Key words: Cervidae, Boosted Regression Tree, Habitat Suitability Assessment, Landscape Pattern

Thermal Landscape Pattern Change in Response to Land Use Changes of Beijing within the Six-Ringed Road in Recent Twenty Years

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Abstract: Urbanization and urban expansion are the dominant factors in regional landscape evolution, and can significantly affect local climate. Urbanization alters the ground surface land and it's thermal properties, alters the surrounding atmospheric circulation characteristics, it increases heat sources in the blooming urban areas. The increased heat can lead to a deterioration of air quality and negative health effects. Urban heat island formed in urban development process was considered an urban thermal environment problem, therefore, it is significant to understand the distribution of landscape pattern of thermal environment in urban planning, and studies on relationship between urban land-cover transformation and land surface temperature (LST) may help us in comprehension of thermal environment change dynamics and future city land-use landscape planning. Remote sensing represents a major source of urban information by providing spatially consistent coverage of large areas with a series of historical data, it is now possible to monitor and analyze urban thermal environment and land use change. Fortunately, we can obtain the historical land use information from Landsat data, and it is one of the most widely used satellite images for LST retrieving and free download availability from the website of United States Geological Survey (USGS). It provides a possibility for us to study thermal landscape pattern change in response to land use changes. Beijing is a

dynamic urban. The city has the high urbanization ratio among provinces and municipalities in China，and it's development mainly along the traffic trunk. In recent years, Beijing urban area within the six-ringed road was developing rapidly, the urban landscape structure took on the obvious alteration especially during the preparations for the Olympic Games in 2008. As consequences, impact of urbanization on the city's environmental condition was presented and needs be identified, particularly on urban thermal environment. In this paper, Beijing urban area within the six-ringed road was taken as an object of study. By integrating historical summer Landsat images, this study explored the thermal landscape pattern change in response to land use changes from 1994 to 2014. In this study, accurate land use change information was extracted firstly. Next, inversed surface temperature from Landsat image was classified to different levels, the changes of thermal landscape pattern was analyzed using a series of spatial metrics quantitatively which were derived from FRAGSTATS software. Finally, this essay explored the dynamic mechanism of thermal environment change through analyzing relationship between land use and temperature. The results of the study illustrated that different land use types have different effects on thermal environment, and the thermal landscape pattern change is not only related to the location of land use type, but also with the shape, size and so on.

Key words: thermal landscape pattern, landscape index, land use, Beijing within the six-ringed road,

Regional Development Optimization Strategy for Ecological Sustainability – a Case Study in the Southwest China

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Abstract: This paper provides a large-scale regional division approach which presents a development optimization strategy for ecological sustainability. The case study region, known as key ecological security area of southwestern China, has the extremely high development potential due to the "western development" policy. How to coordinate environmental protection and regional development is paid more and more attention. Based on the superposition of 15 indicators of environment and development potentials, the environmental values and development benefits were quantified and a partition map for four different deveopment strategy zones was presented in this region, including conserve zones (34.90%), construction zones (35.84%), conflict zones (14.05%) and low-tension zones (15.21%). Further, conflict zones were divided in 5 levels including extreme conflict (36.20%), serious conflict (28.07%), moderate

conflict (12.28%), minor conflict (6.55%) and slight conflict (16.91%). Covariance analysis between the partitioned results and the GDP data proved that theoretical analysis of the regional division was basically reasonable and suggested the reference significance of actual social economic development.

Key words: environmental value, development benefit, superposition, partition map,

Spatial-Temporal Dynamics of Upland Meadow Coverage and Its Response to Climatic Change

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Abstract: The upland meadow in Wugong Mountain as study area, and based on the 1995,2002,2010 and 2015 TM remote sensing image, this study used ENVI 5.1 and ArcGis10.0 software to calculate the vegetation coverage distribution pattern and dynamic change of upland meadow in Wugong Mountain, abstracting the normalized difference vegetation index (NDVI), using dimidiate pixel model.The results showed that :⑴The area showed a decrease progressively trend which decreased by 9.72% during the study period.This was due to climate changing and transition zone of trees and meadow moving up, it maked upland meadow area shrinking.During the past 20 years,with establishment of wugong mountain scenic area - development of tourism - ecological restoration of mountain meadow,the vegetation coverage increased firstly and then decreased, then increased ,overall a downward trend .That reflected the change of vegetation coverage on the time series curve;⑵ Vegetation coverage presented the distribution characteristics that it was high in southeast and low in northwest on space.Low coverage meadow area concentrated in precipice of northwest slope and part of the ridge line, while high coverage meadow area concentrating in the southeast slope. ⑶The degradation and improvement of mountain meadow coexisted in the study area. It presenged degradation characteristics overall where the northernmost end of mountain meadow, the low altitude area of southeast and south slope of Bai Hefeng - Jiu Long area; The vegetation showed improvement characteristics overall on the southern slope of Fa Yunjie. The degraded area of upland meadow was more 1.78% than improved area ；⑷ Analyzing the partial correlation of interannual variation between climate factor and vegetation coverage, it is found that the correlation between vegetation coverage and temperature was -0.444, and precipitation was 0.856. Vegetation coverage was negatively related to temperature, and positively correlated with precipitation. Its partial correlation with annual

precipitation was higher than its partial correlation with annual average temperature, that explained that vegetation growth of Wugong Mountain was more affected by annual precipitation than annual average temperature.The research proved that using that method for inverting large area distribution and variation of mountain meadow coverage was feasible and accurate.

Key words: Upland Meadow, Vegetation Coverage, Spatiotemporal Variation, Climatic Change

Assessment on the Gross Primary Productivity of National Forest Nature Reserves in China

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Abstract: Forest is the largest carbon pool for the terrestrial ecosystem. Gross Primary Productivity (GPP) determines the initial matter and energy flow in the terrestrial ecosystem, which is an important link between the terrestrial and the atmospheric carbon pool. Quantifying the GPP of vegetation is of primary interest for studies of carbon cycle and global climate change. Based on GPP data from vegetation photosynthesis model (VPM) from 2000 to 2014, we evaluated the annual mean GPP of 114 national forest ecological nature reserves in China. During the 15 years, the annual mean GPP not only increased in the entire protected area, but also increased in the functional areas (core area, buffer area and experimental area). The maximum of annual mean GPP appeared in 2013 (entire protected area: 765.99 gC m-2; core area: 789.64 gC m-2; buffer area: 937.99 gC m-2; experimental area: 680.69 gC m-2), while the minimum in 2001 (entire protected area: 566.35 gC m-2; core area: 602.13 gC m-2; buffer area: 706.05 gC m-2; experimental area: 484.58 gC m-2). In general, the annual mean GPP fluctuated slightly in 2000-2014, and there were troughs in 2001 and 2005 (except the experimental area) and a peak in 2013. During the 15 years, the ranking of the annual mean GPP among the four areas was always: buffer area> core area> entire protected area > experimental area. In terms of the trend of annual mean GPP for each individual area, 112 protected areas increased and 2 protected areas decreased during the 15 years. The slopes of entire protected area, core area, buffer area and experimental area were mostly between 10 and 30 gC m^{-2} $year^{-1}$. At last, the slopes of annual mean GPP (in entire protected area, core area, buffer area and experimental area) were inversely proportional to the areas of the protected areas. Overall, our results can provide useful information to manage forest nature reserves in the future.

Key words: GPP, National Forest Nature Reserves, Annual Variation, Functional Areas

An Assessment of Mammalian Diversity in Agroforestry Systems of Assam and Implications for Management

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Abstract: In Assam, Northeast India the practice of agroforestry systems is pre-dominant. Almost all the households have a homegarden for cultivation of vegetables and fruits and agrisivilculture system for paddy cultivation. From British period, the forest ranges of Assam have been converted in tea plantations. Line transects of 1 km in length were employed during mornings and night in all the three types of agroforestry systems for two seasons namely post-monsoon and winter for evaluating their mammalian diversity. Among the 18 mammal species encountered, Elephas maximus is endangered, Macaca assamensis is near threatened and Trachypithecus pileatus is Vulnerable, 12 species are least concern and the rest are Not assessed according to the IUCN Red data list. Among the three agroforestry systems the highest mammal diversity was found in homegardens (16), followed by agrisilvicultural systems (13) and tea gardens (10). The highest diversity in homegardens might be because of its structural and floristic complexity which supported diverse numbers of species with different food and shelter requirements. Moreover, the homegarden owners were more tolerant and most often used firecrackers, scarecrows or throw stones to deter the mammals as compared to the tea gardens where the tea tribes were fond of hunting and might be one of the reason for low diversity. The homegardens were also easy sources of pigeons, goats, hens and ducks which attracted small carnivores as compared to the other two systems. The tea crops which is a dominant crop and the shade trees which are sparsely spaced do not offer much food diversity to meet the diverse food requirements of the mammals. Similarly, the agrisilvicultural system with less tree diversity and use of pesticides and insecticides might be reducing the food diversity and amount of prey species to predate upon respectively. In the homegardens, Elymnias hypermnestra had the highest encounter rate (2.402) which suggested that it had ample of food resources available in homegardens. Individuals of Elymnias hypermnestra had been observed feeding on several fruit trees like Areca catechu, Zizyphus sp., Cocos nucifera, flowers of Bombax ceiba, Erythrina indica etc. which were abundantly available in homegardens. In agrisilvicultural system, Elymnias hypermnestra had the highest encounter rate (0.304). This might have been because of the bamboo grasses, Areca catechu, and other trees planted on the bunds or interspersed between the agricultural crops which might have been providing Elymnias hypermnestra shelter and food. Similarly in tea gardens, Macaca mulatta had the highest encounter rate (0.734). As the tea tribes were not fond of the meat of Macaca mulatta this species might have been hunted the least and this

might explain its higher encounter rate. The tea tribes can be given some training and subsidies for animal husbandary, poultry rearing and fisheries production so that hunting in tea plantations can be curbed. Agroforestry systems like homegardens can be promoted as role models to conserve mammal diversity in human-dominated landscapes in future policies.

Key words: Homegarden, Agrisilvicultural Systems, Tea Gardens, Mammalian Diversity

Effects of Human Settlements on Waterbird Abundance at a Ramsar Site in the Yangtze River Floodplain

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Abstract: Wetland ecosystems are currently heavily threatened, resulting in declining populations of many waterbird species. We used 6 years survey data from Shengjin Lake National Nature Reserve in the Yangtze River Floodplain, China to study the effects of habitat (wetland and water area and Normalized Difference Vegetation Index [NDVI]) and proxies of human activities (boats, grazing domestic geese and buffalos, and distance to human settlements) as determinants of waterbird species abundance. Effects were guild-dependent: distance to nearest human settlement had the greatest and universally adverse effects on the abundance of all guilds. Wetland and water surface area, and number of domestic geese had no effect on abundance in any of the guilds. NDVI negatively affected numbers of dabbling ducks, larger and smaller wading birds, was positively correlated with the abundance of diving birds and had no effect on the abundance of the other guilds. Numbers of buffalos were positively correlated with the abundance of larger and smaller wading birds abundance, but had no effect on the abundance of other guilds. These results suggest that although the abundance of waterbird species can be affected by vegetation and animal husbandry, Yangtze River wetlands would most likely benefit most from reduced pressure from the proximity to the surrounding human population.

Key words: Protect Area, Biodiversity, Human Effect, Conservation

Biodiversity Assessment in Abandoned Settlements with Indicator Plant Species

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Abstract: In the traditional rural landscapes of Japan, people engaged in agricultural activities have unintentionally created habitat such as semi-natural grassland, paddy wetland and coppice forest, which harbors diverse organisms adapted to anthropogenic disturbances. However, these habitats are at risk due to abandonment of rural landscapes with population decline. On the other hand, there may be an increase opportunity to provide habitats for species preferring to undisturbed landscapes due to disappearing agricultural activities. In order to evaluate the changes in species composition in abandoned settlements, we compared occurrences of indicator plant species in abandoned settlements and those in inhabited settlements in Japan based on field surveys. We focused on three types of species typical in mown grasslands, paddy wetlands, and forests that could be affected by abandonment of rural landscapes. The species inhabiting mown grasslands and paddy wetlands that had adapted to agricultural activities will be possibility decrease in association with abandonment of rural landscapes. Conversely, the species inhabiting forests that prefer undisturbed landscapes have a potential to expand their habitat in the abandoned rural landscapes.

To identify the abandoned rural settlements of sufficient size to establish belt transect, we used dozens of documents (historical topographic maps, comprehensive lists of schools, a geographical dictionary, aerial photographs, etc.) to select 21 abandoned settlements and their neighboring inhabited settlements which are practicing agricultural activities. In these settlements, we established a 1 km × 100 m belt that included typical elements of the rural landscapes (coppice forests, grasslands, paddy fields, residential areas, etc.) and examined the existence/absence of the indicator plant species in each 100 m segment. The indicator plant species were selected on short perennials characteristically observed in each vegetation type based on phytosociological characteristics and having large distribution ranges; e.g. Platycodon grandifloras or Patrinia scabiosifolia (character species of Miscanthetea sinensis) were selected as the grassland indicators, Sagittaria trifolia or Monochoria vaginalis (character species of Oryzetea sativae) were selected as the paddy indicators, and Ardisia japonica or Tripterospermum japonicum (character species of Camellietea japonicae and Fagetea crenatae) were selected as the forest indicators.

The occurrence frequencies of the paddy indicators and the grassland indicators in the abandoned settlements were lower than those in the counterpart inhabited settlements which are located neighboring each abandoned settlement. The paddy indicators, especially, rarely occurred in the abandoned settlements despite occurring frequently in

the counterpart inhabited settlements. Conversely, the occurrence frequencies of the forest indicators in the abandoned settlements were slightly higher than those in the inhabited villages. Our results suggest that the habitats of specific species adapted to anthropogenic disturbances are disappearing in line with abandonment of settlements, and the habitats of species that prefer undisturbed landscapes are increasing in the future.

Key words: Population Decline, Land Abandonment, Land Transitions, Traditional Rural Landscapes

Precipitation Regulate the Family Age-Temperature Relationship with Chinese Evergreen Broadleaved Woody Plant Species

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Abstract: Species richness pattern is thought to result from a combination of current ecological conditions and deeper-time evolutionary history. However, the character of the evolutionary process, and to which extent it underlies the species richness-current environment correlation, are debated. The Tropical Niche Conservatism (TNC) and Out of the Tropics (OTT) hypothesis proposes mechanisms linking environmental tolerances, diversification, dispersal, and evolutionary history underlying patterns of biodiversity in biological communities along environmental gradients, while predict contrasting trends in clade age and phylogenetic relatedness along thermal and water gradients. Focusing on evergreen broadleaved woody plant species (EBWPs) in China, this study tested the predictions of the TNC and OTT hypothesis. We related the species richness, phylogenetic structure and age-related indices of EBWPs in equal-area grid cells across China with minimum temperature and mean annual precipitation. Our study showed that the family age of EBWPs in grid cells was positively correlated with temperature and precipitation, which is consistent with the age-related prediction of the TNC hypothesis. Moreover, results indicated that precipitation in arid area had much more stronger effect on the evolution of EBWPs and significantly altered the relationship between family age indices and minimum temperature, showing strong evidence for water-stress conservatism being a strong factor in determining the species richness and composition of EBWPs at continental extents. Specifically, our results provides the first general evidence that the relationship between the phylogenetic indices and temperature is weak in arid regions of China, thus providing some support for evolutionary theories about how climate gradients shape biology.

Key words: family age, Tropical Niche Conservatism hypothesis, Out of the Tropics (OTT) hypothesis,

Identity and Specificity of the Mycorrhizal Fungi Associated with Platanthera Chlorantha Cust. Ex Rchb.

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Abstract: Platanthera chlorantha Cust. ex Rchb is a kind of orchid with great ornamental value and medicinal value. Mycorrhizal fungi and orchids are extremely closely related. The development of all the plants of orchid directly depends on the presence of fungal partners. We analysed root samples of P. chlorantha collected in three different sites (Zhuanghe, Lingyuan and Fengcheng) of Liaoning province. The results showed that species composition of the three P. chlorantha plants had high similarities, as 82.31% of taxa were shared.

The P. chlorantha collected in Zhuanghe had 2 dominant mycorrhizal fungi，8 common mycorrhizal fungi. The 2 dominant mycorrhizal fungi were Agaricales (34.68%) and Trichoderma (15.86%). And among the 8 common mycorrhizal fungi, 7 of them were Ascomycetes fungi. The P. chlorantha collected in Lingyuan had 2 dominant fungi too, which belonging to Agaricomycetes (34.95%) and Rhizoctonia (14.29%) respectively. There were 7 common mycorrhizal fungi found in this plant, and all of them were belonging to Ascomycota. There were also 2 dominate mycorrhizal fungi found in the P. chlorantha collected in Fengcheng, Metacordyceps (33.00%) and Cladophialophora (10.66%). The number of the common mycorrhizal fungi found in this plant was 14, and almost all of them were belonging to Ascomycota.

As shown above，the plants in different sites had different dominate fungi. The P. chlorantha plants collected in Zhuanghe and Lingyuan shared one of their dominate fungi, Agaricales. However, the abundance of this fungus was exceptionally low in the plant collected in Fengcheng, just accounted for 0.18%. Meanwhile, the dominate mycorrhizal fungi found in the plant collected in Fengcheng were also exceptionally low in the other plants collected in other places.

In summary, although the three P. chlorantha plants were collected in different sites, they had a high similarity in the composition of Mycorrhizal fungi species，which reflected the specificity of orchidaceae on its mycorrhizal fungi. However, they were different in dominate fungi. The P. chlorantha collected in Zhuanghe was in vegetative phase, the P. chlorantha collected in Lingyuan was in early florescence, and the P. chlorantha collected in Fengcheng was in blossom period. In addition, the habitats of the P. chlorantha plants collected in Zhuanghe and Lingyuan were highly similar in climatic conditions. It seems that the differences in dominant mycorrhizal fungi found in the P. chlorantha plants collected in different sites may be due to their different growth stages and habitats.

Key words: mycorrhizal fungi, orchid,

Linking Terrestrial Biodiversity and Historical Land-Use Transitions

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Abstract: One of the biggest threats to biodiversity is land-use change. Despite the widespread recognition of importance of biodiversity conservation for ecosystem services and human well-being, the majority of terrestrial areas have been transformed to cropland, pasture, and urban. The response of individual, population, and community to land-use change have been studied for various taxonomic groups including mammals, birds, amphibians, and plants. Currently, a huge amount of extensive and high-resolution land-use datasets is available, which makes it possible to evaluate how land-use change affects global biodiversity at the fine spatial scale. The magnitude of land-use change is typically evaluated based on the area and intensity of land-use, and thus it remains considerable uncertainties regarding to other aspects of land-use change such as historical land-use transition and rate of change, in particular at large scales.
Here we developed a new index of land-use change that quantified the historical transition and rate of change from 1500-2010 (~every 10 years) based on a global land-use map. By comparing the index in and out of biodiversity hotspot, we examined the relationship between past land-use change and terrestrial biodiversity. Furthermore, we detected unrecognized biodiversity hotspots, and forecasted areas where biodiversity is likely threatened by future land-use change based on an existing climate change scenario.
Key words: Biodiversity, Biodiversity Hotspot, Land-Use Change

Habitat Selection of European Nightjar Caprimulgus Europaeus in the Managed Temperate Coniferous Woodlands

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Abstract: Intensive forest management generally negatively effects biodiversity. However, creating new open habitats during timber harvesting inside large woodlands may facilitate rare bird species. Especially, clearcuts are often used as a breeding habitat by nightjar. To investigate the influence of habitat parameters on occupation of territories by nightjar, clearcuts of different size were selected in Knyszyńska Forest. This large coniferous woodland area is situated in temperate zone in north-eastern Poland. The study was conducted in the breeding period 2014. From May to June three

controls during nights and stimulation by male mating voice in selected points were done. Nightjars occupied 30% all available clearcuts. Results showed that this species preferred plots with small and medium undergrowth vegetation. Occupation of breeding territories was significantly influenced by the age of the forest canopy in the vicinity of the clearcut. The birds willingly inhabited clearcuts surrounded by tree nurseries (1-3 years old), but they avoided longer walls of old forest. The nightjars also chose areas with a higher number of clearcuts in the neighbourhood. Distribution of birds was not influenced by the distance to the nearest roads, human settlements, forest edges or edges of other large clearcuts. Present study showed that current forest management create the suitable breeding habitats for nightjars.

Key words: Birds, Clearcut, Forest Management, Breeding Habitat

The Potential Spatial Distribution Patterns and Effects of Invasive Species Tithonia Diversifolia in Yunnan Province, southwest of China

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Abstract: Biological invasion is one of major threats to biodiversity. Accurately predicting the potential spatial distribution pattern of invasive species is critical for effective management. Since from 1930s, Tithonia diversifolia has been imported from Center American as decorative plant to China. It is an invasive species and widely spreads in Yunnan Province. The objective of study is to detect the current spatial distribution patterns of T. diversifolia in Yunnan, predict its the potential distribution range. To achieve this objective, firstly, totally 9828 GPS points of the T. diversifolia were collected in whole Yunnan Provinces in 2015. Afterward, the maximum entropy (Maxent) model was applied to predict the potential distribution of T. diversifolia in Yunnan province. The primary results would show that, the accuracy of AUC values respectively were 0.904 and 0.814 for predicting potential distribution of T. diversifolia in Yunnan by Maxent and GAPR. Temperature is the most critical factor for potential distribution of T. diversifolia, followed by altitude, but precipitation is a relatively insensitive factor.

Key words: Spatial Distribution Pattern, Invasive Species, Biodiversity, Ecological Niche Model

T9-02: The Importance of Biodiversity in Human-Modified Landscapes

Biodiversity and the Functioning of Managed Forests

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Abstract: Ecological systems, including the collection of inhabiting organisms (biodiversity) and the vital functions provided and the resultant benefits (ecosystem functions and services), face increasing threats from the stresses of an expanding human population. This is also the case for forest ecosystems. Forests support a vast majority of terrestrial taxa and provide numerous ecosystem functions and services. Although changes in the extent of forests are spatially heterogeneous, intact forests still continue to disappear. Even in regions with a net increase in forested areas, forest ecosystems are indeed under threats and rapidly changing their structural and functional characteristics. At the same time, numerus efforts to conserve and restore forests are also given in many regions. Currently, there is an increasing recognition for and demands on the roles of managed forests for biological conservation and ecosystem functions. Given such situations, there are several important things to be considered. First, there is now increasing recognition that ecosystem management and restoration need to be grounded in ecological theory, although knowledge is limited and thus is often heuristically applied to actual management and restoration. Second, the issues surrounding forest biodiversity and ecosystem services are multifaceted, in terms of the spatial, temporal, biological, and societal scales. In these regards, I describe the present state of the art and then focus on some applied studies in forests from local-scale observatory studies to large-scale meta-analyses. Based on them, I describe potentials of applied studies in human-modified forest landscapes for future forest use, conservation and restoration within the context of social-ecological systems.
Key words: Forests, Biodiversity, Ecosystem functions, Ecosystem services,

An Assessment of Mammalian Diversity in Agroforestry Systems of Assam and Implications for Management

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Abstract: In Assam, Northeast India the practice of agroforestry systems is

pre-dominant. Almost all the households have a homegarden for the cultivation of vegetables and fruits and agrisivilculture system for paddy cultivation. From British period, the forest ranges of Assam have been converted in tea plantations. Line transects of 1 km in length were employed during the mornings and night in all the three types of agroforestry systems for two seasons, namely post-monsoon and winter for evaluating their mammalian diversity. Among the 18 mammal species encountered, Elephas maximus is endangered, Macaca assamensis is near threatened and Trachypithecus pileatus is Vulnerable, 12 species are Least concern and the rest are Not assessed according to the IUCN Red data list. Among the three agroforestry systems the highest mammal diversity was found in homegardens (16), followed by agrisilvicultural systems (13) and tea gardens (10). The highest diversity in homegardens might be because of its structural and floristic complexity which supported diverse numbers of species with different food and shelter requirements. Moreover, the homegardens owners were more tolerant and most often used firecrackers, scarecrows or throw stones to deter the mammals as compared to the tea gardens where the tea tribes were fond of hunting and might be one of the reasons for low diversity. The homegardens were also easy sources of pigeons, goats, hens and ducks which attracted small carnivores as compared to the other two systems. The tea crops which is a dominant crop and the shade trees which are sparsely spaced do not offer much food diversity to meet the diverse food requirements of the mammals. Similarly, the agrisilvicultural system with less tree diversity and use of pesticides and insecticides might be reducing the food diversity and amount of prey species to predate upon respectively. In the homegardens, Elymnias hypermnestra had the high encounter rate (2.402) which suggested that it had ample of food resources available in homegardens. Individuals of Elymnias hypermnestra had been observed feeding on several fruit trees like Areca catechu, Zizyphus sp., Cocos nucifera, flowers of Bombax ceiba, Erythrina indica etc. which were abundantly available in homegardens. In agrisilvicultural system, Elymnias hypermnestra had the high encounter rate (0.304). This might have been because of the bamboo grasses, Areca catechu, and other trees planted on the bunds or interspersed between the agricultural crops which might have been providing Elymnias hypermnestra shelter and food. Similarly in tea gardens, Macaca mulatta had the high encounter rate (0.734). As the tea tribes were not fond of the meat of Macaca mulatta this species might have been hunted the least and this might explain its higher encounter rate. The tea tribes can be given some training and subsidies for animal husbandry, poultry rearing and fisheries production, so that hunting in tea plantations can be curbed. Agroforestry systems like homegardens can be promoted as role models to conserve mammal diversity in human-dominated landscapes in future policies.

Key words: Agroforestry Systems, Homegarden, Agrisilviculture, Mammalian Conservation

Diurnal Variation in Dung Beetle Community Dynamics in Two Tropical Habitats: Is Competition a Driving Force?

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Abstract: Competition acts as a powerful selective force in shaping and maintaining the community dynamics of species. Species sharing same resources find it difficult to coexist in the same ecological niche. Interspecific competition often leads to competitive displacement of one species. We tested this hypothesis by studying the diurnal variation in community structure and composition of dung beetles of tropical rainforest fragments and adjoining home gardens in two seasons in a rural environment. These two habitats are different in terms of their physical and vegetatiion structure and composition and use. While the sacred forests are closed relic primary rainforests with limited anthropogenic and grazing pressure, the home gardens are open orchards and often used to maintain livestock. We sampled dung beetles using dung baits in day and night in dry and wet seasons from 12 paired sites. We used relative abundance, species richness, biomass, and community structure and composition of dung beetles in two diurnal periods to study community dynamics of two habitats. Dung beetle abundance, species richness, and biomass were significantly higher in home gardens than sacred forests. In both habitats night sampling in wet period yielded more species, abundance, and community-level mean weight (CWM) of dung beetles. The generalized linear mixed models predicted that a) the habitat type has a strong effect on dung beetle richness and abundance, and a weak effect on CWM of dung beetles, b) habitat type, season, and diel period have an interactive effect on abundance, and c) habitat and season have an interactive effect on CWM of dung beetles. The nocturnally-active dung beetles of two habitats were more similar than the diurnally active dung beetles. The striking turn over of species was observed in home garden between day and night (dissimilarity=93%), which has a striking difference in temperature between day and night. In sacred groves, relatively less turn over of species was observed between the diel periods (40%), perhaps due to stable temperature maintains inside the forest between the two diel periods. Interestingly, 43% of species caught in home garden during night were similar to that was collected from sacred forest in day.The results suggest that the competitive partitioning of dung beetle communities might be explained by the thermal tolerance of the species.

Key words: Competition, Dung Beetle, Diurnal Variation, Community Dynamics

Engineering Improved Ecosystem Function Using Plant Traits and Environmental Heterogeneity.

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Abstract: Ecological engineers often seek to improve ecosystem functioning by selecting plant species with particular characteristics. Research from agroecosystems as well as constructed ecosystems suggests that plant traits can predict ecosystem functions in monocultures, but there is less evidence that traits can be used to select species mixtures that enhance the performance of ecosystem services. We present results from several studies on extensive green roofs and urban spontaneous vegetation. We discuss the use of canopy and leaf traits to improve ecosystem services from green roofs. While several ecosystem functions related to productivity can be maximized in monocultures by using plants with a suite of traits related to rapid growth, species mixtures can lead to higher functioning compared with the best monocultures. Using four simple leaf or canopy traits, functional diversity (Rao's quadratic entropy) was a weak predictor of aboveground biomass and soil organic matter production in species mixtures. We discuss how the functioning of plant species mixtures could be predicted a priori by using plant traits. Surveys in urban spontaneous vegetation reveal that ecosystem services beyond those related to productivity may not be predicted by the same traits and make suggestions toward a predictive approach to the functional benefits of species mixtures. Functions related to supporting biodiversity of invertebrates are predicted by plant diversity variables and abiotic spatial heterogeneity but were not related to productivity, whereas functions related to carbon capture and thermal regulation were predicted by productivity. In species mixtures, the spatial scale of species interactions may also be important to functioning. Green roof ecosystem functions related to productivity can be enhanced by fine-scale mixtures, where several species grow in close proximity allowing interactions and complementarity effects. Spatial heterogeneity can be maximized by coarse-scale mixtures that promote environmental differentiation due to stronger plant-soil feedbacks. The role of spatial heterogeneity in promoting ecosystem functions, however, is unclear. We end by presenting an approach to engineering enhanced functioning using plant traits in species mixtures.

Key words: Community Ecology, Ecosystem Services, Green Infrastructure, Constructed Ecosystem

Biodiversity Holds Promise for the Restoration of Polluted Ecosystems: A First Field Experiment

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Abstract: A large area (~4.3 million km^2) of the Earth's surface has been impacted by pollution, and restoring polluted ecosystems is a key challenge facing humanity today. There is increasing evidence that biodiversity can be harnessed for improving the effectiveness of restoration of polluted ecosystems, which highlights the necessity for conserving biological diversity. The currently available evidence, however, is from laboratory-based studies and has not yet been validated in sufficiently replicated field-based studies. Here we presented the results of a first field experiment evaluating the contribution of biodiversity in improving the effectiveness of restoration of polluted ecosystems. We established replicated plots with varying levels of plant species richness (0, 1, 4, 8 or 16 species per plot) on a heavily polluted mining site. Plant coverage and biomass yield of the plots increased with species richness. In contrast, concentrations of pollutants (i.e. heavy metals) accumulated in plant shoots and bioavailability of pollutants in the soils decreased with species richness. These observed positive effects of plant diversity became more pronounced over time. Moreover, plant diversity was found to have considerable effects on soil microbial communities, providing insight in the mechanisms by which plant diversity can improve the effectiveness of restoration of the polluted ecosystem. Our results demonstrate that biodiversity holds promise for the restoration of polluted ecosystems and justify biodiversity conservation efforts.

Key words: biodiversity, degraded ecosystem, ecological restoration, field evaluation,

Agricultural Land-Use Legacies and Habitat Restoration Shape Diversity and Composition of Plants and Soil Microbes

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Abstract: Intensive land use activities, such as agriculture, are a leading cause of biodiversity loss and can have lasting impacts on ecological systems. Yet, few studies have investigated how land-use legacies impact multiple taxa across levels of biodiversity, including richness, composition, and phylogenetic diversity (the total amount of evolutionary history in a community). We also know little about if, and how, restoration activities might mitigate legacy effects on biodiversity. We studied ground-layer plant and soil bacteria communities in 27 pairs of Remnant (no

agricultural history) and Post-agricultural (agriculture abandoned >60 years ago) longleaf pine savannas in South Carolina, USA. Half of our plots were restored by thinning trees to reinstate open canopy conditions. We found that agricultural history had no impact on plant species richness, but did alter community composition and reduce phylogenetic diversity by 566 million years per 0.1 ha. Habitat restoration increased plant species richness by 27% and phylogenetic diversity by 914 million years. Land-use history and restoration also had distinct impacts on soil bacterial communities composition, similar to what we found with plants. In both plants and soil microbes restoration altered communities but did not overcome the effects of agricultural land use on community composition. These results demonstrate the persistence of agricultural legacies, even in the face of intensive restoration efforts, and the importance of considering biodiversity broadly when evaluating human impacts on ecosystems.

Key words: Restoration, Human Land Use, Biodiversity, Community Ecology

Assesing the Efficacy of Manipulative Nutrient Addition Experiments on Mollusc Assemblages in a Tropical Mangrove Ecosystem

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Abstract: Anthropogenic activities in mangroves could cause over-enrichment of nutrients in this coastal ecosystem. The over-loading of limiting nutrients, mainly nitrogen and phosphorus in mangroves are a potentially significant force in structuring one of the most important macrofaunal groups in mangroves, the molluscs. In mangroves, molluscs are important macrofauna, facilitating nutrient cycling and nutrient retention in the sediment. Previous studies indicated that molluscs can also be potential bioindicators in detecting possible contaminants in a water body. Despite the importance of molluscs, information on the spatio-temporal distribution of this macrofaunal group and responses to nutrient enrichment is limited in tropical mangrove ecosystems. In addition, confounding patterns of species diversity and distribution influenced by mangrove habitat complexity and heterogeneity could lead to inaccurate assumptions in determining the responses of macrofauna to nutrient induced modifications. To address this, experimental approach is needed to elucidate effects from spatial complexity and temporal heterogeneity. Previous studies done by ecologists involving in situ experimental nutrient addition at different ecosystems showed varying degrees of success in determining responses, which were specific from different organisms. Using experimental additions of N and P, the effects of nutrient enrichment on mollusc assemblages across multiple spatio-temporal scales in

mangroves was determined in a tropical mangrove in North Peninsular Malaysia. At three mangrove sites, samples of mollusc and sediment were collected in 1 m by 1 m plots treated with different fertilizers, comprising nitrogen (N), phosphate (P), diammonium phosphate (N+P) and a control where no nutrients were added. Environmental data such as detrital and organic matter biomass were analysed to determine the potential variable(s) that could interact with nutrient additions and explain patterns of mollusc assemblage composition. Preliminary data analysis indicated no effects of nutrient treatments were found on total mollusc abundance and species diversity ($p>0.05$). However, spatio-temporal scales appeared to influence mollusc abundance, characterized by high abundance at specific mangrove sites at the meter scale and differing patterns of mollusc assemblages between the wet and dry season. Lack of effect from nutrient treatments indicate the possibility of macrofauna species resistance towards nutrient enrichment. This suggests that in complex ecosystems such as mangroves, spatio-temporal scales could play an important role in mediating the effects of nutrient enrichment on mollusc assemblages.
Key words: nutrient addition, molluscs, tropical mangrove, manipulative experiment,

Evaluation of Diversity of Butterflies and Their Host Plants along an Urban-Rural Landscape: A Spatial Scale Approach towards Conservation

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Abstract: Butterflies are good indicators of environmental alterations as they are sensitive and are directly affected by changes in the habitats, atmosphere, temperature and the weather conditions. Therefore butterflies are treated as an important model group in ecology and conservation. Diversity and distribution of butterfly is very much dependent on availability of specific host plants vis-à-vis vegetation type of a particular area. Quantitative and qualitative reduction of habitats in response to urban development affects native floral and faunal diversity. Depletion of floral habitats corresponds to decrease in butterfly species richness. Monitoring of butterfly species richness has been used as a surrogate for evaluating other biotic diversity. The present study is a preliminary attempt to make an inventory of the harmonization between abundance of butterflies with its respective nectar plants along an urbanization gradient vis-a-vis to emphasize the need for their conservation. The information on the spatial scale distribution of the butterflies against the plants is crucial for the purpose of management and conservation of butterflies. The survey of the urban, suburban and rural areas in and around Kolkata, India, revealed the presence of 88 species of butterfly

associated with 40 species of plants. The results reveal significant positive correlation between the diversity of butterflies and the host plants in all the sites. However, the relative importance of a plant species in hosting the butterflies varied with the areas. Similarly, the link of the butterfly to the different plant species varied significantly, justifying the urban-rural gradient as factors for the differences. It is apparent that the urban areas of Kolkata can sustain diverse butterfly species which includes species of requiring conservation effort. Considering the landscape of Kolkata, steps to enhance urban greening should be adopted to maintain butterfly diversity and sustain the ecosystem services derived from them. The rise of urbanization is interfering with the ecological function of the butterflies. Without appropriate management for these potential bio-indicators, the concord is at stake. The present study thus calls for a restriction in various anthropogenic activities including construction of buildings at the cost of habitat loss of responsive species. Findings of this study will also contribute to future attempts in understanding the complex nature of mutualistic interaction between butterflies and flowering plants that is essential for continuity of ecosystem services.
Key words: Environmental Indicator, Urbanization Gradient, Butterfly, Diversity

Phylogenetic Diversity and the Function of Green Roofs

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Abstract: Green infrastructure is increasingly used in cities around the world to adapt to and mitigate the effects of climate change on urban environments. Green roofs are one type of green infrastructure, consisting of designed plant communities covering conventional roof surfaces. These contribute to critical ecosystem services in cities; such services include building cooling in warm seasons and reduction in urban flooding through the interception of rainwater. Many examples of urban wildlife, including some threatened species, also benefit from green roofs. Taxonomic and functional trait diversity have each been shown to improve the ecosystem services provided by green roofs. These taxonomic and trait differences that contribute to ecosystem services are the product of past evolutionary change and phylogenetic diversity (PD), which quantifies the relatedness among species within a community. Phylogenetic diversity of plant and animal communities is increasingly used as a diversity measure to understand natural systems. This is because communities with distantly-related species (high PD) are expected to be more functionally diverse than those with closely-related species (low PD). Therefore, we predict high PD communities will improve water capture and cooling benefits of green roofs. Using a species pool of 28 plant species in 12 families, we designed six community combinations of different levels of PD. Each of these communities were planted in a module and replicated twice, with the addition of a

substrate only module as control. Each set of modules were installed at ten green roofs along an elevation gradient and in three ground level controls. We collected roof temperature using dataloggers placed in each module, and conducted an experimental watering treatment in every module to simulate rainfall to record water capture following a rain event and water loss via evapotranspiration. We found that the maximum surface temperature and the diurnal variability were positively correlated with PD in the plant community. Increasing PD in the plant community also led to greater volumes of rainwater capture and the amount of water lost via evapotranspiration 48-hours following the rain event. Overall, site had a strong significant effect on all green roof ecosystem functions. Since no two green roof sites are the same and they vary tremendously in microclimate, our study illustrates the importance of including multiple sites in studies of green roof performance. We show that phylogenetic diversity (PD) had an effect on green roof functioning, illustrating that PD provides valuable information when choosing plants for green roof projects. Understanding how to use PD as a tool to promote the relationship between plant diversity and ecosystem functioning will ultimately improve the application and effectiveness of green infrastructure as well as our understanding of these mechanisms in urban planning and design. Further, this understanding could ease the application of these tools to less well-known species in natural areas.

Key words: Green Infrastructure, Urban Greening, Biodiversity-Ecosystem Function Relationships, Stormwater Management,

Ants Indicate Brunt of Urbanization

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Abstract: Ants are excellent indicators of major ecosystem processes and changes, such as fragmentation, degradation, land use change, and even urbanization. We sampled litter-dwelling ant community of fragmented primary forests of sacred forests in an urban-rural gradient in the Western Ghats to study how urbanization is affecting ant community structure and composition. We trapped ants using pitfall traps from 12 rural sacred groves located in a forest-dominated landscape and 10 sacred groves in anthropogenic rural-urban landscape. Interestingly, neither the abundance, species richness, nor the species diversity of ants varied significantly between urban and rural sacred groves, suggesting that the primary measures of diversity did not very significantly between sacred forests. The area of sacred forest did not affect the community structure or composition of the ants. But, there was a crucial turn over of species occurred between the rural and urban sacred groves. The noticeable change was observed in the exceptionally high abundance of a globally important invasive ant

species, Anoplolepis gracilipes in urban sacred forests. Sacred forests of these two types of landscape varied considerably by the environmental variables, and this geographical distance significantly explained the geographical distance of the sacred groves based on the ant community structure. We conclude that the sacred forests locate in urban landscape are vulnerable to the invasive ant species.

Key words: Urbanization, Indicator Species, Ants

Indicators for Monitoring of Landscape Planning in Germany

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Abstract: Local landscape planning is the instrument of nature conservation and landscape management for preparatory land use planning. This contribution examines the extent to which this planning instrument has a spatial effect and influences the landscape quality and structure. Is the impact of municipal land-use planning measurable with landscape indicators based on geo-information data? Which indicators are necessary to show the current processes of landscape change in a differentiated way?

The change in land use in Germany currently can be characterized mainly by four processes: land take for housing, commercial and transport, fragmentation by infrastructure, the conversion of land for renewable energies and the intensification of use in agriculture. Indicators will be presented in order to identify spatial trends of this development and to open up possibilities for control by spatial and landscape planning. An overview of the developed indicators will be given and then two indicators will be explained in more detail.

The first one, the “Landscape attractiveness” describes a landscape’s potential for nature-based recreation. The indicator was derived from eight equivalent parameters for the determination of human use and landscape structure. It was supposed to be applicable with already existing geodata. A five-tier scale hereby assists with the requirement to provide a coarse classification of municipalities in regards to landscape attractiveness. An evaluation of the provision of cultural ecosystem services for landscape-oriented recreation becomes hereby possible.

Until now Germany's national land use monitoring systems have lacked an indicator to capture the naturalness respectively hemeroby of the landscape. Based on digital spatial data on land use and the mapping of potential natural vegetation, the second indicator has now been estimated for the whole of Germany. A hemeroby index that considers all hemeroby classes of a reference area (e.g. administrative unit, regular grid cell) is presented as well as an indicator named “Proportion of certain natural areas”. The

results on hemeroby of several time-cuts can be used to estimate the cumulative impact of land use changes on the environmental status.

It could be shown that municipalities with a landscape plan have on average a higher proportion of natural areas, a lower hemeroby index (ie lower cultural impact), a higher density of borders between settlements and open spaces, a smaller mean area size of undeveloped areas and a higher density of wooded ecotones in comparison to municipalities which have not set up a land-use plan. All these are indications that the landscape plan contributes to an improvement, above all, in the structure (and quality) of the landscape.

Key words: Landscape Indicators, Hemeroby, Naturalness, Ecotones

Bird Community Disassembly after Habitat Fragmentation

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Abstract: Biodiversity change in anthropogenically transformed habitats is often nonrandom, yet the nature and importance of the different mechanisms shaping community structure are unclear. Here, we extend the classic Theory of Island Biogeography (TIB) to account for nonrandom processes by incorporating species traits and phylogenetic relationships based on a study of faunal relaxation following habitat loss and fragmentation. Two possible mechanisms can create nonrandom community patterns on fragment islands. First, small and isolated islands might consist of similar or closely related species because they are environmentally homogeneous or choose for certain shared traits, such as dispersal ability. Alternatively, communities on small islands might contain more dissimilar or distantly related species than on large islands because limited space and resource availability result in greater competitive exclusion among species with high niche overlap. In our study, breeding birds were surveyed on 36 islands and two mainland sites annually from 2010 to 2014 in the Thousand Island Lake region, China. We assessed community structure of breeding birds on these subtropical land-bridge islands by integrating species' trait and evolutionary distances. We additionally analysed habitat heterogeneity and variance in size ratios to distinguish biotic and abiotic processes of community assembly. Results showed that functional-phylogenetic diversity increased with island area, and decreased with island isolation. Bird communities on the mainland were more diverse and generally less clustered than island bird communities and not different than randomly assembled communities. Bird communities on islands tend to be functionally similar and phylogenetically clustered, especially on small and isolated islands. The

nonrandom decline in species diversity and change in bird community structure with island area and isolation, along with the relatively homogeneous habitats on small islands, support the environmental filtering hypothesis. Our study demonstrates the importance of integrating multiple forms of diversity for understanding the effects of habitat loss and fragmentation, and further reveals that TIB could be extended to community measures by moving beyond assumptions of species equivalency in colonisation rates and extinction susceptibilities.

Key words: island biogeography, functional trait, phylogenetic structure, environmental filtering,

T9-03: Landscape Homogenization and Intensification: Patterns of Change

Minute Ecological Variations across Endau-Riau Region Informs Ease of Unity for Termite Diversity and Pest Management Albeit Oil Palm Intensification

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Abstract: Assessments of termite variations along the oil palm intensification gradient across a small straits geographical separation (Endau to Riau) using a modified transect protocol were carried out elucidate the formulation of biodiversity and pest management strategies within a biogeographical region. Species of termites were compared across the transects from Endau, Peninsular Malaysia from the east, through to Belilas, Riau Province, Indonesia to the west, whilst optimal protocol for rapid assessment of termites were verified. As the standardized rapid assessment protocol introduced by Jones and Eggleton was the most accepted protocol for diversity assessment of termites across biogeographical regions, the method was validated for suitability in oil palm ecosystems due to differences in vegetation, farm layout and microhabitats. The modified protocol campaign conducted for 10 years enabled a total of 58 termite species within five subfamilies identified across the region. Diversity from end to end indicated small diversity changes from east to west. Distribution of termites tend to show higher populations parallel to the direction of windrows compared to traverse field. Transect orientation due to wind direction had skewed effect on termites which tend to be higher in the north than in the other fields, but was not significant between fields. More populations were found on peat (217 populations) as compared to clay (168 populations) and sandy soils (169 populations) but was not siginificantly different at large. Termites were found most often utilizing fronds piles (153 populations) as food and habitat resource than others such as oil palm stands, forest timber remnants, stumps, soil humus and mounds, suggesting the resource shifts of termite assemblages from natural to intensive monoculture. Therefore, due to the minute ecological variations across Peninsular Malaysia and Sumatera at its smallest geographical separation, we recommend that the management strategies for termite diversity as well as pest be formulated in a unity for within the Sundaland even across intensification of oil palm monoculture.

Key words: Oil Palm Intensification, Species Conservation, Integrated Pest

Management, Biogeographical Region

Varying Agricultural Intensity Causes Structural Differences in Interspecific Networks of Ground Beetles (Coleoptera: Carabidae)

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Abstract: Carabidae are often considered as biological control agents against agricultural pests, and therefore, the impact of agriculture on their community ecology is relatively well known. There is, though, a substantial knowledge gap in how interspecific networks in carabid assemblages are formed, whether they bear common structural features in different habitats and how the topology of the network changes under stress. In the present study we primarily aimed to investigate how the interspecific network responses to stress derived from agricultural intensification but the topological similarities in these networks over a large spatial scale were also investigated. Interspecific networks of ground beetle were modelled from count data, obtained from various sources including the authors' own data collections, from Europe, North America and Asia, using Bayesian network learning algorithms. The strength and directionality of interactions (links) between two species (nodes) were estimated. Each network was assigned to one of the two groups based on the level of agricultural intensity they are managed: 1) no or very little agricultural management and 2) intensive agricultural management. Several network properties (such as connectance, modularity and average link number per node etc.) were calculated and compared amongst geographical locations and agricultural intensity. The proportion of weak and strong, as well as the proportion of positive and negative, links were also calculated. Principal component analysis (PCA) on network properties was used to investigate the similarities of networks, and analysis of similarities (ANOSIM) was conducted in order to test the validity of grouping based on agricultural intensity. Most of the networks we studied shared some common properties in their topologies, the most important of these being that, whilst a high number of species had few links to others, the number of highly connected species remained low. Furthermore, positive links greatly outnumbered negative ones, a phenomenon that emphasizes the importance of mutualistic relationships in ecological networks. In our networks the connectance increased with agricultural intensity, whilst modularity showed a declining, however not significant, effect. These changes are likely to be caused by the lower species number and the increasing dominance of generalist species in more intensively managed assemblages. The proportion of weak links was higher with low agricultural intensity but the positive to negative link ratio did not show significant differences. In

the PCA networks from the same agricultural intensity level clustered more together than those from the same geographical region, emphasizing the importance of agricultural pressure on network structure. However, the picture is not entirely clear, as ANOSIM results did not indicate a significant grouping of networks based on agricultural intensity.Since interspecific networks are crucial for ecosystem functioning, and thus delivering ecosystem services, they are of a great conservation and economic interest. Disintegrating networks may jeopardize the delivery of ecosystem services, therefore, understanding how they function, and how they can be sustained, even in agricultural land, begs for further research.

Key words: Ecological Network, Agriculture, Ecosystem Function, Carabidae

Bayesian Networks for the Analysis of Ecosystem Services Trade-Offs in Silvopastoral Systems

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Abstract: Ecosystems generate multiple resources that are underpinned by ecological entities and processes, known as ecosystem services (ES): the contributions of nature to human wellbeing. Frequently, different ES are interlinked, which translates in positive or negative covariation between ES, determining synergies and trade-offs to be considered in ecosystem management. However, despite their importance, the knowledge about the ecological functions that regulate the different ES is often limited and fragmented, especially what regards how different management practices affect the capacity of natural systems to produce ES or about the trade-offs between different ES. Functional traits of organisms are indicators of ecological function that can be linked to important ES. In this study, we explored the use of plant functional traits as indicators of ecological functions that underlay important ES, i.e. competitive and facilitative interactions, herbivory and soil formation in African savannas under silvopastoral use. We developed a model of ecological function – ES generation implemented as a Bayesian Network (BN) to represent the probabilistic relationships between specific "effect traits" of trees and three ES, i.e. grassland productivity and soil fertility under the trees, and fodder quality of trees for different livestock species. The BN enabled the integration of different data sources. Use used both field measurements of eco-physiological effect traits of trees and assessment of ecological response on understorey grassland and soil, on one side, and data on tree fodder quality from existing databases and expert opinions on animal preferences for the different fodder

species, on the other. We classified trees in functional groups (PFG), estimated the linkages between these groups and the studied functions and evaluated the influence of environmental characteristics on these linkages. We found that different PFG vary in their effects on the different functions, and that these effects can be strongly modulated by characteristics of the physical environment. For example, there were marked differences in the productivity of the understorey grassland between different PFG both within and across environments, which indicates that the attributes of trees play an important role determining the effect of trees on understorey grassland. In contrast, the observed effects of trees on soil properties, were generally positive and independent of the physical environment, suggesting trade-offs in some cases between grassland productivity and soil formation. The net effects of trees on the soil and on grassland productivity were generally unrelated to the preference of the tree fodder by animals. The only noteworthy correlations observed were among preference classes for the different livestock species. The preferences of sheep and goat were negatively correlated with those of cattle, suggesting that management strategies that seek to simultaneously maximize the preferences of the three livestock species might be difficult to achieve.

Key words: Ecological Functions, Plant Traits, Ecosystem Services, Bayesian Networks

Spatio-Temporal Patterns of Cropland in Korean Peninsula during 1990~2015

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Abstract: Study on long-term landscape change of cropland in neighboring countries is of great referential significance to the utilization of cropland resources and implementation of scientific cropland policy in China. Korean Peninsula, adjacent to China, plays an important role in the international environment of Northeast Asia. Therefore, we aim to quantify the spatio-temporal changes of cropland in the Korean Peninsula by means of Landsat (TM/OLI) image data. Object-based image analysis (OBIA) and decision-tree classification methods were used to obtain the distribution of cropland in 1990 and 2015.We analyzed the landscape changes of cropland by landscape metrics, transfer matrix, dynamic degree model. Results show that the overall classification accuracy of cropland data is 93.10% in 1990 and 92.52% in 2015, respectively. The cropland with significant changes distributed in the areas with slope less than 3 °and elevation less than 300 m in Korean Peninsula. Total area of cropland increased by 3845.24 km^2, and the dynamic degree of cropland was 0.26%. Landscape index of cropland increased, including patches number (PN), largest patch index (LPI),

and patch cohesion index (COHESION), but mean patch size of cropland decreased in Korean Peninsula during the past 25 years. Moreover, there are obvious spatial differences on quantity, pattern, changing rate of cropland between South and North Korea. Area of cropland in the South Korea decreased by 426.25km^2 while cropland in the North Korea increased by 4271.89km^2. In South Korea, the lost croplands were converted mainly to artificial surface (60.30%) and forestland (30.14%). In North Korea, expanded croplands were mainly converted from forestlands (94.12%). During the 25 years, although natural factors affected the changes of cropland, human forces including policy regulation, economic development, population growth, urban sprawl played the primary roles in the cropland changes. Additionally, the regional differences of cropland changes were mainly due to different agriculture policy regulations implemented by different countries. The achievements of this study can provide scientific guidance for the protection and sustainability of cropland resources in China, especially in the Northeast China.

Key words: Landscape Change, Remote Sensing, Object-Based Image Analysis (OBIA), Korean Peninsula

Biodiversity in Homogeneous Agricultural Landscapes. What Actions Can Be Taken to Improve Its Conservation?

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Abstract: Since the mid-1990 ś the traditional production systems in the Pampas of Argentina shifted from a diversified agriculture-livestock rotation to a specialized continuous agriculture based on crops of high profitability (mainly oilseeds). The resulting environmental simplification of the productive landscape has caused a series of impacts, including the reduction in the surface area of habitats for biodiversity around the cultivated areas, loss of connectivity between remaining patches of native vegetation and/or protected areas, and loss of diversified food sources for wildlife species. However, in those landscapes there are linear elements, some of which are relics of spontaneous vegetation and others are man-created, that have the potential to act as connectors between patches of native vegetation and play an important role in conserving biodiversity and its functions in agroecosystems. Taking advantage of an existing Soil Conservation Law in Entre Rios province that promotes the incorporation of common terraces to mitigate water erosion, an initiative (GEF-PSE Project) was launched to encourage integration of vegetated (non-cultivated) terraces to add biodiverse services in the already soil-related services supported by the law. The

Project is located in Aldea Santa Maria (Department Paraná, Entre Rios), encompassing a watershed of about 15,000 ha and involving 30 small and medium-size farms ranging between 100 and 300 ha. As part of its technical proposal, the Project initially emphasized the benefits of implementing vegetated terraces in the agricultural plots to evacuate water surpluses while increasing carbon stocks and biodiversity at the same time. To test this hypothesis, carbon (C) and biodiversity (BD) were monitored in 60 agricultural plots of four land uses: i) native forests, ii) agricultural plots with common terraces, iii) agricultural plots with vegetated terraces and iv) agricultural plots with cultivated terraces. Results indicated no significant differences for C and BD among the different land uses. Based on those results, a multiscale approach (instead of considering only types of agricultural plots) to improve BD conservation in agroecosystems was adopted. To increase landscape heterogeneity and connectivity, management of linear landscape elements was incorporated and a new type of terraces was developed (reservoir terraces). To evaluate the effects on BD of managing at a multiscale approach, two sub-watersheds with contrasting landscapes (classified according to the spatial configuration of natural elements) have been selected: i) sub-watershed "2" representing the current situation of homogeneous landscape and ii) sub-watershed "4" representing the modelled future scenario obtained from social cartography and developed jointly between farmers and technicians (with the incorporation of natural vegetation in the main watercourses, vegetated edges in the roads and the modeling of terraces reservoir to achieve connectivity among patches). Monitoring of C and BD is currently underway in sub-watershed "2", and farmers from sub-watershed "4" are starting to incorporate linear landscape elements and different type of terraces. This experience highlights the importance of linking scientific information, adaptive management and environmental planning and modelling as inputs for policy formulation to improve biodiversity in homogeneous agroecosystems.

Key words: Biodiversity, Agricultural Landscapes, Multi-Scale Approach, Argentinean Pampas

Application of Space-For-Time Substitution Method in Validation of Long-Term Biomass Predictions of a Forest Landscape Model

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Abstract: Validation of the long-term biomass predictions of forest landscape models (FLMs) has always been a challenging task. Based on space-for-time substitution method, forest biomass-age dynamic curves were generated from a forest form map in the Lesser Khingan Mountains area and used to compare with long-term biomass

predictions of LANDIS-II model at landscape scale in biomass the accumulative period. The results showed that the mean forest age and biomass of initial forest landscape were 50 years and 84.2 Mg ha^{-1}, respectively. High consistency and significant linear correlations were found between forest form map derived biomass and simulated biomass in the accumulative period for the whole Lesser Khingan Mountains area and most sub regions, and the RMSE ranged from 17.56 Mg ha^{-1} to 53.27 Mg ha^{-1}. However, a considerable difference of the mean maximum biomass (53.45 Mg ha^{-1}) existed between the two biomass datasets at the landscape scale. Despite the poor performance of space-for-time method was found in the validation of predicted biomass in the final stable period. It is still a great attempt to apply the space-for-time substitution method in validating time series biomass predictions of FLMs when only limited forest inventory data is available.

Key words: Forest Landscape Models, Landis-Ii Model, Forest Biomass, Space-For-Time Substitution Method

Spatiotemporal Dynamics of Coastal Wetlands and Reclamation in the Yangtze Estuary during 1960s-2015 Based on Remote Sensing

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Abstract: This paper aims to monitor spatiotemporal patterns of coastal wetlands and reclamation in the Yangtze Estuary during 1960s-2015. Series satellite remote sensing images obtained from 1980 to 2015 and topography maps of 1960s were employed to extract changes of reclamation and coastal wetlands. Area-weight centroids were calculated to identify the movement tendency of reclamation and coastal wetlands. The results showed that: from 1960s to 2015, the net area of natural wetland declined 574.3 km^2; while man-made wetland and reclamation increased 553.6 km^2 and 543.9 km^2; respectively. During five study phrases, the fastest change speed of net area of natural wetland was -13.3 km^2/a in 1990-2000, and that of man-made area was 24.7 km^2/a in 1990-2000, as well as that of reclamation growth of 27.6 km^2/a in 2000-2010. Conversion of coastal wetlands mainly occurred in Chongming Island, Changshu City and the east coast of Shanghai City. Reclamation is common across coastal area, and its major types were settlement and man-made wetland, typically distributed in Chongming Island, Lianyungang City and the east coast of Shanghai City. Natural wetland turned to arable land and settlement, and man-made wetland gained from reclamation by occupying arable land. The centroid of natural wetland generally moved towards the sea, however, man-made wetland expanded equally in all directions and near inland. Meanwhile, the centriod of reclamation migrated to Shanghai City. Natural

factors such as sea level rise, erosion-deposition changes, and reclamation activities together determined dynamics of Yangtze Estuary wetlands. However, reclamation activities for construction of ports, industries and aquaculture were demonstrated to be the key causes for the dynamics. Those results revealed dynamics of coastal wetlands and reclamation, which can support regional government to put forward sustainable land use and land development plannings.

Key words: Dynamics Of Coastal Wetlands and Reclamation, Remote Sensing, Driving Forces, The Yangtze Estuary

Ecological Intensification and Biodiversity: The Case of Pollination Services

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Abstract: Policy-makers and scientists globally are calling for alternative approaches to conventional intensification that reduce the ecological footprint of agriculture. Ecological intensification is based on the improvement of crop yield through enhancement of biodiversity, and may be a sustainable pathway towards greater food supplies, yet we know little about the efficacy of this approach. Such sustainable increases may be especially important for the two billion holders of small farms or fields, many of which are undernourished. Using a coordinated protocol across regions and crops, this study quantified to what degree enhancing pollinator density and species richness can improve yields on 344 fields from 33 pollinator-dependent crop systems in small- and large-holdings from Africa, Asia, and Latin America. For holdings less than 2ha, results show that yield gaps could be closed by a median of 24 % through higher flower-visitor density. For larger holdings, such benefits only occurred at high flower-visitor richness. Therefore, integrating the promotion of wild-insect species richness with single-species management (e.g. honey bees) should benefit farmers and society. Different combinations of local and landscape practices can result in similar outcomes in terms of promoting pollinator richness, providing alternative solutions suited to different agricultural settings. In general, effectiveness of large-scale practices (e.g. natural or organic area) varied according to the smaller-scale practices carried out (e.g. plant diversity within fields), and vice versa. Worldwide, this study demonstrates that ecological intensification can create synchronous biodiversity and yield outcomes. A system-based approach to crop pollination and other ecosystem services should be implemented, accounting for the cost and benefits (including those beyond crop production) and interactions of species and habitat management.

Key words: Ecological Intensification, Landscape Homogenization, Pollination,

Biodiversity

Interactions and Feedbacks between Land Use Change, Species Richness and Productivity: An Integrative Approach through Meta-Analysis.

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Abstract: The conversion of land for human activities is a global change driver that potentially affects the Earth's capacity to sustain biodiversity and ecosystem's productivity. In order to integrate scattered data on the three main components of this system, three meta-analyses were carried with studies dating from 2000 to 2016, that reported effects of different intensities of land use change on species richness and productivity, worldwide, on multiple taxa and ecosystem types. In this talk, I present the results of analyzing these meta-analyses independently. The impact of increasing the intensity of land use change on mildly modified and native ecosystems was overall negative moderate (Hedges' g ~ -0.5) and negative large (Hedges' g > -1) on species richness and biomass, respectively. Urbanization showed the highest impact on these two variables compared to grazing and agriculture, which may denote the relevance of promoting ecology in urban areas. Models including taxa, spatial scale, extent of study and intensity of land use change as moderators could all partially, but not completely explain the significant heterogeneity in global data. In all, results highlight global patterns that may be hard to appreciate with non-quantitative, non-integrative reviews. Furthermore, during this talk I will present the challenges found during the integration of global data, the need to find common grounds for experimental procedures as well as the relevance of online repositories and open data policies. This study highlights the importance of systemic analysis to understand and predict global change as opposed to studying variables in isolation.

Key words: Global Change, Meta-Analysis, Biodiversity, Productivity

Agricultural Landscape Pattern and a Case Study toward Enhancement of Ecosystem Service in China

Rongzhen Yu

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Abstract: China has undergone rapid urbanization and landscape change in rural area

since the economic reform. Unprecedented land use and landscape changes caused decrease and fragmentation of farmland, reduction of biological habitat and ecological service. In this paper, change of agricultural landscape pattern was interpreted by using case study. The problems of land use, agricultural infrastructure and semi-natural habitat were identified and evaluated. The study results showed that landscape homogenization, block features, and characters loss were general weaknesses of local rural ecological landscape. Distance between shelterbelts wider than standard was popular among areas, and this showed up in about 80% major shelterbelt and minor shelterbelt. Shelterbelt missing was a common problem in rural landscape within 18% - 38%. Land over- pavement of agricultural infrastructure threatened local eco-system, for example, about 30% road over paved than necessary. Bad status for utility became a significant problem of agricultural infrastructures with a proof that near 40% field roads and 20% ditches required maintenance. However, different areas showed various trend of local landscape change. Metropolitan rural landscape faced high pressure of construction land expanding and land over -pavement of agricultural infrastructure. The semi-natural habitat was greatly decreased in intensive agricultural area. Agricultural land was abandoned in mountain area. These studies have indicated that the construction of agricultural infrastructure and environmental stewardship should be paid more attention to in the improvement of agricultural rural landscape and ecological service. For these purpose, the pilot project for improvement of rural landscape function was demonstrated. Meantime, the questionnaire survey was conducted to explore farmers attitudes towards their willingness to participate in environmental stewardship measures. Results showed that lacking characteristics was a nationwide rural landscape problem, as well as lack of greening, over hardening and abandonment of rural roads and ditches, lack of landscape maintenance and settlement hollowing, and waste treatment, green space, and hygiene facilities needed improvement. Though farmers were not satisfied with rural infrastructure projects, 68.3% of the investigated farmers were still willing to participate in such engineering projects and 98.7% would accept at least one environmental stewardship measure. There was a great possibility to introducing landscape stewardship measures in rural infrastructure engineering projects and managed by farmers while subsidies should be provided as compensation for economic risk.

Key words: Agricultural Landscape, Land Consolidation, Ecosystem Service, Environmental Stewardship

Key Indirect and Direct Drivers in Relation to Nature's Benefits to People: A Multi-Scale Approach to Assess Ecosystem Services Shifts and Changes across Landscapes

Sandra Luque

IRSTEA National Research Institute of Science and Technology for Environment and Agriculture, France

Abstract: Nature and Nature's benefits to people is not just about agenda-setting assessments, policy development, and policy implementation to successfully target planning and management. It demands mainly a comprehensive system understanding, through good knowledge of directional changes in local-scale biodiversity. Hence, a multi-scale approach, including space and time, seems to be needed to accurately assess the impact of land-use change on biodiversity and to have a better understanding of the mechanisms that contribute to the maintenance of species diversity in particular in degraded and fragmented landscapes.

The preservation of biodiversity has become a major challenge for sustainable development at national, European (Habitats Directive) and international level (Convention on Biological Diversity). In order to address the problem; different contexts scenarios and models of biodiversity and ecosystem services often characterize a range of cause-effect pathways and explore the consequences of a variety of policy, planning or management options. But no single combination of scenarios and models can address all decision contexts, and gradients of change, so a variety of approaches are needed. This presentation will discuss applications of scenarios and models to gain an integrative knowledge of the complex dimensions of biotic homogenization that impacts ecosystem services

Key words: Trade Offs, Ecosystem Services, Spatio Temporal Scales, Planning

Different Response Patterns of Epigaeic Spiders and Carabids to Environmental Factors in an Intensively Cultivated Agricultural Landscape

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Abstract: The aim of this study was to determine the relative effects of landscape scale management intensity, plant diversity, and local management intensity on diversity patterns of two different natural enemies of carabid beetles and epigaeic spiders. There eight common types of habitat were selected for sampling, including four cultivated habitats (home garden, paddy field, rainfed field, tidal flats field) and four semi-natural

habitats (field margin, woodlot, grassy field of dike, shelterbelt). Within fields, carabid beetles and spiders were captured by pitfall traps. Diversity patterns of study natural enemies were affected both by local variables (local management, plant diversity and different habitat) and by landscape scale management intensity. Species richness of both farmland and semi-natural habitat, presumably because of human disturbance like more pesticide, herbicide and tillage operation, both carabids and spiders decreased with soil nitrogen. Semi-natural habitat differed from farmland in that they had higher individuals of spiders. Plant diversity influenced spider abundance and species composition but not that of carabid species. We considered that carabid species studied consist of carnivores, omnivores or generalist herbivores, and only a few contain plant specific species. Different functional groups may have different responses to plant diversity. Landscape scale management intensity has an interaction influence on spider abundance with soil nitrogen. The abundance of spiders increased with the increase of soil nitrogen in small mean patch size landscapes. The intense management causes the decreased of the diversity of spider assemblages but increased of the dominance of a few wide spread species. The results show that spider and carabid species abundance and richness was differentially affected by local and landscape scale factors. Even in same taxonomic group, different species have different way to response to environmental factors. Our research also suggested that big patch size can compensate for negative effects from intensive agricultural practices, but it may in most cases only increase the number of generalists. We suggest that there are two processes need to be addressed to halt biodiversity loss in agricultural landscape. There is a need to conserve semi-natural open habitat patches of diverse size to favor poor dispersers and habitat specialist species. At the same time, if agricultural intensification is inevitable, optimized fertilizer input or any other human disturbance are needed to stop the homogenization of intensive agriculture landscape.

Key words: Carabids beetles, Spiders, Different Scale, Landscape

A Unique Method to Trace the Dynamic Expansions of Spartina Alterniflora

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Abstract: Three types of Landsat images were embedded in MODIS pixels which were selected by three observation points. Combined with history and field survey data, there were all beaches in each MODIS pixel in 1984 until Spartina alterniflora was naturally expanded. Phragmites australis and Suaeda salsa also live in this wetland. Comparing with spectral indices, Spartina alterniflora has a longer growth cycle and higher

productivity than Suaeda and Reed. This is one reason why it has spread so fast here. From 1990-2000, Spartina showed a quick invasion trend, the rate is ranging from 15.5% to 44.4%. After that, two inland MODIS pixels have changed to pure Spartina pixels, while the other one which is near the coast completely was expanded in 6 year ago.

Key words: Spartina Alterniflora, Spectral Indices, Biological Expansions, MODIS Pixel

Simulating Land-Use Change and Its Effect on Biodiversity Conservation in a Watershed in Northwest China

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Abstract: Land-use management strategies play a major role in biodiversity change. In many parts of the world, local governments are under increasing pressure to regulate human activity to mitigate negative impacts on ecosystems. This study aimed to analyze the effects of different land-use patterns on biodiversity change across a typical artificial desert watershed. We first analyzed land-cover change based on past and future management scenarios in a watershed spanning Gaotai, Linze, and Ganzhou counties in northwest China. We then analyzed the effect of different land-use patterns on biodiversity change in the watershed. We found that the crucial land-cover changes are likely to occur in the wetland reserves and areas established for the Grain for Green Project around the oases, and such changes could affect biodiversity throughout the entire watershed landscape. Thus, our findings indicate that land-use management strategies for the middle and southeast parts of the watershed are particularly important for future management of biodiversity and the integrated ecosystem services of the entire watershed landscape.

Key words: Land-Use Management, Biodiversity, Scenario Analysis, Spatial Modeling

T9-04: Achieving Land Degradation Neutrality: Challenges to Sustainable Development of All Countries

Integrated Soil, Water and Vegetation Hazard Mapping for Sustainable Agriculture in the Context of Land Degradation Nutrality in Iran

Ali Darvishi Boloorani

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Abstract: Land degradation will reduce food production up to 12% globally in next 25 years and population growth will dictate 50% more demand for food in 2030. These demands will require millions of hectares of additional agricultural lands. Cropland preservation and management is fundamental component of food security and is critical issue to sustainable development. In fragile ecosystems of arid and semi-arid areas like Iran the situation is even more severe. This paper offering an integrated modeling based on remote sensing imagery. Here a Wind Erosion Index (WEI), Normalized Environment Health Index (NEHI) and Soil Water Sufficiency Index (SWSI) are developed using the available time-series products of MODIS. The modeling conducted in 1000 m ground resolution for the period from 2000-2015. These modeling shows the significant hazards are threatening the fragile ecosystems and agricultural activities in Iran. The modeled hazard demonstrates that the time series of MODIS-products can be integrated and used to identify land degradation across the country. The time-series hazard maps provide detailed and beneficial evidence to assist in better investments and management of resources that will lead to land degradation neutrality.

Key words: Remote Sensing, Integrated Modeling, Modis-Products, Land Degradation Nutrality

Land Degradation Neutrality in the Contest of Sustainability Policies

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Abstract: After the approval of the UN Agenda 2030 and Sustainable Development Goals - SDGs, many countries are taking advantage of the opportunity offered by the connected target to enhance, among all, environmental protection and are on the way to to set national targets. Italy is launching its sustainable development strategy based on

the SDGs and on the best available scientific knowledge, at internaztional and national level. For the target 15.3 "by 2020, combat desertification, and restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land-degradation neutral world." that refers to the Goal 15 "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss", a specific project on the framework of the UNCCD was launched by the Italian Ministry of the Environmentwith the main Italy's Research Institutions (ISPRA, ENEA, CREA, CNR)in order to define and adopt specific national targets to be reached by 2030, well founded on a scientific basis. National data were utilised where available, integrated with data coming from models and remote sensing.The project was elaborated looking at ensuring coherence between methodologies approved by UN Statistical Commission and adopted in UNCCD reporting system with similar reporting systems, among them on climate change field. The target elaborated in the first project phase have been proposed to policy makers with a view of their institutional adoption.
Key words: Land Degradation Neutrality, SDG, Reporting Coherence

The Challenges of Soil Sustainability in Pakistan under Changing Climatic Conditions

Azeem Khalid

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Abstract: Pakistan is one of the top ten countries most vulnerable to climate change and a large part of its economy is based on agriculture which is climate sensitive. Many environmental factors are directly linked to land and soil degradation. Any deterioration in environmental quality and services leads to land degradation, which may be triggered by climate change and other environmental factors. Soil is very important for sustainable development and to ensure food security to provide sufficient food and fiber in the long term. Pakistan is predominantly an arid to semi-arid country where annual precipitation is less than 300 mm, resulting in soil degradation. More than 90% of Pakistan's soils are low in organic carbon (<1%) and harsh climatic conditions in Pakistan also prevent the production and maintenance of high levels of organic matter in the soil. Similarly, water scarcity is a major problem, threatening agricultural yields in Pakistan. In addition, rapid population growth and increased industrial pollution are causing serious environmental concerns and deterioration in soil quality and crop productivity. Ecological and biological services provided by soils are an integral part of carbon and water cycles. Therefore, effective and careful soil management is necessary to maintain long-term sustainability, especially in the context

of climate change. In this talk, soil degradation in context with the climate change will be discussed critically and remedial measures will be suggested for sustainable soil management.

Key words: Soil Degradation, Climate Change, Environmental Pollution, Soil Management

Quantifying Erosion and Its Impacts on Soil Quality in Wind-Water Erosion Crisscross Region of Northwestern China

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Abstract: Wind and water erosion are two dominant types of erosion that lead to losses of soil and nutrients. The contributions of wind and water erosion to total erosion and their effect on soil quality in regions where both types of erosion occur, however, remains elusive. We used cesium-137 (137Cs) tracer technique to quantify wind and water erosion and to validate the relationships of the degradation of soil quality and wind-water alternate erosion in a hilly agricultural area for different slope aspects and positions. The results showed that the 137Cs inventory was 26.5% higher on southeast- than northwest-facing slopes, possibly due to the effect of wind erosion. The 137Cs inventories increased from the top to the bottom of slopes, due to the high runoff and sediment transport from upper towards lower sections of slopes. The percentage of total erosion caused by wind and water were estimated to be ≥46.05 and <53.95%, respectively. The 137Cs inventories were correlated with soil physicochemical properties ($P<0.01$ or <0.05). Areas of lower 137Cs inventories indicated lower soil organic carbon, total nitrogen, clay, and silt contents but higher sand content, perhaps due to severer wind and water erosion. The soil-degradation index was -42.83% and -29.32% on the northwest- and southeast-facing slopes, respectively, and was 31.54% higher on northwest- than southeast-facing slopes. The wind-water alternate erosion accelerated the degradation of the soil quality of sloping cropland and caused a serious decrease in the nutrient contents of the infertile soils in regions where both types of erosion occur.

Key words: 137Cs, soil degradation index, wind erosion, water erosion

Land Degradation Neutrality (LDN) Goals in Drylands. It's Possible? For Whom?

Elena Maria Abraham

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Abstract: The RIO+20 United Nation Conference on Sustainable Development recommended identify urgent actions to achieve the goal of a Land Degradation Neutral word (LDN). Taking this challenge, The United Nations Convention to Combat Desertification defines Land Degradation Neutrality (LDN) as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems" (UNCCD, 2012, p.8). Within the UNCCD this definition is intended to apply to affected areas as defined in the text of the Convention, with the objective of achieving a zero rate of land degradation by 2030. This would imply that desertification should be avoided or compensated through the restoration of degraded lands (UNCCD, 2012). According to the SPI (2016), LDN is a new initiative intended to halt the ongoing loss of healthy land through land degradation, creating a target for land degradation management and promoting a dual-pronged approach of measures to avoid or reduce degradation of land, combined with measures to reverse past degradation (Orr et al., 2016). The objective is that losses are balanced by gains, in order to achieve a position of no net loss of healthy and productive land. This poses a great challenge of articulation among the various dryland actors in the world, but above all around the circle of knowledge generation, governance and welfare of the local populations involved. For this goal not to become something unattainable and a mere discourse, it is considered essential to look at the causes of degradation, and therefore in the options in recovery, wondering how, where and for whom the efforts are directed. This presentation focuses on the relationship between degradation / desertification in drylands, taking in account Latin America, especially Argentina, and within this Mendoza, to analyze the context conditions provided by the driving forces as a tool for understand the dynamics of the construction of the territory. These dynamics generate territories that hold central positions (eg irrigated areas in drylands) while others are relegated to marginal positions (non-irrigated land) with subsistence economies. This pattern is repeated in all the territories of the Region, referring to poverty as a cause of degradation and local people as agents of it. It is intended to put in crisis this affirmation, reinforcing the idea that poverty is a consequence and not cause. Based on this, restoration proposals should focus on a deep understanding of these dynamics in order to understand the underlying factors that determine the degradation of a territory, which generally respond to territories and societies very far from those where the effects of degradation are suffered, taking into account the demands and needs of affected local

populations.This contribution analyzes spatial and temporal dimensions, sensitivity and resilience in drylands, concepts such as integrated assessment, development models and governance of drylands, sustainable land management (MST) and the evaluation of its impact. L The methodology used combines the methods of land use planning and the integrated assessment of desertification, putting in value participatory experiences in the construction of knowledge Abraham & Torres (2014).

Key words: Drylands, Land Degradation Neutrality, Integrated Assessment, Participatory Processes

An Analysis of Soil-Related-Policies in Italian Rural Development Plans to Achieve Land Degradation Neutrality

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Abstract: Soil is considered as a hinge among different environmental and climatic priorities, in order to tackle the following problems: erosion, water availability, carbon footprint, soil biodiversity, resilience and adaptation to climate change.

The European Common Agricultural Policy (CAP) is implemented by means of Rural Development Plans, that currently cover the period 2014-2020. Each of the 21 Italian regions approved its plan, which is based on a common framework, that allows local customization, both on the allocation of budget and in the identification of single activities to be promoted by public policies. Although Land Degradation Neutrality does not have yet a strong visibility within CAP, rural development policies do have a strong relevance on achieving LDN at national and regional level.

The paper examines the various soil-related policies, in terms of budget and current level of expenditure at regional level. It also identifies relevant experiences, with a special focus on agro-climatic payments, collective actions and no-till farming, for the importance that they can have on the improvement of soil quality and of carbon stocks. Organic farming is also considered as a way to improve the quality of soils as well as organic soil content.

The analysis is the result of a collaborative effort with the participation of Italian regions in the National Rural Network and clearly identifies how policies can have a synergistic effect on reaching Land Degradation Neutrality, and also byby improving the quality of the soils, enhancing resilience and adaptation to climate change and increasing revenues of farmers.

Key words: Soil, Policies, Italy, Land Degradation Neutrality

Changing Land Management Institution and Its Effects on the Development of Gully Erosion in Black Soil Area of Northeast China

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Abstract: Land management institution is the integral human decision made based on assessing quantitatively land system change and its ecological effects, which is prerequisite to understand and propose sustainable land management strategies. Under the goal of achieving land degradation neutrality and the background of readjustment of Chinese agricultural structure, it is necessary and urgent to pay attention to the influence of different land management institutions on land system changes.

The evolution process of land management institution, experienced army-owned farms (A1) and collectively owned People's Commune (B1) (1947-1956), to state-owned farms (A2) (after 1956) and household contract responsibility system (B2) (after 1978), to the farmer specialized cooperatives (B3) (after 2006), which could be reflected by the types of farmers. The boundary of army owned and state-owned farms were delineated based on the thematic map. Other region outside the farms was tilled by individual farmers.

The gully data in the study area were extracted by interactive human-machine interpretation method, based on remote sensed images of the Corona images centered the year of 1965 with spatial resolution of about 3m, Spot5 images centered the year of 2005 with spatial resolution of 5m and GF-1 images with 2m spatial resolution obtained in 2015. The gully data of 1965 had been validated by historical observation records, and that of 2005 and 2015 validated by field survey.

Through the analysis with comparing the number, speed and erode area of gullies developed respectively under the institutions of A and B, the results showed that erosion gullies increased during the period of 1965- 2005. The increasing speed of number, length and erode area of gullies under B was 5.25, 6.77 and 12.8 times of those under A.

For the area of individual farmland was nearly 4 times larger than the area of state-operated farms, we then normalized the value. The results indicated when land management institution of B1 was implemented in 1965, the number, length and erode area of gullies outside state-operated farms was 6.60, 7.79 and 8.55 times of those inside the state-operated farms. While land management institution of B2 was implemented in 2005, the times of the number, length and erode are of gullies outside state-operate farms decreased to 1.39, 1.77 and 3.03.

Compared to the land management institution of B, the level of mechanization, management, input and environmental awareness under A were much better to prevent effectively the development of gullies. However, compared to B1, the land

management institution of B2 could arouse the enthusiasm and initiative of individual farmers to better manage the farmland. The results would provide a reference to the readjustment of agricultural structure and decision making of sustainable agricultural institution.

Key words: Land Management Institution, Gully Erosion, Remote Sensing, The Black Soil Area

Study on Soil Erodibility K Value in Typical Areas of Shaanxi Province

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Abstract: According to the DEM and the content of the clay and sand of the Shan Xi province to study the different area's spatial variability and vertical characteristics of soil erodibility (K-factor),and divide Shan Xi in three parts: the north of Shan Xi, the middle of Shan Xi and the south of Shan Xi, and extract respectively two counties from those three parts: the Shen mu county, Gan quan county , Da li county, Qian yang county , Yang xian county and Ning shan county. After processing, getting their DEM and the content of clay, sand and then calculate these areas' content of silt and K-factor based on the Soil Particle-Size Distribution, then establish the spatial of figure in Arcgis to get the distribution characteristics of soil erodibility (K-factor) of different counties:(1) The value of K of north of Shan Xi is big; (2) the middle of Shan Xi' value of K is bigger; (3) the value of K of the south of Shan Xi is smaller. Finally according to these characteristics to get the conclusions: (1) The value of K is influenced by the content of silt; (2) The value of K is also influenced by the content of organic matters.

Key words: Soil Erodibility (K-Factor), The Soil Particle-Size Distribution, Spatial Variability and Vertical Characteristics

The Development of Sustainable Agriculture in Drylands as a Mechanism to Prevent Land Degradation

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Abstract: Drylands are an under-used resource in the production of food and biomass crops. Sustainable agricultural usage of drylands is also effective in the prevention of land degradation and desertification. Indeed, rising population levels and climatic

change necessitate consideration of these so-called 'marginal lands' that are not presently used in intensive crop production. A major impediment to the exploitation of marginal lands in warm to hot regions is the lack of access to fresh-water for irrigation. In light of predictions of increased temporal and spatial variability of rainfall, alongside higher industrial and domestic demand for fresh-water in many arid regions, the development of agricultural production in marginal lands must proceed on the basis that supplementary irrigation will not be possible or restricted to specific periods in the life-cycle of the chosen crop. Therefore, any crops grown on these marginal lands should be drought tolerant. Phenotyping and precision agriculture may offer innovative solutions to facilitate usage of these marginal lands. Perennial biomass crops require little input in terms of fertilisation or pest control, making them largely carbon neutral or negative in terms of their effect on atmospheric CO_2 levels. However, the rapid growth of biomass crops is sustained by high rates of photosynthesis that are accompanied by high levels of stomatal conductance and transpirative water-loss, possibly making them unsuitable for growth in arid areas with limited water availability. Phenotyping studies of rapid growth biomass crops such as the giant reed (Arundo donax) may enable the identification of varieties suited to growth in drylands, or the attributes that confer tolerance to drought. Precision irrigation may also enable the development of high value climate-resilient crops, such as olive (Olea europaea) and argan (Argania spinosa) or neglected species (eg. Nitraria tangutorum) in marginal drylands. In these crops application of deficit irrigation/water harvesting technologies can dramatically enhance yield and enable production of high value products in dryland areas previously considered to be unsuited for agriculture. Drought tolerant food and energy crops can therefore play an important role in food and energy security, the prevention of desertification and economic development of dryland areas. However, an understanding of the physiological processes that underpin the responses of these crops to drought is essential to the successful revitalisation of marginal drylands.

Key words: Drylands, Land Degradation, Bioenergy, Food Security

Remote Sensing for Monitoring and Mapping Land Productivity in Italy: A Rapid Assessment Methodology

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Abstract: Rational: International policy makers at the RIO+20 United Nation Conference on Sustainable Development recommended countries and the international community to identify urgent actions to achieve the goal of a Land Degradation Neutral

word (LDN). Net Primary Productivity (NPP) and persistent deviations from the norm in ecosystems NPP can be taken as an indicator of land degradation or improvement. Long-term trends of NDVI have been proposed by global (Bai et al, 2008) and regional (Cherlet M., et Al, 2014) studies as quantitative indicators for land productivity (LP). These studies highlighted the powerfulness of remote sensing techniques for the monitoring and assessment of the impact of natural and anthropogenic processes that may affect land productivity.

Methods: NASA MODIS NDVI data available from the year 2000 to present have been used, in this study, to check if their spatial (250x250m) and temporal MVC (Maximum Value Composites) pixel resolution may be exploited for operational and degradation monitoring purposes. Annual mean of NDVI MVC for each pixel were generated for the Italian territory as indicator of annual mean greenness. The temporal trends parameters have been computed for the annual mean NDVI at individual and 3x3 pixel levels using linear least square regression and Mann-Kendall (MK) and Contextual MK confidence test over the 2000–2015 period. This technique represents a simple, yet robust, way to reveal long-term trends in the yearly sequence of LP. The significant trends have been used to assess LP trends for forest, agricultural and grassland land covers on the basis of CORINE-2012 land cover classes.

Results: Positive and negative trends at national and sub national scales in Italy (95% confidence level) for the years 2000-2015, as calculated from NASA MODIS satellite observations show that land productivity in is increasing over of the national territory.

The geographic distribution of the changes across Italy is not at all uniform because northern Italian regions have higher negative trends and southern regions have higher positive trends. Although forests are reported to be expanding nationally in terms of surface, NDVI trends highlight that in northern regions, natural vegetation shows the higher LP negative trends. Southern Italian regions show the highest LP positive trends both in natural vegetation and agricultural areas due to the persistent reduction of production activities. LP has statistically significant correlation with time in 28%, precipitation in 18%, a combination of time and precipitation of the territory indicating that the progressive land abandonment and land use change is the main cause of the observed LP trends.

Outcomes: NDVI trends, as land productivity proxy, depend on several biophysical processes such as precipitation changes, soil erosion, salinization and soil organic matter content decrease. Anthropogenic processes such as land use changes, forest fires and biotic effects due to pathogens of natural and anthropic origin may also be relevant. The trend of the land productivity is the result of the combination of different possible causes that may also be inter-dependent and therefore hardly distinguishable. Nevertheless long-term NDVI negative trends may represent a warning signal, of land productivity change indicating ongoing degradation processes and the need of more in depth studies. The specific figures reported, referring to the Italy case study, are

strongly dependent from the observational period but, keeping this in mind, the methodology proposed aims to improve the ability to address land degradation and desertification monitoring and assessment using state of the art scientific data and tools.
Key words: Land Degradation, Remote Sensing, MODIS NDVI, Vegetation Trends

Controlling Erosion and Fighting Against Desertification in the Loess Plateau: Lessons and Mechanisms

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Abstract: Widespread land degradation and desertification has become a major problem in many regions of the world. In the Chinese Loess Plateau, for example, water erosion is one of the most key environmental issues which restrict regional sustainability from a long-term run. In order to restore the degraded ecosystems in such regions, large-scale revegetation and watershed management projects have been conducted during the past several decades. However, due to the improper plant selection, unwise spatial arrangement and little knowledge on the deep mechanisms of plant-water-microtopography interactions, our humans actually have made many mistakes in practice. In this report, we summarized the major problems and consequences of integrative watershed managements. We try to find the deep reasons from the social and natural aspects. Facing this question, we have launched a series of specific investigations and questionnaires to get first-hand data for further analysis. In the meantime, we also established long-term monitoring and field experiments in several typical regions of the Loess Plateau. Systematic research and monitoring were conducted to quantify the relationships between vegetation restoration, slope terracing measures and ecohydrological services. Based on the comprehensive analysis on social and natural aspects, suggestions regarding how to improve ecosystem management and fight against land degradation were discussed.
Key words: Ecological Restoration, Terracing, Land Degradation, Water Erosion

T9-05: Landscape Sustainability Science - Linking Biodiversity, Ecosystem Functions, Ecosystem Services, and Human Well-Being

Trace and Heavy Metal Pollution in the Water and Sediment of the Ga-Selati River, Olifants River System, South Africa

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Abstract: The Ga-Selati River is a tributary of the Olifants River which is one of the most polluted rivers in South Africa. During the past few decades, the river has been subjected to prolonged and cumulative ecosystem stress as a result of human activities such as mining, agricultural, industrial and human settlements in the catchment, all of which have caused a decline in the water quality. The results of the study show a gradient from upstream protected (pristine) sites with relatively good water quality to downstream sites with poor water quality. The pristine sites generally exhibited significantly lower turbidity, TDS, and conductivity values as compared to the agricultural, mining and industrial downstream sites. The concentrations of heavy metals in overlying water were low, however, high concentrations of some heavy and trace metals were found at certain locations signifying the occurrence of some local contaminates. The analyses indicated that there is a significant difference in the metal concentrations in the sediments among the sites for aluminium, chromium, nickel, iron and strontium. The high concentrations of certain metals in the water and sediment may pose health risk to the rural communities which rely on the river for drinking water and food (e.g. fish). Although acid mine drainage has been implicated in the mobilization of metals in rivers in South Africa, further research is required to elucidate the impacts of the increased metal levels to aquatic biota and human populations reliant on resources from the river.

Key words: Heavy Metals, Land Use, Pollution Gradient, Water Quality

Operationalizing Landscape Sustainability from a Perspective of Multiple Interacting Social-Ecological Systems: A Modeling Framework and Its Application

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Abstract: Landscape sustainability, with its pivotal role in bridging local and global sustainability, is gaining growing research interests. However, operationalizing the concept of landscape sustainability is still a challenge. To help meet this challenge, here we present a spatially explicit hierarchical approach to model landscape sustainability, based on a perspective of multiple interacting social-ecological systems (MISES). In this paper, we first discuss the theoretical bases for the MISES perspective, including landscape conceptualization, hierarchy theory, and social-ecological systems as complex adaptive systems. Second, we describe how the MISES perspective can be used to elaborate the spatially explicit hierarchical modeling framework to operationalize the concept of landscape sustainability, with general mathematical formulations of the underlying social-ecological interactions. Third, by specifying the mathematical descriptions of the social-ecological processes within a specific context, we demonstrate how the modeling framework is used in an agent-based simulation of the sustainability dynamics of a coupled rural-urban landscape. In conclusion, we highlight the strengths and limitations of our MISES perspective and modeling framework, and propose ways forward for future improvements.
Key words: Human-Environment Systems, Coupled Infrastructure Systems, Agent-Based Modeling, Scale

Study on accouting of Gross Ecosystem Product based on land over classification in Hebei province in1980-2013

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Abstract: Based on the field investigations, an analysis was conducted using RS and GIS technologies on the RS images of Hebei taken respectively in 1980, 1990, 2000,2005,2010,2013 in order to reveal the spatial and temporal characteristics of land cover land change during the last 33 years. Combined with land cover in Hebei province, accounting the value of GEP in Hebei Province. The value of GEP in Hebei Province was about 700.42 trillion yuan, 380.4765 trillion yuan, 357.62 trillion yuan, 324.05 trillion yuan, 315.83 trillion yuan, 380.03 trillion yuan in 1980, 1990, 2000, 2005, 2010, 2013.The results is a very useful technical support for its economic development and environmental protection management in Heibei province.
Key words: Land cover, Gross Ecosystem Product,

Urban Expansion and Regional Sustainability in the Ecologically Vulnerable Areas in China: A Multi-Scale Landscape Perspective to the Agro-Pastoral Transitional Zone in Northern China

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Abstract: As one of the largest agro-pastoral ecotones in the world and the most ecologically vulnerable areas in China, the Agro-Pastoral Transitional Zone in Northern China (APTZNC) has always been concerned due to its environmental degradation, poor concentration and sensitivity to climate change. Recently, fast urban expansion has also been seen in the APTZNC with the steady population increase, rapid economic development and the release of the National New-type Urbanization Plan (NNUP) in China in 2012. However, few researches have been done to systematically investigate the spatiotemporal change, driving forces and consequences of urban landscapes in the APTZNC. The primary goal of this study was to understand how the urban land expanded in the APTZNC in the past (1992-2015) and what such expansion imply to the environmental sustainability in this region. To achieve the goal, we first examined the spatiotemporal change of urban land in the APTZNC from 1992 to 2015 at multiple scales from the whole, to the prefecture-level city, to the county-level city with the support of the multi-source remotely sensed data. Then, we discussed the related impacts of the urban landscapes on the cultivated land, the ecosystem services and the environment sustainability in the APTZNC. We found that rapid urban expansion took place in the APTZNC from 1992 to 2015, with the urban land increased from 566km ^{2} to 3800km ^{2}, having the annual increase rate of 8.63% , 0.53% higher than the national average. Among the three modes of urban growth—infilling, edge expansion, and leapfrog—in the APTZNC, the edge expansion was the primary mode to have 1984 km ^{2}, accounting for 61.35% of the total area of the expanded urban land. We also found such rapid urban expansion brought obvious impacts on the food and meat production with occupation of the cultivated land and grass land, increasing the ecological footprints and water stress in the APTZNC. Thus, we consider that the APTZNC is facing the challenge to balance the ecological carrying capability and the rapid urban expansion. We argue that more concerns are needed to maintain and improve the environmental sustainability of the ecologically vulnerable areas while implementing the NNUP in China.

Key words: Urban Expansion, Spatiotemporal Pattern, Ecologically Vulnerable Areas, Sustainability

Drivers and Interaction of Ecosystem Services in the Agro-Pastoral Transitional Zone of China

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Abstract: The restoration of degraded vegetation can effectively improve ecosystem services, increase human well-being, and promote regional sustainable development. Understanding the changing trends in ecosystem services and their drivers is an important step in informing decision makers for the development of reasonable landscape management measures. Understanding the linkage between ecosystem services is important for promoting ecosystem service management and sustainable development.

From 2001 to 2014, we analyzed the changing trends in five critical ecosystem services in the Xilingol Grassland, a typical of grasslands in North China, including net primary productivity (NPP), soil conservation (SC), soil loss due to wind (SL), water yield (WY) and water retention (WR). Additionally, we quantified how climatic factors and landscape patterns affect the five ecosystem services on both annual and seasonal time scales. Overall, the results indicated that vegetation restoration can effectively improve the five grassland ecosystem services, and precipitation (PPT) is the most critical climatic factor. The impact of changes in the normalized difference vegetation index (NDVI) was most readily detectable on the annual time scale, whereas the impact of changes in landscape pattern was most readily detectable on the seasonal time scale. A win-win situation in terms of grassland ecosystem services can be achieved by increasing grassland aggregation, partitioning the largest grasslands, dividing larger areas of farmland in smaller patches, and increasing the area of appropriate forest stands.

The relationships of ecosystem services were characterized as tradeoff and synergy in most of the current studies. Here, we found that there is another relationship, namely, constraint effect between ecosystem services, which was represented by extracting constraint line from the scatter plot. Selecting the agro-pastoral transitional zone of North China as the study area, we examined the relationships between paired ecosystem services of NPP, SC, SL, WY, and WR, in which the constraint effects of one ecosystem service on the others were represented by extracting upper constraint lines from the scatter plots of the paired ecosystem services through the method of segmented quantile regression on the levels of landscape, class, and ecoregion, respectively. The results indicated that there are seven kinds of constraint effects between the ten paired ecosystem services, namely, (1) positive linear, (2) negative linear, (3) logarithmic, (4) negative concave, (5) backwards S-shaped, (6) hump-shaped, and (7) wave-shaped. The constraint line approach enriched the understanding of

linkages between ecosystem services and the potential drivers and can be used by policy makers to detect and design the land use schemes in terms of ecosystem service optimization.

Key words: Ecosystem Services, Land Use and Cover Change, Climate Change, Constraint Line

Integrating Ecosystem Services in Landscape Planning Based on Multi-Objective Spatial Optimization and Game Theory

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Abstract: Context: Applying ecosystem services (ES) concepts and indicators to support sustainable landscape planning and management has been recognized by more scientists and policy decision makers. Spatial landscape planning can help create alternative land use patterns protecting ecosystems and thus supporting the provision of needed services they provide. The landscape optimization is so complicated, for the conflict between multiple objectives, and furthermore, the conflict of interest between multiple stakeholders. Multi-objective spatial optimization, could guide effective decision making based on integrated assessment and trade-off of ESs, while the game theory could lead to fair and feasible solution which satisfies the needs of the different stakeholders.Objectives: In order to improve the efficiency and feasibility of ecological restoration and management of the Chinese Loess Plateau, we explore the optimization method integrating a genetic algorithm and game theory in landscape planning, under the framework of ecosystem services. Method: We construct a coupled model based on the most popular multi-objective optimization genetic algorithm, NSGA-II, and game theory. The spatial multi-objective optimization algorithm is aiming to find the optimal solutions to maximize the multiple key ecosystem services and cost-benefit. The involvement of game theory utilizes multi-stakeholder games to find a practicable way to coordinate the land use competitions. This model is integrated in our spatial decision support tool, SAORES. Using SAORES, we make a case study on the Yangou catchment, located in the middle of the Loess Plateau in Shaanxi Province, China. Based on impact assessment and scenario analysis of the Grain to Green Program (GTGP), we optimize the farmland retiring planning, involving multiple objectives which include the eco-compensation and the key ecosystem services, considering the conflicted interest at the views of the different stakeholders.Results: The integrated assessment shows that, the aim of the GTGP, the water and soil retention are prominent improved. Optimization for GTGP provides a series of optimal solutions, which are

better than other single optimized solutions, and are twice the cost-effectiveness of the actual situation. The general optimization approach emphasizes on the environment and public benefit, without enough concern for the perception and interest of the different involving stakeholders. This will make difficult to implement the planning. The spatial heterogeneous farmland retiring plan and the graded compensation solution are needed to make more practicable and sustainable ecosystem restoration. Conclusions: This study develops a spatial landscape optimization model, integrating a modified spatial multi-objective optimization algorithm and game theory. This model can improve the scenario analysis and multi-objective optimal planning design for ecosystem management and planning, from the efficiency and feasibility. The spatial multi-objective optimization lead to spatial optimal allocation of different land use types to improve the key ecosystem services, and the introduction of game theory simulate the public participation in decision making. The case study demonstrates the potential and effectiveness of this model for ecosystem service management, especially in the Loess Plateau.

Key words: Ecosystem Services, Landscape Planning, Multi-Objective Spatial Optimization, Game Theory

Spatiotemporal Pattern of the Global Fine Particulate (PM2.5) Pollution: A Multiscale Landscape Analysis

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Abstract: Fine particulate (PM2.5) pollution have adverse impacts on human health, visibility, and sustainable development. Awareness of the spatiotemporal pattern of PM2.5 pollution is critical to environmental management. However, a global analysis of the dynamics of the PM2.5 pollution has been lacking in recent years. Therefore, our objective was to reveal the spatiotemporal patterns of PM2.5 pollution at multiscale between 2000 and 2014. In our analysis, we used the WHO's Air Quality Guideline (AQG, 10μg/m3), Interim Target-1 (2IT-1, 35μg/m3), and two fold the IT-1 (2IT-1, 70μg/m3) as the standards to divided the PM2.5 pollution in three levels, including AQG to IT-1, IT-1 to 2IT-1 and >2IT-1. Then we analyzed the spatiotemporal patterns of PM2.5 pollution at the global and continental scales, as well as at that of countries. We found that global PM2.5 pollution is characterized by large area and wide distribution. In 2014, the area exposed to PM2.5 pollution is 6,457.39×104km^2, equivalent to almost half of the global territory. The area of AQG to IT-1, IT-1 to 2IT-1 and >2IT-1 are 4,697.32, 1,611.54 and 148.52×104km^2 separately. PM2.5 pollution experienced obvious change worldwide between 2000 and 2014. The area of AQG to

IT-1 decreased with a trend of 125.10×104km^2/year, mainly located in North America and South America. However, the area of IT-1 to 2IT-1 and >IT-1 increased significantly with a trend of 30.52×104km^2/year and 9.11×104km^2/year separately, which mainly occurred in Asia and Africa. Developing countries are facing great challenges of PM2.5 pollution. For the area of >IT-1, 89.97% is located in developing country. Furthermore, for increased area of >IT-1 between 2000 and 2014, 92.92% is occurred in developing country. Therefore, developing countries must pay close attention to PM2.5 pollution, practices such as emission reduction and optimizing energy structure need to be taken to improve the air quality.

Key words: Pm2.5 Pollution, Pattern and Changes, Environmental Sustainability, Developing Country

Linking Biodiversity, Ecosystem Function, Ecosystem Services, and Human Wellbeing: The Landscape Sustainability Science Paradigm

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Abstract: To make ecology not only relevant to, but also an integral part of, the science and practice of sustainability, it is necessary to link biodiversity, ecosystem function, ecosystem services, and human wellbeing. To do so, I argue, a landscape approach is needed. Landscapes represent a pivotal scale domain for such efforts as they provide a common stage for ecological plays and human actions, and couple regional/global scales above and local ecosystem scales below. Landscape sustainability is the capacity of a landscape to consistently provide long-term, landscape-specific ecosystem services essential for maintaining and improving human well-being. Landscape sustainability science (LSS) then is a place-based, use-inspired science of understanding and improving the dynamic relationship between ecosystem services and human well-being in changing landscapes under uncertainties arising from internal feedbacks and external disturbances. While LSS emphasizes place-based research on landscape and regional scales, significant between-landscape interactions and hierarchical linkages to both finer and broader scales must not be ignored. To advance LSS, spatially explicit methods are essential. In this presentation, I will discuss the key concepts, methods, and examples of LSS, illustrating how biodiversity, ecosystem function, ecosystems services, and human wellbeing can be linked in dynamic landscapes.

Key words: Landscape Sustainability Science, Ecosystem Function, Ecosystem Services, Human Wellbing

Landscape Connectivity and Water-Supply Stability in the World Cultural Landscape Heritage of Honghe Hani Rice Terraces

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Abstract: The stability of water supply is the key to the sustainability of the World Cultural Landscape Heritage of Honghe Hani Rice Terraces. We take corridor systems including river-ditches and terrace-ridges in Quanfuzhuang River basin within the property region as the studying object, select slope and the distances from rivers and ditches as the two resistant factors, analyze the connectivity of river-ditches and its' impacts on the stability of terraces' water supply based on the least-cost distance model by using ARCGIS, the results indicate: Taken ditches, rivers, or river-ditch network as the source for irrigation stability analysis, 1) the maximum number of minimum-cumulative- resistance-value is 6368, 4782 and 3178 respectively, that means the river-ditch networks increased the landscape connectivity and accelerated the irrigation efficiency as well as the stability of terraces' water supply, and 2) The water-supply-stable rice terraces has a 24.81, 53.26, and 66.36 percentage of the total area respectively, that mean the river-ditch networks increased the area of water-supply-stable rice terraces. 3) Taking the spring-water-irrigation terraces in account, both the water-supply-stable area and the landscape stability or sustainability are increased.

Key words: Landscape Connectivity, Least-Cost Distance Model, The Cultural Landscape of Hani Rice Terrace, Water Supply Stability

The Effects of Rapid Urbanization on Vegetation Cover in Metropolises of China over Last Three Decades

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Abstract: The world’s most remarkable urbanization in China during past three decades had been exerting profound effects on vegetation cover and productivity through physically transforming vegetated surface in impervious surface. Normalized Difference Vegetation Index (NDVI) was recognized as a proxy for vegetation productivity, which is the most integrative indicator of ecosystem functions. Better understanding the impact of urbanization on vegetation activities is vital to revise urban planning, to design green space and to promote the effective development of cities in China. In this paper, we used satellite derived night light data, vegetation index data and socio-economic data to analyze spatio-temporal patterns of vegetation changes and

evaluate influence of urbanization on vegetation cover in China's 46 metropolises (full-year 2015 GDP greater than 500 billion and provincial capital) over the last three decades. Firstly, we consulted former researches and empirically inter-calibrated the annual nighttime stable light (NSL) images (1992-2013) collected by the US Air Force Defense Meteorological Satellite Program's Operational Linescan System (DMSP/OLS) to improve the continuity and comparability of the dataset. Secondly, based on extracted built-up area with NSL, trends in the Global Inventory Modeling and Mapping Studies (GIMMS) NDVI for urban land and outer buffers were calculated and compared. Finally, we analyzed the relationships between vegetation activities and urbanization across different cities and periods. Our results suggest that the vegetation cover of built-up area in most cities (78%) except partly western cities like Wulumuqi and Lasa is not as good as the buffer zones and the NDVI increase rate of most cities (83%) and across all cities during 1982-2013 is remarkably less than that of the buffer zones. The percent of vegetation degradation pixels in built-up area of most cities was larger than that in buffer zones, and it was opposite for pixels experienced degradation restoration. The variations in yearly relationships between mean NDVI and mean digital number value for all the pixels in each urban land revealed that cities with higher the light appeared to have more vegetation biomass in the early years, and the negative correlations became weak in the more recent years, which mean that the adverse impacts of urbanization on vegetation in built-up area were gradually diminishing, even disappearing. From 1982 to 2013, the significant NDVI changes in built-up area of most cities (67%) followed 'U' shapes, first falling then rising with enhancement of urbanization level. This phenomenon may further verify that positive urbanization effects exist in urban growth. Overall, current urbanization has resulted in deterioration of urban vegetation across most cities in China during the past three decades, but the negative impacts were reducing with the slowdown of urban expansion, and more attentions and investments in urban green space. More works are needed to distinguish turning point of NDVI change for each metropolis and maintain the balance of urban ecosystem in the context of swift urbanization in China.

Key words: Nighttime Light Data, Normalized Difference Vegetation Index (NDVI), Urbanization, Vegetation Cover Change

Evaluation of Green Appearance Percentage in Recreational Open Space

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Abstract: Recreational open space, with the speeding up of urbanization process, is

becoming more important as part of the support and carrier of leisure and recreational activities. This paper presents the research which focuses on correlation between green appearance percentage, landscape components in the scene and user's landscape evaluation, and provides insight for design and management.

The first process of this study refers to twenty photographs that depicted recreational open spaces with different levels of green appearance percentage in Shanghai and generates a questionnaire survey. From October to November, 2016, 83 people were surveyed using eye tracking and web photo-questionnaire consisting of twenty photographs. The survey was analyzed using SPSS statistic methods including bivariate correlation and partial correlation analysis in order to analyze correlation between user's landscape evaluation, eye tracking data and the proportion of landscape components in the scene.

The results show: Photographs with high green appearance percentage were perceived as high landscape evaluation. Trees, grass, other people, visually dominant element and hardscape in the scene are significantly related to landscape evaluation. To this issue, in recreational open space, to plant planting can improve the visual landscape quality and increase user's favor. Control the proportion of trees, grass, other people, visually dominant element and hardscape may improve landscape evaluation.

Key words: Green Appearance Percentage, Landscape Evaluation, Recreational Open Space, Eye Tracking

Study on the Change of Landscape Space in the Core of the World's Important Agricultural Cultural Heritage ——a Case Study of the Longxian Village in Qingtian County of Zhejiang Province

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Abstract: Abstract: Qingtian Zhejiang rice fish symbiosis system as China's first global agricultural cultural heritage, attracts many domestic and foreign tourists every year, tourism development affects the development of the village and the living standard of the local people, but at the same time, the space landscape of the dragon village, which is also the core of the heritage, has produced great changes. The author uses the field questionnaire survey, comparative analysis research method and geographic information system three methods, from the whole space, architectural form, three aspects of land use to analyze the landscape of the village from 2005 to 2013 in the evolution of space, exploring its evolution process and driving factors. Research shows, the evolution of landscape pattern is the result of tourism development, overseas Chinese factors and policy factors, among them, the overseas Chinese factor has played

a subtle role in the change of the landscape pattern of the dragon village.
Key words: Agricultural Cultural Heritage, Village landscape, spatial variation, Longxian village

Water Shortages Influence the Sustainable Development of the Drylands of Northern China: Evidence from the Water Stress Index

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Abstract: Developing a greater understanding of water stress dynamics is crucial for sustainable development in global drylands. The primary goal of this study was to examine the water stress dynamics throughout the drylands of northern China (DNC). We first calculated the water stress index (WSI) of all 474 catchments in the DNC in 2003 and 2014. Then, we investigated the water stress dynamics in the DNC between 2003 and 2014 at multiple scales, which included the entire DNC, the drainage basins, and the main cities. In 2014, we found massive water stress in DNC over an area of 2.05×106 km^2, which accounted for 52.13% of the total area of the DNC (Fig. 1). From 2003 to 2014, the water stress in the DNC increased primarily because of increases in the area of irrigated croplands and the population of urban areas, and the total increase in the water stress area reached 3.14×105 km^2, which accounted for 7.98% of the total area of the DNC (Fig. 2). We also found that water shortages influenced the sustainable development of the DNC because the population and urban land area within the water stress region of the DNC have rapidly increased over the past two decades. Thus, we argue that effective actions are required to address the water stress in the DNC.
Key words: Drylands Of Northern China, Water Stress Index, Water Shortage, Sustainable Development

Design and Assessment of Urban Stormwater Green Infrastructure to Improve the Health and Well-Being of Residents in Detroit, MI, USA

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Abstract: To address the problem of combined sanitary sewage and urban stormwater polluting surface waters in Detroit, MI, USA, we collaborated with local government decisionmakers to design and implement a new form of land-based green infrastructure (GI) on vacant property. Employing vacant property that permeates the residential landscape matrix of Detroit, this new form of GI is particularly relevant to landscape

multi-functionality. We use a design-in-science approach to iteratively propose, develop, and assess the performance of this form of GI. Water quality and quantity, governance characteristics, and human health and well-being are factors in our assessment.

Here, we describe our transdisciplinary study design and the essential functional elements of our design for this new form of GI. We focus on neighborhood residents' perceptions and behaviors relative to this form of GI, and implications for human health. In this study, we surveyed all households located within 800 feet of our four pilot sites (n=164) to assess residents' perceptions of the attractiveness and safety of this GI design, its anticipated effects on their mental health, physical activity and interactions with neighbors, and its anticipated effects on their own homes' property values and neighborhood safety. We discuss the implications for residents' health and well-being and for the stewardship and sustainability of GI.

Key words: Water Quality, Social Survey, Perception, Urban Landscape

Linking Landscape Pattern and Soil Water Conservation in Loess Plateau of China

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Abstract: Soil water is reliable water resource for plant growth in arid and semi-arid regions. For decreasing serious soil erosion and improving regional ecosystem services, large-scale human-introduced vegetation restoration was initiated in the Chinese Loess Plateau in late 1990s. Great changes have taken place in the landscape pattern of the Loess Plateau. However, these activities may result in excessive water consumption and soil water deficit if no appropriate scientific guidance were offered. This in turn impacts the regional ecological restoration and sustainable management of water resources. In this study, soil water content in depth of 0-5 m was obtained in growing seasons from 2014 to 2016 by field observation and geostatistical method in 6 small watersheds with different landscape pattern. Profile characteristics and spatial-temporal patterns of soil water conservation ability were compared and analysed between different landscape types, hillslopes, and watersheds. The results showed that: (1) introduced vegetation consumed excessive amount of water when compared with native grassland and farmland, and induced temporally stable soil desiccation in depth of 0-5 m. The introduced vegetation decreased soil water conservation ability to levels lower than the reference value representing no human impact in all soil layers, and no significant difference had been found in soil water content between different introduced vegetation types. (2) The analysis of differences in soil water at hillslope and watershed

scales indicated that landscape type determined the spatial and temporal variability of soil water. Soil water conservation ability at watershed scale increased with the increasing area of farmland, and decreased with increasing percentage of introduced vegetation. The landscape structure determined the soil water conservation ability and spatial pattern determined the spatial-temporal variability of soil water conservation ability at watershed scale. (3) Large-scale vegetation restoration with introduced vegetation diminished the spatial heterogeneity of soil water at different scales. The landscape pattern optimization should be preferred in vegetation type selection in the Loess Plateau to improve the water resources management and maintain the sustainability of vegetation restoration.

Key words: Vegetation Restoration, Soil Water Conservation, Spatial-Temporal Pattern, Landscape Pattern Optimization

The Effects of Green Space on Self-Reported Health at Different Spatial Scales in Singapore

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Abstract: An emerging number of studies on the relationship between green space and health lead us to suggest that such a relationship is scale-dependent. For instance, there are generally no or poor relationships between green space and health in studies conducted at the city level; at smaller spatial scales, different strengths in the association between green space amount and health outcomes have been reported. However, detailed understanding on the dependence of green space and health relationships on scale of analysis is still scarce as very few studies explicitly examine such a dependence. We report in this presentation a study which examined green space and association with health in the context of a high-density compact city. We derived the self-reported health data from a Singapore national health cohort survey conducted from April 2014 to April 2015. A total of about 2000 points were used for analysis. The quantity of green space at the buffer area with radii of 400 m and 800 m linked to each respondent's residential address were calculated using vegetation cover data. Through spatial assessment and correlation analysis, we analyze the relationship between green space quantity and self-reported health at two spatial scales. The results from this study contributes to the importance of considering scale in spatial analyses and help to inform policy making about the appropriate scale for greenery planning and provision.

Key words: Green space, Self-reported health, Scale effect, Singapore

Bamboo Status, Consumption Pattern in and Around Inani Protected Forest of Cox's Bazar, Bangladesh

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Abstract: The Inani Protected Forest of Cox's Bazar district is one of the major reservoirs of bamboo in the South-Eastern part of Bangladesh and collection of bamboo is notably important to the inhabitant of that area. The study was carried out in natural forest and homestead bamboo stand using vegetative sampling, questionnaires, key informant interviews and local market observations to assess production and monetary services. The study found 7 bamboo species in the homestead of which 3 were available in natural forest. Melocanna baccifera comprised the highest abundance (2133 culm/ha) in both study area. In case of natural regeneration, the same species showed highest performance with 11 culm/clump. Local demand of bamboo ranged from 6% to 32% of the total collection, mostly used for building materials, utensils, farm equipment and betel leaf cultivation. Rest of the collected bamboos were sold that could generate a handful income ranging from 2000- 100000 taka/year. Though proper management system was absent in natural forest and homesteads the relative productivity in the former was less than the later due to over exploitation. The presence of more species and higher productivity in the homestead could reduce the over exploitation pressure on the adjacent natural forest.

Key words: Bamboo Diversity, Bamboo Utilization, Monetary Services, Bamboo Potential

Behind the Rapid Expansion of Urban Impervious Surfaces in China: Major Influencing Factors Revealed by a Hierarchical Multiscale Analysis

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Abstract: Identifying major factors influencing the dynamics of urban impervious surfaces (UIS) is crucial for better understanding urbanization patterns and their impacts on the environment. However, studies that simultaneously consider multiple UIS-influencing factors on multiple administrative levels and spatial scales are still lacking. The main goal of this study thus was to determine the major socioeconomic factors that shaped the spatiotemporal patterns of UIS in China from the county to

provincial levels during the recent decades. Specifically, based on remote sensing and statistical data from 1992 to 2009, we examined the relationship of UIS to a suite of socioeconomic factors, and investigated how the relationship changed with hierarchical administrative levels and corresponding spatial scales. Our results show that the key influencing factors of UIS varied substantially across hierarchical administrative levels: economic factors dominated the provincial level, demographic factors dominated the county level, and a mixed group of economic, demographic and traffic factors were important at the prefectural level. This suggests that, for determining major influencing factors for UIS, a hierarchical or multiscale approach is preferred to any single-scale analysis. Our findings from such a hierarchical perspective provide useful information for formulating mitigation strategies for excessive UIS expansions and for designing more sustainable cities. Evidently, policies to control rampant expansion of UIS in China need to combine macro-scale economic regulations with micro-scale demographic planning measures.

Key words: Urban Impervious Surfaces (UIS), Socioeconomic Factors, Urbanization, Hierarchical Analysis

Optimization Schemes for Grassland Ecosystem Services under Climate Change

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Abstract: The ecosystem and associated ecosystem services in arid and semiarid area are sensitive to climate change and human activities. Guiding human activities based on optimization on ecosystem services can make human adapt to climate change effectively, which is vital for regional sustainability. We evaluated potential distribution of four ecosystem services: net primary productivity (NPP), soil conservation (SC), water yield (WY), and water retention (WR) in the grassland and agro-pastoral transitional zone of China (GAPTZ) under future climate scenarios of representative concentration pathway (RCP) 4.5 and RCP 8.5 in 2050, respectively. We designed four grazing intensity scenarios of ungrazed (UG), lightly grazed (LG), moderately grazed (MG), and heavily grazed (HG) and analyzed impacts of climate change and grazing on the four ecosystem services. Finally, we respectively presented the optimization schemes of grazing intensity in GAPTZ under the objectives of strong sustainability in which total ecosystem services should not degrade compared to the scenario of ungrazed and weak sustainability in which total ecosystem services can endure degradation to some extent. The results showed that spatial distribution patterns of ecosystem services in GAPTZ are similar in the RCP 4.5 and RCP 8.5 scenarios. Both

of climate change and grazing will exert an influence on supply and interrelation of ecosystem services. The northwest and the north-central of GAPTZ are sensitive areas for ecosystem services to climate change and grazing activities. In some topical areas of GAPTZ, LG and MG can stimulate grassland to tiller and enlarge ecosystem services integrally. HG has the severest negative effect on ecosystem services overall. It notably decreases the vegetation coverage of grassland and reduces the transpiration of plants, which promotes runoff and increases the risk of soil erosion. In the alfafa (Medicago sativa L.) planting areas, HG will exert little negative effect on overall ecosystem services. Under the objective of weak sustainability, LG can be widely adopted in GAPTZ. Under the objective of strong sustainability, grazing should be banned in the northwest and the north-central of GAPTZ. Studies on the change of ecosystem services under the scenarios of future climate change and human activities have important practical significance in formulating regional adaptation measures and realizing regional sustainability.

Key words: Arid Area, Grazing Intensity, Human Activities, Arid Area

Mapping Cultural Ecosystem Services through Crowd-Sourced Information: An Empirical Approach across European Landscapes

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Abstract: There is an increasing interest in the ecosystem-based approach to land management that calls for operational cost-effective methods for assessing ecosystem services (ES) at different spatial scales. When focusing on intangible ES, such as cultural ecosystem services (CES), it is particularly challenging to assess both the capacity of ecosystems to provide them and the extent of their use by people. This is why it is becoming important to develop methods to capture people CES' perceptions and be prepared to monitoring their evolution and variability in terms of space and time. Hence, the potential of crowdsourcing geospatial data is growing with the advances in web technology and the emergent accessibility to internet and mobile devices, allowing the acquisition of an increasing amount of worldwide distributed data which would have been unthinkable until recently. Within this context we propose to identify emergent patterns of spatial distribution of CES based on the presence of visitors inferred from geolocalized Flickr photos. These spatial patterns could be used to assess and understand preferences and the factors that determine their provision from local to broader scales. In particular, explanatories variables related to landscape settings but also to the Flickr users' timeline will be extracted to investigate how CES beneficiaries interact with their environment and natural settings according to its complexity and

their mobility behaviours in space and time. This will allow us to gain a better insight in CES and the complex interrelation perceived across time and space.

Key words: Nature-Society Interactions, Land Management, Cost Effective Method, Spatio-Temporal Scales

Restriction on Urban Sprawl: An Approach Based on Ecological Security Pattern

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Abstract: Ecological security patterns indicate some potential spatial patterns at the landscape level which is significant to land use allocation with spatial constraints. It can be identified by simulating different ecological processes relating to land use and land cover change. In recent years, the rapid expansion of urban built-up area has caused plenty issues such as the destruction of the ecological system, land degradation and urban sprawl. Analysis of ecological security pattern is not only essential to protect natural environment but also important to land use planning especially in restricting urban sprawl. In this study, a case was made in Changchun City, which is an important grain production area and commodity grain base located in northeast China facing severe conflicts between urban expansion and ecological security. The ecological security pattern was constructed by the minimal cumulative resistance model and the basic farmland preservation area was added to be a second constraint for protecting cultivated land. The result shows that ecological security pattern under low security level is the most basic pattern to maintain the indispensable urban ecological processes. The proportion of ecological land is 40.2% under this pattern and the ratio is respectively 71.1% and 85.5% under medium and high security level. In addition, the supply of available construction land can't keep up with the demand under the dual constraints of ecological security patterns and cultivated land protection. In view of the situation of urban sprawl and ecological degradation, appropriate suggestions have been proposed to promote industrial structure adjustment and determine city function reasonably. It is helpful to optimize land use pattern and allocation which can also accelerate the sustainable development of natural ecosystem and urbanization system.

Key words: Ecological Security Pattern, Urban Sprawl, Landscape Pattern, Changchun City

Study on Simulation and Optimization of Landscape Pattern and Urban - Rural Development Strategy in Liaohe Watershed

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Abstract: The study area is Liaohe Watershed in Liaoning Province, China. Landscape pattern of Liaohe Watershed was analyzed based on the data of land use, hydrology, meteorology, socioeconomics and ground ecology monitoring in the period of 2000, 2005 and 2010. Combined method of 3S technology, field investigation and CLUE-S model was used. The developing pattern of urban and rural in Liaohe Watershed was predicted and optimized based on the future land use and ecological security demand.The results are as follows：(1)In different scenarios in the Liaohe Watershed, it shows explicitly an increase in urban land and a decrease in cultivated land. Under the economic priority development scenario, we concluded that the forest land decreased, the cultivated land conversion range increased, the construction land surrounding the developing zones of the Liaohe Watershed gradually expanded which mainly aggregated in Shenyang, Fushun, Anshan and other industrial developed cities. Under the ecological protection priority development scenario, it is discovered that the forests and wetlands gradually increased which mainly located at the east and the south near the mouth of the Liaohe Watershed. (2) According to the "Three-Zone Planning" of Liaohe Watershed, the optimization plan of urban and rural development pattern of Liao Watershed was proposed. Development strategy of urban agglomeration of Liaohe Watershed was put forward based on the spatial structure of ecology, production and sustainability. The study results can provide scientific and technological support for ecological environment management and ecological civilization construction in Liaohe Watershed.

Key words: Landscape Pattern, Scenarios Simulation, Pattern Optimization, Urban - Rural Development Strategy

Linking Ecosystem Services with Grassland Degradation and Restoration: A Case Study of the Xilin River Basin in Inner Mongolia, China

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Abstract: Ecosystem services (ESs) and their changes of natural ecosystems in northern China play a crucial role in determining regional sustainability. During the past several decades, grassland degradation has become one of the most important

ecological and economic issues in this region. Therefore, understanding the relationships between ESs in the process of grassland degradation and restoration have become increasingly important for improving regional human well-being. Our objective was to explore the relationships between ESs and grassland changes induced by vegetation succession in the Xilin River Basin, Inner Mongolia, China. Using vegetation maps derived from remotely sensed imagery collected in 1983, 1989, 2000, and 2011, we calculated the degree of grassland degradation using the Grassland Degradation Index (GDI). Aboveground biomass (AGB), grazing intensity (GI), soil conservation (SC), water retention (WR), carbon storage (CS), and landscape aesthetics (LA) were also estimated to assess ESs for each year. Results showed that (1) GDI increased during 1983-2000 while it decreased during 2000-2011, indicating that grassland in study area has being in a period of restoration since 2000 after experiencing two decades severe degradation. (2) GDI was significantly negatively correlated with AGB, CS, SC and LA. SC, WR and LA affected by grassland conditions greatly. All ESs declined in 1983-2000 and increased afterwards, except GI. The increasing of SC, however, was slow compared to other ESs, which demonstrating the time lag of soil restoration. (3) Grasslands in the middle and lower reaches experienced worse degradation than in the upper reaches. (4) AGB exhibited synergies with CS, SC, and LA while GI presented trade-offs with them. Meanwhile, GI and WR showed trade-offs with AGB while presented synergies with GI. CS and SC exhibited trade-offs with WR respectively, but synergies occurred with LA. Besides, trade-offs existed between CS and SC and WR and LA. In summary, significant changes occurred of grassland ecosystems in the Xilin River Basin over past three decades. Grassland degradation affected ESs deeply. Improving AGB was not the end of grassland restoration. Other ESs of grassland ecosystems, such as SC and WR, should be taken in account in the future.

Key words: Grassland Degradation Index, Ecosystem Services, Trade-Offs and Synergies, Inner Mongolia Grassland

Classification and Tourists `Perception of Soundscapes in the National Park: A Case Study of Yuntai Mountain

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China

Abstract: According to existing literature, little work has been done to understand the acoustic characteristics and the interaction between biological and anthropogenic sounds in the scenic spots, no mention of the tourists` perception and assessment on it. This paper reviews and analyzes the main soundscape descriptors and research

methodsin the soundscape literature. The aim of this study is to classify the soundscape characteristics in nature scenic spots like Yuntai Mountain based on perceptions ofacoustic environments and to examine useful acoustic indicators to identify soundscape classifications.We established 23 locations acrosstheYuntai Mountain in the middle of May 2016 to record environmental sounds and gathered information in field surveys. In total, 248 visitors were recruited to answer a questionnaireon how they perceived the acoustic environment.The results reveal thatsoundscape parameters as sound strength (LAeq), amplitude and frequency together with the sound spectrum and GIS analysis were examined to be useful and practical ways to understand the acoustic environment in a given place. The results alsoshowedthat1) to some extent, theacoustic environment could highly represent the nature characteristics of the Yuntai Mountain, while lacking of representation for the cultural. People`s tourism and daily production activities had dominate impact on the reconstruction of sound environment.2）Tourists` perception and endure threshold of sound strength were not fit well with the level in urbancity. The noise at entrance or from the maintenance which can be found in the mountain had a negative impact on the tourist experience. However, those high strength sounds of wind and water(LAeq>70 dB)which matched better with the landscape were considerate to be comfortable, although that level of sound strength always to be considerate as annoying noise in the urban city. Suddenly occurred biological sound like twitter can be perceived effectively in a noisy environment. The findings could provide useful information for designing appropriate soundscapes in nature scenic spots.

Key words: Soundscapes, Classification, Tourists Perception, Yuntai Mountain

Resolving the Relationships between Ecosystems and Human Wellbeing in Semi-Arid Sandy Land

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Abstract: Context: Desertification has become one of the most serious ecological and social problems in China. Semi-arid sandy land ecosystems are sensitive and vulnerable to desertification. The status and changing trends of sandy land ecosystems are of great value for delivering ecosystem services to society, and it is necessary to understand the interrelationships of all of their ecological and social components to identify appropriate response options for sustainable development.

Objectives: To explore the long-term dynamics and causal relationships of different components of natural and social systems, and properly assess the effects of nature on human wellbeing in sandy lands.

Methods: Studying the Mu Us Sandy Land of China, we examined the complex relationships among various pressures, ecosystem services, human wellbeing, institutional responses, and drivers of change through a combination of the Driver-Pressure-State-Impact-Response (DPSIR) framework and structural equation models (SEMs). First, 14 indicators were selected to operate the DPSIR framework: population, gross domestic product (GDP), wind speed, wind erosion intensity, precipitation, vegetation cover, crop production, meat production, water yield, carbon storage, number of tourists, poverty gap, ecological footprint, and planting area. Their statuses and trends were analyzed for 1990–2014. Then, the SEMs were used to examine relationships among components of the framework.

Results: During the last two decades, natural and direct pressures on the study area have decreased linearly (i.e., increasing vegetation cover and decreasing wind speed and soil loss intensity). Provisioning, regulatory, and cultural services are continuing to grow. The standard of living measured by the poverty gap increased in conjunction with the change in GDP per capita, although the ecological deficit worsened. There was also rapid growth in conservation responses. All of the components analyzed in the SEMs were related statistically. The conservation efforts had a positive effect on reducing the natural pressures in the sandy lands, and this effectively increased the ecosystem services and improved welfare, as measured by economic indicators. Nevertheless, the ecological deficit continued and was negatively correlated with ecosystem services growth.

Conclusions: Strong relations among DPSIR components illustrate the close relationships among pressures, ecosystem services, human wellbeing, institutional responses, and drivers of changes. The ecology crisis still needs attention despite the increasing conservation work being done in sandy lands. We should rethink conservation programs from a more holistic perspective that will ultimately lead to better impacts on natural systems and human wellbeing.

Key words: Sandy Lands, Ecosytem Services, Human Wellbeing, Structural Equation Model

Pathogen Transmission in Fragmented C: Incorporating Ecological and Epidemiological Perspectives

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Abstract: Habitat fragmentation can considerably alter host–pathogen interactions by modifying host movements, host/vector community composition and micro-environments. Previous studies investigating the effect of fragmentation on

disease risk have shown conflicting results, indicating the complex role of habitat fragmentation in pathogen transmission. By summarizing the publised studies, we demonstrated that habitat fragmentation can play a role in three perspectives, namely epidemiological, ecological and evolutionary perspective. However, only recently a few studies tried to incorporating different perspectives. We here first constructed a synthetic framework integrating these three perspectives. Then, we investigated the effect of connectivity on disease risk in a two-host system in fragmented landscapes by incorporating Levins' metapopulation model and SIR model. We found that the net impact of connectivity on disease risk can be either positive or negative, depending on the relative importance of the facilitation effect through increasing contact rates among patches (epidemiological perspective) versus the dilution effect via increasing species richness (ecological perspective). In addition, different risk indices (i.e. infection prevalence and abundance of infected hosts) react differently to increasing connectivity and species richness. Which risk indicator is more likely to have a negative relationship with connectivity depends on the mechanism of the dilution effect (host regulation or encounter reduction) and its strength. Our study may contribute to a better understanding of the impacts of fragmentation on pathogen transmission.
Key words: Habitat Fragmentation, Pathogen Transmission, Species Diversity, Dilution Effect

Impacts of Urban Expansion on Ecosystem Services in the Drylands of Northern China: A Case Study in the Hohhot-Baotou-Ordos Urban Agglomeration Region

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Abstract: Understanding the impacts of urban expansion on ecosystem services (ESs) in the drylands of northern China is important for improving regional human well-being and sustainability. However, assessments on the impacts of urban expansion on ESs in the drylands of northern China have been inadequate. In this paper, we assessed the impacts of urban expansion on ESs in the Hohhot-Baotou-Ordos (HBO) urban agglomeration region - a rapidly urbanizing dryland region in northern China - at three scales: the urban agglomeration, city, and county. First, we quantified four key ESs in HBO in 1990, including habitat quality (HQ), crop production (CP), meat production (MP), and carbon storage (CS). Second, we analyzed the processes and modes of urban expansion in HBO during 1990-2013. Finally, we evaluated the

influences of urban expansion on ESs at the urban agglomeration, city, and county scales. We found that the HBO region experienced a rapid urban expansion between 1990 and 2013, with urban land area increasing from 314.22 km^2 to 692.10 km^2 and a growth of 1.2 times. The rapid urban expansion in HBO region resulted in obvious decreases of the four key ESs. Among these ESs, CP suffered the worst losses, with a decrease of 13581.41 t, accounting for 0.99% of total CP in HBO in 1990. At the same time, MP and CS decreased by 70.19 t and 1.65 TgC, accounting for 0.25% of total MP and 0.29% of total CS in HBO in 1990, respectively. In addition, HQ decreased by 0.47, and accounting for 88.68% of the mean HQ in HBO in 1990. The two modes of urban growth – edge expansion and leapfrog – had the greatest impacts on ESs in HBO region. Between 1990 and 2013, the decreases of CP, MP, and CS caused by edge expansion accounted for more than 60% of the decreases of these ESs in HBO. The losses of MP caused by leapfrog accounted for more than 1/3 of the losses of these ESs in HBO. The large-scale decreases of cropland and grassland during the urban growth of edge expansion and leapfrog were the main causes for the losses of ESs. Thus, we suggest that efficient utilization of urban land and effective management with respect to urban growth of edge expansion and leapfrog are needed to confine the impacts of urban expansion on ESs in HBO.

Key words: Ecosystem Service, Urban Growth Mode, The Drylands of Northern China, Multi-Scale Analysis

The Influence of Spatial Patterns of Canopy Gaps on Sapling Species Richness in Xishuangbanna Tropical Forest Landscape, southwest of China

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Abstract: Tropical forests are highly dynamic and diverse ecosystems, but our understanding of the processes that shape the local abundance and spatial distribution patterns of the tree species within them is still rather limited. In tropical forests, the creation of canopy gaps by one or multiple tree falls is one of the main causes of disturbance and thus potentially one of the main drivers of forest dynamics. The objective of study is to address the relationships between sapling richness and spatial patterns of canopy gaps in Xishuangbanna tropical forest landscape. We assume that the spatial patterns (size, shape and arrangement) of the canopy gaps may have strongly influence on the sapling richness in the tropical forests. To achieve this objective, firstly, the map of canopy gaps was generated by using an unmanned aerial vehicle (UAV) and very high-resolution images in one 20 hectare and ten 1 hectare tropical forest plots in

Xishuangbanna, which have been set up by Xishuangbanna Tropical Garden, CAS since from 2007. Based on the canopy gap map for each plot, we will survey the saplings which linking with each gap. Afterward, the sapling richness will be calculated for each canopy gap. Finally, the relationships between sapling richness and spatial patterns of canopy gaps can be addressed. The primary results would show that, the spatial patterns of canopy gaps have greatly relationships with saplings richness.

Key words: Tropical Forest Landscape, Canopy Gaps, Biodiversity, Unmanned Aircraft Systems

THEME 10

Ecohydrology and Watershed Management

T10-01: Eco-Hydrological Processes in the Changing World: Knowledge and Application

Statistical Modeling of Nutrient Delivery from Watershed Landscapes/Sources to River

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Abstract: Determining riverine nutrient sources (point vs. nonpoint sources and agricultural/forest vs. residential landscapes) is essential for assessing and developing mitigation strategies to reduce excessive nutrient loads that induce eutrophication. However, application of watershed mechanistic models to assess nutrient inputs is limited by large data requirements and intensive model calibration efforts. Simple export coefficient models usually imply considerable uncertainty in adopted export coefficients from other studies. To overcome these issues, based on the fundamental hydrological differences in driving nutrient delivery to river from different sources or landscapes, several statistical models were developed relating the riverine nutrient load to nutrient inputs from point and nonpoint sources as well as from agricultural/forest and residential landscapes in nonlinear forms. Estimates of contributions to riverine nutrient load from point and nonpoint sources as well as from agricultural/forest and residential landscapes can be easily achieved through calibration of the several model parameters. The efficacy of these statistical modes demonstrated for nitrogen and phosphorus source apportionments using a 6-year record for the ChangLe River and a 31-year record for the Yongan River in eastern China. These case studies indicated that riverine retention/release functions play an important role in regulating temporal riverine nutrient load magnitude as well as in apportioning contributions from point and nonpoint sources. Changes in anthropogenic nutrient input magnitude and components, land-use, and climate as well as legacy source can amplify nutrient export from watershed landscapes to rivers. These statistical models are applicable for catchment-based water quality management strategies with limited data requirements, providing a simple, effective and economical tool for apportioning nutrient sources to rivers.

Key words: Nitrogen, Phosphorus, Hydrology, Water pollution

Sediment load variation and simulation in the Yarlung Tsangpo River

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Abstract: Suspended sediment in large rivers has been widely used as a proxy to evaluate regional soil erosion severity and ecological environment condition. Modeling the sediment dynamics in the large revisers is important for practical river management. The Yarlung Tsangpo River (YTR) flowing from west to east across the southern part of the Tibetan Plateau is the longest river in Tibet. However, sediment transport in the YTR is rarely reported due to data scarcity. This study collected daily runoff and suspended sediment concentration (SSC) data for three years from four hydrological stations along mainstream and three along the tributaries of YTR. It is shown that sediment transport mainly occurred from July to September during the rainy season, with highest erosion intensity in the upper middle reach between Lhaze and Yangcun and large deposition in the lower middle reach between Yangcun and Nuxia. Annual sediment transported to the Nuxia station, i.e., the terminus of middle reach was 10.43 Mt with a catchment average sediment yield of 54.4 t/km^2/yr which is lower than the other headwater areas of the Tibetan Plateau. Due to the unique topography and climate features of the Tibetan Plateau, traditional sediment rating curves (SRCs) and subdivision methods such as discharge classes (low, normal and high flow) and discharge stages (rising and falling limbs) have various deficiencies in estimating SSC in the YZR. As a result, new SRC subdivision methods based on flood ranks (FR) and SSC stages (SSCS) were proposed in this study. Results showed that the new methods were more accurate for estimation of SSC and subsequent sediment load in the YZR, and could also be helpful for sediment transport study in other alpine river basins under similar conditions.

Key words: Suspended Sediment, Soil Erosion, Sediment Rating Curve, Sediment Yield

Roles of Alpine Grassland Vegetation on Hillslope Hydrological Processes in Permafrost Watershed

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Abstract: An understanding of water yield properties within the frost vegetation-active soil system is critical to accurately forecasting the influence of global climate change on the water cycle in the permafrost regions. However, there are little knowledge on the mechanism of the impacts of the frost soil thawing–freezing cycle and vegetation cover coupling on the hydrological processes in the permafrost region. Two main types of grasslands on the Qinghai-Tibet Plateau, alpine swamp and alpine meadow, were selected for this study. The impacts of alpine grassland cover changes on the hillslope

water cycle were analyzed in terms of runoff generation, precipitation interception, dew water formation, and soil water dynamics of the active layer, etc. The results showed that different types of grasslands led to different runoff generation regimes; namely, runoff varied linearly with precipitation in alpine swamp, whereas in alpine meadow, runoff exhibited an exponential precipitation-dependence. The decrease in vegetation cover in alpine swamp leads to a decrease in soil moisture content in the top 20 cm of the soil, a delay in the thawing start time in the spring, and a decrease in both surface runoff and subsurface interflow. In alpine meadow, however, the decrease in vegetation cover led to a significant increase in the depth of topsoil moisture content during the thawing period, earlier occurrence of thawing, and an increase in the runoff generation ratio. The alpine meadow vegetation canopy had a higher maximum interception ratio and saturation precipitation than alpine swamp vegetation. With the decrease in vegetation cover, the rainfall interception ratios decreased by almost an identical range in both the alpine meadow and alpine swamp grasslands. Dew water commonly occurs on alpine grassland, accounting for about 12.5-16.5% of precipitation in the same period, and thus, is an important component of the water cycle. With the degradation of vegetation, surface dew water decreased; however, the ratio of dew water formed in the air to the total amount of dew water rose significantly. The results also showed the vegetation cover significantly controls the young water fraction of the streamflow. At the hillslope scale, the changes of alpine vegetation cover had a great influence on the water cycle, which were partly attributed to that the changes of alpine vegetation cover directly altered the surface energy balance, surface water cycle processes, and the thermal and hydraulic properties of active soil.

Key words: Alpine Grassland, Hillslope Water Cycle, Influence, Permafrost Watershed

Effects of hydrological gradients on plant functional compositions and ecosystem functioning in Poyang Lake wetland

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Abstract: Functional trait approaches have greatly improved the mechanistic understanding of the impacts of biodiversity in ecosystem. Yet, what the relative importance of different biodiversity components (i.e., taxonomy and function) in determining ecosystem processes remains unclear. We evaluated how hydrological gradients (i.e., soil water content and elevation) affected the taxonomic diversity, functional identity and functional diversity, and assessed how changes in these measures of diversity ultimately drove variations in above-ground biomass (AGB). We

sampled 129 plots and measured seven functional traits and abundance of 27 plant species in Poyang lake wetland. Results showed that a combination of hydrological gradients and functional trait composition (i.e., the community weighted means, the single trait functional diversity and the multiple trait functional diversity) better explained variations (40.8%) of AGB. No significant relationships between taxonomic diversity and AGB were observed. A significant functional response of wetland plant communities to hydrological gradients was observed, although no clear patterns upon taxonomic diversity varied along the gradients. The dominant species became taller with thicker stem and co-occurring species showed greater divergent distribution of stem diameter towards higher soil water content. As elevation increased, the dominant plant had thinner leaves with later onset of flowering and longer flowering duration, and co-occurring species showed less divergent distribution of lamina thickness and leaf dry mass content. Our results highlight that the positive BEF relations were largely attributed to the co-operations of selection effects and complementary effects, as evidences that the dominant trait values (i.e., community weighted mean of shoot height) and trait diversity (i.e., functional evenness) improved biomass production of wetland plant.

Key words: Poyang Lake, Hydrological Gradients, Functional Compositions, Ecosystem Functioning

Understanding Eco-Hydrological Processes by Coupling the Carbon and Water Cycles

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Abstract: Future climate change will have unprecedented impact on ecosystem function and hydrological regime. Changes in water availability will result from altered rainfall quantities and dynamics, warmer temperatures influencing evaporation and plant transpiration, and the modulation of these fluxes through changes in vegetation structure and function. The strong regulation of ecosystem on carbon and water fluxes by stomata is well understood at the leaf level. However, at regional scales the coupling is complex, and is dependent on the plant canopy leaf area and the physiological response of plants to soil water stress, soil properties and atmospheric boundary layer dynamics. Because water and carbon are cycled through the landscape at different rates, the degree of coupling between the two cycles can also vary at different time scales. In this study, we first examined the global flux station data to identify dominant controls on evapotranspiration and gross primary production (GPP). Results showed that precipitation and potential evaporation exhibited different controls on annual

evapotranspiration depending on climatic conditions. GPP showed strong correlation with both precipitation and potential evaporation. We then estimated annual GPP by combining an analytical water use efficiency (WUE) model with evapotranspiration obtained from hydrological observations and the results agreed well with the observations. This study demonstrated the importance of coupling the carbon and water cycles in eco-hydrological modelling for estimating future water availability and ecosystem function.

Key words: Ecohydrology, Carbon Cycle, Water Cycle, Climate Change

Global Scale Estimation of Vegetation Dynamics from Microwave Observations for Ecological Monitoring

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Abstract: Satellite measurements in the visible to infrared (IR) bands have long been widely used to gauge vegetation dynamics at large scales. High spatial resolutions (e.g. 500 m) and high sensitivity to photosynthetic activities can be achieved at visible/IR bands thanks to the short wave lengths. However, the advantages of visible/IR come with challenges like cloud covers (complete blockage even under light cloud conditions) and shallow penetration in the canopy (only the outer layer of plants/trees is seen). In these respects, microwave satellite measurements offer many advantages, e.g., unaffected by clouds and sensitive to the overall biomass instead of the outer surface, although the spatial resolution is lower (25-50 km). Existing models for soil moisture remote sensing from passive microwave measurements, e.g. Land Parameter Retrieval Model (LPRM), have been able to estimate soil moisture and Vegetation Optical Depth (VOD) simultaneously but they suffer from strong noises in daily VOD retrievals. This work tries to produce smooth VOD retrievals (with an assumption that VOD basically remains unchanged over a short time period like days) using multiple X-band brightness temperature (Tb) observations from the AMSR-E sensor. The methodology utilizes Tb values under a moving-time-window setup to estimate concurrently the soil moisture of each day and a constant VOD in the window. The smooth VOD along with soil moisture retrievals is generated for the 10-year duration of AMSR-E (2002-2011) with a 7-day moving window. The spatial patterns of resulted global VOD maps are in coherence with vegetation biomass and climate conditions. The new VOD datasets have the potential to improve large scale ecological monitoring, especially for areas of high cloud coverage. Also, the methodology proposed is generic and can be implemented over currently operating microwave missions like AMSR2, SMOS and SMAP.

Key words: Microwave, VOD

Response of Transpiration to Seasonal Rainfall Redistribution in a Subtropical Evergreen Broad-leaved Forest

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Abstract: Conducting precipitation manipulation experiment to investigate the response of evergreen broad-leaved forest trees to predicted changes in precipitation helps evaluate this forest type response mode to future climate regimes and quantify the impacts of precipitation changes on forest ecosystems, and thus provides fundamental information for its conservation and management. In this study, we conducted a two-year seasonal rainfall redistribution experiment to assess the response of transpiration in dominant species to changes in precipitation in a subtropical evergreen broad-leaved forest. In accordance with the precipitation patterns observed in southern China in recent decades, we administered 3 treatments in a manipulated rainfall experiment including a drier dry season and wetter wet season treatment (DD), an extended dry season treatment (ED) and an ambient control treatment (AC). The total amount of precipitation is almost equal across the three treatments (with standard error of 46 mm and 52 mm for 2013 and 2014, respectively). Our results showed that the DD treatment reduced daily transpiration for Schima superba by 15.8% and 7.6% in the first and second hydrologic year, respectively, while the reduction was 25.3% and 13.4% under the ED treatment. In contrast, neither treatment showed an obvious effect on another dominant species of the forest, Michelia macclurei. At the stand level, the extended dry season treatment caused a decrease in transpiration during the spring drought period and the irrigation period. Moreover, S. superba had a lower ratio of the transpiration to manipulated precipitation than M. macclurei under DD and ED but not under the AC treatment, and showed decreased sensitivities to total solar radiation and vapor pressure deficit under DD and ED treatments. These results indicate that the deep-rooted S. superba may have a weaker ability of obtaining water than the shallow-rooted M. macclurei during the early periods under future changes in precipitation patterns, which could potentially cause dominance shift of species in the forest community.

Key words: rainfall redistribution, transpiration response, sap flow, evergreen broad-leaved forest

Dynamic Modeling of Climate Change Impacts on Vegetation–hydrological Process in Jinghe Watershed

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Abstract: In order to reveal the impacts of climate change on vegetation-hydrological processes of Jinghe Watershed, in this paper, based on the CRU TS 3.23 dataset and the 0.5×0.5 °grid data from the China Meteorological Administration, meteorological data were reconstructed from 1901 to 2012, and vegetation and hydrological effect of Jinghe watershed were simulated dynamically by using LPJ dynamic global vegetation model. The results are as follows. 1. The abrupt change point of annual precipitation in Jinghe watershed occurred in 1960, that is, the annual average precipitation during the years of 1961-2013 increased obviously than that in the years of 1916-1960, and the abrupt change point of annual average temperature occurred in 1953, from the process perspective, the annual average temperature has experienced a oscillating process from relatively low to high and then go back to low temperature period, finally it returned to high period. 2. The annual runoff (R), the annual actual evapotranspiration (E), the runoff coefficient (α), and the average value of various functional vegetation's leaf area index (LAI) are all found to have a positive correlation with the annual precipitation, while no fixed relations with annual average temperature. According to the analysis of the Net Primary Productivity (NPP), the influences of annual precipitation and annual average temperature on the NPP are not fixed relations.

Key words: Vegetation–Hydrological Process, Dynamic Global Vegetation Model, Jinghe Watershed

The Determinants on the Hysteretic Relationships between Sap Flow and Meteorology in a Humid Subtropical Catchment

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Abstract: Hysteretic phenomena between transpiration (sap flow, SF) and meteorological factors (MFs) have long been recognized, however, the determinants on lag time (LT) of SF vs. different MFs are still inconsistent. This study aims to propose an integrated index that works for all of the LTs of SF vs. different MFs. This index reflects the difference in meteorological factors between the hourly mean value when SF rate at highest state and the hourly mean value at the inflection point (time) when the SF has the first sharp rise, and named D-value (DV) in this study. Based on the in-situ monitoring of SF dynamics (for Zenia insigins Chun) during Jan. 2014 to Jul. 2015 in

a humid subtropical catchment, DV presents well performance in explaining all of the LTs between SF and MFs: R2 is 74.0, 77.4, 63.3 and 77.7% for TEMP (temperature), PAR (photosynthetic active radiation), VPD (vapor pressure deficit), and RH (relative humidity), respectively. In addition, PAR often advanced 67.4 min before SF, while TEMP, RH and VPD often lagged behind SF by 90.5, 91.6 and 92.9 minutes, respectively. This study will be helpful for further understanding of hysteretic phenomena and improving modeling of transpiration processes.

Key words: Earth's Critical Zone, Ecohydrology, Soil Hydrology, Landscape Ecology

Application of Biofilm's Carbon and Nitrogen Stable Isotope Ratios as Supplementary Index for River and Stream Ecosystem Assessment

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Abstract: Biological indices are useful tool representing the structure and function of ecosystems. For the monitoring of streams, the diatom indices are extensively used as important water environment indicators. However, the information regarding the interactions between diatom community and various environmental stresses are still limited, and for non-taxonomists, identification of diatoms is an arduous task requiring high-level taxonomic skills. Benthic biofilms consist of microorganisms (e.g. plankton, bacteria), and fine detritus particles (e.g. fecal material, soils) adhering fluvial substrates. Diatoms are the primary component of biofilms. In the present study, we measured carbon and nitrogen stable isotope ratios of biofilm which includes diatom community, and tested its availability as supplentary index for diatom indices. Stable isotope analysis of carbon and nigroen is a practical technique in food web studie. δ13C signatures can describe the sources of organic components. On the other hand, δ15N signatures can indicate the trophic position of organisms and water environment condition (e.g. eutrophication and impacts from human). Therefore, stable isotope analysis of benthic biofilm can provide valuable information for the interpreting the response of biological indicators against various environmental stresses. Simultaneously, stable isotope analysis potentially makes monitoring water environment easier. We collected biofilm samples from 15 streams including urban, agricultural, and undisturbed natural streams in spring and fall, and measured their carbon and nitgroen stable isotope ratios. Each site at least three pebble-to-cobble sized stones and their slurry respectively divided in four parts: diatoms observation, benthic biofilm stable isotope analysis, chlorophyll a measurement, and preservation. Diatom species compositions were analyzed according to the European standard 13946：2003,

and hot ethanol method was used for chlorophyll a measurments. The relationships among the water quality parameters, diatom indices, and biofilm stable isotope ratios were estimated by correlations and multivariate analyses. The linearity between the indicies was tested, and supplementary information given by isotope analysis such as sources of organic components and pollution was applied to the interpretation of diatom indicies and ecosystem health assessment.

Key words: Biofilm Stable Isotope Analysis, Diatom Indices, Bio-Indicator

An Experimental Investigation of Kinetic Fractionation of Open-Water Evaporation at a Large Lake

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Abstract: The oxygen isotopes of water (H218O and H216O) are tracers widely used for the investigation of earth science problems. The tracer applications are based on the premise that the 18O/16O ratio of open-water evaporation (delta_18OE) can be calculated from environmental conditions. A long-standing issue concerns the role of kinetic fractionation, or diffusion transport, in the evaporation process. Here we deployed an optical instrument at a large lake (area ~2400 km^2) to make in-situ measurement of delta_18OE and delta_D of open-water evaporation. Our results show a much weaker kinetic effect than suggested by the kinetic factor epsilon_k adopted in previous studies of Lake Hydrology (14.2‰). By incorporating in the H218O isotopic mass balance of the lake and a lower epsilon_k value (~6.2‰) used for ocean evaporation in global climate models, we obtain a lake evaporation rate that agrees with an independent eddy-covariance observation but is 70% higher than if the standard lake epsilon_k value of 14.2‰ is used. These results may have important implications for the studies on terrestrial hydrological cycle, paleoclimate reconstruction and climate models.

Key words: Stable Isotope, Kinetic Fractionation, Craig-Gordon Model, Lake

Spatial Distribution of Qinghai Spruce Forests and the Thresholds of Influencing Factors in a Small Catchment, Qilian Mountains, Northwest China

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Abstract: Forest restoration in dryland mountainous areas is extremely difficult due to dry climate, complex topography and enhancing climate change. Thus, exact identification of suitable sites is required. This study at a representative small watershed of Qilian Mountains in Northwest China aimed to determine the important factors and their thresholds limiting the spatial distribution of Qinghai spruce forests, the absolute dominant tree species in the study region. It was found that the potential distribution area of Qinghai spruce forests is within an ellipse with the axes of elevation (from 2673.6 m to 3202.2 m) and slope aspect (from -162.1 ° to 75.1 ° deviated from North). Within this ellipse, the suitable sites have a soil thickness ≥40 cm and suitable slope positions (lower-slope, lower- or middle-slope, any slope position if the elevation is <2800 m, 2800-2900 m, <2900 m, respectively). The corresponding threshold of mean annual air temperature at the upper elevation boundary is -2.69 ℃, while the threshold of mean annual precipitation at the lower elevation boundary is 374 (331) mm at the small watershed (and study area). The high prediction accuracy of forests distribution using the above mentioned 4 factors can help to increase the afforestation success through identifying suitable sites.

Key words: Qinghai Spruce Forest, Spatial Distribution, Topography Factors, Climatic Factors

Landscape Layout Affect the Karst Depression Ecosystem Waterlogging Tolerance

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Abstract: Southwest China, as one of the largest contiguous karst regions in the world, is a fragile ecosystems and characterized by enclosed depressions surrounded by overlapping hills and ridges. Increasing extreme rainfall event caused by climate change and poor drainage of karst depressions make depression waterlogging more

frequently, which would undermine the stability of the Ecosystem in karst areas. However, the effect of waterlogging on the karst depression ecosystem is quite few.
In a typical karst catchment of southwest China, an extreme rainfall event was occurred in summer and can provide an opportunity to test whether the current landscape layout is benefit for karst depression ecosystem waterlogging tolerance. Therefore, two main crops of Maize and Napier grass at different relative elevation (RE) in karst depression was selected to evaluate the influence of extreme rainfall event on percentage of dead parts, component biomass, and functional traits (leaf photosynthetic capacity and fine root biomass) of these two crops.
After flooding, the mortality of Napier grass and Maize was 10.5% and 90.5%, respectively. Napier grass was dead below RE 3 m (elevation 386 m), and Maize seeds stop developing below RE 6 m (elevation 389 m). With relative elevation decreasing, leaf photosynthetic capacity of Napier grass had no significant change (except the lowest point below RE 3 m), but that of Maize was weakened significantly ($P>0.01$). Moreover, fine root biomass of Napier grass (361.8-1499.5 kg/hm2) was 2 orders of magnitude higher than that of Maize (6.8-42.2 kg/hm2) to stop soil erosion. It is essential to make good use of micro topography to adjust the agricultural layout for facing the problem of increasing extreme rainfall event in the future. Napier grass was recommended to plant in low-lying place (below elevation 389 m) and Maize in relatively high elevation farmland (above elevation 389 m) to upgrading waterlogging resistance and disaster mitigation of ecological function of karst depression ecological system. In doing so, this landscape design may resist waterlogging better than before.This study was supported by the National Natural Science Foundation of China (41471233; 41571130073)
Key words: Ecohydrology, Mortality, Functional Traits, Micro Topography

Relationship between Typical Shrub/Grass Ecosystem and Soil Moisture at Different Scales in the Loess Plateau, China

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Abstract: Due to the significant impact of global climate change on ecosystem restoration in semi-arid and arid regions, researches on the relationships between soil moisture and vegetation have attracted increasing attention from researchers. The Loess Plateau of China is typical arid-semiarid area and it occupies 6.54% of the area of China. After many years from the beginning of the Grain to Green project, shrub and grass land occupied more than half of the total area of Loess Plateau, while the conflict between plant and soil water content becomes more evident with the area and age of

shrub and grass planting areas increasing. Most of the existing studies focus on a chosen scale while multi-scale studies are needed in the general construction of vegetation restoration in this region. In our study, Transect scale, catchment scale and region scale are chosen as research scales. For regional scale, 60 sampling points were chosen in different precipitation gradients; for catchment, 150 sampling points were chosen in the Ansai catchment and for transect scale, 9 sampling points were distributed along each slope in Liuping watershed. The dominant species in all the sampling points are typical shrub or grass such as Medicago sativa L., Stipa Bungeana Trin., Caragana Korshinskii Kom. or Hippophae rhamnoides L. The results show that the impact of vegetation on soil moisture is more obviously in catchment scale, while the impact of precipitation and soil properties on soil moisture increases gradually as the increasing of scale. The decreased soil water content is more obvious in the soil layers with active vegetation roots. Although the Medicago sativa L. and Caragana Korshinskii Kom. have better economic benefits, the Stipa Bungeana and Trin. Hippophae rhamnoides L. are more suitable for restoration due to the ecological benefits. With regard to the spatial distribution of vegetation restoration, the economic and ecological benefits must be balanced so that the ratio of artificial vegetation and natural restoration can be optimized to realize the continued sustainability of vegetation restorations.

Key words: Soil Moisture, Scales, Shrub/Grass, Loess Plateau

Shifting Determinants for Long Term Stream Drying: Insights from the Coupled Human and Natural Systems in the Loess Plateau of China

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Abstract: The human domestication of vast landscapes has recently generated research interest in analyzing how human activities shape ecosystems that provide vital ecosystem services (ES) in coupled human and natural systems (CHANS). As a very important ES that provides for the provisioning of fresh water in support of human life and economic development, human intervention has strongly altered patterns of river runoff. However, few studies have addressed the anthropogenic changes that have altered the complexity and nonlinearity of runoff. This study applied transition analysis and found stream flow of a typical CHANS in the Loess Plateau has continued to decrease since the 1960s, at an average rate of −0.93 mm per year ($P < 0.001$). Although precipitation was dominant in causing variations in stream flow both for the entire period of 1961–2009 and soon after recovery from disturbance, human regulation

played a dominant role ($P < 0.05$) in creating the transition point that caused stream drying in year 1970, 1981 and 1996. Most importantly, the provisioning of fresh water to central cities in the middle reach of Yellow River as an ES was greatly altered following each anthropogenic transition year. Our results highlight the need of studies that address the dynamic and nonlinearity of ES provisioning in CHANS, which are of great concern in addressing the stability of the ecosystem itself and are essential to human needs.

Key words: Runoff Decrease, Climate, Human Intervention, Loess Plateau

Ecohydrology of Shrub Encroachment in the Inner Mongolia Grassland

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Abstract: Increases in the density and cover of shrubs in former grasslands, commonly referred as shrub encroachment. However, the transition states of shrub-encroached ecosystems are still poorly known, and the effects of human disturbances are difficult to quantify during the transition process. This study investigated the plant biomass, community characteristics, and water capturing capability of the shrub and interspace grass patches during the different transition states of Caragana microphylla Lam-encroached grassland in response to the intensity of anthropogenic disturbances. The results indicate that the number of plant species increased with the disturbance intensity at the shrub patches and that the total aboveground biomass (AB) significantly decreased from the slightly disturbed site to the moderately disturbed site, then significantly increased from the moderately disturbed site to the seriously disturbed site. The total belowground biomass (BB) was much greater in the shrub patches than the interspace grass patches at the above three sites. The total porosity, macroporosity and mesoporosity decreased with the increasing of disturbance degrees and the macroporosity was over times greater in soil under C. microphylla Lam than those in inter-space grass. The results also suggest that grass or shrub dominance were alternative stable states in the processes of shrub encroachment but that a threshold existed during state transition. Shrub traits and soil architectures coordinate each other to evolve a self-organized strategy and holistic soil-vegetation adaptation system to accumulate water, storage, and efficient use at different scales. Shrub tended to form larger, higher and sparser configuration in dry and wet sites, while smaller, shorter and denser ones in middle sites. We found that shrub in the Gobi desert and Typical steppe responded much faster with 3.6 ± 2.0 day and 6.4 ± 4.6 day, respectively, contrast with a durable response in Desert steppe (10.2 ± 6.5 day).

Key words: Shrub Encroachment, Ecohydrology, Self-organized Strategy

Temporal Analysis of Aridity Index in the Changwu Tableland of Northwest China from 1957 to 2013

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Abstract: The Changwu tableland is located on the southern Loess Plateau, China, where water scarcity is the main constraint on agricultural production and ecological construction. This paper aims at investigating the temporal trend of aridity index (AI) and its influencing factors for the Loess tableland over a recent-past period (1957-2013). The AI was defined as the ratio of potential evapotranspiration (ET0) to precipitation (P). The ET0 was calculated using the FAO Penman-Monteith equation. During the past 57 years, the annual AI varied from 0.97 to 3.62 with an average of 1.64, which showed a slightly upward trend, the monthly AI decreased from 4.43 in January to 0.78 in September and then rose to 5.68 in December. The seasonal AI was significantly affected by P. The return periods of the extreme values were all more than 50 years. Among the various meteorological factors, vapor pressure and wind speed had the maximum contribution to the change in AI. The average annual temperature increased by 0.7 oC, while the ET0 decreased by 24.3 mm, which showed the "evaporation paradox". The decline in ET0 was greater than that in P, due to combined effect of meteorological factors. The upward trend of annual AI was insignificant.

Key words: Aridity Index, Potential Evapotranspiration, Frequency Analysis, Loess Plateau

Stand Transpiration of a Treeline Forest in Tibet

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Abstract: It is important to understand the seasonal patterns in transpiration and its influential factors of mountain forests, which is basis for predicting the effects of the climatic warming on hydrological responses of mountain forest and water resources in Himalayas.Sap flows of different tree size were continuously monitored throughout one growing season at a Smith fir treeline forest in southeast Tibet. The relationship between sapwood area and diamater at the beast height (DBH) was established for

Smith fir, which were used to scale up the sap flows of individual trees to stand level transpiration.The total stand tranpiration was 169 mm per year, and was unevenly distributed across growing season months.The averged daily stand transpiration in the early growing season (May and June) was significantly lower than that in July to September (0.76 VS. 1.21 mm per day).Moreover, the relationship between daily stand tranpiration and vapor pressure dificit(VPD) was higher in July and September than in the early growing season. The results are important for understanding the hydrological response of high-elevation forest ecosystems to climate change.

Key words: Stand Transpiration, Sap Flow, Mountain Forest, Southeast Tibet

The Impacts of Harvesting on Soil Moisture in the Shrub Encroached Grassland of Inner Mongolia Plateau

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Abstract: In grassland management, harvesting is a common method which widely impacted community structure, physiological ecology and yield et al. of ecosystems. Current researches paid more attention to the variation of aboveground processes, which ignored the underground dynamic including soil moisture. Soil moisture was almost the only water source and metabolism basis of plants in arid and semi-arid regions. Therefore, the aims of this study was to identify potential effects of harvesting on the distribution and abundance of soil moisture in a shrub encroached grassland. We monitored soil water beneath Caragana microphylla canopy and interspaces grass with high resolution and continuous measurements. Two years after one-off harvesting, we separately buried probes in natural shrub, natural grass, shrub removal, and grass removal at the depths of 5, 15, 30, 50, 80 cm to observe the dynamics of soil moisture from June 2015 to May 2016. The results showed that C. microphylla were shorter by 0.32m in height and sparser by 9.79% in coverage after removal. Harvesting was seemed to benefit the soil water recovery especially under grass with 18% augment in soil water capacity, promote a balanced distribution of soil moisture between shrub and grass, and bring an upward distribution structure of soil moisture. Effects of rainfall, evapotranspiration and snowmelt on soil moisture were discussed to explain the phenomenon above. NG and NS had an advantage in infiltration after rainfalls, but more water remained under harvesting part due to the decrease in plant evapotranspiration. Furthermore, snowmelt compensated more soil water in all layers of GR and SR. Harvesting increased soil water content and narrowed the gap of it between shrub and grass, which could weaken survival advantages of shrub. From the perspective of control shrub and water conservation, regular harvesting with

appropriate period was suggested to local governors. Our results could provide theoretical basis for the sustainable production and guide reasonable harvesting of grassland.

Key words: Caragana Microphylla, Shrub Encroachment, Grassland Harvesting, Soil Moisture

Integrated Hydro-biogeochemical Modeling for Investigating Water and Carbon Dynamics in Agricultural Lands

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Abstract: Greenhouse gas emissions due to anthropogenic activities continue to alter the climate, and the induced changes of hydrological and ecological processes (i.e., water and carbon cycles) attract a growing public concern. Process-based numerical models in environmental science can help understand and quantify the terrestrial material cycles in nature. However, the existing models usually focus on the cycles of one element (e.g., water or carbon). For example, a representative hydrological model, Soil and Water Assessment Tool (SWAT), focuses on the water cycle at watershed scale, whereas a classic biogeochemical model, DayCent, emphasizes carbon storage and fluxes of ecosystems at landscape scale. Using either one of the two models is not enough for understanding the complex environmental issues. Therefore, this study was to use our newly-developed SWAT-DayCent Coupler to evaluate the comprehensive environmental consequences caused by large-scale biofuel production-induced land-use changes in agricultural lands. The study results could be valuable for understanding the water and carbon dynamics of ecosystems and informative for decision-makers when seeking the sustainable watershed management.

Key words: Model Coupling, Water Cycle, Carbon Cycle, SWAT-DayCent

Eco-hydrological Process Alteration Response to Landscape Change in a Typically Urbanized Watershed of Beiyun River in Beijing

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Abstract: Urbanization greatly changes the landscape pattern and has presented a growing rate of negative effects on surface hydrological processes including the runoff volume, intensity, groundwater recharge and evapotranspiration. However, it is not well understood to what extent the urbanization affect hydrological processes at watershed

scale. Taking a urbanized catchment of Beiyun River in Beijing as an example, we assessed the effects of urbanization on the hydeologicl system quantitatively based on a spatially-distributed hydrological model named WetSpass and WetSpa extension (Water and Energy Transfer between Soil, Plants and Atmosphere). Analysis results indicated land use varied greatly of which the built-up land increased 457 km^2 while cropland decreased 694 km^2 from 2000 to 2012. In addition, the mean annual precipitation presented a downward trend. Results by WetSpass model revealed the built-up land with higher impervious surfaces was characterised by higher runoff and lower groundwater recharge compared with forests, grassland and cropland. The WetSpa extension further estimated that the land use/land covers viariation and precipitation change made contributions of 62% and 48% to the reduction in mean annual runoff, respectively. With the increase of forest cover rate, the runoff in the wtershed decreased. The reduction of runoff became smaller significantly when the proportion of forest increased to over 65%, but the interflow and groundflow continued increasing. This paper will provide a better insight about impacts of urbanization on hydrological processes at watershed scale.

Key words: Urbanization, Landscape Pattern, Hydrological Process, Wetspa Extension

Variations of Rainfall Redistribution Patterns and Canopy-Derived Dissolved Organic Matter in Three Forest Types along an Elevation Gradient, southwest China

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Abstract: Different forest types not only alter the rainfall distribution pattern, but also lead to the changes of dissolved organic matter (DOM) deposition. Dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) in rainfall contribute significantly to carbon and nitrogen cycling in forest ecosystems. However, there was limited information on the variations of rainfall redistribution and the dissolved organic matter (DOM) concentrations and depositions in bulk and stand precipitation within different forest types along an altitudinal gradient. To determine the different rainfall redistribution patterns and the variations in the DOM concentrations and depositions in different forests, the water amount, DOC and DON concentrations and depositions were measured in bulk precipitation, throughfall and stemflow within three forest types, i.e. broadleaf forest (BLF), broadleaf-coniferous forest (BCF) and coniferous forest (CF), during the wet season (May to October) on Gongga Mountain, China in 2015. Precipitation amount was largest in BCF (1209.38 mm) but smallest in CF (960.33 mm)

during the study period. The throughfall amount were account for 56.09%, 55.65% and 72.37% of precipitation amount in BLF, BCF and CF. Conversely, the interception rate was lowest in CF (27.44%) but highest in BCF (44.12%). Stemflow contributed smallest portion to the rainfall redistribution, 0.24%, 0.22% and 0.18% in BLF, BCF and CF, respectively. During the growing season, the concentrations of bulk precipitation in BLF, BCF and CF were 3.92, 4.04 and 2.65 mg L^{-1}, respectively, for DOC and were 0.38, 0.26 and 0.29 mg L^{-1}, respectively, for DON. BCF had the highest DOC deposition both in bulk precipitation (45.12 kg $^{ha-1}$) and stand precipitation (98.52 kg $^{ha-1}$), whereas the highest DON deposition was in BLF (3.62 kg $^{ha-1}$ bulk precipitation and 4.11 kg $^{ha-1}$ stand precipitation). The leave area index was not the determined factor to the variations of DOM deposition in these forests, while we found correlation between the meteorological conditions of precipitation and air temperature and the DOM depositions along the elevation gradient during the research period.

Key words: Rainfall Redistribution, Dissolved Organic Matter, Throughfall, Stemflow

T10-02: Stream Ecological Restoration and Ecosystem Services

Drought Effects on Tropical Headwater Streams and Sustainability of Ecosystem Services

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Abstract: The impacts on extreme climatic variability on ecosystems are already affecting the habitat quality of head-water tropical streams. Cumulative effects of environmental changes can result in incremental losses of biodiversity and as well as abrupt shifts in the abundance and number of native species. Without effective long-term studies these changes can go unnoticed until thresholds are exceeded that cause collapse in system dynamics that result in novel, non-native species assemblages. Losses of native species often eliminate or reduce ecosystem processes that sustain freshwater ecosystem services. Drought-driven stresses such as reduced dissolved oxygen and warmer water temperatures can decrease effectiveness of natural ecosystem services such as supplies of reliable clean water supplies and sustainable harvest of fish and shellfish. People are responding to ensure reliable goods and services by protecting those species that break down organic matter and recycle nutrients as well as filter-feeding species that remove suspended organic particulates. Outreach programs such as Citizen Science help initiate new social networks by sharing and learning of alternative modes of sustaining clean water resources. Results from long-term studies (since 1988) in the Luquillo Mountains of Puerto Rico provide a case study of the effects of bio-filtration by dense populations of native freshwater shrimp (Atya lanipes). These filter-feeding species are consumed by large shrimp (Macrobrachium carcinus) that are managed for sustainable harvest by local populations. A major benefit of engaging a multi-generational community of participants in water quality management is the persistent increase in mutual sharing of knowledge about how rivers function to provide clean water for people and essential habitats for diverse species.

Key words: Drought, Biodiversity, Ecosystem Services, Tropical Streams

Species and Functional Diversity Recovery of Macroinvertebrate Community in Restored Unban Streams, Puyang County, Zhejiang Province, China

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Abstract: Functional recovery of degraded streams or rivers is a core aim of the most ecological restoration programs. However, it was rarely evaluated in China though large amount of investment in restoring degraded streams or rivers in the past decade. We piloted a case study on the species and functional diversity recovery, one-year after an intensive restoration practice of instream habitat and the strict controls of watershed point pollution source. We sampled macroinvertebrate assemblages from 9 urban sites along the restored mainstream and 15 sites located in the restored urban tributaries, and additional 2 non-urban mainstream sites, 7 non-urban sites and 3 non-restored unban-tributary sites, in April 2016. We calculated 4 functional trait diversity indices representing functional measure based on 9 qualitative traits, namely functional richness (FRic), functional dispersion (FDiv), functional evenness (FEve) and Rao's Quadratic Entropy (RaoQ). We identified macroinvertebrate identified a total of 123 macoinvertebrate taxa, and found the moderately increase of species richness, Shannon-Wiener diversity index, Simpson index and evenness in restored stream sites. In terms of functional diversity, except the slightly increase of FRic, indices of FDis, RaoQ and FEve of restored stream sites increased greatly, even a higher average value of FEve than that in non-urban streams. However non-restored sites had the extremely lowest values of measured species and functional diversity indices. Our results indicated an obvious recovery of community species diversity and function in restored streams, and the functional homogenization stem from the intensified stress. We suggested a time-scaled monitoring of function dynamic of restored streams would provide more insights in the community stability, resilience and resistance during recovery process.

Key words: Functional diversity, Urban stream, Macroinvertebrates, Yangtze River Delta

Multiple Stressors and 'Ecological Surprises' in New Zealand's Running Waters: A Review

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Abstract: Multiple stressors are a rapidly growing research area in ecology, ecotoxicology and environmental chemistry. During the past decade, a substantial body of research has accumulated concerning the effects of agricultural stressors on running water ecosystems, and much of this research has been conducted in New Zealand. Moreover, only in New Zealand have researchers studied the same stressors using observational studies (field surveys) and manipulative field experiments at three spatial scales (stream reaches, streamside channels and streamside mesocosms). We review this body of research, focusing on studies that (i) investigated the effects of at least two in-stream stressors, (ii) separated the effects of each stressor and (iii) quantified stressor interactions using statistical tests. The most commonly studied in-stream stressors were nutrients, deposited fine sediment, flow reduction and increased water temperature. Our review poses the following five questions: 1. Is there evidence for complex interactions among agricultural stressors across all four observational and experimental approaches? 2. Do experiments and surveys provide similar answers, or do mesocosm experiments detect stressor interactions more often than lower-replication reach-scale experiments or uncontrolled surveys? 3. What is the strength and pervasiveness of each stressor? 4. Does the complexity of stressor interactions differ across ecosystem components and trophic levels (i.e. algae, invertebrates, fish)? 5. Are higher organisational levels (e.g. ecosystem or community) less prone to complex interactions than lower levels (e.g. population level)? The final section of our review focuses on management implications from these combined findings, including the challenge of setting limits for in-stream stressors in scenarios where stressors interact strongly.
Key words: Multiple Stressors, Stream Ecology, Sediment, Nutrients

Effects of Cascade Hydropower Dams on the Spatio-temporal Patterns of Fish Diversity in Qingjiang River, Central China

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Abstract: Hydropower dams are considered the major factor contributing to significant modification of river ecosystems, including the changes of river continuity, hydrographic conditions and fish diversity. In this study, we explored the patterns of fish compositions and spatio-temporal distribution induced by cascade hydropower dams in Qingjiang River (Hubei Province), a major tributary of the middle Yangtze. The river was divided in three reservoirs (i.e. Shuibuya, Geheyan, and Gaobazhou) from upstream to downstream by the construction of three hydropower stations around 2000. We carried out fish sampling and resource assessment with gillnets, fishery

surveys and hydroacoustical detection in the three reservoirs from 2016 to 2017. A total of 68 species belonging to 5 orders and 17 families were collected. Only 26 species were found in all the three reservoirs, and 35 species were recorded in the early 1980s before the construction of the cascade hydropower dams. Compared with the historical records, the number of species that prefer riparian and benthic-cave habitats decreased significantly, while the number of lentic species increased in each reservoir with the change of hydrologic conditions. At present, fish species richness were higher in Geheyan Reservoir and Gaobazhou Reservoir (47 and 50 fish species) than in Shuibuya reservoir (33 fish species). Our seasonal hydroacoustic surveys showed that Geheyan Reservoir had higher fish density than the other two reservoirs throuthout the year. The seasonal patterns of fish densities in Geheyan Reservoir and Gaobazhou Reservoir were: summer >autumn >spring > winter, while the pattern in Shuibuya Reservoir was: summer > spring >autumn > winter. The distribution patterns of fish were as follows: Horizontally, fish density tend to increase from lower to upper part of the reservoirs. Vertically, fish density generally tend to decrease from upper to lower layer of the water column, but fish were more likely to migrate to deeper layer in winter. The results indicated that fish species composition and spatio-temporal distribution patterns have been greatly altered by the construction and operation of cascade hydropower dams, mainly due to the ecological and longitudinal disconnectivity, changes in hydrographic conditions and flow patterns.

Key words: Cascade Hydropower Dams, Qingjing River, Spatio-temporal Patterns, Fish Diversity

The Effects of Anthropogenic Subsidy and Herbicide on Ecosystem Functioning in Urban and Rural Streams

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Abstract: One of the main tasks in ecology is to predict how land use changes affect ecosystem functioning, such as leaf litter decomposition. We conducted field experimental manipulation to investigate how anthropogenic subsidy (chicken) and herbicide stressor (glyphosate) affect the breakdown of leaf litter (Cinnamomum camphora) in coarse and fine-mesh leaf litter bags in streams in a human impacted urban area (Suzhou) and a relative natural area (Huangshan). Anthropogenic subsidy significantly decreased leaf litter breakdown both in Suzhou and Huangshan streams, and this pattern was not affected by the mesh size of leaf litter bags and sampling dates. However, herbicide did not have significant influence on leaf litter decomposition, with slightly increased leaf litter breakdown rates in Suzhou while slightly retarded leaf litter

decomposition in Huangshan. The interaction of glyphosate and anthropogenic subsidy differed between Suzhou and Huangshan, with +antagonistic effects in Suzhou streams while –antagonistic effects in Huangshan streams. As we expected, leaf litter decomposed faster in Huangshan streams than in Suzhou streams, as well as faster in coarse mesh bags than in fine mesh bags. In rural Huangshan area, leaves decomposed fastest in medium human-disturbed stream and slowest in high human impacted stream; and in urban Suzhou streams, leaf litter decomposition rates were higher in relative fast flow streams than in streams with slow flow. Moreover, leaf litter breakdown rates were higher during the first 15 days than in the later 15 days. Our results suggest that anthropogenic subsidy and its interaction with herbicide (glyphosate) can influence leaf decomposition in aquatic ecosystems, and their impacts would be differ under the disturbance condition of freshwaters and through time.

Key words: Leaf Litter Breakdown, Glyphosate, Land Use, Multiple Stressors

Multiple Stressors & Stream Macroinvertebrate Dynamics: A Mesocosm Experiment Manipulating Sediment Grain Size & Flow

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Abstract: Land-use change to agriculture remains the dominant driver of biological change in both terrestrial and freshwater ecosystems. Agricultural stressors seldom operate in isolation, and their impacts on stream ecosystems generally reflect an integrated response to multiple stressors. Agricultural practices that increase catchment erosion can often result in fine sediment deposition in streams with adverse effects on benthic invertebrate communities. Changes in land and/or water use (e.g. water abstraction for irrigation) can also modify stream flow that may interact with fine sediment deposition rates, thus modifying stressor effects. In this this study, we investigated the relationship between fine sediment grain size and flow velocity on macroinvertebrate community dynamics (i.e. benthic, drift and emergence densities) in 60 flow-through stream mesocosms. Our experimental treatments comprised four fine sediment treatments (no added sediment, silt: 0-0.125mm, fine sand: 0.125-0.250m, coarse sand: 1-2mm) combined with three flow velocities (fast, medium, slow) in a replicated full-factorial design. Invertebrate community- and population-level variables responded significantly to sediment and/or flow manipulation yielding both additive and non-additive outcomes, frequently mediated through dynamical shifts among benthic, drift and emergence assemblages. Our results imply that fine sediment (of varying size) and reduced flow velocity can have pervasive detrimental impacts on stream invertebrates, especially for sensitive invertebrate taxa (e.g. EPT taxa).

Key words: Multiple Stressors, Land-use Change, Synergism, Freshwater Management

Interactions between Subsurface and River-Riparian Ecosystems under Human Pressure

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Abstract: Groundwater provides important ecosystem services not only as potable water but also indirectly by maintaining unique habitat for aquatic organisms and mediating nutrient cycling when it interacts with river water. Those important functions are under strong pressure due to human activities such as direct abstraction or discharge of contaminants. Modifications of groundwater-surface water interactions at interfaces (i.e., riverbed or hyporheic zone) due to regulations of surface flow, alterations of channel forms, and eutrophication of surface water are also of concern. However, the some of the ecological functions of groundwater for riverine-riparian ecosystems remain unknown and the responses of those to human activities are fragmentally known. This study overviews recent findings on ecosystem processes in and functions of groundwater upwelling or hyporheic zones in relation to anthropogenic influences to highlight knowledge gap and potential and need for restoration.

The effects of eutrophication of river water, flow regulations, and placements of cross-sectional structures (groundsills) on salmon (Oncorhynchus keta) redd distributions, and community structures of hyporheic and benthic invertebrates, and contributions of those invertebrates to terrestrial organisms such as carabid beetles were studied in two gravel river systems, Hokkaido Japan. In Toyohira River, data on long-term (>5 yr) salmon redd distributions and river-riparian arthropod communities were examined in a segment containing sections with and without groundwater upwelling. In Satsunai River, 3-yr data of insect emergence in sections with and without influences of point-source nutrient enrichment were examined with riparian-river food-web data. Groundwater provided important salmon spawning habitat in colder winter especially when flow was low while the distributions were limited by groundsills in warmer months. In both studies, we observed trophic linkages between subsurface (hyporheic) zones and riparian consumers; a fair amount of potential food resource from river to riparian zone originated from subsurface zone. In both study, groundwater pollution was inferred and its signature was detected in riparian consumers through riparian-river food web. Our findings highlight strong interactions between subsurface and river-riparian ecosystems under human pressure, but call for

attentions to the vulnerability of those interactions to changes in water quality, quantity, and physical structures of river interfaces.

Key words: Groundwater, Subsidy, Pollution, Flow Regime

The Role of Climate and Physical Factors in the Past, present and Future of Stream Fish community, Taiwan

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Abstract: Rivers ecological processes are influenced by prevailing climatic conditions, human activities and increased water usage and modifiers of river flow by dam. Taiwan river ecosystems are characterized by natural disturbances including annual floods, occasional catastrophic earthquakes, and typhoon and anthropogenic barriers. The Dajia River, 124.2 km in length, is located in west-central Taiwan. The stream has a gravel bed and a regulated flow regime, with dams and reservoirs extracting a significant portion of the flow. As the aquatic habitat of Dajia River is subject to more less rapid change from earthquake and typhoons, periodical or directed changes in climate and human activities, ecosystem change is an important process in stream because it alters habitat structure and resource availability. The objectives of the study were to: (1) describe the climate, physical events and human activity effects and to find evidence that fish population persistence necessary to adapt to habitat variability and extreme climate impacts, then describing and integrating these in traditional stream fish community ecology; (2) explain how spawning timing of fish species coincides with resource availability under altered hydrological conditions. The peak discharges result from Plum rains and Typhoons periods from June to September, and low flows result from winter with lower precipitation. A total of 18 fish species including eight endemic species of fish belonging to nine families were identified in the middle section of Dajia River during the survey period. Eight of these species (Acrossocheilus, paradoxus, Zacco pachycephalus, Varicorhinus barbatulus, Rhinogobius candidianus, Pseudobagrus adiposalis, Crossostoma lacustre, Hemimyzon formosanum, and Cobitis sinensis) were found every year and were considered major components of the fish community. The characteristic types of fish fauna in these ecosystems are predominantly endemic species. Climate related changes in flood and debris flows are shape most aspects of these fish species' life histories. Such influence is illustrated by the fact that endemic species such as A. paradoxus C. lacustre H. formosanum and R. candidianus produce eggs continuously during reproductive periods. Due to long-term effects of disturbance regimes, the fish fauna in Dajia River exhibits four basic characteristics. First, the fish fauna were predominantly endemic, such that their

dominance in the fish community controlled community structure. Second, the most persistent species were likely to be those possessing life histories capable of adapting to and surviving plum rains and typhoon disturbances. Third, study results showed that the reproductive cycle timing in endemic species was often associated with plum rains and typhoons, with behavior of fish responsible for regulation of the earlier life history stages so that fish are physiologically ready for spawning when the flooding occurs. Fourth, the flow of the Dajia River has long been regulated by anthropogenic factors affecting the stream ecosystem; fish species population showing low resilience to such variability during vulnerable life history stages can be greatly reduced in abundance. This study has implications for determining freshwater fish population responses to natural and anthropogenic disturbances and provides guidance for natural resource management.

Key words: Stream Fish Community, Endemic Species, Climate Change, 921 Earthquake

Detect Water Pollution of North Canal River System in Beijing with Micronucleus Test Method

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Abstract: The North Canal river system is the only water system that originates in Beijing and considered as the most important water system in the area. The micronucleus test with broad bean Vicia faba root tip cells was used to study the genotoxicity of pollutants in the water of North Canal river system. Eight water samples collected from the river sections at Twin Towers Bridge, Chaozong Bridge, Shahe River, Shahe Reservoir, Lingou Rivier, Bahe River, Wenyu River and Yangwa Gate in October, 2016 were used to treat V. faba root tip cells directly. The water pollutants in the monitored sections have damaged in various degrees on the root tip cells of V. faba, which is showed by different kinds of abnormalities such as micronucleus producing, chromosome fragment, chromosome loss and Chromosome Bridge, etc. The micronucleus rate (MCN ‰) of V. faba root tip cells treated by the 8 samples has vary from 7.54‰ to 103.83‰, which is significantly higher than that of the control ($P<0.01$). Thus, the pollution index (PI) has a range from 4.60 to 41.54. At anaphase of mitosis, the ratio of abnormal cells in the root tips rises to 60% as the micronucleus rate increases at the meantime. The results show that the water is heavily polluted in the branches of the North Canal river system.

Key words: Vicia Faba Root Tip Cell, Micronucleus Frequency, Pollution Index, North Canal River System

Ecological Effects of Vegetative Filter Strips over Lakeshore in Nansi Lake

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Abstract: Nansi Lake, the largest freshwater lake, locates in the southwest of Shandong Province. It is also the major regulation and storage hub in the east route of Water Transfer Project from South to North. Since the 1980s, the water quality has been deteriorating year by year, the wetland area is decreasing and the ecological environment suffered serious damage. Lakeshore is the important transitional zone between the Lake Ecosystem and terrestrial ecosystem. With the interference of human activities gradually enhancing, the lakeshore ecosystem is also suffering severe degradation. Vegetative filter strips (VFS) is the area of vegetation (grass, tree, shrub or even crops) between the source of pollution and water (river, lake, etc). It has a good effect for water and soil conservation, embankment protection, and soil erosion reduction. In addition, the vegetation root and litter can be fixed around the embankment soil, reinforced the embankment erosion resistance ability. The subject is based on the local characteristics of the lakeshore in Nansi Lake, combined with the technological achievements of lakeside repair at home and abroad, constructed embankment repair and diversity demonstration zone and wetland ecological restoration demonstration area through the method of combined engineering and plant planting. At the same time we established the method of the VFS ecological effect assessment in Nansi Lake lakeshore. In the water and soil conservation assessment, we selected some monitoring indicators which are representative and can reflect the ecological effects of the VFS, and the direct index is used to determine the accuracy and practicability of each data such as soil compaction, soil texture, plant roots, ground litter etc. Then, the sum score of each sample is obtained by summing up all the index values of each sample, and finally import the statistical software for direct analysis. In the community characteristics, we estimated from the aspects of plant richness, plant coverage, plant height, aboveground biomass. Comprehensive study shows that, although the demonstration area is shorter, the overall ecological status is better than the control area in the aspect of water and soil conservation. We found that VFS in the lakeshore improved the soil texture, enhanced the ability to resist soil erosion, conducive to water and fertilizer retention, and also formed a large amount of ground litter, thereby increasing the soil organic matter and nutrients. The plant richness, the height of the community and the aboveground biomass were also higher in the demonstration area.

Key words: Ecological Effects, VFS, Lakeshore, Nansi Lake

Health Condition Assessment of Geum-river Aquatic Ecosystems Using the Vegetation and Its Meaning to River Management in Korea.

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Abstract: In order to get as ecological basic data for river management, I estimated health condition of Geumgang mainstream and Mihocheon using vegetation and investigated it for synecological methods. Then, collected data was analysed.Appeared plants in study area were 268 species and the number of appeared plant colonies was 54. Riparian vegetation index (RVI), vegetation health condition assesment method, was evaluated as 38.3 'Normal(C)'. Geumgang mainstream's upper stream1(G-U1), upper stream4(G-U4) and mid stream3(G-M3) were highest as 66.7 and Geumgang mainstream's down stream1(G-D1) was lowest by 3.3.Riparian vegetation index under upper stream, middle stream, down stream in Geumgam mainstream and Mihocheon was highest in Geumgang mainstream's upper stream and lowest in Geumgang mainstream's down stream. Riparian vegetation index was negatively correlated with biological oxygen demand (BOD) and chlorophyll-a (Chl-a) in study sites.PCA using species cover degree data of belt transect in each study sites was separated by two groups. One group was consisted of ‘best (A grade)' and ‘good (B grade), the other group was comprised of 'normal(C grade)' and ‘bad (D grade).Cluster analysis was separated by 5 groups: Digitaria ciliaris Koel. Community group, Salix gracilistyla Miq. Community group, Erigeron annuus Pers. community group, Humulus japonicus Siebold & Zucc., Salix koreensis Andersson, Miscanthus sacchariflorus Benth., and Phragmites japonica Steud. community group, Conyza canadensis Cronquist and Echinochloa crusgalli var. echinata Honda community group. Study sites having similar health condition also was grouped in analysis. These result was similar in PCA.Dominance value of study sites was significantly correlated with vegetation area, structure area, waterway area, spot width, waterway width, bank height and number of species in CCA analysis.As a result, it means that the high health condition sites are dominated by Salix, Fraxinus and phragmites spp. increasing plant diversity and the low health condition sites have a wide structure area simplifing plant diversity by river maintenance work. Thus, the hight health condition area needs to maintain condition through continuous monitoring and the low health condition area needs to restore ecosystem services.

Key words: River Assessment, Management, Ordination

The Appraisal of Stream and River Restoration: A Framework in China

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Abstract: Stream and river ecosystems have been suffering tremendous degradation and habitat loss due to human disturbance. The ecological restoration of running-water ecosystems receives great interest worldwide. However, it appears that there is a widespread lack of Post-Project Appraisals (PPAs) to stream/river restoration, which not only hinders progress in ecosystem restoration science but also limits the application of adaptive ecosystem management, whereby coordinated activities are systematically evaluated and lessons learned incorporated back in decision-making processes. In China, where the remediation of polluted stream/river ecosystems started over a decade ago, most of restoration projects were left without ecological monitoring and no evaluation to identify if the restoration approach or techniques were efficient enough to recover ecosystem health, in terms of biological diversity, ecosystem function and ecosystem service in the restored ecosystems. For developing PPAs in riverine systems to improve the success and efficiency of stream/river ecosystem restoration and adaptive management in China, a river restoration monitoring and evaluation framework will be established by summing up PPAs guidelines popularized around the world. By evaluating stream/river restoration studies completed in rural, urban and rural-urban joint zones in China, as well across the world, we assessed a variety of evaluation approaches for restoration projects. In consideration of the ecological responses to riverine restoration, following parameters were selected to be monitored: 1) Physiochemical attributes reflecting environmental and habitat changes; 2) Biological diversity including microbial organisms, algae, macrophytes, macroinvertebrate, fish etc.; 3) Ecosystem function reflecting the river health; 4) Ecosystem services upon which human depends. The framework of Post-Project Appraisals will be generated specifically to appraise the restoration of Chinese degraded or damaged aquatic ecosystems, including “black and smelly water bodies”, for enhancing the effectiveness of ecosystem restoration actions in increasing provision of multiple ecosystem services and reversing of biodiversity losses.

Key words: Ecosystem Services, Biodiversity, Stream and River Restoration, Post-project Appraisals

Study of Water Forest Conservation Layout in Karst Desertificated Catchment in Case of Shilin Bajiang Catchment of Yunnan Province, China

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Abstract: the documented data from the experiments and observation about relationship between forests and catchment water production gave the fact that the synergism between the water forest's vertical structure and its horizontal pattern of precipitation is important for catchment's water production. On the base of the synergism, the experiments, observations and model simulation were designed and made for Shilin karst desertificated Bajiang river catchment of Yunnan Province, China. Compared to forest of Pinus Yunnanensis, Karst secondary forests and scrub， limestone outcrops and farming land,the zonal forest(forest of Cyclobalanopsis glaucoides) site has only 3% to 50% of their overland's runoff and 1.1 to 4times of epikarst water production, and 1.1 to 10 times of their infiltrating water,2~30 times of containing water in the litter zone with the in-forest evapotranspiring water being 20%~83% of their evapotranspiration. And also, the karst forest obviously reduced the loss of water and soil from the rock-soil interface. The annual rainfall in the catchment uplands with the zonal forest is 43% (over 280mm annually) higher than the annual precipitation, but the rainfall in the extensive area of Forest Pinus yunnanensis 24% lower than the annual rainfall. The assessed results of the Shilin plant vegetation series' water conservation structure by AHP (analytic hierarchy process) is forest of Cyclobalanopsis glaucoides, forest of Pinus yunnanensis, secondary forest, karst scrub and grass. And therefore, the zonal forest (forest of Cyclobalanopsis glaucoides) could be as the end plant communities of the local water resource forest.The simulated results of the Bajiang river water production's response to change of forest area in the up and down parts of the Bjiang catchment is that the water production would be significantly increased by augmenting the upstream forest area with reduce of peak flow. And therefore, the preferential strategy of the improving water conservation there is that the end plant community of water conservation forest are being maintained and restored in the uplands like karst hills and mountain ridges. The six patches of the water forests restoration were divided with one belt of the riparian forest landscape.

Key words: Ecological Restoration, Water Forest, Karst Desertification, Catchment Water Production

Effects of Anthropogenic Disturbances on α and β Diversity of Fish Assemblages and Their Longitudinal Patterns in Subtropical Streams, China

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Abstract: Identifying the spatial patterns of α and β diversity of biotics is an important yet little-understood area of basic and applied ecological research. Although the upstream-downstream patterns of α diversity of stream fishes are numerously reported, β diversity has received less attention. In this study, we surveyed fishes along the upstream-downstream gradients in three headwater streams of the Qingyi River, China, which were affected by different extents of human activities. We aimed to assess how anthropogenic disturbance affect α and β diversity of stream fishes and their upstream-downstream patterns. We found that, compared with that in the Shuxi Stream disturbed less, endemic species decreased and cosmopolitan species increased in the Maxi and Puxi Stream disturbed heavily. The streams disturbed heavily showed lower α diversity and higher β diversity than that in the stream disturbed less. This among-stream variations in fish diversity only occurred at the mid-downstream, not upstream segments. α diversity increased downstream and β diversity decreased downstream from headwaters to mouth in the stream disturbed less. Whereas, this upstream-downstream pattern in fish diversity shifted in the streams disturbed heavily, in which both α and β diversity showed the quadratic distributions with the hump-shape for α diversity and the U-shape for β diversity, respectively. Our results suggest that the habitat modification by anthropogenic activities may cause some cosmopolitan fishes replacing many endemic fishes in upland streams. This replacement processes result in α diversity decreasing and β diversity increasing, and shift the spatial patterns in fish diversity along the upstream-downstream gradient. Therefore, in future, it is necessary for us to restore local habitat conditions and river-segment connectivity for the conservation of stream fishes in upland areas.

Key words: α and β Diversity, Anthropogenic Disturbance, Upstream-downstream Pattern, Headwater Stream

T10-03: Moving Towards a New Understanding of Ecohydrological Processes across Scales

Spatial and Temporal Variations of Potential Evapotranspiration in Southwestern China from 1962 to 2013

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Abstract: Potential evapotranspiration (PET) is crucial to water resources assessment and climate change. Based on the Penman-Monteith equation which is proposed by Food and Agriculture Organization (FAO) and daily meteorological data of 90 meteorological stations in Southwestern China, daily potential evapotranspiration of 90 meteorological stations was calculated. Then, various statistical methods were used to analyze its spatial and temporal variations. The results showed that the mean annual potential evapotranspiration in whole Southwestern China during recent 52 years was 3209.8 mm, the highest potential evapotranspiration value was in Yunnan Province which was 3664.7mm, followed by Sichuan Province (3015.0mm), Guizhou Province （2972.4mm），and Chongqing Municipality (2958.0mm). PET in summer was the biggest, followed by spring, autumn and winter. Distribution characteristics of four seasons is different from that of annual value. Moreover, the linear changing trend of potential evapotranspiration in Southwestern China was 0.9mm/10a. 31 stations showed the decreasing trend ($p<0.1$and 17 stations show increasing trend ($p<0.1$. PET in spring and summerdecreased which accounted for 55.6% and 63.3% of whole stations, respectively. While PET in autumn and winter increased which accounted for 62.2% and 58.9% of whole stations, respectively. Through abrupt change testing and moving t-test, a significant abrupt point was found in 1995 for PET of Southwestern China ($p<0.05$). Among 90 stations, abrupt points of 76 stations concentrated in 1980s. In additional, 15 stations had no abrupt points which mainly distributed in the eastern margin of the Tibetan Plateau. On the whole, the potential evapotranspiration in Southwestern China increased slightly from 1962 to 2013. However, some regions appeared the opposite trend. The abrupt testing also showed the same rule. Complex terrain environment and climate characteristics is main reasons which reflected the unique feature of hydrometeorology changes in Southwestern China.

Key words: Potential Evapotranspiration, Penman-monteith Equation, Mann-kendall Test, Changing Trend

Research on Cumulative Effects of Forest Change on Flow Regimes in Large Watershed Based On River Ecological Protection

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Abstract: Forest plays an important role in hydrological cycle, and forest changes will inevitably affect runoff across multiple spatial scales. The influences of forest changes on flow regimes are essential for analysing forest-related hydrological response. This study used the Meijiang River, one of the headwaters of the Poyang Lake as an example to identify the cumulative impact of forest changes for research on forest change-induced hydrological responses. Forest coverage rapidly increased from 41% in 1989 to 65% in 1994 and steadily rose to 71% in 2006 in this watershed. The flow regimes were defined according to the demand of river ecological protection in the first. We focused on high flow and low flow that play a decisive role in the structure and functioning of aquatic ecosystems, riparian ecosystems and flood plain ecosystems and made a comprehensive analysis of the effects of forest changes on the flow, frequency, duration, occurrence time and rate of change of high flow and low flow. Then the SWAT model, a widely used to simulate surface water and predict the environment impact of land use and land management practices, was applied to simulate the hydrological process of the Meijiang River basin. The results of the forest change scenarios were compared to quantify the cumulative effects of forest changes (destruction and restoration) on flow regimes. At the end, we predicted future changes in flow regimes of high flow and low flow at different levels of forest change, and analysed potential threats to river and lake ecosystems. This study will provide us with an exhaustive way to quantify the hydrological impact of large-scale forest changes in the Meijiang River watershed, which is crucial for downstream water resource management and ecological protection in the Poyang Lake basin.

Key words: Forest Change, Flow Regime, SWAT Model, Ecological Protection

Understanding Forest and Water Relationships for Sustaining Watershed Ecosystem Services in the Anthropocene

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Abstract: The Earth has entered the Anthropocene epoch that is dominated by humans who demand unprecedented quantities of goods and services from forests. The science of forest hydrology that studies the interactions between forests and water at multiple scales has developed greatly during the past century. Forest ecohydrology has

provided a basic understanding watershed science and offers management principles that maximize the benefits of forests for people while sustaining ecosystem services. However, the rapid pace of changes in climate, disturbance regimes such as wildland fires, invasive species, human population growth, and land use expected in the 21st century is likely to create substantial challenges for watershed management that may require new approaches, models, and best management practices. These challenges are likely to be complex and large scale, involving a combination of direct and indirect biophysical watershed responses, as well as socioeconomic impacts and feedbacks. We discuss the complex relationships between forests and water in a rapidly changing environment, examine the trade-offs and conflicts between water and other resources, and propose new management approaches for sustaining water resources in the Anthropocene.

Key words: Ecohydrology, Climate Change, Forests, Watershed Management

Divergence in Strategies for Coping with Winter Embolism among Co-occurring Temperate Tree Species in NE China

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Abstract: In temperate ecosystems, freeze-thaw events are an important environmental stress that can induce severe xylem embolism (i.e. clogging of conduits by air bubbles) in overwintering organs of trees. However, no comparative studies of different adaptive strategies among sympatric tree species for coping with winter embolism have examined the potential role of the presence or absence of embolism refilling by positive xylem pressure. We evaluated the degree of winter embolism and hydraulic architecture traits in 22 deciduous angiosperm tree species typical of temperate forest sites in NE China. Co-occurring trees growing in a common garden were used to minimize variation caused by differences in proximal environmental conditions and to ensure that interspecific variation reflected genetic differences between species. Four functional groups with potentially different strategies for coping with winter embolism were compared: positive xylem pressure generating species (PXP) that are all diffuse-porous, except a semi-ring-porous species, large (LDP) and small (SDP) statured diffuse-porous tree species that are unable to generate positive xylem pressure, and ring-porous species (RP). The PXP group exhibited nearly full recovery from winter embolism in contrast to the other three groups, which showed persistent and relatively high degrees of hydraulic dysfunction during the subsequent growing season. The absence of a functional trade-off between hydraulic efficiency and safety against freeze-thaw induced embolism in the PXP group and the presence of a trade-off in the

other three groups, suggests that the ability to generate root or stem pressure for embolism refilling may partially free some temperate tree species from adaptive constraints imposed by winter embolism formation. Efficient winter embolism reversal by positive pressure in PXP species did not distinguish them from their non-xylem pressure-generating LDP counterparts in terms of various measures of xylem hydraulic efficiency during the growing season. Divergence in the ability to refill winter embolism through generation of positive xylem pressure implies a series of functional trade-offs that may partially explain the co-existence of these two types of temperate tree species.

Key words: Winter Embolism, Functional Groups, Positive Xylem Pressure, Temperate Forest

Rainfall Redistribution and Throughfall Spatial Distribution in a Larix Gmelinii Forest in the Northern Greater Khingan Range, Northeast China

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Abstract: In forested ecosystems, complex forest canopies may redistribute and chemically modify the composition of rain water; this field within the study of ecological hydrology has recently attracted a considerable amount of attention. Throughfall is a major part of the rainfall penetrating the forest canopy and redistributes rainfall, and throughfall patterns can affect the distribution of soil water as well as the cycling and use of nutrients. Furthermore, spatial variability in the amount of throughfall can affect the concentration and deposition of solutes and the spatial distribution of nutrients in a forested landscape. Therefore, changes in throughfall beneath the canopy have very important effects on water balance, hydrological processes, and nutrient cycling within forest ecosystems. Many studies have analyzed the effects of the forest canopy on the interception and redistribution of rainfall, and the regularity of throughfall in different forest types; these studies provide a clearer understanding of the hydrological processes involved in rainfall interception and redistribution. However, few studies have addressed the horizontal spatial distribution of throughfall under a forest canopy. The goal of the present study was to determine the spatial heterogeneity of throughfall under a forest canopy and to explore the ecological mechanisms of the effects of canopy structure in a Larix gmelinii forest on throughfall. Several factors, such as distance (of the sampling site to the trunk), canopy thickness, and leaf area index (LAI), can all influence the spatial distribution of throughfall. Throughfall was measured under a Larix gmelinii forest canopy at three

locations—beneath the canopy itself, beneath the canopy edge, and in canopy gaps—during 19 rainfall events, using 38 rain gauges during the period of development of a stable canopy (Jul.–Aug. 2013). The spatial heterogeneity of both forest canopy structure (LAI and canopy thickness) and throughfall were analyzed using statistical methods. The spatial variability of throughfall in the Larix gmelinii forest analyzed here was estimated for different rainfall events. The results indicate that the canopy interception, throughfall, and stemflow were 35.14 mm, 148.61 mm and 0.2507 mm during the observation period, which accounted for 19.10%, 80.77%, and 0.14% of the rainfall in an open field, respectively. The throughfall ratio increased with increasing amounts of rainfall, and the relationship between these could be described with a power function ($p < 0.01$). The coefficient of variance of throughfall decreased with increasing rainfall amounts, and the relationship between these could be described with a logarithmic function ($p < 0.01$). Structural characteristics of the canopy were found to be the most important factors controlling the spatial variability of throughfall, and the throughfall amount was significantly negatively correlated with the degree of complexity within the canopy structure ($p < 0.01$). Given the stable canopy structure, the variance coefficient of throughfall decreases with increasing rainfall depth significantly ($P< 0.01$). The distance, canopy thickness and LAI were all can influence throughfall spatial distribution, when considering the ecological mechanism, canopy thickness was the most important canopy structure/factor that affects the spatial redistribution of throughfall in a Larix gmelinii forest.

Key words: Larix Gmelinii Forest, Rainfall Redistribution, Throughfall, Spatial Distribution

Combined Effects of Rainfall Regime and Plot Length on Runoff and Soil Loss in the Loess Plateau of China

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Abstract: The combined effects of rainfall-vegetation-scale on runoff and soil loss are still unclear. In this study, events of runoff and soil loss of forest, shrub and grass were measured in plots with length of 5, 9, or 13 m in the Loess Plateau from 2008 to 2016. Fifty-nine erosive rainfall events were recorded and classified in three rainfall regimes using K-means clustering. Regime 1 events were the most frequent type of rainfall with high intensity, short duration and low rainfall depth. Regime 2 events were the least frequent type of rainfall with converse characteristics compared to regime 1 events. Regime 3 events had moderate level of rainfall indices between those of regime 1 and 2 events. The variations of runoff and soil loss with rainfall regimes and plot lengths

under different vegetation types were detected.
The results showed that the runoff coefficient of the three types of vegetation cover was in the order of grass>shrub > tree, and soil loss was in the order of grass > tree > shrub. However, the orders of runoff and soil loss changed with rainfall regime. The highest runoff coefficient was found under rainfall regime 1, followed by regime 3, and then regime 2. Soil loss under shrub cover had the same order as that of runoff, whereas for tree and grass cover, the order of soil loss was regime 3 >regime 1 > regime 2. Both the runoff coefficient and soil loss decreased with increasing plot length, while the scale effects were influenced by vegetation type and were highly dependent on the rainfall regime. Scale effect on runoff and soil loss fluctuation induced by rainfall regime 2 was the largest under tree and shrub cover, and that induced by rainfall regime 1 was the least.
Key words: Erosion, Rainfall Regime, Scale Effect, Vegetation Type

The Development and Application of a Tool for Assessing Streamflow Response to Vegetation Change and Climatic Variability in Large Watersheds

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Abstract: Vegetation change and climatic variability are commonly recognized as two major drivers influencing streamflow change in watersheds. Although the past century has witnessed quantities of researches on streamflow response to vegetation change and climatic variability, most results are derived from small watersheds ($<100km^2$). Researches on streamflow response to vegetation change and climatic variability in large watersheds are limited and conclusions are inconsistend due to the lack of widely-applicable methods. In order to simplify large watershed studies, an assessment tool (Assessment Tool For Streamflow Response To Vegetation Change And Climatic Variability SRVCCV) based on Matlab GUI was developed for batch processing of multiple watersheds to quantify the streamflow responses to vegetation change and climatic variability by use of an integrated non-modelling methodology (statistical methods and modified double mass curve). The modified double mass curve was developed to remove the climatic effect on hydrology while non-parametric Mann-Kendall tests and Wilcoxon ranksum tests were used to identify the change point of the slope of double mass curve. Once the change point was found, the respective contributions of vegetation change and climatic variability on streamflow could be calculated. Thus, the assessment tool includes three major functions. First, it has the data preprocessing module such as trend anal ysis and change point detection by

utilizing the non-parametric Mann-Kendall methods. Second, it provides several ways (e.g., Hargreaves and Thorthwaite equation, Budyko's equation) to estimate the evaportranspiration which is then used to calculate the effective precipitation. Finally, it can quantify the respective contributions of vegetation change and climatic variability on streamflow. This tool has been successfully used in Meijiang and Niyanghe watersheds and it is promising to be applied to numerous wathersheds.

Key words: Vegetation Change, Climatic Variability, Streamflow Change, Batch Processing

Plant-Soil System Act as Buffer Zone and Its Seasonal Variation Need More Attention

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Abstract: The water conservation dynamics for plant and soil has been widely but separately characterized. While the plant-soil system was a medium building a connection between deep earth and atmosphere, providing a transmissive layer of energy and substances of earth surface. The plant-soil system can act as a buffer or a retardant factor to retard or lengthen the time scales of the hydrological processes and water conservation service. The buffer contains two basic characteristics: storage capacity and buffer capacity. The former determines the storage limit or threshold of material (e.g. water storage capacity) which has been fully recognized in recent studies. The latter indicates the exchange rates for water or solutions in/out the buffer zone (e.g. the time span of recession flow, the changing rate of soil moisture, difficult or easy to store water), which is important in moisture variation across multiple time scales. Therefore, the plant-soil system and the associated interactions play an important role in Earth's water cycle system and its ecosystem services. Attentions should be focused on varying rate of soil moisture and more comprehensive monitoring of the dynamics in the buffer zone at seasonal or intra-seasonal timescale, even at multi-day timescale. This will enhance our understanding on hydrological variability at local or regional scales, and will allow scientists to address uncertainties in hydrological and climate models.

Key words: Storage Limit/Threshold, Storage Excess, Water Conservation, Buffer Zone

A Global Review on Hydrological Responses to Forest Change across Multiple Spatial Scales: Importance of Scale, Climate, Forest Type and Hydrological Regime

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Abstract: Despite extensive studies on hydrological responses to forest cover change in small watersheds, the hydrological responses to forest change and associated mechanisms across multiple spatial scales have not been fully understood. This review thus examined about 312 watersheds worldwide to provide a generalized framework to evaluate hydrological responses to forest cover change and to identify the contribution of spatial scale, climate, forest type and hydrological regime in determining the intensity of forest change related hydrological responses in small (<1000 km^2) and large watersheds (≥1000 km^2). Key findings include: 1) the increase in annual runoff associated with forest cover loss is statistically significant at multiple spatial scales whereas the effect of forest cover gain is statistically inconsistent; 2) the sensitivity of annual runoff to forest cover change tends to attenuate as watershed size increases only in large watersheds; 3) annual runoff is more sensitive to forest cover change in water-limited watersheds than in energy-limited watersheds across all spatial scales; and 4) small mixed forest-dominated watersheds or large snow-dominated watersheds are more hydrologically resilient to forest cover change. These findings improve the understanding of hydrological response to forest cover change at different spatial scales and provide a scientific underpinning to future watershed management in the context of climate change and increasing anthropogenic disturbances.

Key words: Forest, Runoff, Scale, Climate

Projecting Water Yield and Ecosystem Productivity to Climate Change across the Australia Continent

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Abstract: Predicting the response of water yield and carbon fluxes to future climate change is essential for Australia's ecosystems in terms of forest management and meeting carbon mitigation targets. In previous work, at a continental scale Australian streamflow (Q) and vegetation showed distinct responses to climate change.

The objectives of this study were to test a monthly ecohydrology model, WaSSI-C, and to investigate the potential impacts of climate change on water and carbon processes

using the most recent climate projections derived from 20 Global Climate Models (GCMs) of the Coupled Model Intercomparison Project phase 5 (CMIP5). The performance of the WaSSI-C model was comprehensively assessed with measured Q at 222 Hydrologic Reference Stations (HRSs). Simulated water and carbon processes were predicted to spatially vary under changing climate across all Stations. Across the 222 HRSs, the WaSSI-C model generally captured the spatial variability of mean annual and monthly Q as evaluated by Correlation Coefficient (R = 0.75–0.97), Nash–Sutcliffe Efficiency (NS = 0.13–0.90), and normalized Root Mean Squared Error (0.02–0.34). Compared with the baseline period of 1982–2013 across the 222 HRSs, temperature (T) across all RCPs (RCP2.6, RCP4.5, RCP6.0, and RCP8.5), was projected to rise by 0.45 to 2.98 ℃ by the late-21st century (2081-2100 averages), while annual precipitation (P) was projected to vary by -209 – +203 mm yr−1 (-7 – +20 %). Taking RCP4.5 as an example, over 90% of the watersheds would see a decrease in annual Q, while the most significant decrease (> 40 mm yr−1 or 85 %) was found in the centre and the eastern part of the Australia. Future climate change may result in a significant reduction in water yield but an increase in ecosystem productivity. On average, gross ecosystem productivity was projected to increase by 17 ~ 255 g C m−2 yr−1 (2% ~ 17%) while water yield was projected to decrease by 5 ~ 211 mm yr−1 (34% ~ 99%) by the late-21st century. Overall, WaSSI-C showed good performance for estimating water and carbon processes in Australia. The results provided a foundation for understanding the impacts of climate change on Australia's ecosystem services and important information for future watershed management.

Key words: Climate Change, Ecohydrology Model, Water Yield, Gross Primary Productivity

A Multiple Time Scale Modeling Investigation of Leaf Water Isotope Enrichment in a Temperate Grassland Ecosystem

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Abstract: Understanding the controls on temporal variation in plant leaf δ2H andδ18O valuesis importantfor understanding carbon–water dynamicsof the biosphereand interpreting a wide range of proxies for past environments. Explaining the enrichment mechanismsunderfield conditionsischallenging.To clarify the leaf water isotopic enrichment (LWIE) process at theecosystem scale,fourmodels with a range of complexitiesthat were previously conducted at the leaf scalehave been tested to simulate canopy foliage water ina multispecies grassland ecosystem.Although the exact importance of considering non-steady-state (NSS) or/andisotopic diffusion inbulk leaf

isotopic simulationshas been reported inprevious studies,our findings suggested that the steady-stateassumption(SSA) is practically acceptable as a first-order approximation.TheSSAPéclet model with dynamics of scaled effective path length (Leff) was the best option for reproducing the bulk-leaf-water isotopic ratio with an hourly-mean dataset, while anSSAtwo-pool model was the best option atthe daily-mean timescale for a grassland ecosystem.Relative humidity wasthe most controlling factor for canopy foliage water stable isotope composition because of its high sensitivity and variation. The results highlighted thatcanopy foliage water was a well-behaved propertythat was predictablefor a multispecies grassland ecosystem, and model performancedivergedat hourly or dailytime-scales.

Key words: Foliage Isotopic Enrichment, Advection-Diffusion, Numerical Modeling, Non-Steady-state

Developing Reforestation Systems to Restore Ecohydrological Function in Semi-Arid Australia

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Abstract: This paper reviews the approaches that have been used to drive broad-scale reforestation, to restore eco-hydrological function, in south-western Australia, a zone with 300-1200 mm $^{yr-1}$ annual rainfall and a Mediterranean climate. In this region dryland farming systems have been developed across 20 million ha through the replacement of natural vegetation. This zone is now beset with major problems such as dryland salinity, salinization of water resources and profound biodiversity loss as well as a changing climate as evidenced by a changing hydrological balance. Because salinity results from a disruption of the landscape water balance, reforestation has represented a major component of attempts to tackle the problem. Consequently, there has been considerable effort in the last three decades to develop reforestation options at scale to stabilise the landscapes, with a range of approaches revolving around the development of profitable options having been developed, including pulpwood and carbon plantings over 0.5 million ha. Whereas there has been success in restoring water quality in higher rainfall areas through watershed reforestation, there has been less success in tackling dryland salinity. Issues with reforestation include (a) obtaining sufficient scale of activity to impact watershed water balances, (b) obtaining a hydrological response without displacing farm production and rural communities and (c) gaining payment for non-forest benefits such as water quality and biodiversity. Conclusions relevant to global dryland systems are drawn.

Key words: Desertification, Biodiversity, Reforestation, Carbon Mitigation

Variation of Leaf Turgor Loss Point across China's Forests and Its Relationship with Hydraulic and Economic Traits

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Abstract: 1. Leaf turgor loss point (tlp), a commonly-used and easily-measured trait, is now found to showcase strong value in predicting many aspects of plant drought response. To further provide insight in the roles of tlp in ecological studies, we aimed to answer following questions: (1) what is the biogeographical pattern of leaf turgor loss point (tlp) across China's forests; (2) can tlp be used as a good predictor of hydraulic safety margin? (3) how do tlp correlates with key leaf economic traits?
2. We compiled a date set of tlp for 368 species, belonging to nine major forest types in China. Aridity index, hydraulic (vulnerability to cavitation, minimum leaf water potential) and economic traits (specific leaf area, leaf density, maximum CO_2 assimilation rates and leaf life span) were also gathered if available. Linear regressions of tlp against aridity index and other branch and leaf functional traits were analyzed.
3. Our results showed a significant relationship between tlp and aridity index, for forests from humid environments had lower tlp than those from arid environments. As expected, tlp was significantly correlated with leaf hydraulic safety margins (SMleaf). Interestingly, most species from tropical and subtropical regions showed positive values of SMleaf, with subtropical evergreen forest showed large SMleaf at 1.67 MPa, indicating a low drought risk in this forest community under current climatic conditions. Further, tlp was found to be significantly correlated each leaf economic traits included in this study.
4. We suggest that tlp could be used to estimate the vulnerability of species and forests in response to drought, and predict the positions along 'fast–slow' plant economics spectrum.

Key words: Turgor Loss Point, Biogeography Pattern, Drought Tolerance, Economic Traits

Hydrological Recovery in Two Large Forested Watersheds of Southeastern China_importance of Watershed Property in Determining Hydrological Responses to Reforestation

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Abstract: Understanding hydrological responses to reforestation is an important subject in watershed management, particularly in large forested watersheds (> 1000

km^2). In this study, we selected two large forested watersheds (Pingjiang and Xiangshui) located in the upper reach of the Poyang Lake watershed, Southeastern China (with an area of 3261.4 and 1458 km^2, respectively) to assess the effects of large-scale reforestation on streamflow. Both watersheds have similar climate and experienced comparable and dramatic forest changes during the past decades, but with contrasted watershed properties (e.g., the topography is much steeper in Xiangshui than in Pingjiang), which provides us with a unique opportunity to compare the differences in hydrological recovery in two contrasted watersheds. Streamflow at different percentiles (e.g., 5 %, 10 %, 50 % and 95 %) were compared using a combination of statistical analysis with year-wise method for each watershed. The results showed that forest recovery had no significant effects on median flows (Q50 %) in both watersheds. However, reforestation significantly reduced high flows in Pingjiang, but had limited influence in Xiangshui. Similarly, reforestation had significant and positive effects on low flows (Q95 %) in Pingjiang, while it did not significantly change low flows in Xiangshui. Thus, hydrological recovery is limited and slower in the steeper Xiangshui watershed, highlighting that watershed property is also important for determining hydrological responses to reforestation. This finding has important implications for designing reforestation and watershed management strategies in the context of hydrological recovery.

Key words: Hydrological Recovery, Forested Watershed, High Flows, Low Flows

Soil Erosion Evaluation at Global Scale: A Review

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Abstract: Soil erosion can trigger land degradation and affect the nutrient cycles at global scale. Based on the relative research results, the main research progresses of soil erosion evaluation at global scale can be concluded as follows. (1) Due to human activities and climate change, soil erosion has been accelerated globally in the last several decades. Human activates may contribute more to the change of soil loss. (2) Through there are several research results of soil erosion rate at global scale, there are big differences among soil erosion rate, and larger uncertainties may be a huge challenging for further study. (3) There are many soil erosion models at plot scale, watershed scale and regional scale; but it is hard to find some soil erosion models at global scale. How to calculate the erosion factors at global scale is still one of the challenges. (4)Land-ocean sediments transfer will change the carbon cycle and terrestrial productivity, but it is still unknown for the possible situations with climate change. (5)More and more global date are emerging, and the evaluation accuracy will be updated with new global data. While, there still a long way to go to develop the

global database for soil erosion evaluation.
Key words: Soil Erosion, Global Scale, Climate Change, Land

Forest Cover Change and Water Yield in Large Forested Watersheds: A Global Synthetic Assessment

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Abstract: The effects of forest cover change on water yield have long been studied across the globe. Several reviews have summarized the impacts of forest change and water yield from the small and paired watershed experiments (PWE), but no any synthetic assessment has been conducted based on studies of large watersheds (>1000 km^2). We conducted a synthetic analysis based on the studies from 162 large studied watersheds across the globe to explore how forest cover change affect annual water yield. Our first-ever assessment confirms that deforestation increases annual water yield while reforestation decreases it, which is consistent with results from PWE. More importantly, we found that forest cover and climate variability play a co-equal role in annual water yield variations. The effects of forest cover change and climate variability to annual water yield variations can be additive or offsetting. Thus, their interactions can critically determine the magnitudes and directions of water yield changes. We also found that the hydrological sensitivities to forest cover change in smaller and dryer watersheds are higher than those in larger and wetter ones. The implications of those findings for sustainable water and watershed management are discussed in the context of future land cover and climate changes.
Key words: Large Watersheds, Forest Changes, Annual Water Yields, Hydrological Sensitivities

The Effect of Forest on Water Resources Regulation in Different Scales in China.

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Abstract: The water shortage is one of serious causal factors for water ecological security which is a serious threat to the sustainable development of social economy in our country. The forest vegetation is the most important biological measures for water security, so the water ecological security of watershed and regional is the basic requirement of the country. In order to clarify the relationship between forest and water,

we study the interception, transpiration and runoff at different scales in different regions of the country. The results show that in the stand scale, forest evapotranspiration and leaf area index and canopy density, biomass, and other factors were positively correlated; the runoff in the northern area of China dominated by surface runoff, while which dominated by interflow in the southern region, besides, soil flow is far greater than the amount of surface runoff; in the slope scale, forest vegetation could decrease the surface runoff by 28.17%~56.97%, increase the flow by 44.68%~329.19% in soil, meanwhile, in this scale, rainfall and the soil water content (SWC) before rainfall is the main factors affecting the runoff in soil while the effects of forest vegetation on runoff is not obvious; in the basin scale, with the increase of the forest cover, the runoff and runoff ratio in small watershed showed a downward trend, while the subsurface flow and base flow of total runoff ratio increased, the forest vegetation could reduce 67% total runoff including 14% reduction in the surface runoff ratio, 11% augment in the interflow ratio and 3% augment in the basic flow ratio; in the regional scale, human activities (Gullies Engineering) play a leading role in the runoff change (83~95%), its contribution rate is far greater than the climate change (3~13%) or forest vegetation (1.3-3.2%) contribution rate, in the area without Gullies Engineering, the forest vegetation account for about 8~13% on runoff.

Key words: Water Resources, Regulation

Modelling Diurnal and Seasonal Hysteresis Phenomena of Canopy Conductance in an Oasis Forest Ecosystem

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Abstract: Canopy conductance (gc) is considered a key and complex variable in most land surface models. Diurnal hysteretic responses have been observed for gc in relation its environmental factors, posing some unavoidable challenges for the widely used gc models. This study combined sap flow (SF) methods with eddy covariance (EC) measurements in 2014 to investigate diurnal and seasonal variations in gc during a growing season of an oasis Populus euphratica forest. The results showed that responses of both SF-measured gc and EC-measured surface conductance gs to environmental factors formed hysteresis loops throughout the day. Hysteresis loops of gc existed at different stages of growth and development in the P. euphratica forest and showed significant seasonal variation. A three-step linear model and the Jarvis model were both used to simulate variations in gc. Scalar functions of the Jarvis model showed that midday gc was more sensitive to D in the early growing season (from May to July), and was more sensitive to R (except in May) and T in the late growing season (from

August to October). Although the Jarvis model effectively simulated midday gc, the three-step linear model worked more precisely to simulate gc hysteresis loops throughout the growing season (R2 = 0.88). This study highlighted the importance of dividing the daytime in different time periods and dividing the growing season into different stages to simulate diurnal and seasonal gc hysteresis loops. These results are helpful in achieving a better understanding of the bulk behavior of stomata in response to changing environmental conditions in oasis ecosystems.

Key words: Hysteresis Loops, Sap Flow, Eddy Covariance, Canopy Conductance

The Hydrological Response to Climate Variability and Hurricane -Induced Forest Change in a Coastal Experimental Watershed

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Abstract: Rainforest plays an important role in water cycle in a tropical watershed. Forest disturbances such as logging, fire, insect infestation, and hurricane may produce significant impact on dry/wet season flows and associated ecological functions. The hydrological impact of logging and fire has been well studied, while the impact of hurricane-related forest changes on water has been less investigated. In this study, we examined the impact of climate variability and hurricane-induced forest changes in Jianfengling catchment based on a 16-year experimental study. Jianfengling rainforest is a typical tropical rainforest ecosystem with limited anthropogenic disturbances in Hainan Island of China, where hurricanes are the dominant forest disturbances. By a combined use of experimental data and remote sensing data, we identified a decreasing trend in NDVI and EVI of the study watershed from 1990 to 2005 due to forest loss by hurricanes. The results show that forest loss due to hurricanes led to an increase in both annual water yield and wet season water yield while climate variability had a negative effect on them. The lagged the response of dry season water yield to forest loss by hurricanes was also found. The offsetting effects of climate variability and forest loss by hurricanes led to a stable water yield in this tropical rainforests.

Key words: Climate Variability, Hurricane, Tropical Rainforest, Dry/Wet Season Flows

T10-04: Ecohydrology and Watershed Management

Zonal Features of Runoff Formation in Central Siberia

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Abstract: Spatial-temporal features of river runoff formation and influence of climatic factors on runoff were analyzed for river basins of Central Siberia. The catchment area of studied river are located in different landscape zones: from forest-tundra to the zone of middle taiga. A considerable extent of the area from north to south and the associated differences of climatic parameters (temperature of air and precipitation) determine the features of the hydrological regime of the studied rivers.

Thus, it was found that the annual flow of the rivers significantly correlated with a complex of hydro-climatic parameters and its increase is due to rising of precipitation, especially snowfall. Increasing air temperatures in the spring, when it is combined with low air humidity and wind activity, affects the reduction of annual flow, by increasing evaporation from the snow surface. The same time, the increase of air temperatures in the middle of summer and in the beginning of autumn causes the increase in the annual flow of the rivers. It indirectly indicates that moisture of periodically thawing upper soil horizons takes a certain part in formation of river flow.

The regression models of annual and minimal runoff, which reflect local features of climatic factors in the formation of river flow, were obtained. The winter low flow of studied rivers significantly correlated with the amount of liquid precipitation, but has complex relationships with air temperatures of different months. Warming of atmospheric air in the end of the summer provides the thawing of permafrost and increases the winter low flow, but winter air temperatures contribute to a reservation of underground water and to alimentation of rivers by this moisture.

Our investigations allowed identifying the positive correlation between the annual runoff of rivers and forestation of catchment. However, the increment in annual runoff is not equivalent to each percentage increasing of forestation at watershed. The runoff sensitivity to changes of forestation catchment increases from south to north. Thus, the results confirm a conception of geographically deterministic hydrological role of forests, which states that in conditions of cold climate the forest "works" as the store of a moisture and is the factor of river runoff increase. In a warm climate the forest in comparison with treeless territories, “works” as the best evaporator.

Key words: Siberia, Runoff, Precipitation, Evaporation

Using Flow Duration Curves and Flood Frequency Analysis for Habitat Restoration in the Sacramento River, California

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Abstract: The Sacramento River has a number of endangered anadromous salmonid species, including winter-run Chinook salmon (Oncorhynchus tshawytscha).The Bureau of Reclamation has been implementing the Upper Sacramento River Anadromous Salmonid Habitat Restoration Program, which stresses the need for habitat rehabilitation for winter-run Chinook salmon, specifically habitat for juvenile rearing and emigration. Previous research has shown that salmonids in general have benefitted from past and ongoing restoration activities within the Upper Sacramento River watershed (Department of the Interior, 2015). This paper will describe the methodologies used to quantify streamflow magnitude, frequency, and duration for a proposed side channel. The side channel is designed to support juvenile rearing and emigration of winter-run Chinook salmon especially between the months of July to March, which is the critical time period for these life stages. We constructed a flow duration curve based on historical water flow data in the Sacramento River from 1961 to 2015. Sufficient water flow in the side channel is crucial to enable the movement of juvenile winter-run Chinook salmon and to ensure that the channel remains connected to the main channel – so that the juveniles are not left in isolated pools to perish.Based on channel design, the side channel flow can be manipulated; depending on the flow in the main channel. Subsequent to plotting the flow duration curve, a flood frequency analysis was conducted to determine the viability of this side channel design. Findings indicate that our streamflow estimation methods 1) work well for designing side channels in rivers that have long term (30 years+) flow records available, and 2) can be implemented in other basins with similar long term flow records.

Key words: Winter-run Chinook Salmon, Flow Duration Curve, Flood Frequency Analysis, Habitat Rehabilitation

Study on the Key Factors and Controlling Methods of Water Bloom in Hanjiang River, China

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Abstract: Since 1990s, the middle and lower reaches of the Hanjiang River has been a "water bloom" phenomenon, residents living water and industrial and agricultural water along the river have caused a serious threat. Especially after the implementation

of the South-North Water Diversion Project, the problem of "water bloom" has become a major issue of national and local attention.By monitoring the Hanjiang River water bloom process, Bureau of Hydrology, Changjiang River Water Resources Commission determined the Hanjiang bloom is "diatom bloom", the dominant species is Cyclotella sp. Combined with the biological characteristics of the species, we reveal the control factors of water bloom from the four aspects of nutrition, light, temperature, water velocity. According to the hydrological data of Hanjiang River Basin in 26 years (daily precipitation and flow data, 1990-2016) and water quality data analysis, such as nitrogen and phosphorus in water of Hanjiang River nutrient concentration is not for the main controlling factors of water bloom in Hanjiang River. The three factors of light, water flow and water temperature are the necessary conditions for the occurrence of water in the Hanjiang River. The warning value can be set to continuous sunshine for more than 3 days, the flow rate of the river is less than 500m3/s and the water temperature is more than 10 ℃. Appropriate control measures should be taken to meet the above warning value, we will give full play to the management functions of the basin, through the water conservancy optimal scheduling, regulating the flow of the river, so as to control the occurrence of blooms.

Key words: Water Bloom, Key Factor, Controlling Method, Hanjiang River

Development and Evaluation of a Physically Based Multiscalar Drought Index: The Standardized Moisture Anomaly Index

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Abstract: In this study, a new physically based multiscalar drought index, the Standardized Moisture Anomaly Index (SZI), was developed and evaluated, which combines the advantages of the Palmer Drought Severity Index (PDSI) and the Standardized Precipitation Evapotranspiration Index (SPEI). The SZI is based on the water budget simulations produced with a sophisticated hydrological model, and it also includes a multiscalar feature to quantify drought events at different temporal scales taken from SPEI.

The Chinese Loess Plateau was selected to evaluate the performance of the SZI. Our evaluation indicates that the SZI accurately captures the onset, duration, and ending of a multiyear drought event through its multiscalar feature, while the PDSI, which lacks this feature, is often unable to describe the evolution of a multiyear drought event. In addition, the variability of the SZI is more consistent with observed streamflow and the satellite normalized difference vegetation index than that of the Standardized Precipitation Index and the SPEI. Although the SPEI includes potential

evapotranspiration (PE) as water demand, water demand is often unrealistically estimated based solely on PE, especially over arid and semiarid regions. The improved drought quantification with the SZI is the result of a more reasonable estimation of water demand by including evapotranspiration, runoff, and any change in soil moisture storage. In general, our newly developed SZI is physically based and includes a multiscalar feature, which enables it to provide better information for drought monitoring and identification at different temporal scales.

Key words: Drought index, Water Balance, Evapotranspiration, Water Demand

Spatial Variability in Soil Hydraulic Conductivity and Related Hydrological Response in the Heihe River Watershed, Northwest China

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Abstract: Soil hydraulic conductivity is a very important parameter for both hydrological and ecological processes. Understanding its variability is critical to the modelling of hydrological processes and the water resources management of river basins, especially in the arid and semiarid mountainous waersheds. In this study, a total of 32 soil profiles with 5 layers within 0-70 cm were sampled under different land cover types: forest, meadow, high coverage grassland (HCG), medium coverage grassland (MCG) and barren land in the upper reach of the Heihe River Watershed, Northwest China. Saturated hydraulic conductivity (KS) was measured for each sample. The vertical variation of KS and soil hydrological response under different land covers were analyzed. Results show that KS value in layer 5 was significant lower than the values of above 4 layers. KS decreased in the order of forest, meadow, HCG, MCG, and barren land, corresponding to the degree of vegetation degradation. The KS decreased with depth under forest, HCG and barren land, but increased first and then decreased under meadow and MCG. The dominant stormflow paths (DSP) for different land covers were different: forest was dominated by deep percolation (DP), HCG was dominated by subsurface flow (SSF), meadow was prevailed by Hortonian overland flow (HOF) and had no SSF, while MCG and barren land were also dominated by HOF, but still formed SSF. The results provide important information for improving the accuracy of mountainous hydrological modeling, and in turn leading to sustainable management of water resources in the study watershed.

Key words: Saturated Hydraulic Conductivity, Soil Hydrological Response, Land Cover, The Heihe River Watershed

Biocapacity Optimization in Regional Planning

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Abstract: Ecological overshoot has been accelerating across the globe. Optimizing biocapacity has become a key to resolve the overshoot of ecological demand in regional sustainable development. However, most literature has focused on reducing ecological footprint but ignores the potential of spatial optimization of biocapacity through regional planning of land use. Here we develop a spatial probability model and present four scenarios in optimizing the biocapacity for a river basin in Northwest China. In the maximal biocapacity (MB) scenario, we first calculated the probability for the four land use categories in each cell and then replaced the original land use category only if the most probable land use category had a higher biocapacity than the original one. In the optimal biocapacity (OB) scenario, we replaced the original land use category with the most probable land use category. We implemented the OB scenario but prohibiting the increase of croplands (the OBC scenario), given the ongoing government policy on Grain for Green. We further carried out the OB scenario but do not allow for further increase of water demand (the OBW scenario). The potential of enhanced biocapacity and its effects on ecological overshoot and water consumption in the region were explored. Two scenarios with no restrictions on croplands reduced the overshoot by 29 to 53%, and another two scenarios which do not allow croplands and water use to increase worsened the overshoot by 11 to 15%. More spatially flexible transition rules of land use led to higher magnitude of change after optimization. However, biocapacity optimization required a huge amount of additional water resources, casting considerable pressure on the already water-scarce socio-ecological system. Our results highlight the potential for policy makers to manage/optimize regional land use so that to address ecological overshoot. Investigation on the feasibility of such spatial optimization complies with the forward-looking policies for sustainable development and deserves further attention.

Key words: Biocapacity, Spatial Optimization, Water Resource, Planning

Study of Function Reforging of Urban Water System Health and Related Project Governance Technology

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Abstract: Because of climate change and the decline of environmental carrying capacity, the water ecology of the cities in China faces the two extremes of severe waterlogging and severe insufficiency of the water supply. People should be clearly aware that the overall water resource crisis has been extremely urgent, and only by constantly seeking to bring man and the natural water environment in harmony with each other can cities develop healthily and sustainably. On the basis of making a statistical analysis of urban water systems and making an empirical analysis of civil water ecological construction, this paper obtains the key factors of the healthy development of urban water systems and, on these grounds, establishes the system model for the redesign of urban water systems based on health functions. With a view to the comprehensive improvement of the functions of urban water safety, water security, water ecology and so on, this paper conducts a path analysis for civil water ecological city construction in terms of various aspects of water utilization, water ecological environment, water management, water safety and water culture, and it discusses water system connectivity, dynamic balance of water quantity, exploitation and supplementation of groundwater, water ecological restoration and a sponge-type city construction project governance system. This study takes Jinan City as an example, regarding the special hydrogeologic conditions of a compound city with slopes and plains, we details ideas for building various demonstration zones, including a ground water infiltration and replenishment demonstration area, a water conservation demonstration area, a comprehensive demonstration area of new development, a road flood control demonstration area, an old city upgrading and reconstruction demonstration area, and a high risk control demonstration area for waterlogging. The study contributes to regulating the project governance behaviors of water-related activities, following the laws of the natural hydrological cycle and striving for the ultimate goal of "Better city, better life".

Key words: Water System Health, Function Reforging, Shandong Province, Water Ecological City

Evaluation of Soil Erosion on Watershed Scale in the Middle Reaches of the Yellow River Basin

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Abstract: The study area, the middle reaches of the Yellow River, is the most serious area of soil erosion in the Yellow River basin. Using the data of land cover, meteorological and terrain from 2000 to 2010, this study extracted the vegetation coverage based on GIS and RS, and calculated soil erosion modulus by revised

universal soil loss equation (RUSLE), then explored the correlation between soil erosion and vegetation coverage and analyzed the temporal and spatial variation characteristics of soil erosion in different ecosystems and basin scale. Results showed that: (1)In the middle reaches of the Yellow River, the vegetation coverage is low in northwest and high in southeast and presents a fluctuating upward trend over time, and there is a negative correlation between soil erosion modulus and vegetation coverage; (2)The intensity of soil erosion in different ecosystem of study area decreased during 2000-2010 and the erosion situation is significantly improved; (3)The amount of soil erosion in the Yellow River's secondary basin has reduced in different degrees over the past 10 years; (4)Throughout the study period, the amount of soil erosion was increased in Yi River, Fenghe and Heihe watershed, and reduced in other tertiary basins. The results of this study have some guiding significance for the soil and water conservation measures in the middle reaches of the Yellow River, and the multi-scale soil erosion assessment method and the soil erosion assessment mind through the elimination of climate factors to realize the vegetation as the dominant factor of soil erosion can also be used for reference in other areas.

Key words: The Middle Reaches of the Yellow River, RUSLE, Multiple Regression, the Multi-Scale Soil Erosion Assessment Method

Effects of Precipitation Variability and Land Use/Cover Changes on Spatio-Temporal Variations of Streamflow and Sediment Load in the Loess Plateau, China

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Abstract: Understanding the impacts of land use/cover change (LUCC) and climate variability on hydrological responses is important to the design of water resources and land use management strategies, especially in water-limited areas. Within China’s Loess Plateau there have been concerted revegetation efforts and engineering measures over the last 50 years aimed at reducing soil erosion and land degradation. As a result, streamflow, runoff coefficient, sediment yield and sediment concentration have all decreased considerably and the flow-sediment relationships also altered significantly. Human induced LUCC was the dominant factor, contributing over 70% of the streamflow and sediment load reduction, with reductions of annual precipitation contributing the remaining 30%. In this study, we use data on 50-year time series (1961-2011), showing decreasing trends in the annual sediment loads of fifteen catchments, to generate spatio-temporal patterns in the effects of LUCC and precipitation variability on sediment yield. The space-time variability of sediment yield

was expressed as a product of two factors representing: (i) effect of precipitation (spatially variable) and (ii) fraction of treated land surface area (temporally variable). Under minimal LUCC, annual sediment yield varied linearly with precipitation, with the precipitation-sediment load relationship showing coherent spatial patterns amongst the catchments. On the other hand, the effect of LUCC is expressed in terms of a sediment coefficient, i.e., ratio of annual sediment yield to annual precipitation, which is equivalent to the slope of the sediment yield-precipitation relationship. Sediment coefficients showed a steady decrease over the study period, following a linear decreasing function of the fraction of treated land surface area. In this way, the study has brought out the separate roles of precipitation variability and LUCC in controlling spatio-temporal patterns of sediment yield at catchment scale.
Key words: Streamflow, Sediment Load, Spatio-temporal Pattern, Loess Plateau

Evaluating Canopy Transpiration and Water Use of Two Typical Planted Tree Species in the Dryland Loess Plateau of China

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Abstract: Large-scale vegetation restoration has been conducted in China's Loess Plateau over the past several decades to control soil and water loss. However, no specific guidelines are followed in plant species selection for the balance of vegetation restoration and water demand. In this study, we measured canopy transpiration characteristics of oriental arborvitae (Platycladus orientalis) and Chinese pine (Pinus tabulaeformis), two species that are commonly planted in restoration efforts, and recorded water input and output for these two species during the growing season. P. tabulaeformis had a higher tolerance than P. orientalis to warmer and drier environments and used water over a wider time span. Canopy transpiration significantly increased when rainfall exceeded 15 mm and negatively correlated with net change of soil water content. Meanwhile, rainless intervals also affected the canopy transpiration recovery. Canopy transpiration of P. tabulaeformis was 25.4% higher than that of P. orientalis. Soil water content under P. orientalis declined by 28.4% after the growing season, while it slightly increased under P. tabulaeformis (0.7%). Our results suggested that although P. tabulaeformis plantation had higher canopy transpiration, this water use did not drastically reduce soil water content, mainly due to the lower evaporation caused by the dense canopy cover. However, the low soil water content also implied that a better management, such as a mixed plantation of these two species and other supplemental water-conservation techniques, should be considered to better use of water in this semiarid region.

Key words: Canopy Transpiration, Sap Flow, Soil Water, Water Budget

Cumulative Effects of Cascade Hydropower Station on the Landscape Patterns in Wujiang Catchment

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Abstract: Wujiang River located in Guizhou province of China is a branch of upper reaches of Yangtze River. It has been extensively developed for 13 different hydropower stations. They were constructed and completed between 1976 and 2014. The construction of dams plays an important role in water and electricity supplement for the surrounding region. However, the negative effects of dam on the ecosystem and environment is systematic and cumulative. We think it is of significance to study the influence scope of landscape patterns in both upstream and downstream zones after the dam construction. The spatial accumulation effect is produced when the spatial distance between two dams is less than the distance, which is required by the ecosystem could recover from the disturbance. Previous studies indicated that the effects of the individual dam on landscape patterns in upper regions (i.e. 10km) of a dam is greater than that in downstream zone. However, few studies focus on the cumulative effects of the cascade dams on the landscape patterns at the catchment scale. Besides, some government implementations, such as returning farmland to forest, may influence the changes in landscape patterns as well. In this study, we analyze the cumulative effects of cascade hydropower stations through calculating the pure influence of individual dam on the landscape patterns in different time periods by remote sensing and GIS approaches.

Key words: Cumulative Effects, Dam, Landscape Patterns, Wujiang Catchment

Impact of Floodgates Regulation on Water Quantity and Quality Processes：A Case Study of Wuxi City, China

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Abstract: Floodgates is one of major river regulation in basin development and utilization and have changed natural structures and processes in running waters and associated environments. In this paper, one-dimensional modeling system was presented for assessment of the impact of floodgates operation on river flow regime. Furthermore, a comprehensive framework based on the one-dimensional model and

linear programming model was established to assess the impact of floodgates operation on pollutants emission. The results showed that floodgates operation reduced water level and river discharge and had negative impacts on pollutants concentration. The concentration of COD and NH_4-N significantly increased due to floodgates operation. In addition, The allowed emissions of COD and NH_4-N thus were reallocated in the 10 pollution sources. This information is fundamental for a successful management of river ecological regulation and, can be as a basis for future environmental and ecological impact studies when new floodgates are proposed on rivers.
Key words: Floodgates, Flow Regime, Pollutant Emission, Ecological Regulation

Response of Streamflow to Climate Warming-induced Permafrost Thaw in Large Watersheds in Northeastern China

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Abstract: Permafrost degradation or thawing due to global warming has become an emerging ecological issue as it greatly shifts hydrological regimes, changes future water availability and influence aquatic ecological services. Several recent studies have related observed increases in winter baseflow to permafrost thaw which can enhance infiltration and deepen groundwater flow paths. However, no studies have been done to quantify the relative contributions of permafrost degradation to annual streamflow. In this study, the large watersheds (Upper Tahe River, Tahe River, and Duobukuer River watersheds) located in the south margin of Xing'an-Baikal permafrost distribution region in Northeastern China, were used to quantify the response of streamflow to climate warming-induced permafrost thaw.

The long-term winter baseflows (1973-2012) data from Tahe River and Duobukuer River watersheds showed significant positive trend, and exhibited significant positive correlations with air temperature and the thawing index. The statistical analyses indicate that the positive trend in winter baseflow are likely caused by climate warming-induced permafrost thaw.

In order to quantify the relative contribution of permafrost thaw to the changes of annual streamflow, the sensitivity-based method and the Kendall-Theil Robust Line method were firstly used to distinguish the relative hydrologic effects of climate variability and the combined contributions of forest change and permafrost thaw on the streamflow changes of the Upper Tahe River. A simple method including the Stefan equation and considering changes to winter baseflow was then employed to separate out the respective impacts of permafrost thaw and forest change. The results suggest that permafrost thaw plays an important role on long-term streamflow trends in this

region, which must be considered when assessing future water availability under climate warming impacts.

Key words: Climate Warming, Permafrost Thaw, Hydrologic Change

Hydrologic Responses to Soil and Water Conservation Policy and Associated Land Surface Change in a Loess Hilly Watershed of China

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Abstract: During the past decades, great efforts have been made to conserve the soil and water in the Loess Plateau, and the water discharge and sediment load in the Yellow River has shown a sharp decreasing trend. Although many studies have focused on the direct driving factors, such as climate change, check dam, Grain for Green, and so on, the debates still exist in terms of the possible mechanism and the quantification method, because of complexity and spatial heterogeneity of hydrological processes in this area. To find a reliable method, we chose a typical watershed in the Loess Plateau and combined the hydrological modelling and statistical analysis to quantify the contribution of climate change, soil and water conservation measures and ecological restoration policy to watershed hydrology. We first calibrated and validated the Soil and Water Assessment Tool (SWAT) in the reference period which has relatively less human interference. Then we simulated the hydrological responses of climate change, conservation measures and land use change using calibrated model. Finally, the contributions of each driving factor to streamflow were calculated based on different simulation experiments. Our research proposed a new method for attribution study on the watershed hydrology and will benefit water resources management and ecological sustainability in the Loess Plateau.

Key words: Hydrological Modelling, Soil and Water Conservation, Land Use Change, Ecological Restoration

An Improved Algorithm to Calculate the Water Surface Profile of Natural Mountainous Stream based on Energy Balance Equation

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Abstract: As one of the key factors of engineering design, the correct calculation of the water surface profile is the basis for mountain-flood disaster prevention. Due to its clear

physical meaning and convenience to be implemented, the Energy Balance Equation has been widely employed to calculate the water surface profile in the past decades. When this equation is directly applied to simulate natural stream flows, however, the unfavorable conditions such as oscillation, non-convergence, etc. often occur, especially in mountain areas. In order to overcome this drawback, an improved algorithm based on the Energy Balance Equation has been proposed in this article, where the Froude Number and Section Energy Curve have been combined together to control the process of iterative optimization. In mountain areas, the gradient of streams is larger than that of plains and the torrent and tranquil flow often change alternately along the directions of the water flow. The Section Energy Curve, viz. the curve representing the relationships between water depth and mechanical energy at a cross-section of the river channel, is similar to an upwards parabola with respect to that (a) normally, there are two different water depths corresponded to the same mechanical energy at a cross section under the same discharge condition – one is for torrent and the other is for tranquil flow; and (b) on the critical status, the mechanical energy becomes the lowest and there is only one corresponding water-depth remained. Correspondingly, when the energy balance equation is independently utilized to calculate the flow pattern of one cross section, the Iterations could be randomly converged to the state of either torrent or tranquil flow, which will result in unexpected oscillations and/or non-convergences. Keeping this unfavorable condition in mind, the authors have employed the section energy curve to control the iterative optimization operations, which can be characterized by the following four steps: (1) In the process of each iteration, calculate the Froude Number (Fr) according to the equation of Fr=(V/gh)^0.5, where V and h respectively represent the average flow speed and the average water depth of the cross section.(2) If Fr is larger than 1, the water flow can be regarded as a torrent and the iterative operation will be conducted on the left side of the section energy curve.(3) If Fr is smaller than 1, it tends to be a tranquil flow and the iterative operation will be conducted on the right side of the section energy curve.(4) If Fr is equal to 1, the water flow is on the critical status, i.e. there is only one corresponding water-depth and thereby it is unnecessary to restrict the scope of the iterative operations.In this way, the uncertain oscillations or non-convergences can be avoided. As a result, the proposed algorithm has revealed very satisfied water surface profiles in the conducted experiments with test beds of the real-world data in the mountainous areas of Loufan and Gujiao, Shanxi, China.

Key words: Water Surface Profile, Energy Balance Equation, Froude Number, Section Energy Curve

Distribution and Assessment of Surface Water Quality，Heavy Metals in Sediments and Combined Pollution in the Haihe River Basin in China

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Abstract: The Haihe River Basin is one of the most polluted river basins in China with huge population and highly developed industry and agriculture. Contamination investigation in the Basin is essential to develop pollution control strategies and systematic approaches for the better management of water environment. Mean concentrations of total nitrogen (TN), total phosphorus (TP), ammonia nitrogen (NH3-N), nitrate nitrogen (NO3-N), chemical oxygen demand (COD) in waters and heavy metals (Cd, As, Pb, Cu, Ni, Zn, Cr) in sediments were investigated. Eutrophication index（EI）and potential ecological risk index（RI）were used to evaluate pollution condition in surface water and sediments. Mean EI (67.93) in the Haihe River Basin showed serious eutrophication in this region and RI (111.48) indicated low risk level of heavy metals. Downstream Plain of Bei Si River (BSRDP) watershed were faced with the most serious eutrophication with a mean value of EI (75.72) that significantly higher than other watersheds due to anthropogenic emissions. Cd showed the highest potential ecological risk. Cd, Zn and Cu and Pb were the most anthropogenically enriched elements in the Basin as indicated by enrichment factor (EF) values ＞2. RIs in ZiYa River (ZYR) and Da Qing River (DQR) watersheds implied these watersheds were faced with moderate risk and EFs in these regions showed human activities were the main incentive of heavy metals enrichment in these regions. Combined pollution of pollutant was found in pairs in single media with significant correlations between Zn–Ni (0.809**), Cr–Ni (0.673**) ,Cu–Ni (0.686**), Zn–Cr (0.617**), TN–NH3-N (0.611**) and TN–NO3-N(0.605**) and significant correlations (0.318*) between EIs and RIs showed combined pollution of eutrophication in water bodies and heavy metals in sediments happened in Haihe River Basin especially in the central areas such as DQR (0.992**), ZYR (0.627**) and BSRDP (0.631**) watersheds where strong human activities exists. Population and industry structure in serious combined polluted areas showed intensive human activities in agricultural and industrial production and urban life in these regions was the main cause for the combined pollution in Haihe River Basin.

Key words: Eutrophication, Potential Ecological Risk, Combined Pollution, Industry Structure

Using a Hydrodynamic Model to Simulate the Transport of perflUoroalkyl Acids in Xiaoqing River, China

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Abstract: As a class of emerging persistent organic pollutants (POPs), perfluoroalkyl acids (PFAAs) have been widely used in manufacturing processes and products, such as polymers, surfactants, lubricants, pesticides, textile coatings, nonstick coatings, stain repellent, food packaging, and firefighting foams for more than 60 years. However, their persistence, hazardous effects, long-range transport and potential accumulation in food web have attracted wide attention, especially perfluorooctane sulfonate (PFOS) and perfluorooctnoic acid (PFOA). Due to the relatively high polarity and solubility of PFAAs, water has become the primary pathway for PFAAs and served as the major medium for their transport. We use DHI MIKE-11 model which is a one-dimensional modeling system. In this study, the transport of PFOS and PFOA was modeled using DHI MIKE 11 river model to assess their transport from the fluorochemical park in Xiaoqing River to the downstream where the industrial water enters the Bohai Sea. We developed three scenarios to assess the risk of PFOS and PFOA in surface water: the measured concentrations, constant maximum and the magnitude of a continuous constant load. In scenario 1, the model was run with an input of loads that change over time according to the concentration series interpolated from the measured concentrations. In scenario 2, the model was run using constant maximum loads that were based on the maximum values of the measured concentrations in order to find out the maximum concentrations of the current PFOS and PFOA. In scenario 3, we estimated the magnitude of continuous constant PFOS and PFOA loads, which would cause the PFOS and PFOA concentrations at the estuary to a harmful level. Simulation results are used to calculate the flux of PFOS and PFOA from the Xiaoqing River estuary in the Bohai Sea. The findings will assist in monitoring the status and trends of emerging POPs and will help assess the risk to both humans and wildlife, in the estuarine and coastal areas of the Bohai Sea, China.

Key words: Hydrodynamic Model, POPs, Transport, Risk Assessment

Relationship between Groundwater Quality Index of Physics and Chemistry in Riparian Zone and Water Level Change Effected by Operation of Three Gorges Reservoir

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Abstract: Riparian zone hydrology is dominated by shallow groundwater with complex interactions between groundwater and surface water. There are obvious relations of discharge and recharge between groundwater and surface water. Water level is an important hydrological incident that affects groundwater quality in riparian zone. By observing variations of physical and chemical groundwater indicators in riparian zone along the middle reaches of the Yangtze River, especially those took place in the period of regulation for water and sediment at the Three Gorges Reservoir (TGR), relationship between the groundwater quality in riparian zone and the flood water level and quality in the river is studied. Results show that, the quality of groundwater at 500 to 2000 m from the river bank is significantly affected by water level operation in different seasons. Physical and chemical indicators of water change strongly in this area. The groundwater pH value is lower by 0.2 to 0.6 with the water level change, with great seasons varieties by the operation of the TGR. The NH3- of groundwater is affected dramatically, which is more obvious than other N indicators of groundwater. Conductivity, NO3- and TN was affected to a lesser extent show that the range of 500 to 2000 m in riparian, and the salt accumulation quality changes with seasons. The result indicates that there is a very close relationship between groundwater and surface water and the operation of the dam, and it is the typical land and water ecotone between groundwater of riparian zone and the river. Rational protection for this region is critical for the conservation of water quality both in the river and groundwater.

Key words: Riparian Zone, Groundwater Quality, Nutrition, Operation

Application of Stable Isotopes Technology in Forest Hydrological Process—A Case Study in Sub-Alpine Forest in Western Sichuan of China

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Abstract: Regulation of the hydrological processes is one of the important ecological functions of forest. The sub-alpine forests near the headwaters of Mingjiang River in Sichuan Province of China play an important role in the conservation of soil and water

and maintenance of ecological balance in up-reaches of Yangtze River. To quantify the distribution differences and dynamics in the precipitation, canopy interception and mountain snow melt water between a sub-alpine coniferous forest and a sub-alpine shrub ecosystem under different precipitation intensities, we used the hydrogen and oxygen stable isotopes technology to examine hydrological processes of sub-alpine ecosystems. We found that the two vegetation types displayed different patterns of stream water δD (δ18O) dynamicsunder different precipitation intensities. For a rainfall event of < 10 mm, the increase in the rainfall δD (δ18O) led to an increase of stream water δD (δ18O), with the peak occurring on the fourth day in sub-alpine coniferous forest as compared to the peak on the third day in the sub-alpine shrub. For a rainfall event of 10~20 mm, stream water peaked on the second or third day in the sub-alpine coniferous forest, but on the first or second day in the sub-alpine shrub. For a rainfall event of 20~30 mm, stream water had no time delay and peaked on the first day. The observed patterns of stream water time delays indicated that the two sub-alpine ecosystems differ in regulation capacity with the well-developed old-growth dark coniferous forest exerting more significant regulatory control over the hydrological processes.

Key words: Hydrogen And Oxygen Stable Isotopes, Hydrological Processes, Sub-Alpine Forest, Western Sichuan of China

Habitat Model Development of Mangroves and Its Implications on Watershed Sediment Management

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Abstract: Mangrove forests provide a variety of benefits in the whole ecosystem. It is acknowledged that sea level rise effects have become increasingly severe on the impacts of mangrove ecosystem. Habitat suitability index is an ecological model widely applied to evaluating the quality of habitats and helping integrated management. The HSI and field investigation were adopted to develop the mangrove habitat model for Wazwei wetland in the Tanshui River, northern Taiwan. The mangroves expand from south to north in Wazwei, while the spatial distribution shows that the biomass in the southern region is greater than that of the northern region. There exists a positive relation between the area covered by mangroves and the surface elevation. Besides, there is a trend that mangroves in all mature-forest areas are still growing. The biological, environmental and habitat-related parameters are compiled and analyzed. Mangroves in specific regions within the Wazwei experienced lodging and damage after extreme typhoon events. It was recorded that there were once mangrove forests

growing on the current bare mudflat. It is deduced that mangrove forests may return to the region in the future according to our investigation. Step function was used to build the suitability-index models of inundation frequency and sorting coefficient. The dependent variables of these two suitability indices are both mangrove biomass per unit area, which can represent the health conditions of mangroves. The results of suitability-index function of inundation frequency proved to coincide with the mangrove distribution in Guandu wetland, indicating that the model already has the predicting and simulating ability. The modeling results related to the sediment effluent of upstream reservoir has demonstrated that the wetland morphology and landscape changed obviously and the mangrove habitat might be restricted.

Key words: Mangrove, Watershed, Habitat Suitability, Sedimentation

Phosphorus Use Efficiency in the Food Production and Consumption System: Evidence from Zhangzhou Prefecture in China

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Abstract: The anthropogenic phosphorus (P) scarcity and the negative ecological effects of P-induced eutrophication and pollution are being aggravated by the inefficient use of P from field to fork in developing countries, calling for substantial reduction in demand through improved use efficiency and recycling. Using substance flow analysis, dozens of mass balance models were constructed, and then flow charts were drawn to systematically present P flows in the Zhangzhou prefecture of Fujian province in China from 1995 to 2014. The charts were used to identify where P use efficiency can be improved, and to understand the changes in resource demand and environmental load of P metabolism for developing policies related to improving P metabolism efficiency and recycling. The results showed that there were significant differences in the increase of annual P input to the three agricultural production subsystems: 0.64×104 t P and 20% for crop farming, contributed mainly by fertilizers; 679 t P and 15% for livestock ranching; and 2.54×104 t P and 325% for aquaculture, respectively, over the duration of these 20 years. While the total input amount of the entire system increased 1.73 times, from 4.42×104 t P in 1995 to 7.67×104 t P in 2014, this increase was mainly contributed from crop farming and aquaculture every year. Furthermore, since 1995, the increased amount of annual net P loss to the environment from the three subsystems—crop farming, livestock ranching, and aquaculture—reached 0.6×104 t P, 783 t P, and 2.32×104 t P, respectively, by 2014, with increase rates of 31%, 8487%, and 325%. Clearly, the increase in annual P demand and its net loss from aquaculture were much higher than those from the other two

subsystems. This result indicates that it is much more urgent to improve P use efficiencies in the aquaculture subsystem (without overlooking the importance of improving P use efficiencies in crop farming), for the reduction of anthropogenic P demand in the prefecture, compared with the other subsystems. In the food consumption subsystem, annual food P consumption significantly increased, by 236% (559 t P $^{yr-1}$) for urban residents and fell slightly, by 6.76% (116 t P $^{yr-1}$) for rural residents, from 1995 to 2014. Accordingly, per capita food P footprint increased 70% for urban residents and decreased 3.85% for rural residents over the 20 years. As a result, net environmental P load increased 17% (183 t P $^{yr-1}$) from rural residents' excreta and 114% (374 t P $^{yr-1}$) from urban residents' excreta, respectively. Therefore, it is quite safe to assume that urbanization was one of the dominant driving factors exacerbating the environmental load and resource shortage of P metabolism, and should be considered when developing policies related to improving P metabolism efficiency and recycling. But the effect of urbanization on P loss was mainly by residents' changing food consumption amount and patterns, rather than from discharging wastewater, and WWTPs can play little role in reducing P load of the system in the prefecture, as most of the P loss occurred during agricultural production.

Key words: Phosphorus Flows, Resource Footprint, Environmental Load, Substance Flow Analysis

Research and Implementation of Ecological Environment Remote Sensing Monitoring System

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Abstract: With the rapid development of the earth observation, the ability of national environmental monitoring and application level of remote sensing is significantly improved. This paper discusses the recent progress in ecological environment remote sensing technology development and application. Further on, the setup of national environmental monitoring satellite system is introduced, and then the setup and operation of national environmental monitoring technology system is systematically discussed.

Key words: Environmental Remote Sensing, Operational Application, Monitoring System

Effects of Vegetation Pattern and Rainfall Intensities on Runoff and Soil Erosion at Loess Slope under Rainfall Simulations

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Abstract: Abstract: Water erosion is one of the most severe issues in the arid and semiarid regions, which would hinder the recovery and development of ecosystem. Based on this background, to scientifically implement soil and water conservation, the runoff plot and rainfall simulation are effective methods in figuring out the runoff dynamics disciplines. In this study, such methods were used to explore the relationship between vegetation pattern positions and runoff and soil erosion. Three major rainfall intensities (15 mm/h, 30 mm/h and 60mm/h) and six study plots were designed, including arbors-shrubs-herb (A-S-H), arbors-herb-shrubs (A-H-S), shrubs-arbors-herb (S-A-H), shrubs-herb-arbors (S-H-A), herb-shrubs-arbors (H-S-A) and herb-arbors-shrubs (H-A-S), from the up slope to the down slope respectively. Results showed that: Runoff indices sharply increased with the increment of rainfall intensities under similar underlying surfaces. Approximately 2 and 4 times increase in rainfall intensity can induce much multifold increase in total runoff volume (3.10 and 12.53 times) ,total soil erosion (6.87 and 46.39 times), mean flow rate (3.03 and 12.38 times), which raised the alarm to caution against the risks of hydrological disasters induced by potential rainfall variation in the context of climatic change. Moreover, with the similar total biomass in the slope, total discharge ranked high to low as A-H-S, A-S-H, H-S-A, H-A-S, S-H-A, S-A-H. Soil loss ranked from high to low as A-H-S, A-S-H, H-A-S, S-H-A, H-S-A, S-A-H. At last, according to RDA and correlation analysis, vegetations patterns located in the lower positions (middle and down slope) acted as more powerful buffers in preventing runoff generation and surface soil erosion. Findings in this study can provide scientific references for reasonably runoff control and ecosystem restoration regarding vegetation arrangements in a slope in the arid and semiarid regions.

Key words: Vegetation Distribution, Rainfall Simulation, Soil and Water Conservation

Remote Sensing for Retrieving the Spatial Distribution Characteristics of Snow in the Northern Daxinganling Mountains

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Abstract: Relations between the forest and water cycle was a hot topic of current research. Snow was solid water, hence snow was an important part of the forest water cycle. Estimating the water resources of snow by using remote sensing can monitor the spatial distribution characteristics of snow from point to large-scale. In this area, microwave remote sensing had many advantages, which was all-weather detection, penetrating power, free from cloud interference and so on. At present, passive microwave remote sensing was more commonly used. But it cannot satisfy the inversion of snow features in small scale regions because of its low spatial resolution. On the other hand, active microwave remote sensing do better than passive microwave remote sensing in spatial resolution. But it was currently less used in snow estimation, as its technology of snow identification have been not mature yet. The estimation of snow by optical remote sensing has been studied for nearly half a century, and a great deal of research results have been obtained, which are suitable for small and medium scale snow observation. The research was completed at the forest land of the northern Daxing'anling Mountains to explore the optimal algorithm for snow estimation by using optical remote sensing. Meanwhile, by comparing with the latest optical satellites, GF^{-1} and Landsat8, in the performance of snow estimation, this symposium provides a theoretical basis for establishing the snow remote sensing retrieval model, and analyzes the spatial distribution characteristics of regional snow cover and monitor of regional snow cover, and understands the forest hydrological process more deeply, and realizes the regulation of forest water resources and better manage the basin water resources.
Key words: Remote Sensing, Snow, Forest, Northern Daxing'anling Mountains

Application Progress of Atmospheric Water-vapor Hydrogen and Oxygen Stable Isotopes in Eco-hydrology Research

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Abstract: Abstract: Eco-hydrology, an interdisciplinary of ecology and hydrology, aims to achieve the sustainable use of water resources, is facing two challenges: (1) the conversion of hydrological and ecological principles in different temporal and spatial scales; (2) integrating process-based hydrology method with manipulation experiments characterized ecology method to promote eco-hydrology research. Atmospheric water vapor hydrogen and oxygen stable isotope real-time empirical datum provide possibility to solve the above challenges. By classifying literatures on applying atmospheric water vapor hydrogen and oxygen stable isotope in analyzing ecohydrology, we found atmospheric water vapor isotope research results has already been in time-scale, local scale, watershed scale, climate indication. However,

atmospheric water vapor isotope application is still in start-up phase from the perspective of promoting eco-hydrology development. In the future, atmospheric water vapor isotope is expected to merging with eco-hydrology models, perfecting manipulate experiments, offering policy guidance on sustainable utilization of water resources.

Key words: Hydrogen Stable Isotope, Oxygen Stable Isotope, Hydrology, Ecology

Variability in Soil Saturated Hydraulic Conductivity and Stormflow under Vegetation Degeneration in Permafrost of the Qinghai-Tibet Plateau, China

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Abstract: Alpine meadow is a major vegetation types on the Qinghai-Tibet Plateau. The soil of alpine meadow is degrading because of the changes of global climate. The variability in soils saturated hydraulic conductivity and stormflow under different vegetation coverage are two keys to the modeling of watershed runoff and the water resources management of river basins. Based on ecological index (SL), different degrees of vegetation degeneration are divided in non-degraded (ND), lightly degraded (LD), medium-degraded (MD), severely degraded (SD), extremely degraded(ED). In this study, a total of 24 soil profiles with five layers within 0 ~ 70 cm were sampled from different degrees of vegetation degeneration. Saturated hydraulic conductivity (Ks) of each sample was measured, and the vertical variation of Ks and stormflow were analyzed. Results show that Ks value in layer 5 was significantly lower than the values of above four layers. The Ks increased first and then decreased with vegetation coverage reduction. The dominant stormflow paths for different vegetation coverage were different. Under the condition of maximum precipitation rate of 36.84mm/h at 1-year return period, ND was dominated by Hortonian overland flow (HOF) and subsurface flow (SSF), whereas others were dominated by SSF. Under the condition of maximum precipitation rate of 84.75mm/h at 10-year return period, HOF can form on LD and ED. This study contributes to improving the accuracy of watershed hydrological modeling and, in turn, more sustainable management of water resources in the study watershed.

Key words: Qinghai-tibet Plateau, Vegetation Degeneration, Permafrost, Hydrological Process

Effects of the Three-Gorges Dam on Wetland Distribution on the Middle and Lower Reaches of Yangtze River

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Abstract: The Three-Gorges Dam (TGD) has shown great effect on the water regime of the middle and lower reaches of Yangtze River. It is most likely to further impact the whole wetland ecosystem of this area, which could be reflected in the dynamic of wetland area and landscape pattern metrics. Here, we plan to use Landsat data to analyze the variation of wetland distribution on the middle and lower reaches of Yangtze River. Then, combining the meteorology and hydrology data, we will analyze the relationship between hydrological variation and wetland area variation. We will also establish a model to quantify the superimposed effect of climate change and TGD operation on wetland distribution. Overall, the study could provide basis for assessing TGD's influence on the wetland ecosystem of the middle and lower reaches of Yangtze River, and further guide wetland protection and dam management activities.
Key words: The Three-gorge Dam, Wetland, Yangtze River

Which Pollutants in the Rivers of the Bohai Region of China Represent the Highest Risk to the Local Ecosystem

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Abstract: Freshwater aquatic organisms can be exposed to hundreds of persistent organic pollutants discharged by natural and anthropogenic activities. Many persistent organic pollutants which are extremely persistent have been banned or restricted by international conventions. However, human society still needs stable organic molecules with properties such as fire resistance, non-reactivity and plasticising properties, so the environment will continue to be exposed to such chemicals, but just how much of a risk do they represent? Given our limited resources it is necessary to identify, from the existing evidence, which is the greatest threat so that control measures can be targeted wisely. The Bohai coastal region, located to the east of Beijing is one of the China's most important manufacturing areas. The region has a combined population of 231 million people. There are more than 40 rivers flowing in the Bohai Sea, a semi-enclosed sea, and they convey many chemical pollutants to the Bohai Sea. The focus of this study was to rank POPs according to the relative risk they represent for aquatic

organisms in rivers in the Bohai Region. The chemicals were ranked on the ratio between the median environmental levels and the median effect concentrations. Ecotoxicity data for Chinese local freshwater species and standard test species were selected for each chemical. The widest range of species and end-points were considered. To ensure that all the species were fairly considered, a "median of median" way of calculation was used, so the final ecotoxicity dataset allocated a single value for a particular chemical. Only bed-sediment concentrations were available so water levels were calculated based on the known local sediment organic carbon concentration and the Koc. Of the POPs studied, fluoranthene was ranked as the highest threat, followed by phenanthrene, naphthalene and p,p'-DDE. The risk from p,p'-DDE may be magnified due to being highly bioaccumulative. However, the greatest overlap between river concentrations and effect levels was for lindane. Overall, fish was the most sensitive species group to the risks from POPs. Hotspots with the highest concentrations and hence risk were mainly associated with watercourses draining in Tianjin, the biggest city in the Bohai Region.

Key words: Ecological Risk, Risk Ranking, Bohai Region

Characteristics of the Soil Water Profile under Different Land Uses in a Small Watershed of the Southern Loess Plateau

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Abstract: Precipitation resource is very limited in the Loess Plateau, however, the soil reservoir has a strong function to regulate water supple to plants because of deep soil layer here. Soil water is the critical factor for plant growth, vegetation rehabilitation and eco-environmental construction in this region. Soil water distribution characteristics of 0-6 m profiles under different land uses in the Wangdonggou watershed in tableland-gully region of the Loess Plateau were investigated and analysed based on the monitoring in 2003 and 2011. Results showed that cropland and natural grassland did not have a dried soil layer which came from biological use in the 6 m soil profile, but 16-year apple orchard, alfalfa, and forestland had dried soil layers in 2011. Soil water content in the 6 m soil layer for apple orchard was lower with tree age increasing (6 years old, 16 years old and 25 years old). As for the same measuring point, soil water storages in the 3-6 m layer of Robinia pseudoacacia forestland and apple orchard in 2011 decreased 47.9 mm and 127.2 mm than in 2003, respectively; while soil water storages in the same layer of cropland and natural grassland in 2011 increased 150 mm

and 88.8 mm than in 2003, respectively.Land use type has obvious significant effect on temporal change of deep soil moisture. This study could serve the reasonable land use and vegetation restoration for the Loess Plateau from the point of view of the conservation and utilization of soil water resources.

Key words: Soil Water Profile, Land Use, Soil Desiccation, Wangdonggou Watershed

Decouples of N and P Cycles in Lake Eutrophication: Evidence from a Watershed-Scale Study

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Abstract: 1. Background: The balance of biogeochemical N and P cycles is key to the succession of ecosystems. In eutrophic lakes, accumulation rates generally differ between N and P, but the mechanisms is unclear. Most studies test the mechanisms of biogeochemical processes. However, very few studies have direct tested the importance of input sources, which might be due to the limited data of N and P inputs in the watershed scale. 2. Methodology: Here, based on a comprehensive data collection of N and P cycles in the Poyang Lake watershed, China, we determined the N and P cycles and how human activities had altered the cycles during the year 1980-2010.3. Principle findings: Our results demonstrated that during the year 1980-2010, as the increased population and economic development, (1) TN and N:P ratio of water increased while TP kept constant; (2) both TN and TP of sediment increased while N:P ratio decreased; (3) both the amount of N and P inputs and N:P ratio increased, which could be due to the increased contributions of sources with high N:P ratio (i.e. industrial seawage), (4) for lake sediment, organic matter positively correlated with TN and TP, and organic matter increased with time. These might due to lowering water level in dry season and increased areas of littoral meadow, thus increased input of organic matter in soil. (5) Consistent to previous studies, we found that eutrophication decouples N and P cycles in freshwater ecosystems. However, we found that water N: P ratio increased rather than decreased with eutrophication because the input rate of N was much greater than P. Contrast to most studies from lakes with long water exchange cycles, in the Poyang Lake with much shorter water exchange rate, water exchange is more important than biogeochemical processes (i.e. denitrification) in N and P cycles. 4. Conclusions and implications: Based on watershed-scale analyses, our results clearly demonstrated that changes in the composition of N and P input source, rather than biogeochemical processes, contributed to most changes in Lake N and P cycles. Based on the

evaluation of effects of human activities (i.e. industrialization vs reservoir building) on N and P cycles, our study emphasize the importance of watershed scale studies on the research of lake ecosystem eutrophication.

Key words: Eutrophication, Urbanization, N: P Ratio, Poyang Lake

T10-05: Blue Carbon: A Key Ecosystem Service in Coastal Wetlands

Soil Greenhouse Gas Emissions Should Be Considered for the Assessment of Climate Change Mitigation by Mangrove Wetlands

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Abstract: Mangrove soils have been recognized as sources of greenhouse gases, but the atmospheric fluxes are poorly characterized and their adverse warming effect has been rarely considered with respect to the potential of mangrove wetlands for climate change mitigation. A recent study balanced the warming effect of soil greenhouse gas emissions with the plant carbon dioxide (CO_2) sequestration rate derived from the plants' net primary production in a productive mangrove wetland in South China, and demonstrated that warming effect of soil gas emissions partially (21%) reducing the benefit of mangrove plants. The two trace gases, nitrous oxide (N_2O) and methane (CH_4) also made relevant contribution to the total warming effect. Comparisons of soil gas emissions with plant CO_2 capture rates in some other worldwide mangrove wetlands also showed the adverse role of gas emissions in reducing the benefit of plant CO_2 sequestration. Moreover, soil greenhouse gases emission could be greatly stimulated by anthropogenic nutrient inputs, which enhance the warming effect. Studies in some highly nutrient-enriched mangrove wetlands showed that the mangrove soils subjected to nutrient enrichment are intensive sources of greenhouse gases, while their warming effect largely or totally offset the benefit of plant CO_2 sequestration. We therefore propose that an assessment of the reduction of atmospheric warming effects by a mangrove ecosystem should take in account both soil greenhouse gas emissions and plant CO_2 sequestration, especially for those wetlands subjected to exogenous nutrient input.

Key words: Mangrove, Global Warming, Greenhouse Gases, Soil

Greenhouse Gas Emissions in Coastal Salt Marshes and the Effect of Restoration

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Abstract: Salt marshes play an important role in global and regional carbon cycling. We measured greenhouse gas (GHG) emissions (CO_2, CH_4, N_2O) biweekly for two growing seasons across a nitrogen-loading gradient of four Spartina salt marshes in Waquoit Bay, Massachusetts, USA. We also measured GHG emissions in a tidally restricted wetland and a restored wetland. The GHG flux measurements were made in situ with a state-of-the-art mobile gas measurement system using the cavity ring down technology that consists of a CO_2/CH_4 analyzer and an N_2O/CO analyzer. We observed strong seasonal variations in greenhouse gas emissions. We found that the studied salt marsh was a significant carbon sink when all GHG fluxes were combined. The restored coastal wetland decreased CH_4 fluxes compared with the tidally restricted freshwater marsh. We conclude that restoration or conservation of the coastal blue carbon sink has a significant social benefit for carbon credit.
Key words: Coastal, Blue Carbon, Salt Marsh, Greenhouse Gas

The Contribution of Seaweeds Mariculture to Blue Carbon

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Abstract: Seaweed is considered as an important part of blue carbon. China is the largest producer of cultivated seaweeds in the world, with an annual production of more than 2 million Mt in recent years. Through the activity of seaweeds mariculture, about 0.4 millions MtC^{y-1} are being removed from the coastal ecosystem by harvesting. To understand the ecological function of maricultural seaweed in the ecosystem and to clear its carbon sink mechanism are needed to promote the development of seaweed carbon sink. In this study, the growth and loss of mariculture kelp Saccharina japonica in Sungo Bay, a typical suspended longline cultural area, China were investigated. The distribution of pH, dissolved inorganic carbon (DIC) and pCO_2 in the surface water, and the sediment rate, buried rate of kelp debris in the sediment of Sungo Bay were investigated. The results showed that individual net primary production ranged between 0.9 and 1.3 g C day^{-1}. And the ratio of total loss of carbon to gross production of kelp was 61% and of which, loss from distal erosion, fall-off and break-off in carbon was 91.5%, 4.2% and 4.3%, respectively. During photosynthesis, maricultural kelp had significantly influence on the inorganic carbon system of Sungo Bay. pCO_2 and DIC decreased from farming area to the non-farming area after kelp harvested. The pCO_2 level within the farming area ranged from 267 to 442 μatm and the mean value (332 μatm) was strongly under-saturated with respect to the atmosphere (~400 μatm) in March and May while over-saturation occurred in August (646 μatm) and November (550 μatm). The seasonal sea-air CO_2 flux were calculated, and Sungo Bay acted as a net carbon sink area considered the around year results. Maricultural kelp debris can

accelerate the transport of particulate matter from sea water to seabed. The TOC contents of surface sediments ranged from 0.29 % to 0.61 %, with an average of (0.46 ± 0.11) %. High values of TOC mainly occurred in the south near the bay mouth and in the west inner the bay. Results of a three end-member mixing model showed that sedimentary organic carbon in the shellfish farming area was mainly from seaweed and shellfish bio-deposition, while seaweed was the main source of organic carbon in the regions of bivalve-kelp multi-culture and kelp monoculture. Therefore, if considered the total ecological function, such as detritus of maricultural seaweed buried in the sediment, its carbon sink would be much more than the "removed carbon sink" by harvested of maricultural seaweed.

Key words: Maricultural Seaweed, Kelp Saccharina Japonica, Sungo Bay, Inorganic Carbon System

Tidal Marsh with Phragmites Australis Exhibits Higher Methane Emission than Those with Suaeda Japonica Due to Biogeochemical and Microbiological Differences

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Abstract: Phragmites australis-dominated areas have expanded rapidly during the last 20 years in tidal marsh located in Suncheon Bay, South Korea. Previous studies have shown that the dramatic shift in carbon budget, soil biogeochemistry, and methane emission occurs when tidal marsh vegetation changes, but the exact mechanisms involved with the shift have not yet fully understood. Therefore, it is necessary to illustrate the mechanisms of the shift in the marsh environment due to vegetation changes such as conversion from Suaeda japonica to P. australis. We conducted two different field experiments, one year monitoring along with chronosequence analysis, and an incubation experiment with soil samples collected from different habitats. The field experiments showed that P. australis-dominated marsh had higher methane emission than S. japonica-dominated marsh. The reasons for the higher amount of methane emission in P. australis marsh were higher concentration of DOC, soil moisture, and ratios of mcrA/pmoA and mcrA/dsrA genes. The higher ratios of mcrA/pmoA and mcrA/dsrA genes indicate relatively less amount of methane oxidation by methanotroph and competitive inhibition by sulfate reducer, respectively. In addition, the incubation experiment showed differences in the microbial community structures between P. australis and S. japonica marsh soils. The results of this study showed that the expansion of P. australis in Suncheon Bay may increase methane emission in this area by changing the soil biogeochemistry and microbial interactions.

Key words: Methane, Tidal Marsh, Phragmites Australis, Microbial Community

Blue Carbon in China: Present and Future

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Abstract: With 18 000 km mainland coastline, over 300 km^2 sea areas claimed under jurisdiction, and diverse coastal ecosystems, China has great potential to develop blue carbon not only for greenhouse gas reduction but also for sustainable development purposes. As the largest aquaculture country worldwide, Chinese scientists originally proposed the idea of fishery carbon sink, mainly referring to carbon sequestration by seashells and marco-algae culture, in the beginning of 21st century. Chinese scientists also deepened understanding of the ocean carbon cycle mechanism through researching microbe carbon sink. The release of Blue Carbon Report in 2009 inspired Chinese scientists and government that has written blue carbon in several national plans and policies. The State Oceanic Administration also pays great attention to blue carbon and starts policy research since 2016.

Blue carbon has been categorized into coastal ecosystem carbon, fishery carbon, and microbe carbon in China. According to the result of a preliminary research, there are about 25 000 hm^2 mangrove in South China in 2013, 30 000 hm2 seagrass bed and 1207~3434 km^2 salt marsh along China's coasts, which sequestrate about 1.51~3.22 million tons CO_2 annually. The cultured macroalgae and seashells absorb about 11.2 million tons CO_2 annually without diets and nutrients input. Although carbon transferred into rDOC by microbes has not been precisely quantified, the important role and huge amount of carbon sequestrated by microbes have been widely recognized.

Fast developed economy and expended urban areas threaten and even destroy over half of China's seagrass, mangrove and salt marsh in the past 50 years. The idea of blue carbon reminds Chinese the value of coastal ecosystems and necessity of reviving them. Some pilot restoration projects shows the bright future of increasing blue carbon in China. By culturing seashells and macro-algae together, standardizing culture methods, and developing marine ranches, the amount of CO_2 sequestrated by fishery will increase greatly.

Key words: Blue Carbon, China, Fishery Carbon, Coastal Ecosystem

Assessment of Urban Low-carbon Development Level

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Abstract: Construction of low-carbon city is an important sustainable development strategy. The concept of urban low-carbon development level was proposed in this paper to evaluate the effect of low-carbon city construction. Focusing on natural, economic, and social factors, the indicator system was established in the framework of three-dimensional structure model. And analytic hierarchy process was adopted to determine the weight of each indicator. Finally, the urban low-carbon development level was comprehensively quantified based on the weighted sum model. By choosing Guangzhou, Shenzhen, Dongguan and Foshan as the cases, the effect of construction of low-carbon city in Guangdong Province was checked, based on which the imbalance of low-carbon development was explored. Moreover, some suggestions were put forward to promote low-carbon development in Guangdong Province.
Key words: Low-carbon City, Guangdong Province, Imbalance

Differences in Carbon Sequestration Capacity of Mixed Seagrass Meadows Explained by Differences in Below-Ground Microbial Activity

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Abstract: Abstract: Recent studies have reported significant variability in soil organic carbon (SOC) storage capacity among seagrass species, which has important implications for nature-based climate mitigation initiatives that involve seagrass restoration. However, the factors driving this variability are poorly understood, limiting our ability to make informed decisions about which seagrass types are optimal for carbon offsetting and why. Some, but not all, of this variability can be explained by morphological differences among species (which affects trapping capacity, autochthonous SOC production, robustness, etc.) and biogeography (which affects allochthonous SOC delivery among other). Here we test the hypothesis that differences in SOC storage capacity among species within the same geomorphic environment can be explained (in part) by below-ground processes; specifically, differences in the activity of microbes harboured by different seagrass species. To do this we built on previous studies we have conducted in Xincun Bay, South China Sea; a semi-enclosed, nutrient enriched (due to fish farming) bay containing two seagrass species - Enhalus acoroides and Thalassia hemprichii - that form large, mixed meadows. Despite the close proximity of the two seagrass species to one another, we found that the relative contribution of seagrass plant material to bacterial organic carbon (BOC) was half that in E. acoroides than it was in T. hemprichii, even though the composition of SOC was

the same in the two meadows. Correspondingly, we found that production of SOC-decomposing enzymes by microbes was about 50% lower in E. acoroides soils than in T. hemprichii, suggesting that SOC is less susceptible to microbial attack in E. acoroides than T. hemprichii soils. Overall this research suggests that microbial activity can vary significantly among seagrass species, thereby causing fine-scale (within-meadow) variability in SOC sequestration capacity.

Key words: Eutrophication, Bacteria, Climate Change, Blue Carbon

Benthic Community Metabolisms of Intertidal Mudflats Change along a Latitudinal Gradient

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Abstract: Coastal wetlands are recognized as carbon sinks among global ecosystems due to the high productivity. However, previous studies have suggested that temperate intertidal mudflats turn to be carbon sources, especially in winter season. To clarify the changing of carbon sequestration between temperate and tropical intertidal mudflats, primary production and respiration of benthic microalgae were measured in situ during emersion along the coasts in East Asia (116~122˚E). We used closed-chamber method to monitor CO_2 fluxes both in summer and winter at six mudflats located from 22.48˚N to 40.60˚N. The results showed that both primary production and respiration declined significantly from low- to high-latitude in winter, but when in summer, the similar trend was only detected in primary production. Furthermore, primary production in winter declined two times greater than that in summer. In the regression analysis, this trend was highly correlated with the soil temperature rather than soil composition. Therefore, intertidal mudflats are carbon sinks in summer but carbon sources at high-latitude in winter may due to the low soil temperature.

Key words: Primary Production, Respiration, CO_2 Flux, Soil Temperature

滨海湿地“蓝碳”的三维分布格局、碳汇价值及其影响因素分析 以中国盐城为例

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Abstract: 以中国盐城为例，利用野外调查、遥感资料及室内分析手段，论文研究了滨海湿地“蓝碳”在垂直海岸线、平行海岸线、垂直于地表方向上的分布格局，应用碳税法计算了湿地的碳汇价值，在此基础上讨论了影响“固碳”能力及碳汇价

值分布的因素。结果表明，盐城滨海湿地的植被地上净初级生产力在南-北方向上呈非地带性分布特征，在东-西方向上呈现“低（200-300 g/m2· y）-中（300-400 g/m2· y）-高（400-500 g/m2· y）”的三级梯度分布特征，植被覆盖度的贡献高于月平均气温和月平均降水量。互花米草、芦苇、水稻群落中的“蓝碳”累积量由地表向地下逐渐升高（凋落物>地下根系>土壤），与植物地上部分、凋落物、地下根系相比各植物群落表层土壤中的“蓝碳”累积量相对更高。不同湿地每公顷年均碳汇价值由大到小依次为芦苇（14751 $）、农田（12969 $）、互花米草（10668 $）及碱蓬（8024 $）。周期性淹水环境导致植物采取不同生存策略，高度、密度、凋落物及地下根的生物量分配决定了滨海湿地“固碳”能力及“碳汇”价值的转化。
Key words: 滨海湿地, 蓝碳, 碳汇价值, 分布格局

Multiple-factors Regulated Carbon Processes in the Coastal Salt Marshes: Implications on Sea-level Rise Impacts

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Abstract: The natural wetland ecosystems of tidal salt marshes, with large storage quantities of carbon, are defined as the “Blue Carbon Sink”. However, the open habitats of coastal salt marshes are vulnerable to external disturbances, e.g. plant invasion and community change, tidal flow and salinity gradient, and sedimentary regime change. It is hypothesized that the complicated vegetative and hydrological environment in the coastal salt marshes might be the key factors regulating the multiple-component processes of carbon budget.

In the Yangtze Estuary, we investigated the spatiotemporal dynamics of salt marsh vegetation including Spartina alterniflora (an invasive species), Phragmites australis and Scirpus spp. A process-based grid model considering the seasonal life-cycle of seed bank dynamics, seedling establishment, and clonal propagation and hydrodynamic conditions, simulated well the vegetation pattern dynamics in the intertidal zone. We also investigated the photosynthetic performance of the exotic S. alterniflora (C4 species) and the dominant native P. australis and Scirpus spp. (C3 species), in order to reveal the impacts of plant invasion on the gross (GPP) and net primary production (NPP) of the coastal salt marshes. The leaf-to-canopy production model with species-specific (C3 and C4 types) parameterizations could reasonably simulate the daily trends and annual GPP amount against the flux measurements, and the modeled NPP agreed with biomass measurements. Our results suggested that rapid expansion rate of S. alterniflora made it the leading contributor of primary production in the estuary.

In the same area, the spatial and temporal distribution of soil organic carbon (SOC)

stocks and the influences of sedimentation and vegetation on the SOC stocks of the coastal wetland were examined. Stocks of SOC showed temporal variation and increased gradually in all transects from spring to winter. The SOC stocks tended to decrease from the high marsh down to the bare mudflat along the three transects in the order: P. australis marsh > S. alterniflora marsh > S. mariqueter marsh > bare mudflat. Our results also suggest that interactions between sedimentation and vegetation regulate the SOC stocks in the coastal salt marshes.

Furthermore, to explore the effects of sea level rise (SLR), sediment reduction (SR) and saltwater intrusion (SWI) on the vegetation patterns and primary production in the Yangtze Estuary, range expansion monitoring and stress experiments were conducted, followed by model prediction. The results showed that the combination of SLR and SR resulted in degradation of P. australis and S. alterniflora at low-elevation flats, while the area of S. mariqueter was not reduced significantly. The decrease in the area of vegetation would reduce the gross primary production under SLR and SR. SWI exacerbates the impacts, especially for P. australis, because S. alterniflora and S. mariqueter have a higher tolerance of salinity. This study indicated that the carbon processes in the coastal salt marshes would be modified due to species-specific adaption to intertidal geophysical features, hydrological disturbance and sedimentary regime change.

Key words: Salt Marsh, Carbon Processes, Vegetation Dynamics, Sedimentary Regime

Effect of Eutrophication on Sediment Organic Carbon Sequestration in Tropical Seagrass Bed in China

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Abstract: Seagrass beds, a global substantial “Blue Carbon” sinks, are experiencing worldwide decline mainly induced by eutrophication. Nutrient over-enrichment decreased seagrass leaf photosynthesis by directly ammonium toxicity or indirectly light diminish due to algal bloom. This inhibited leaf carbon fixation of seagrass, leading to a decline in carbohydrate content and to internal carbon-limited conditions. The carbon transfer from aboveground tissue to belowground tissue and its biomass were also reduced. Does the alteration of seagrass belowground tissue induced by eutrophication affect the sediment organic carbon storage? There has been very little evaluation about the influence of eutrophication on sediment organic carbon (SOC) sequestration capacity in seagrass bed. Not only the magnitude of SOC pools but also

their compositions affect C storage. Furthermore, labile organic carbon can (LOC) respond to changes in the vegetation community and sediment microclimate induced by environmental changes more rapidly than total organic carbon. However, little information is available on the LOC pools dynamics in sediment core in coastal wetland, especially in seagrass beds. We surveyed a tropical seagrass bed in South China Sea along fish farming-induced gradients of nutrient to assess the variability in the SOC and its composition in 30 cm sediment core. In summary, statistically lower SOC was observed in the sediment layer where seagrass's roots mostly thrive close to fish farming, indicating lesser input of organic carbon from smaller seagrass belowground tissue. Greater exchangeable organic carbon was found in all layers of sediment core approaching fish farming. Microbial biomass carbon showed higher concentration in the upper partial sediment core around root system far from fish farming. Nutrient enrichment markedly induced larger ratio of LOC pools almost in all layers in sediment core. Polyphenol oxidase activity was higher in lower-half sediment core near fish farming, resulting in enhanced decomposition and poorer carbon sequestration. Therefore, eutrophication indirectly reduces the carbon sequestration capacity in seagrass bed by enhancing LOC with shorter resident time, and the composition of SOC pools should be considered when studying the seagrass SOC sequestration capacity. Measures should be taken to reduce the release of nutrient in seagrass bed for enhancing carbon sink. Furthermore, the estimated organic carbon stock of the top 30 cm sediment in seagrass bed was 6.80 MgC/hectare, and more investigation on SOC pools in seagrass bed along the China coast should be carried out, to get better understanding the ecological function of seagrass bed as "Blue Carbon" sinks.

Key words: Seagrass Bed, Sediment Organic Carbon, Labile Organic Carbon, Nutrient Enrichment

T10-06: Ecosystem Adaptation to Extreme Events at Watershed Scale

Status and Historical Changes of Fish Assemblages in the Three Gorges Reservoir

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Abstract: Dams change river habitat severely, followed by variation of fish assemblage. With the aim to survey the specific variation processes of fish assemblage along the river channel during and after dam construction, the status and history changes of fish assemblage compared with previous periods (year 1975, 1999-2000, 2005-2006 and 2006-2009) were investigated in the lower, middle and upper sections along the Three Gorges Reservoir. The fishing yield (CPUE) was largest in the upper section, followed by the lower section while lowest in the middle section. The CPUE increased compared with periods before first filling, after first filling and after second filling in the upper section, while no difference was observed in the middle section. The fishing efficiency also varied among gill types and sections. A total of 56, 52 and 76 fish species were found in the lower, middle and upper sections, respectively, which were less than previous periods. The transition from lotic to lentic habitats were associated with transition in fish structure, with lotic fish groups decreased while lentic and general fish groups increased from the upper to lower sections. History changes indicated severely decline of long distance migrant species and lotic groups, while increase of small-body and resistant groups. Process of history changes varied among sections, e.g. that lotic fish groups still are mainly fishing targets in the upper section. NMDS and Cluster plot further revealed section specific history changes in fish structure. The section specific succession process of fish assemblages in this study is likely to be crucial in fishery prediction and management in the face of such large-scale hydroelectricity plans.
Key words: Biodiversity, Fishing Effiency, Fish Assemblage, Dam Construction

The Response of the Soil Microbial Food Web to Drought under Different Plant Systems

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Abstract: Anthropogenic disturbances are continuously causing climatic changes and challenges for ecosystem stability. Under the current scenarios of climate change, there has been and will be increasing the frequency and severity of extreme climate events like drought. Therefore, it is urgent to investigate the effects of disturbances on ecosystem system. An agroforestry experiment was conducted that involved three planting systems: monoculture of the focal species Zanthoxylum bungeanum and mixed cultures of Z. bungeanum and Medicago sativa and Z. bungeanum and Glycine max. Soil microbial food web (microorganisms and nematodes) was investigated under manipulated drought in the three planting systems to assess whether presence of neighbor species alleviated the magnitude of drought on nutrient uptake of the focal species by increasing the stability of soil microbial food web. Our results indicate that drought significantly decreased soil water content, but significantly increased soil nitrate nitrogen in three planting systems. Drought did not have significant effect on soil microbial biomass and community structure in the three planting systems. However, drought increased significantly microbial physiological stress in monoculture and Z. bungeanum and G. max mixed culture. In monoculture, drought did not have significant effect on nematode density. Drought significantly increased total nematode density, herbivores density, bacterivores density and fungivores density in Z. bungeanum and M. sativa mixed culture. In Z. bungeanum and G. max mixed culture, drought significantly decreased total nematode density, bacterivores density and fungivores density. The total nematode resistance index, bacterivores resistance index and fungivores resistance index in monoculture were higher than Z. bungeanum and M. sativa mixed culture and Z. bungeanum and G. max mixed culture. Under drought treatment, Z. bungeanum in Z. bungeanum and M. sativa mixed culture had higher leaf nitrogen contents than the monoculture and Z. bungeanum and G. max mixed culture. The correlation analysis suggested that the leaf nitrogen contents of Z. bungeanum had a significant negative correlation with the microbial physiological stress index, fungivores resistance index and omnivore-predators resistance index. After 45 days recovery, microbial biomass and nematode density recovered to control level, but microbial and nematode community structure did not restore to control level in monoculture. In Z. bungeanum and G. max mixed culture, total microbial, bacterial and fungal biomass and herbivores density were higher than control, and microbial and nematode community structure did not recovery to control level. However, microbial biomass, nematode density, microbial and nematode community structure restored to control level in Z. bungeanum and M. sativa mixed culture. Thus, differences in functional traits of neighbors had additive effects and led to a marked divergence of soil food-web resistance, resilience and nutrient uptake of the focal species. Presence of neighbor species can indirectly alleviate focal species via increasing the stability of soil food web under future climate change.

Key words: Drought, Agroforestry System, Microorganism, Nematode

Forest Restoration Implications of Drought Tolerance and Associated Vegetation of Tectona philippinensis Benth. & Hook

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Abstract: Forest restoration uses native species because of their abilities to restore degraded forest ecological integrity to its original state. However, there has been very little information on the use of native species in restoration in the Philippines. One species that has potential in forest restoration is Tectona philippinensis which is a critically endangered species. Its tolerance to water-deficient stress and its associated vegetation were analysed to provide insights on its potential to forest restoration in the country. Four treatments: control, every seven days watering, every fifteen days watering and every one month watering were used to test the tolerance of wildings against the stress. Four 40 m x 40 m plots were established from riparian area to the peak of a coastal hill to determine the associated vegetation. Results show that the species grows in association mostly with Terminalia polyantha and Vitex parviflora. The watering experiment supports the assertion that T. philippinensis can thrive under drought conditions. Results support the ability of T. philippinensis to survive under harsh conditions and environment in association with associated species in different elevational gradients. Consequently, the species can be of consideration to be used for restoring of degraded forests in the Philippines.

Key words: Drought resistance, Endemic, Forest restoration, Terminalia polyantha

Variations in Chlorophyll Content and Hydrogen Peroxide Production in Wheat and Lettuce in Response to Nanoparticles Exposure

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Abstract: Titanium dioxide nanoparticles have utilized in many commercial products due to their unique biological properties. This extensive consumption cause their entry in ecosystem where they effect plant biochemical functions. The physiological effects of wheat (Triticum aestivum) and lettuce (Lactuca sativa) to different concentrations (0, 20, 40, 60, 80, 100 mg kg^{-1} of soil) of TiO_2 nanoparticles (TNPs) were explored in this study. An increase in fresh and dry biomass (46% and 52%), chlorophyll content (68%) and H_2O_2 generation (36%) was observed in lettuce as compared to control in concentration dependent manner. However, wheat showed maximum increase in fresh and dry biomass (60% and 72%) and chlorophyll content (29.7%) at 60 $mgkg^{-1}$

concentration level of TNPs. The results suggested that wheat could not tolerate the high concentration of TNPs due to overproduction of H_2O_2 content (79.2%) and DNA damages. It is also confirmed that same type of NPs have different effects on different plant species.

Key words: Titanium Dioxide Nanoparticles, H_2O_2, Chlorophyll, Wheat and Lettuce

Hydrological, Environmental and Spatial Variables Interact to Determine Species, Trait Composition and Beta Diversity of Pelagic Algae

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Abstract: There has been increasing interest in algae based bio-assessment, particularly trait-based approaches are increasingly used now. However, some aspects still remain limited. For example, the contribution of hydrological variables to algal community's variation has been rarely reported, and the main drivers of species, trait composition and beta diversity of algae communities are less studied. The aim of this study was to link species and trait composition to multiple factors (e.g., hydrological variables, local environmental variables and spatial factors), and to determine the importance of multiple factors in shaping species, trait composition and beta diversities of pelagic algae communities.

Pelagic algae were collected from 59 sites of a German lowland catchment, where a well calibrated hydrological modelling enabled to simulate long-term discharge at each sampling site. We related algal species, trait composition and beta diversities (Bray-Curtis and Jaccard) to hydrological, local environmental and spatial variables. Canonical redundancy analysis with variation partitioning was used to study species and trait composition in relation to multiple factors, while a distance-based approach was conducted to examine the relationships between beta diversities with the multiple factors.

Both trait and species composition showed significant correlations with hydrological, environmental and spatial variables, respectively. However, multiple factors explained higher variation of trait composition (55.0%) than species composition (43.1%). Variation partitioning revealed that the hydrological and local environmental variables outperformed spatial variables. Both species and trait based beta diversities were significantly related to hydrological, environmental distances, while the pure spatial distance was shown to be less important. In addition, the decay of community dissimilarities against environmental distance was consistently weaker compared with

hydrological distance, suggesting that environmental filtering did not account for much of the among-site differences in species and trait compositions.
Species and trait composition varied substantially in relation to hydrological, local environmental and spatial variables indicating that these three factors interact to shape pelagic algae community. The important contribution of hydrological variables emphasizes the need to include hydrological variables in long-term bio-monitoring campaigns.
Key words: Beta Diversity, Functional Traits, Multiple Factors, Variation Partitioning

Watershed-Lake System Responses to Anthropogenic Pressures, Ecosystem Thresholds, and Climate Change: Insights from Lake Champlain, Vermont, USA

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Abstract: A growing body of research has highlighted the importance of extreme events for lake water quality and ecosystem dynamics; however, the definition of "extreme" is complex and ecosystem-specific. In this talk, we highlight several ways in which different types of "extreme events" can interact with ongoing anthropogenic pressures to impact the development of cyanobacteria blooms in shallow eutrophic areas of Lake Champlain (VT and NY, USA, and Quebec, Canada). We present a combination of long-term data analysis; comprehensive high-frequency field data collection; neural network and threshold modeling, and process-based integrated land use-watershed-lake models to identify critical thresholds controlling cyanobacteria bloom development at a variety of temporal scales. We find that long-term trends in lake nutrient concentrations and cyanobacteria blooms are driven by interactions between anthropogenic nutrient inputs and critical thresholds of meteorological conditions, particularly wind mixing and thermal stratification. Because of this, the system is highly sensitive to prolonged heat waves with low wind speed, which can activate nutrients derived from the catchment and trigger severe cyanobacteria blooms. Under future climate change scenarios, our models indicate that Lake Champlain is likely to experience more frequent extreme cyanobacteria blooms, and that these blooms are likely to be much worse under high greenhouse gas emission scenarios. Our results suggest some possible management interventions, but also highlight the importance of adaptive management to incorporate new insights from ongoing research.

Key words: Cyanobacteria Blooms, Integrated Ecosystem Modeling, Watershed-Lake Interactions, Critical Thresholds

Spatiotemporal Variations of Major Ions and Their Controlling Factors of the Seti River, Central Himalayas, Nepal

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Abstract: The characterization and assessment of water quality in the head water region of Himalayas is necessary for securing water and satisfy the needs of humans and ecosystems. Therefore, to assess the hydrogeochemical characteristics and their controlling factors, a total of 45 (3×15) water samples were collected from 15 sites for pre-monsoon, monsoon and post monsoon in 2016 from Seti River, a major tributary of Gandaki River Basin (GRB) of Central Himalayas, Nepal. The pH, EC and TDS were measured on site whereas major ions (Ca2+, Mg2+, K+, Na+, HCO3-, Cl-, SO42-, NO3-) and Si were analyzed in the laboratory following the standard procedures. For the elaboration of findings, the correlation matrix, Gibbs, Piper and scattered diagrams were applied. The result revealed mildly alkaline pH with the pattern of average ionic dominance: Ca2+ > Mg2+ > Na+ > K+ for cations and HCO3- > SO42- > Cl- > NO3- for anions during entire the monitoring periods. Furthermore, geochemically different facies of water were observed from the Piper diagram showing the dominance Ca2++Mg2+ over Na++K+ and HCO3- over SO42-+Cl-. In addition the Gibbs diagram implies that the water chemistry of the river basin is primarily controlled by lithogeneic weathering processes. The Na-normalized molar ratios of Ca2+/Mg2+ and Ca2+/HCO3- plots also clearly indicated that the relative significance of carbonates over silicates weathering. The suitability analysis of water for irrigation (SAR and Na+%) and human consumption reveal that the basin has mostly retained natural water quality, however continuous monitoring of hydrogeochemical characteristics is essential under the changing scenarios of global climate and increasing anthropogenic interferences.

Key words: Seti River, Water Quality, Spatiotemporal Variations, Controlling Factors

The Study on Effects of Toxic Algae on Bacterial Diversity

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Abstract: Illumina MiSeq high-throughput sequencing technology was used to

sequence 16S rRNA gene for studying the microbial community structure and bacterial diversity in the ecological systems of Lima、Alexandrium minutum and Protoceratium reticulatum.The composition and diversity of bacterial in the different microbial community structures were analyzed and investigated, abundance index of the Chao1 estimator and the ACE estimator,diversity index of Shannon and Simpson were compared.In this study, the difference and features of the bacterial abundance and diversity in microbial ecological communities of Lima、Alexandrium minutum and Protoceratium reticulatum, relative to that of sea water and nontoxic isochrysis galbana were analyzed and compared.These results may give the theoretical basis for study the ecology of harmful algae bloom, and its forecasting and eliminating.

Key words: Bacterial Diversity, Microbial Community Structure, Toxic Algae

Respiratory Metabolism Responses of Riparian Plant Distylium Chinense to Long-term Submergence

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Abstract: Distylium chinense is an evergreen perennial shrub belonging to the genus Distylium of the Hamamelidacea. This genus is distributed in China, Japan, Malaysia, India and Central America, especially in the riparian areas and wetlands of the Yangtze River and its branches in China. It had a strong submergence tolerance, but the metabolic response mechanism is not clearly defined. The respiratory metabolism for the tolerance of D. chinense to long-term submergence was investigated through the measuring and analyzing the changes in root and leaf starch and soluble sugar as well as the contents of anaerobic respiration enzymes, including ethanol dehydrogenase (ADH), lactic dehydrogenase (LDH) and pyruvate decarboxylase (PDC), in the D. chinense seedling. The survival of the seedlings was also measured and analyzed. One field study and one controlled experiment were conducted to better understand respiratory metabolism adaptation strategies of Distylium chinense to submergence. In the field study performed in the artificial water-level-fluctuation zone (WLFZ) of Xiangxi River, China, all the seedlings at altitudes<170 m above m.s.l. eventually died during the recovery growth after the floodwaters receded. Seedling survival was 91.67% at altitude 173 m above m.s.l.. In the controlled experiment, the two-year-old seedlings were arranged in a randomized complete block design with 4 replicates and 20 seedlings per replicate. Potted seedlings were randomly assigned to five groups: four for complete submergence treatments and one for the control treatment. The seedlings were placed in a big pool divided in four small pools (2.5 m length×2 m width×2.5 m height) filled with tap water and were completely submerged for 30, 60, 90 and 120

days. After soil drainage the submerged seedlings were re-exposed to air and started recovery grow for 60 days. The results showed that the contents of the anaerobic respiration enzymes(ADH, PDC and LDH) in the roots and leaves were increasing with prolonged submergence, which indicated that strong ethanolic fermentation capacity was induced in response to long-term flooding. The activities of anaerobic respiration enzymes in leaves were higher than that in roots.The starch and soluble sugar in roots and leaves had similar trend with anaerobic respiration enzymes. The results showed that the contents of carbohydrate (starch and soluble sugars) in the roots and leaves were increasing with prolonged submergence. But the content of starch and soluble sugar in roots and leaves first decreased at early stages, and then gradually increased during the 60-d recovery period. The higher content of starch were important reason of strong submergence tolerance, and we consider the strategy to fit into long-term submergence is patience type. This study provided the experimental support for the hypothesis that carbohydrate allocation to storage in roots and activation of anaerobic respiration enhances tolerance of D. chinense to submergence, which may be one of effective adaptation strategies of submergence tolerance. Therefore, D. chinense could be considered to be as native pioneer tree species in the re-vegetation in the WLFZ and the other similar degenerative riparian area and stream ecosystem.

Key words: Respiratory Metabolism Responses, Distylium Chinense, Riparian Plant, Long-term Submergence

Conceptual Framework of Homogenizing Ecological Pattern by Extreme Events

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Abstract: Understanding spatial pattern of ecological parameters which feature specific ecosystem is pivotal to protect it by adaptive management in the face of watershed-wide extreme events which are projected to be increased in frequency and magnitude under climate change. Here, we will present a conceptual framework of how might extreme events re-shape ecological pattern by the process of homogenization. This conceptual framework would try to include its theoretical component, data requirements, computation tools, empirical tests and model output. In theoretical aspect, we will review the applications of distance-decay law for quantifying the homogenized spatial pattern in echography; by considering the distance-decay law and illustrating empirical tests, we will discuss about what kind of ecological dataset should be compiled, what kind of computation tools should be employed, as well as what kind of model outputs should be reported to develop data-supported management strategies

specified for ecosystem adaptation to watershed-wide extreme events.

Key words: Ecological, Extreme Events, Homogenization, Data-Supported Management Strategies

Quantifying the Influences of Various Ecological Factors on Land Surface Temperature of Urban Forests

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Abstract: Identifying factors that influence the land surface temperature (LST) of urban forests can help improve simulations and predictions of spatial patterns of urban cool islands. This requires a quantitative analytical method that combines spatial statistical analysis with multi-source observational data. The purpose of this study was to reveal how human activities and ecological factors jointly influence LST in clustering regions (hot or cool spots) of urban forests. Using Xiamen City, China from 1996 to 2006 as a case study, we explored the interactions between human activities and ecological factors, as well as their influences on urban forest LST. Population density was selected as a proxy for human activity. We integrated multi-source data (forest inventory, digital elevation models (DEM), population, and remote sensing imagery) to develop a database on a unified urban scale. The driving mechanism of urban forest LST was revealed through a combination of multi-source spatial data and spatial statistical analysis of clustering regions. The results showed that the main factors contributing to urban forest LST were dominant tree species and elevation. The interactions between human activity and specific ecological factors linearly or nonlinearly increased LST in urban forests. Strong interactions between elevation and dominant species were generally observed and were prevalent in either hot or cold spots areas in different years. In conclusion, quantitative studies based on spatial statistics and GeogDetector models should be conducted in urban areas to reveal interactions between human activities, ecological factors, and LST.

Key words: Urban Forest, Land Surface Temperature (LST), Spatial Statistical Analysis, Geogdetector Model

T10-07: Wetland Restoration, Conservation and Wise Use under Changing Environment

A Bibliometric Study of the Coral Reef in World

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Abstract: Bibliometric methods is a common research tool for systematic analysis in various fields. An effective bibliometric analysis based on the Science Citation Index Expanded (SCI-E) published by Thomson Reuters was carried out to provide insights in research activities on coral reef from 1991 to 2015. Analyzed aspects included document type, language, and publication output as well as distribution of journals, subject category, countries and institutes. Results showed that 1) Number of papers, author number per article and cited reference count per article on arctic benthos increased year by year. 2) Papers on arctic benthos were published by authors from 139 countries or territories. In the top most productive 20 countries, USA, Australia, Canada and UK Denmark took the top four positions on many indicators, such as, total article output, single-country independent articles, international collaborative articles, first author publications and corresponding author publications. Australia, USA, Canada, France, Netherlands and Germany are the most important international collaborative research nations in the field of coral reef research. The USA always took a significantly leading position. 3) There were 5960 institutes contributing to 13490 articles. There were 4589 single-country independent articles and 8901 international collaborative articles. USA had the 17 most productive institutes on the list of the top 30 most productive institutes. Australia had 6 most productive institutes on the list. The James Cook University, Australia took the first position according to many indicators, including total number of articles and h index. James Cook Univ (Australia), Univ Queensland (Australia), Australian Inst Marine Sci (Australia), Univ Miami, USA, Univ Hawaii (USA) and NOAA (USA) took the top five positions. 4) The top four subjects with the most papers on coral reef are marine and freshwater biology, ecology, oceanography and environmental science. According to the number of published articles, Marine Ecology Progress Series ranked the first with 1008 published articles, followed by Coral Reefs (858) and PLoS One. The purpose of this study is to quantitatively analyze the literature on coral reef and weigh the influence of different countries in coral reef studies. It can hopefully facilitate future research on coral reef for Chinese scholars.

Key words: Coral Reef, Bibliometrics, Ecology

Combined Effect of Drainage, Rewetting and Warming on Peatland Greenhouse Gas Fluxes and Vegetation

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Abstract: Northern peatlands function as significant carbon storages. This key ecosystem service may be threatened by anthropogenic activities and climate change. We lack a consensus on the strength and future of the carbon storage of different types of peatlands, or peatlands under different land uses. We studied impacts of forestry drainage and restoration, combined with warming treatment on greenhouse gas flux dynamics in young peatlands with thin peat layers. We measured CO_2, CH_4 and N_2O fluxes with chamber method over two growing seasons and connected fluxes with environmental variables. In addition, we estimated plant species cover and measured the leaf area development form the sites.

Five years after restoration vegetation had started to change towards undrained reference sites. Especially, the cover of sedges had increased and there were no differences in leaf area between undrained and restored sites. Leaf area was lower in drained sites compared to undrained sites. Warming increased leaf area, but had little effect on vegetation composition.

The gas flux dynamics were primarily controlled by water table. Land use change had a clear impact on CO_2 exchange (long term water table change) so that photosynthesis was at lower level and ecosystem respiration at higher level at drained sites than in undrained sites, while restoration had returned the functions close to those at undrained sites. Methane flux was controlled by water table and temperature, but as the water table was at low level during our study summers also at the undrained peatlands, we found no differences between land uses. N_2O emissions were low under all treatments. The moderate warming caused by open top chambers had very little influence on gas flux rates.

Our results indicate that five years after restoration the initial steps towards the successional pathway of peatland development have been taken, when considering both ecosystem functions and structure. Based on our results, the impacts of climate change on peatlands are more likely driven through water table related changes than by direct impacts of warming. Restoration of peatlands is a good means to bring back their key ecosystem functions and services

Key words: Peatland, Greenhouse Gas, Global Warming, Restoration

Evaluation of Alternative Habitat for Two Endangered Plant Species Using Habitat Suitability Index

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Abstract: As a result of the Four-River Restoration Project in Korea, the habitat of endangered plant species of Aster altaicus var. uchiyamae and Polygonatum stenophyllum which had been natively grown in the riparian zone of Namhan River was destroyed and artificial alternative habitats were created. In this study, Habitat Suitability Index (HSI) was used to determine whether the alternative habitats are suitable for each species. From October 2015 to July 2016, Habitat Evaluate Procedures (HEP) were conducted on two alternative habitats of A. altaicusvar. uchiyamae (Gangcheonsum and Sum River) and also on two alternative habitat sites of P. stenophyllum (Gangcheonsum and Chungju) in the Namhan River watershed. As the evaluation parameters for altaicus var. uchiyamae habitat, habitat matrix (ratio of unburied gravel), flood disturbance period, soil nutrients, and light conditions were selected and for P. stenophyllum habitat, soil texture, light condition, and companion species were selected. HSI was applied to evaluate the suitability of each alternative habitat. According to the result of the evaluation, alternative habitats of;A. altaicusvar. uchiyamae and P. stenophyllum located in Gangcheonsum showed relatively high fit indices (each HSI was 0.813, 0.795). On the other hand, alternative habitat of; A. altaicus var. uchiyamae in Sum River and P. stenophyllum;in Chungju were not suitable as alternative habitat of each species (HSI = 0). This is the first attempt to apply HSI for plant species in Korea and proved the usefulness of HSI on plants.

Key words: Alternative Habitat, Aster Altaicus Var. Uchiyamae, Habitat Evaluate Procedures, Polygonatum Stenophyllum

Trends and Drivers of Coastal Wetlands Changes in the Yellow River Delta of China from 1970s to 2015

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Abstract: Coastal wetlands are among the most productive yet highly threatened systems in the world, and the reclamation of coastal wetlands for agricultural, industrial, and urban land use has occurred extensively in coastal regions of China. To make effective conservation and management, it is essential to understand the coastal wetlands' distribution, changes and driving forces. In this study, China's Yellow River

Delta was taken as the research area. Based on multi-temporal remote sensing images and field observational data, the object-oriented classification method was used to identify coastal wetlands and other land covers from 1970s to 2015. Land use dynamic degree model, Markov transition matrix, landscape pattern index were employed to characterize dynamic trends of coastal wetlands in the study area and the driving forces of coastal wetlands changes were analyzed coupled with statistical data. Results indicated that natural wetlands (including saltmarsh, freshwater marsh, beach and mudflat) and human-made wetlands (including canal, reservoir, and aquiculture pond and salt field) both had dramatic changes in the study area. Natural wetlands kept decreasing over the 45-year period and the area of mudflat declined from 1696 km^2 in 1970s to 849 km^2 in 2015. The area of aquaculture ponds increased by 1407km^2 during 1970s-2015 and salt field increased by 909 km^2 from 1970s to 2015. For the study region, increased aquaculture ponds and salt fields were mainly converted from natural wetlands (mudflat and saltmarsh), whereas those lost natural wetlands mostly converted in human-made wetland, cropland and grassland. The number of patches for different wetland types increased in the Yellow River Delta from 1970s to 2015, except salt marsh. The maximum patch index of human-made wetlands showed an increasing trend, and the maximum patch index of the natural wetlands declined. Fractal dimensions of reservoirs and ponds, salt fields, aquaculture ponds were close to 1, which indicating great impacts of human-activities on those land cover patches. Fragmentation degree and shape complexity of natural wetlands increased, whereas human-made wetlands were characterized by increasing average patch area and regular patch shape. Sediment yields and fresh water supplies reduced in the study area due to a decreased deposition growth rate of the Yellow River Delta. Natural factors resulted in a substantial reduction of mudflat. Mariculture, agricultural reclamation, salt industrial and oilfield development were main drivers for the loss of natural coastal wetlands in the Yellow River Delta.

Key words: Coastal wetlands, remote sensing, Yellow River Delta, dynamics

Policy-driven Wetland Loss to Agricultural Reclamation

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Abstract: Wetlands have multiple ecosystem services to human, but been occupied worldwide by agricultural reclamation. To assess this problem, it is necessary to quantify the spatial extent of wetland losses induced by arable land expansion. Here we investigated the amount and pattern of wetland losses in China caused by agricultural reclamation from 1990 to 2010, based on remote sensing data. Our results reveal that

China lost 15863.7 km^2 of wetlands to arable land expansion during these 20 years, of which about 85.5 % took place in the Northeast China. The rate of agricultural reclamation-induced wetland loss was 3 times higher between 1990 and 2000 (1187.7 km^2/yr) than that between 2000 and 2010 (398.6 km^2/yr) driven by different policies. Most of the wetlands loss was converted in dry farmland (75%) rather than paddy field. The Sanjiang and Songnen plains were identified to be two hotspots of wetland loss induced by agricultural reclamation in China. Increasing population and economic development in China is expected to encroach on more wetlands. Although great efforts have been made towards wetland conservation and restoration in recent years, China must develop scientific policies to prevent more wetlands from being wiped out by agricultural reclamation if the country is to achieve its ecological civilization and sustainable development goals.

Key words: Wetland Loss, Agricultural Reclamation, Policy, Remote Sensing

Optimization Program Construction and Evaluation of Coastal Wetland Ecological Network in the Yellow River Delta

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Abstract: Rapid development of coastal economy has led to the loss and fragmentation of coastal wetland habitat. Meanwhile, global climate change adds to the gravity of these effects. Therefore, the ecological network concept is brought in coastal wetland ecological restoration, which was conducive to regional sustainable development. The Yellow River Delta locates in the eastern coastal region of Shandong Province where the marine and terrestrial ecosystems meet. Taking the coastal wetland of Yellow River Delta as research object, we proposed the wetland ecological network based on remote sensing and geographic information systems technology. The research analyzed the spatiotemporal pattern of habitat and ecological corridor in nearly 20 years according to the coastal wetland degradation status, optimized the ecological corridors of coastal wetland with the help of node choose, network analysis, cost analysis and least-cost analysis and so on, established the optimization program of coastal wetland ecological network in the Yellow River Delta, and evaluated the ecological function of the ecological function. The result shows that the network connectivity is quite different in terms of threshold levels of path cost. These network construction and evaluation methods can be used for other ecological network of coastal wetland.

Key words: Ecological Network, Coastal Wetland, Optimization Program, Evaluation

Ecological Response of Endangered Species, Epilobium Hirsutum L. According to Environmental Conditions

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Abstract: In order to collect basic data for conservation and restoration of Epilobium hirsutum L., endangered species, I treated moisture and nutrient on soil differently, which are important factors for the growth. Afterward, I compared results among results growth, reproductive and physiological response of Epilobium hirsutum L. Moisture gradients were setted to 250ml (M0), 500ml (M1), 750ml (M2), and 1000ml (M3) based on field capacity. And nutrient gradients were appointed to 0%(N0), 7%(N1), 14%(N2), 21%(N3) based on nutrient. Shoot length (cm) was ranged in the following increasing order M3 > M2 > M1 > M0 under moisture gradients and N2 = N3 > N0 = N1 under nutrient gradients. The number of leaves (ea) was ranged in the following increasing order M2 = M3 > M0 = M1 under moisture gradients and N1 = N3 > N2 > N0 under nutrient gradients. Leaf width length (cm) was ranged in the following increasing order M3 > M2 > M1 = M0 under moisture gradients. Leaf width length (cm) was ranged in the following increasing order M3 > M2 > M1 > M0 under moisture gradients. The number of runners (ea) was ranged in the following increasing order M1 = M2 = M3 > M0 under moisture gradients and N1 = N2 > N3 > N0 under nutrient gradients. Chlorophyll content (mg•m-2) was ranged in the following increasing order M2 = M3 > M1 > M0 under moisture gradients. Maximum chlorophyll fluorescence (Fm) was ranged in the following increasing order M3 > M0 = M1 > M2 under moisture gradients and N2 = N3 > N0 = N1 under nutrient gradients. Photochemical efficiency of photosystem Ⅱ (Fv/Fm) was ranged in the following increasing order N3 > N2 > N0 > N1 under nutrient gradients. The number of flower buds (ea) was ranged in the following increasing order M2 > M1 = M3 > M0 under moisture gradients and N3 > N2 > N1 > N0 under nutrient gradients. The number of flowers (ea) was ranged in the following increasing order M2 > M3 > M1 > M0 under moisture gradients and N3 > N2 > N1 > N0 under nutrient gradients. Utricle length (cm) was ranged in the following increasing order M1 = M2 = M3 > M0 under moisture gradients and N2 > N3 > N0 > N1 under nutrient gradients. The number of seeds per utricle (ea) was ranged in the following increasing order M1 = M2 = M3 > M0 under moisture gradients and N3 > N0 = N2 > N1 under nutrient gradients. The number of seeds per individual (ea) was ranged in the following increasing order M1 = M2 = M3 > M0 under moisture gradients and N2 = N3 > N0 = N1 under nutrient gradients. These results mean that the maintain high levels of moisture and nutrient content is important for optimum conditions of Epilobium hirsutum L.

Key words: Endangered Plant, Moisture Gradients, Nutrient Gradients

Effects of Current Water Level Scheduling on the Seed Germination and Production of the Annual Plant Xanthium Sibiricum in the Water Level Fluctuation Zone of the Three Gorges Reservoir, China

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Abstract: Vegetation effectively slows down the deterioration rate of the ecosystem in the water level fluctuation zone (WLFZ). Reservoir impoundment influences the natural persistence of the plant community growing at different elevations in the WLFZ. This study used the annual plant Xanthium sibiricum, present in large numbers in the WLFZ after impoundment, to investigate the impact of impoundment on seed germination of X. sibiricum fruits varying in degree of maturity and produced by X. sibiricum plants growing at different elevations in the WLFZ. It also investigated seed production by X. sibiricum under the current water level scheduling mode. The WLFZ of the Three Gorges Reservoir (TGR) was classified in 7 elevation gradients (145-150, 150-155, 155-160, 160-165, 165-170, 170-175 and >175 m). Seeds were collected at different elevations and exposed at these elevations to submergence to varying extents. The seed production of the plants germinated from X. sibiricum seeds was observed. X. sibiricum fruits of different degrees of maturity have good tolerance to flooding. Submergence accelerated the germination course of X. sibiricum seeds. The degree of maturity of X. sibiricum fruits has no influence on the seed production of the plants that are produced from the fruits. Under the normal water level scheduling mode of the WLFZ, X. sibiricum populations growing above 155 m are able to generate mature seeds to provide seed sources to maintain the population. The results of this study can inform vegetation recovery and reconstruction in other regions that have hydrological characteristics similar to those of the TGR.

Key words: Three Gorges Reservoir, Annual Plant Xanthium Sibiricum, Different Degrees of Maturity, Submergence

Soil Seed Banks and Their Implications for Wetland Restoration in Sanjiang Plain, Northeast of China

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Abstract: Soil seed banks provide seeds for the redevelopment of plant communities in wetlands, and can be important component of the ecological restoration of farmed wetlands if seeds can survive periods of cultivation. We asked if key structural dominants and other wetland species were present as seed in the farmed sedge

meadows in northeastern China. We compared the seed banks and standing vegetation of four natural riparian sedge meadows and four adjacent farmed fields along Nongjiang River in drained and flooded conditions. We found that many important sedge meadow species (>30 species, e.g., Calamogrostis angustifolia and potamogeton crispus) survived cultivation as seeds. Unfortunately, farm fields converted from sedge meadows are nearly devoid of dominant Carex species including two keystone tussock-forming species (Carex appendiculata and C. meyeriana). Species of various life history types require either drawdown (emergent, e.g., Carex lasiocarpa and Calamogrostis angustifolia) or flooding (submerged, e.g., Potamogeton crispus and Ceratophyllum demersum) for successful germination. The structure of the seed bank was related to experimental water regime, and field environments of latitude, number of years farmed, and field water depth based on Nonmetric Multidimensional Scaling analysis. Our study indicated that, although certain critical components of the vegetation are not maintained in seed banks, which made it difficult to replicate historic habitat via natural recolonization, the seed banks of farmed sedge meadows could still contribute toward the restoration of novel wetland vegetation assemblages under suitable environmental conditions. Carex reestablishment could rely upon artificial introduction if necessary.

Key words: Wetland Restoration, Soil Seed Bank, Water Regime, Sedge Meadow

The Characteristics on Landscape Ecology of Four-Spot Midget (Mortonagrion Hirosei Asahina) in Danshui River

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Abstract: This study is aimed to analyze the characteristics on landscape ecology of Four-spot Midget (Mortonagrion hirosei Asahina), for reference to the habitat research and restoration. In 2005, it is the first time to find Mortonagrion hirosei which is near threatened species in the International Union for Conservation of Nature (IUCN) Red List in Danshui River, Taiwan. The Society of Wilderness volunteers conducted a quantitative survey to monitor the number variation of Mortonagrion hirosei. However, due to the dramatic changes in the habitat environment, resulting in a rapidly decreased in the number of Mortonagrion hirosei.

According to the results of the literature, the suitable habitat for Mortonagrion hirosei is brackish tidal wetland with tall reeds and some small puddles at ebb. This study site, the confluence wetland of the Keelung River and the Huanggong Stream in the downstream reach and there was the most number of Mortonagrion hirosei in Danshui River, has been selected to analyze the characteristics on landscape ecology for

Mortonagrion hirosei. By the Society of Wilderness survey results that Mortonagrion hirosei most often appear at the interface of tall reeds and grass.

The FRAGSTATS program built by the USDA was employed to compute the related scores of the landscape ecology indices. The latest aerial photos were collected and classified through patch and landscape identification. The patch types included water, mudflat, tall reeds, grass and pavement. We used the landscape ecology indices were total edge (TE), edge density(ED), mean patch fractal dimension (MPFD), area-weighted mean patch fractal dimension (AWMPFD), and interpersion and juxtaposition index (IJI). The results showed that the MPFD index was 1.52, and the larger MPFD means the more complex of the patch shapes. The IJI index was 95.86, showing that the number of adjacent patch types was complicated. The two quantitative indicators were initially representative the characteristics of landscape ecology for Mortonagrion hirosei. The results of this study are the important reference for habitat restoration strategy in the future.

Key words: Mortonagrion Hirosei, FRAGSTATS, Landscape Ecology

Invertebrate Assemblages as Indicators of Ecological Condition in Freshwater Wetlands

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Abstract: The utility of aquatic macroinvertebrates as indicators of the ecological conditions has long been established in rivers and streams. However, useful invertebrate indicators of floodplain wetland condition remain poorly developed. Invertebrates as a group possess several attributes that should make them useful as potential environmental indicators. We sampled soil fauna and aquatic invertebrate assemblages in wetlands across a range of conditions, from relatively pristine "best available" reference sites to obviously human-impacted sites in Northeastern China's Sanjiang Plain. Results demonstrated that overall invertebrate's biodiversity was higher in the reference wetlands than the impacted wetlands. Invertebrates assemblages were concurrently being impacted by river reach, and whether the wetlands were isolated from the river, or not. Some invertebrates, such as ants and their mounds, snail species and beetles were significant indicators of these natural wetlands and impacted wetlands. In NE China, invertebrate assemblages and certain indicator species may provide a robust and rapid indicator of environmental impacts on wetlands. Because invertebrates are distributed widely and are generally easy to sample and identify, this overall approach should have applicability in the many wetlands worldwide where diverse invertebrates assemblages naturally occur. Because invertebrates assemblages vary

strongly both longitudinally along and laterally across floodplain habitats, management of floodplain wetlands should recognize that landscape position plays an important role in local habitat ecologies, and that efforts to limit hydrologic connectivity across floodplains will have important consequences for resident biota.

Key words: Biological Indicator, Wetland, Habitat Quality, Rapid Assessment

Spatial Distribution of Vascular Plants in the Water-Level Fluctuating Zone of Jiangjin Section of the Yangtze River and the Influencing Factors for Its Stability

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Abstract: With the current scheduling and management model of water level of the Three Gorges Reservoir ,the completion of the reservoir construction has resulted in considerable changes in the hydrological characteristics in the Jiangjin section of the Yangtze River ,which is located upstream of the reservoir ,during the flooding season ,thus extending the flooded time and depth in the riparian zone（or water‐level fluctuating zone） ,and the spatial distribution of plant species and their composition in the zone have undergone changes accordingly . The water level in the study section was 193 m in May ,2012 （before flood） and 192 m in November （after flood） ,and a survey was made of the vascular plants at Shilanzi （194-197 m , upstream ）and Shangdukou （197-200 m ,middle） in the riparian zones and at Luhaoba （200 m ,downtream ） in the non‐riparian zone of Jiangjin with the belt transect method and the quadrat method .A total of 61 vascular plant species （mostly herbs） were found in the riparian zones ,of which 37 were distributed in the 194-197 m zone and 57 in the 197 -200 m zone;and 56 species were recorded in the nonriparian zone （above 200 m） ,including trees ,shrubs and herbs .Plant stability in the riparian zones was shown to be co-influenced by flooding, shipping, golding, sand dredging and other human activities.

Key words: Water-level Fluctuating Zone, Plant Spatial Distribution, Influencing Factor, Yangtze River

Laws of Vegetation Community Succession and Plant-diversity in Peatlands

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Abstract: The wetland ecosystem of Jinchuan region, which is located in the middle of Longgang Mountains in west piedmont of Changbai Mountain, is a special ecosystem in Houhe river basin. The ecosystem comprises many peatlands which were developed from the typical crater lakes in Changbai Mountain. The peat in this area is herbaceous peat developed in Holocene, which is characterized by continuous development and high deposition rate. At the same time, the succession and development of the vegetation in these peatlands, which are relatively well preserved with rich plant species, have certain regularity. Therefore, the ecosystem has important significance on mire science research. There were lots of studies on changes of species diversity during the process of vegetation succession, but the researches on vegetation succession of the crater lake peatlands in the eastern part of Jilin Province are rarely reported. The research on plant diversity of the typical wetland ecosystem, which developed on the crater lake peatlands, will provide reference for revealing the law of wetland succession. The space-for-time method was applied to analysis vegetation succession law and plant diversity of the crater lake peatlands according to the vegetation characteristics, species diversity and function diversity of three crater lake peatlands. The conclusion is as follows: (1)The three main sample areas are peatlands with different succession stages. They all developed from crater lakes. They were isolated from each other, then formed biological islands almost without genetic exchanges. Based on the existing evidence, the order of swampiness time of these three peatlands from early to late was: Gushantun, Jinchuan and Hanlongwan. The vegetation succession process of these three peatlands is concentric succession developing from the lake shore to the middle. (2) Due to shorter time of succession, community in Hanlongwan is still in the developmental stage. Therefor, with regard to species diversity index and evenness index, there is no significant difference between the sites of this peatland. By comparison, the number of plant species and species diversity of Jinchuan peatland are significant higher than that of Hanlongwan. In addition, the species diversity of communities in the edge is usually higher than in the center of Jinchuan peatland. Because the evolution history of Gushantun is longer, the peatland inner environment is consistent, and the difference of species composition between every quadrat is not obvious. The results based on the comparative analysis on different plant community functional diversity in Gushantun, Hanlongwan and Jinchuan peatland habitats with different succession stages show that: compared with plant nutrition traits, plant morphological traits were more relevant to the other traits. The mean weight of leaf dry matter content and leaf carbon content of the community in Jinchuan wetland was significantly higher than that in Gushantun and Hanlongwan wetland. This means that leaf nutritional properties of the three peatland are obvious different. As far as one single functional trait is concerned, leaf carbon content could be a representation for functional diversity. Leaf carbon content of different communities in Jinchuan wetland has higher heterogeneity. This phenomenon is similar with species diversity.

Key words: Peatland, Vegetation Succession, Plant Diversity, Vegetation Character

Effects of Current Water Level Scheduling on the Seed Germination and Production of the Annual Plant Xanthium Sibiricum in the Water Level Fluctuation Zone of the Three Gorges Reservoir, China

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Abstract: Vegetation effectively slows down the deterioration rate of the ecosystem in the water level fluctuation zone (WLFZ). Reservoir impoundment influences the natural persistence of the plant community growing at different elevations in the WLFZ. This study used the annual plant Xanthium sibiricum, present in large numbers in the WLFZ after impoundment, to investigate the impact of impoundment on seed germination of X. sibiricum fruits varying in degree of maturity and produced by X. sibiricum plants growing at different elevations in the WLFZ. It also investigated seed production by X. sibiricum under the current water level scheduling mode. The WLFZ of the Three Gorges Reservoir (TGR) was classified in 7 elevation gradients (145-150, 150-155, 155-160, 160-165, 165-170, 170-175 and >175 m). Seeds were collected at different elevations and exposed at these elevations to submergence to varying extents. The seed production of the plants germinated from X. sibiricum seeds was observed. X. sibiricum fruits of different degrees of maturity have good tolerance to flooding. Submergence accelerated the germination course of X. sibiricum seeds. The degree of maturity of X. sibiricum fruits has no influence on the seed production of the plants that are produced from the fruits. Under the normal water level scheduling mode of the WLFZ, X. sibiricum populations growing above 155 m are able to generate mature seeds to provide seed sources to maintain the population. The results of this study can inform vegetation recovery and reconstruction in other regions that have hydrological characteristics similar to those of the TGR.

Keywords: water level fluctuation zone of reservoir; Three Gorges Reservoir; annual plant Xanthium sibiricum; different degrees of maturity; submergence

Key words: Water Level Fluctuation Zone of Reservoir, Xanthium Sibiricum, Different Degrees of Maturity, Submergence

A Study on the Life Form of Plant in Wolyoung Wetland Conservation Area, Jeongeup, Korea.

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Abstract: A study on life form of plants growing in Wolyoung wetland protection area has the following result.

In the literature study conducted in 2011, a total of 153 species of tracheophytes were observed with 50 families, 110 genera, 136 species, 16 variety and one forma while the study in 2015 found out 208 species with 66 families, 145 genera, 182 species, one subspecies, 23 variety and two formas. It also turned out that pteridophytes accounted for 4.81% of tracheophytes and that gymnosperms and angiosperms accounted for 0.48% and 94.71% respectively in 2015. Since mono-cotyledonous plant took up 25.48% of all tracheophytes and dicotyledon 69.23%, most of the tracheophytes were dicotyledon.

Of the tracheophytes studied, there were eight species of naturalized plants with six families, eight genera, seven species and one variety. The naturalized plants had 3.85% of tracheophytes and they take up 2.80% of total 286 species of Korean naturalized plants (Soohyun Park, 2009).

Of the trachephytes, Gramineae has the largest portion as a single family with 21 species, followed by Rosaceae and Compositae with 15 species each.

When comparing results of study done in 2011 and 2015, the number of species increased by 55 in 2015 from 2011. Number of naturalized plant species rose by five. The increase in the number of tracheophytes species and naturalized plants seems to be caused by disturbance, wetland succession and landization which were led by rise in the visitors.

Wolyoung wetland protection area is comprised of four wetlands. Wetland 1 has 152 species of trachephytes. Wetland 2,3 and 4 has 102, 89 and 99 species respectively. Wetland 1 has the highest number of tracheophytes species followed by wetland 2. The difference in the number of species by wetland seemed to be determined by dominance of dominant species in wetlands.

When dormancy form among life form of trachepohytes was compared between 2011 and 2015, geophyte(G) accounted for the biggest portion in 2011 while hemicryptophytes(H) took up the biggest in 2015. Geophyte(G), gemicryptophytes(H) and hydatophytes(HH) all combined had 43.42% in wetland 1, 38.24% in wetland 2, 48.31% of wetland 3 and 49.49% of wetland 4.

As for radicoid form of propagation form, R5 was found the most, followed by R3 and R2,3 both in 2011 and 2015.

Regarding disseminule form of propagation form of tracheophytes, gravity dispersal type (D4) was turned out to have the highest portion, followed by wind dispersal type(D1) and animal dispersal type(D2) both in 2011 and 2015.

Growth form was observed in the order of erected type (e), bunch type (t) and straight rosette type both in 2011 and 2015.

Especially, the rise in bunch type(t) and branch type(b) appears to gradually show the typicality of wetland vegetation since they reflect the characteristics of Gramineae and

Cyperaceae, which are the dominant species in the wetland vegetation.
Key words: Wetland, Life Form, Dormancy Form, Propagation Form

Effects of Rest Grazing on Soil Organic Carbon in the Bog Meadow of Northeast China

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Abstract: Grassland contributes important ecosystem service (Costanza et al., 1997) and provide approximately 70% of the herbage for ruminants worldwide (Holechek et al., 2004). Ecosystem recovery, associated with rest grazing or reducing grazing intensity, has been designed and implemented by China's central government over the past three decades to reduce grassland degradation (Zhou et al., 2011). The Sanjiang Plain in the northeast of Heilongjiang province in China is known for its concentrated distribution of natural low-lying grassland. It was reported that grassland management affects soil organic carbon (SOC) content (Zinn et al., 2005). For example, in alpine meadow of China, the SOC and total nitrogen stocks declined notably in the grazing plots compared to the undisturbed plots (Ma et al., 2016). This study aims to explore potential management strategies that promote the sustainable use of grassland, by analyzing the effect of rest grazing on representative indicators of grassland soil organic carbon and total nitrogen. Experimental plots were located in the Heilongjiang Province in northeastern China. The grassland type is low-lying meadow and marsh meadow. The main species is Deyeuxia angustifolia (Kom.) Chang comb. Nov. In 2010，the grazing plots with three stocking rate levels–including light grazing (LG, 0.6 AU/hm2/month), moderate grazing (MG, 1.0 AU/hm2/month) and heavy grazing (HG, 1.4 AU/hm2/month) – were established using a randomized block design on the study area. In particular, spring rest grazing is no grazing in June, summer rest grazing is no grazing in July and August, and autumn rest grazing is no grazing in September. The local hybrid beef cattle were used to impose the grazing pressure. In 2010, for soil sample of 0-10 cm depth of plots with the autumn rest-grazing, the SOC content of soil in the light grazing plot was significant higher than that under moderate grazing intensity ($p<0.05$), which was significant higher than that in the heavy grazing plot ($p<0.05$, Fig.1). The rest-grazing treatments did not show significant effects in the year of 2011 and 2012 in plots under different grazing intensities. Grazing affects the contents and chemical composition of soil organic matters and the distribution of carbon and nitrogen in soil（Sun et al., 2010）, which further affects the storage and cycling of soil carbon and nitrogen in grassland ecosystem and also its productivity. Milehunas and Lauenroth (1993) analyzed the data sets from 236 areas globally and

found no pattern on the dynamics of soil organic carbon and nitrogen. There are also studies showing that the plots under grazing treatment had lower soil organic carbon contents than plots under rest-grazing treatment (e.g. Ding et al., 2012). In conclusion, rest-grazing did not increased the SOC content in soil in short term.

Key words: Rest Grazing, Soil Organic Carbon, Range Health, Bog Meadow

Impact of Land Use Change on Soil Organic Carbon Sequestration along a Native Wetland to Cropland Chronosequences

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Abstract: A large proportion of wetlands that once existed have been converted in croplands for feeding the rapidly increasing human population. Thus, there is a global concern over the influence of land use change on ecosystem CO_2 exchange and soil carbon sequestration. To date, how the duration of cultivation affects soil carbon (C) storage after wetland conversion has not been well accounted for. The objective of this study was to evaluate the potential effects of wetland cultivation on soil carbon storage. Soil samples were collected from a native wetland (NW) and six chronological sequences of land use change where native wetlands were converted into croplands (CW). The duration of conversion varies between 4 to 100 years (4, 10, 20, 40, 60 and 100 years) and sampling depths were: 0-20, 20-40, 40-60 and 60-80 cm. The changes in soil C stocks, soil nitrogen (N) stocks and following enzyme activities were measured: Phenol oxidase, peroxidase, Beta-glucosidase and N-acetyl-b-glucosaminidase. The results showed that change patterns for the studied parameters were not straight forward along the temporal dimension. The soil C and nitrogen (N) stocks in the NW were significantly lower than the CW ($p < 0.05$). These lower stocks in NW were mainly attributed to higher enzyme activities in NW compared to CW. Moreover, the enzyme activities were negatively correlated to soil C stocks ($p < 0.05$). Overall, these results contrast the view of a simple wetland conversion-soil C storage relationship.

Key words: Wetlands Conversion, Croplands, Soil Carbon Sequestration, Microbial Enzyme Activities

Heterogeneity between Soil Salinity and Nutrients in the Wetland of Yellow River Delta

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Abstract: As the transition between ocean and land, coastal wetlands ecosystem is characterized by frangibility for the severe soil salinization. High soil salinity always prevents nutrients uptake of plants. Consquently, the distribution pattern of plants is very different from one place to another due to the heterogeneity of landforms. The combination of soil nutrients and salinity determines the distribution of plants communities and their succession, which exert great influence on the stability of the wetland ecosystem.

The delta of Yellow River belongs to estuarine wetland as well as coastal wetland. It is characterized by heavy salts and infertility. To make clear the relationship between soil salts and nutrients in different plant communities, we investigated vegetation, sampled soil profiles and analyzed the concentration of salts and nutrients in laboratory. The influences of salinity and nutrient on spatial distribution of plant communities. The results indicate that (1) the soil of different plant communities belongs to the same category of saline. There are significant differences in vertical distribution of salts in different communities. Much salt accumulates on the surface layer of soil in Suaeda salsa and Tamarix communities. (2) The level of soil organic matter in study area is moderate or below. Indices of nutrient vary greatly in different communities. However, total phosphorus is exceptional, there is no significantly different in the concentration of TP among communities, and due to phosphorus is inert. There is close relationship between salts and nutrients is soils. Relationship between organic matter and total nitrogen is linear. Wheras, relationships between total salt and organic matter, total salt and total nitrogen can be described with reciprocal function.

Key words: Yellow River Delta, Soil Salinity, Soil Nutrient, Spatial Distribution

Land Use Dynamic Change and Associated Effects on Eco-Environment in Xianghai Wetland

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Abstract: Abstract: Xianghai wetland is located in the west of Jilin Province with a semi-arid climate. The special geographical location and hydrological conditions determines that the land use of the wetland stands in dynamic changing. And the land use change has an important impact on regional biodiversity and important ecological processes. Based on the support of Geographic Information System, handling the four periods of RS image data from 1976 to 2015, the land use change dynamic change information was derived by spatial analysis method. Then based the land use database, an eco-environment quality index model was used to establish the quantitative relation between land use and its eco-environment effects. The result showed that under the

influence of nature and humanism, during the period from 1976 to 2015, the land use structure changed obviously, the area of marsh and water area decreased and the wetland regulation function weakened. The eco-environmental quality index had a downward trend, and the main driving force of the decline was the change of the marsh area. The land use change of Xianghai wetland has cause a series of ecological environment problems such as wetland function changing, soil quality decline, vegetation degradation and land desertification.
Key words: Land Use Change, Eco-environment Quality Index, Xianghai Wetland

The Function Zoning Based on the Ecological Sensitivity Analysis: A Case of the Lakeshore in Nansi Lake, China

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Abstract: Lakeshore is the transitional zone between the lake ecosystem and terrestrial ecosystem which plays an important role in maintaining the stability of lake ecosystem. With the gradual enhanced interference of human activities, the lakeshore ecosystem degeneration has become a worldwide phenomenon and hence the ecological restoration of lakeshore becomes a research hot spot. Because of the spatial heterogeneity of lakeshore, different lakeshores need different restoration plans. The function zoning of lakeshore is the base of the restoration and reconstruction. The type classification and ecological sensitivity analysis contribute to the function zoning. They can also contribute to the restoration and reconstruction of lakeshore. Nansi Lake locates in the southwest of Shandong Province. It is the largest freshwater lake and the important water source in Shandong Province. It is also the major regulation and storage hub in the east route of Water Transfer Project from South to North. The superior geographical position makes the human interference very strong. Since the 1980s, the water quality has been deteriorating year by year because of the pollution. The wetland area was decreasing and the ecological environment suffered serious damage. Nansi Lake is badly in need for the restoration and reconstruction. This research selected the appropriate classification index based on the field survey and used GIS technology for the type classification. Through this, a two-level classification system was established. We also collected the length of each type and analyzed their characteristics. The type of agriculture-forestry-grass was chosen as a good example. The estuary type, agriculture type and construction type were elected as the primary restoration lakeshore. The results show that there is a serious landscape fragmentation in Nansi Lake. It urgently needs for the ecological restoration and protection. The ecological sensitivity on the selected 59 sites in the lakeshore of Nansi Lake was

analyzed with the index system of ecological sensitivity analysis. Summing all factor scores in each study site, the comprehensive ecological sensitivity scores of each study site was obtained. Again combining with GIS technology, the function zoning of lakeshore in Nansi Lake was completed. The whole area divided in three function zones - the high, medium and low ecological sensitive zones. According to the result, the ecological sensitivity of lakeshore in Nansi Lake is high. The maximum area is in the southwest, the minimum area is in the middle and the medium sensitive area is widely distributed. This result is basically in line with the result of the type classification. At last, different restoration plans for different zones and different types of lakeshore were desighed in order to provide basis for the ecological restoration of Nansi Lake. The type classification and ecological sensitivity analysis can improve the efficiency of the restoration and reconstruction and provide technical support for ecological restoration of Nansi Lake. Furthermore, this research can play a role of reference for the research of type classification, ecological sensitivity analysis and function zoning in other similar lakes.

Key words: Lakeshore, Nansi Lake, Ecological Sensitivity Analysis, Function Zoning

Wetlands Found Newly Through the National Inventory in Korea

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Abstract: Korea has not wide area wetland as it is a mountainous nation. Moreover, a large portion of wetlands in Korea was lost because they were transformed in cultivated land including rice paddy and some of them to urban area in these days. Due to decrease in population, however, the rice paddy located in inaccessible area has been abandoned and restored the natural wetland. 3,357 wetland candidates were selected by applying GIS Map Algebra technique after analysis on the relationship between existing wetland and environmental factors based on slope degree, topographic flexure, hydrological cumulating system, drainage system, and water index. 1,264 wetlands among them were validated in new ones through the field check. The forest wetlands found newly were classified into 10 types based on the Ramsar classification system. Among the types, tree-dominated wetlands of freshwater occupied the highest ratio with 50.2% and in the order of permanent rivers/streams/creeks with 35.4%, seasonal/intermittent freshwater marshes/pools on inorganic soils with 7.0%, ponds with 2.4% and so on followed. As the result of stand ordination(PCA) based on presence-abscence of plant community and species, wetland vegetation tended to be classified into three groups of tree-dominated wetlands of freshwater, permanent rivers/streams/creeks and

seasonal/intermittent freshwater marshes/pools. Rare plants of 82 taxa including 44 families, 69 genus, 73 species, 1 subspecies, 8 varieties and endangered species of 5 taxa appeared in forest wetlands. Those wetlands were little in extent but exist within forest where major biological species including endangered species inhabit. Therefore, it was expected that they could greatly contribute to conserve biodiversity.

Key words: Forest Wetland, GIS, Wetland Plant, Conservation

Dynamics of Greenhouse Gases Emission Fluxes of Different Calamagrostis Angustifolia Wetlands in Sanjiang Plain

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Abstract: To comprehensively understand the Greenhouse Gases and its main affecting factors is of significance to reduce the uncertainty of the evaluation of global Greenhouse Gases budget. In this paper, the characters of greenhouse gases emission during May and September in Sanjiang Plain were studied, using the static chamber and gas chromatogram method.

The results showed that CH_4, CO_2 and N_2O emissions were obviously different during May and September and the CH_4 emission in July made a relatively large contribution to the total CH_4 flux from the marsh wetland in the Sanjiang Plain. CH_4 and CO_2 and N_2O emission peak values were significantly different during May to September. The CH_4 and CO_2 emission emissions from continuously flooded mire were larger than that from seasonal flooded mire. On the contrary, the N_2O emissions from continuously flooded mire were lower than that from seasonal flood mire. During May to September, CO_2 and CH_4 fluxes were obviously correlated with soil water content ($R2 = 0.95$, $P<0.001$). Meanwhile, CO_2 fluxes was obviously correlated with the CH_4 emission fluxes ($R2 = 0.92$, $P<0.001$). The mires were N_2O sink in May and gradually became N_2O source, with increasing temperature until July.

The characters of greenhouse gases emission, during May to September in Sanjiang Plain respond to the soil microbial activity and affect the soil carbon mineralization, nitrification and denitrification.

Key words: Sanjiang Plain, Mire, Greenhouse Gases

Characteristics of Spatial Distribution of Soil Salinity among Different Plant Communities in the Wetland of Yellow River Delta

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Abstract: Vegetation is the indicator of environment, environmental factors are varied among different plant communities. Under the influence of seawater, there is severe salinization in Yellow River Delta, and the spatial heterogeneous of soil salinity is obvious. Analysis on the spatial distribution of soil salinity is good for understanding the mechanism of plant communities' spatial pattern. Based on the investigation of vegetation quadrats and soil samples, we studied the spatial distribution of soil salinity, and correlations among different indices of salt. The results reveal that (1) there is a clear gradient in soil salinity from Suaeda salsa community, Tamarix chinensis community to Phragmites australis community and Cotton community. The salinization in Suaeda salsa community is the heaviest, and it is the lightest in cotton community.(2) Vertically, much salt accumulates in the soil surface in Suaeda salsa community and Tamarix chinensis community, and it accumulates in the sub-surface of soil in Phragmites australis community and Cotton community. (3)Variable coefficient of soil salinity in study area is moderate, and it is varied from one community to another.(4) Relationship between different ions and total salinity is significant, of which, Cl- has the most significant relations to total salinity. So control or reduce Cl- input is an optional approach to alleviate soil salinization in the wetland of Yellow River Delt.
Key words: Yellow River Delta, Plant Communities, Soil Salinity, Conductivity

Optimization Sampling Strategy When Estimating the Macrobenthic Species Richness in Salt Marsh Wetland: What Is the Minimal Effort Required?

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Abstract: The estimation of macrobenthic species richness is challengeable in the heterogeneous intertidal zones of estuary due to the large zero-counts and harsh environment in field sampling, especially in the muddy salt marsh wetland. Transect sampling would be an ideal sampling strategy as the across-shore samples could represent 'niches' along the intertidal gradients by fewer quadrats. However, the relationships between the sampling effort and the accuracy of the estimates have rarely been investigated in salt marsh wetland. Moreover, the transect sampling still needs to be optimized as it can not be ideally applied on salt marsh wetland. This study

optimized transect sampling and investigated the optimal sample effort/interval on a typical salt mash wetland in the Yangtze estuary, China. The transect sampling was optimized by stratification based on pronounced habitat types (tidal flat, tidal creek, salt mash vegetation), termed as the within-transect stratification sampling. Then, the efficiency of this design was evaluated with the data from large scale sampling. The optimal sampling intervals and the minimum sample effort were investigated by Monte Carlo simulations and accumulative species curves. The results showed that the within-transect stratification sampling with typical habitat types was proved to be effective for encompassing 81% species, which can be largely reduced the sampling effort and labor. The optimal sampling intervals for three habitats were determined: 10m for salt marsh vegetation and tidal flat and 1m for tidal creek. Combined with the optimal interval, in order to be confident of obtaining more than 90% of the species, sampling effort must exceed 1.8 m2 by 10m intervals in the salt marsh vegetation, 2m2 by 10m intervals in the tidal flat, and 3m2 by 1m intervals on tidal creek habitat. It was suggested that the differences were influenced by the mobility range of dominant species and habitats physical differences (e.g. tidal water, substrate, vegetation cover). Although more research studies are required to ascertain the generality of these results beyond the muddy salt marsh vegetation we sampled, we tentatively recommend the application of our results in biodiversity surveys on muddy salt marsh vegetation in the intertidal areas. The optimized within-transect sampling could provide the good precision and statistical efficiency in the richness estimates of macrobenthos with minimum sampling effort.

Key words: Intertidal Salt Marsh Wetland, Macrobenthic Species Richness Estimation, Sampling Optimization, Yangzte Estuary,

Influence of Different Habitat Environment on Shoot Length, Biomass and C: N: P Stoichiometry of Four Submersed Macrophytes

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Abstract: A field study was conducted in two contrasting lakes, Erhai and Fuxian (mesotrophic vs. oligotrophic), to clarify influence of different habitat environment on morphology and physiology of four submersed macrophytes, Potamogeton maackianus, Vallisneria natans, Myriophyllum spicatum and Ceratophyllum demersum. The results revealed that distribution depth, shoot length, C: N and C: P ratios of submersed macrophytes were significant lower and N and P concentrations were significant higher in Lake Erhai than in Lake Fuxian, while shoot biomass, C concentrations and N: P ratios were relative stable. M. spicatum was less homeostatic than the other three

species as indicated by its higher variation of shoot biomass, shoot length and C: N: P stoichiometry between the two lakes. V. natans possessed little plasticity in shoot biomass and shoot length and much plasticity in C: N: P stoichiometry, while C. demersum and P. maackianus had a relatively stable nutrient structure and stoichiometric homeostasis. The interspecific difference of plasticity in both morphology and physiology of submersed macrophytes may indicate different fitness or survival strategies in varying habitat environment. Furthermore, we found a weak coupling of tissue N and P in Lake Erhai relative to Lake Fuxian, which was probably due to over-accumulation and convergence stoichiometry of plants in nutrient-rich lake.
Key words: Stoichiometry, Submersed Macrophyte, Interspecific Difference, Varying Habitat

Studies on the Biodiversity of Mollusks of Mangrove Area in the West Coast of Hainan Island, China

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Abstract: To analyze mollusks diversity and spatio-temporal variability of mangrove areas in the west coast of Hainan Island, the mollusks community compositions of six major mangrove areas were investigated in August 2015 (rainy season) and January 2016 (dry season). A total of 77 species of mollusks were identified, which were belonged to 30 families. The major dominant species were Cerithidea cingulate, Assiminea latericea, Arcopella minuta and Sermyla riqueti and so on. The average density and biomass were 324.13 ind./m ²and 142.88 g/m ², respectively. The results of multivariate-AZTI'S Marine Biotic Index (M-AMBI) indicated that the molluscan ecological status of mangrove areas in the west coast of Hainan Island were "good". Cluster analysis showed low similarity among the mollusks communities in different mangrove area, and distance between different area was the major impact factors to similarity. Two-way ANOVA showed that the species number, density and biomass of different mollusks communities had no significant seasonal differences, but the species number and density had significant habitat differences. The constitution of mangrove community in these habitats may have impacts on mollusks communities, mollusks in Avicennia marina community are more abundant than in Rhizophora stylosa. The increase of flora in mangrove can support higher mollusks diversity, whereas no density or biomass. The community structure of mollusks may also be influenced by salinity. Low salinities can promote the distribution of freshwater mollusks, and the density of mollusks is significantly increased.
Key words: Mangrove, Mollusks, Biodiversity, Hainan Island

Initial Succession of Macrobenthos Community to an Early Freshwater Released Salt Marsh Wetland: Implications with China's Yellow River Delta Wetland

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Abstract: Freshwater restoration project was widely used to protect and reconstruct the severe endamaged coastal salt marsh wetland, which was contained of tidal barrier construction and freshwater release. Tidal barriers isolate intertidal areas from tides and ensure the effective implementation of the freshwater and restoration scope, creating distinct conditions on either side of the barrier, and freshwater releases change the receiving area's hydrology, salinity and nutrition, an early freshwater released salt marsh wetland was constructed in the end. To better understand the initial succession of macrobenthos community response to an early restored wetland, we chose part of the northern of China's Yellow River Delta wetland which has been carried out freshwater restoration project for 5 or 7 years. Totally, 6 times of field study were conducted at restoring stands and unrestored sites from 2014 to 2016. The structure of macrobenthos community and the characteristic of the dominated species were recognized as the ecological response. The macrobenthos communities differed greatly between restored (mainly Insecta and Crustacea) and unrestored areas (mainly Polychaetes, Mollusca, Crustacea, and Insecta). Furthermore, we conducted RLQ ordination analysis to represent the relationship among the environmental gradients includes salinity, soil moisture, total organic carbon and soil particle size, macrobenthos richness and ecological characteristics of macrobenthos like salinity tolerance, reproductive cycle, feeding habits and so on. Using non-metric multidimensional scaling and hierarchical clustering, we divided the macrobenthos communities among several groups that mostly agreed with the spatial distribution of the investigated areas. In order to evaluate the tendency of recovery process of the macrobenthos community succession, ecological exergy and structured exergy of macrobenthos at restored and unrestored areas in different periods were calculated. Evidently, exergy revealed to be a useful indicator that there is an increased exergy content along with the freshwater restoration project implementation. Therefore, the integrated the tidal barriers and the freshwater releases showed a positive effect on macrobenthos community, and macrobenthos community developed significantly. The study will be necessary to understand the consequence of freshwater restoration project on coastal wetland.

Key words: Succession, Macrobenthos Community, Freshwater Restoration, Yellow River Delta

Response of Soil Fungal Diversity to Nitrogen Deposition in a Deyeuxia Augustifolia Wetland of Sanjiang Plain, Northeast, China

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Abstract: In order to understand the effects of nitrogen deposition on soil fungal diversity, a study was conducted with a Deyeuxia augustifolia wetland in the Sanjiang Plain, China, using an experimental setup simulating various concentrations of nitrogen deposition for a period of 5 years. Three different conditions were investigated: N1(no artificial deposits, control), N2 with low-level nitrogen deposition (4g $N•^{hm\text{-}2\ a\text{-}1}$) and N3 with high-level nitrogen deposition (8g $N•^{hm\text{-}2\ a\text{-}1}$). At the end of the experiment the soil physiochemical characteristics were determined and high-throughput sequencing was employed to monitor the soil fungal diversity under these different nitrogen conditions. The addition of exogenous nitrogen to the soils changed the physicochemical properties of the soils and affected the fungal community composition and the relative abundance of species: low doses increased the diversity while high doses reduced the fungal diversity. In each of the three types of nitrogen-amended soils, the most predominant and the next most predominant phyla were Ascomycota and Basidiomycota, respectively. The abundance of Basidiomycota decreased with nitrogen deposition, while Ascomycota changed in the opposite direction. A heatmap tree based on ITS rDNA sequences illustrated how different fungal communities responded differently to nitrogen deposition. The findings in the present study provide fundamental data and theoretical insights that can be employed to predict the effects of atmospheric nitrogen deposition on wetland soil fungi and wetland ecosystems in Sanjiang Plain.

Key words: Fungal Diversity, Deyeuxia Augustifolia Wetland, ITS Rdna, Miseq

The Study of Aboveground Biomass Inversion of Reed Wetland Based on MODIS Data in the Western Songnen Plain, China

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Abstract: Remote sensing technology can be used effectively to extract information of wetland vegetation, which directly reflects their growth and development. Reed is one of the important community types of ecosystems, and its aboveground biomass (AGB) is a key index characterizing the quality of wetland ecosystems. In this study, the spatial distribution of reed wetland in the Western Songnen Plain was extracted using the object-oriented classification method combined with multi-seasonal Landsat8 OLI

remote sensing data. Based on field observed reed aboveground biomass data and five spectral vegetation indices, i.e. normalized differential vegetation index (NDVI), ratio vegetation index (RVI), enhanced vegetation index (EVI), modified soil adjusted vegetation index (MSAVI) and weighted difference vegetation index (WDVI) which were derived from moderate-resolution imaging spectroradiometer (MODIS) products, were used to explore the sensitivity of different spectral vegetation indexes to reed AGB and further to develop an optimal remote sensing model for reed AGB estimation and inversion. Results showed that, the object-oriented classification method has good precision, the overall accuracy is 86.89% (kappa=0.7966), which can can be well applied to extract the spatial distribution of reed wetland in the study area. Total area of reeds in 2014 was 1653 km^2 in the Western Songnen Plain, among which the Zhalong Wetland Nature Reserve occupied the largest reed area (1178km^2) in the five wetland natural reserves. Additionally, extremely significant correlations were found between each of the five vegetation indices and reed AGB (<0.01). By comparison, the exponential curve model（y=166.4e^(2.99*EVI)） established with EVI was the optimal model (R2=0.55) for reed AGB estimation and inversion. In the Western Songnen Plain, mean reed AGB based on the exponential curve model was estimated to be 372.1g/m2 and the total reed AGB to be 614000 t, respectively. The maximum reed AGB was observed in the Zhalong Nature Reserve with a value of 438000 t. The averaged reed AGB in five wetland natural reserves could be listed in a decreasing order as Xianghai Natural Reserve (469.7g/m2) > Dabusu Natural Reserve (454.1g/m2) > Momoge Natural Reserve (373.0g/m2) > Zhalong Natural Reserve (372.4g/m2) > Chagan Lake Natural Reserve (369.8g/m2), which has obvious spatial differences. Higher AGB values were examined in the southern area than in the northern. Results of this study could contribute to the protection and management of reed wetland, and the utilization of reed resource.

Key words: MODIS, Vegetation Index, Reed Wetland, Aboveground Biomass (AGB)

Research on the "Fertile Effect" Under Tamarix in the Wetland of Yellow River Delta

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China

Abstract: Wetland plant is the product of wetland environment and it has a driving effect on the positive evolution of wetland ecosystem at the same time. For the purpose of revealing relationship between nutrient cycle and shrub of Tamarix in Yellow River Delta, we investigated the vegetation and soil samples, analyzed correlations between nutrients distribution and Tamarix different communities. It is found that:

(1) In Salsa community, Concentration of SOM varies from 0.2% to 0.9%, Content of AN changes from 10 mg/kg to 40 mg/kg. Content of AP in soil ranges 0.19 mg/kg to 9 mg/kg. And AK varies from 30 mg.kg to 280mg/kg. Vertically, concentration of SOM is low in surface layer of soil, and increase along with the vertically distance increasing, reaching its summit at layer of 20-30 cm, then decreases. Unlike SOM, contents of AN, AP, AK at surface layer are the highest, then decrease gradually. Enrichment rates of nutrients are heterogeneous. Generally, from surface layer of soil(0-5 cm) to bottom layer (30-50 cm), nutrient enrichment rates under canopy increase gradually. Wheras, nutrient enrichment rate at layer of 10-20 cm is the lowest. Furthermore, there does not exist fertile effect with SOM at the layer 0-20cm.SOM has extremely significant relation to AN. Similiarly, AN has extremely significant correlation to AP and AK.
(2) In Tamarix community, Concentration of SOM varies from 0.3% to 1.2%, Content of AN changes from 20 mg/kg to 60 mg/kg.Content of AP in soil ranges 1mg/kg to 10mg/kg. And AK varies from 80 mg/kg to 260 mg/kg. Vertically, concentrations in SOM, AN, AP and AK at the surface layer are the highest, and decrease gradually downward. Nutrients enrichment rate under canopy is higher than that of canopy ridge. And enrichment rate at surface layer is higher than that at bottom.
(3) The nutrients in soil increase from Salsa community to Tamarix community, the fertile effect in Tamarix community is more obvious than that in Salsa community. So can we induce that the plants promotes the ecological evolution of wetland.
Key words: Tamarix, Fertile Effect, Wetand, Yellow River Delta

Distribution of C, N, P and Decomposition of Droppings in the Rongcheng Swan Lake

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Abstract: The Rongcheng Swan Lake in Shandong province is an important coastal wetland and famous whooper swans' habitat in the world. It is of great significance for protecting swans and studying the ecological cycle in the Swan Lake. With increasing of swan quantities a pressure from then existed in this lake. This study analyzed the distribution of C, N, P in water and sediment and the decomposition process of droppings, and discussed its influence on the quality of water and ecological environment in the Swan Lake. The following conclusions were shown below: (1) Some obvious seasonal changes of TN and TP were observed in the water of the Swan Lake. TN varied from 687.49ng/ml to 1595.79ng/ml in the summer and from 117.99ng/ml to 563.20ng/ml in the winter.TP was between 31.55ng/ml and 144.08ng/ml in the summer and between 7.52ng/ml and 64.80ng/ml in the winter. This

meaned the Rongcheng Swan Lake was in a state of excessive nitrogen eutrophication. (2)The TOC of sediment in the Swan Lake was between 0.674%-3.135% in the summer and 0.463%-1.816% in the winter.TN was between 0.109%-0.253% in the summer and 0.064%-0.159% in the winter.TP was between 0.024%-0.067% in the summer and 0.014%-0.048% in the winter. From the shoreside to the lake, TOC, TN and TP increased.(3)The droppings of swan released a quarter of nutrient in four days when decomposing in winter. With the amount of swans increasing, the droppings would become a significant source of N, P.

Key words: Swan Lak, Decomposition of Droppings, Eutrophication, Nutrient

The Landscape Evolvement and Key Driving Factors of Coastal Wetlands in the Yellow River Delta

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Abstract: The Yellow River Delta (YRD) wetland is a typical coastal wetland in the warm temperate zone of China. Massive sediment is transported from the Loess Plateau to the YRD each year by the Yellow River which results in the new-born protogenetic wetland. The special natural conditions of the YRD is suitable for wetland research. It is important to understand the evolution process, land change stages, land change prediction and driving factors of land changes of the YRD wetland. In this study, we used the remote sensing, global positioning system and geographical information system technologies to study the land change processes and driving mechanism of coastal wetlands in the YRD from1991 to 2013. The main results showed that 1) The distribution, composition and structure of wetland had significant changes since 1991. The area of natural wetlands declined from 1997.20 km^2 to 1485.91 km^2 during 22 years (1991-2013), with an average decrease of 23.24 km^2 per year. The area of natural wetlands increased from 112.22 km^2 to 560.21 km^2 during the 22 years, with an increase of 20.36 km^2 per year. Sub-classes of wetlands also showed different change results; 2) Marsh, bush wetland, swamp, salt marsh, tidal flats, soak, pond, paddy field and salina contributed to the main changes of wetlands; 3) The wetland in the YRD was facing some ecological crisis. Both areas of the natural and artificial wetlands might decrease a lot from 2013 to 2021 by change simulation; 4) Both natural and artificial factors promoted the land changes of wetland in the YRD. Our results are expected to contribute to the sustainable development of wetlands in the YRD.

Key words: Yellow River Delta, Coastal Wetland, Landscape Evolvement, Driving Factors

Analysis of Hydrological Connectivity Dynamics of the Wetlands in Honghe National Nature Reserve during the past Three Decades

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Abstract: Due to the intense agricultural development and other human activities in the Nongjiang catchment in the 1980s, the runoff of Nongjiang River was cut off. The hydrological connectivity of wetlands in the Honghe National Nature Reserve (HNNR) has been changed remarkably. The landscape patches of the wetland in the HNNR was analyzed based on the remote sensing image of wetlands in HNNR from 1975 to 2006 by using geographical information system. Based on the habitat availability and the dispersal potential of animal and plant species, 6 distance thresholds (0.1, 0.5, 1.0, 2.0, 4.0, 8.0km) were selected to compute the integral index of connectivity, probability of connectivity, important value of the landscape patches, and lacunarity index by Conefor Sensinode and Apack. The result showed that the average integral index of connectivity (HC) decreased from 0.367 to 0.121, and the probability of connectivity (PC) decreased from 0.686 to 0.219. The patches with important value of the landscape were also identified. The wetland can be restored according to the important value of the landscape patches in different years. Lacunarity index analysis showed that the spatial heterogeneity of wetlands varied in different scales, and the scale transform could reflect the degradation process of wetlands. The results of this study provided a basic data and scientific guidance for future wetland restoration work.

Key words: Hydrological Connectivity, Wetlands, Lacunarity Index, Honghe National Nature Reserve

Effect of Policy Change and Human Activity on Vegetation Pattern and Biodiversity Conservation in Coastal Wetlands: A Case Study in Yancheng, China

Zheng Zang, Qi Xia

China

Abstract: Using the Yancheng National Nature Reserve in China as an example, this study investigated the influence of vegetation pattern in coastal wetlands on global biodiversity. Remote sensing images were used to reproduce the changes in wetland vegetation cover over the relevant years since 1987. The results showed that during the study period, the vegetation displayed a zonal distribution pattern in parallel with the line of latitude, whereas the wetland type changed from sea to land as bare mud flat, hosting Spartina alterniflora, Suaeda glauca, Phragmites australis, and constructed

wetlands dominated by rice. At the landscape level, the number of patches, patch density, and mean nearest-neighbor distance gradually increased during the investigation period, while the mean patch size gradually decreased in the study area. Human activity such as changes in land use patterns resulted in the progressive development of vegetation patterns toward fragmentation, and the non-zonality (intrazonality) distribution of vegetation became more obvious in coastal wetlands. To mitigate interference from human activity on coastal wetlands, an adequate buffer zone should be reserved in coastal wetlands on the basis of the zonal distribution of the vegetation. This buffer zone will guarantee the connectivity of the landscape and the sustainability of policy, further allowing coastal wetlands to play a positive role in global biodiversity conservation work.

Key words: Coastal Wetland, Vegetation Restoration, Remote Sensing Interpretation, Biodiversity Conservation

T10-08: Wetlands: Ecological Restoration, Wastewater Treatment and Catchment Management

Natural and Constructed Wetlands for Water Quality Improvement: Opportunities and Constraints

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Abstract: Wetlands are recognised widely for one of their most important ecosystem services – the improvement of water quality. A variety of ecological processes associated with different kinds of wetland plants help remove particulates, nutrients and a range of toxic substances from the wastewaters passing through them. Natural wetlands differ considerably in their potential for water quality improvement depending upon the hydrological, biological, climatic and other factors as well as the characteristics of the wastewater. However, this characteristic of wetlands has been exploited worldwide by constructing wetland systems especially for the treatment of wastewaters from a wide range of domestic, agricultural and industrial sources. Whereas in most cases, constructed wetlands are used for tertiary/ advanced treatment of wastewaters, in many studies even secondary treatment has been attempted. In countries like India and China, wastewater treatment function has been integrated with the production function of wetlands for raising fisheries, vegetables and other organisms for human consumption. The East Kolkata wetlands – a Ramsar site in India – has received municipal sewage from the metropolis for several decades and support the livelihoods of numerous fisherfolks. Despite the recognition of this important potential for water quality improvement along with energy and resource generation, constructed wetlands have not been favoured as an alternative to conventional wastewater treatment systems in India and most other developing countries. The paper reviews the situation with particular reference to India and discusses the constraints in adopting wetland systems for improving water quality.

Key words: Constructed Wetlands, Ecosystem Services, Water Quality

The Ecological and Biological Characteristics of Pisonia Grandis

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Abstract: As a predominant and fast growth species in the Xisha Islands, Pisonia

grandis (an evergreen of Nyctaginaceae family) plays an important role in wind prevention and sand-fixation. In this study, we chose Pisonia grandis grown on Yongxing Island, Xisha Islands as research objective to examine the morphological and physiological characteristics, nutrient composition of the species. The results showed that Pisonia grandis is a heliophyte, which characterized with large leaves thickness, small specific leaf area, well developed palisade tissue and sparse intercellular spaces in pongy tissue; the activities of Superoxide dismutase and catalase were high, the content of proline content was high, while for the content of malondialdehyde was low, which indicated that Pisonia grandis was drought resistance. In addition, the content of nutrient elements were high for plant leaves and lower for rhizosphere soil, suggesting that Pisonia grandis had strong tolerance to barren soil. In a word, Pisonia grandis can adapt to the environmental stress, such as strong light, drought and poor. Therefore, Pisonia grandis can be used as an important tree species of vegetation restoration in tropical coral island.

Key words: Pisonia grandis, ecological and biological, characteristics, stress resistance

Assessing River Ecosystem Health: Impacts of Human Activities at Catchment Scale

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Abstract: Water shortage and pollution, river structural and functional degradation are serious in the Haihe River Basin (HRB), north China.This study investigated the water quality and macroinvertebrate assemblages of rivers in dry and rainy seasons in 2013. Based on the assessment metrics and standardization methods, the health scores of rivers were calculated. From the score of 0 to 1, the health level could be divided in “very poor”, “poor”, “fair”, “good” and “excellent”, respectively. Results showed that (1) water flow was very important for river ecosystem health under monsoon environment. With the water flow in rivers increased from dry season to rainy season, the overall river ecosystem health level in the whole basin improved from “poor” to “fair”, correspondingly. Due to the smaller river flow and destructive river connectivity by reservoirs and sluices, the river ecosystem health in plain catchments was worse than mountain catchments. (2) Human activities and disturbances had great negative impacts on river ecosystem health. River ecosystem health was significantly negatively ($P<0.05$) correlated with the proportions of farmland and urban land in catchments, with a correlation coefficient of -0.749 and -0.726, respectively. With different human activity intensities, mainly agricultural and industrial development and urbanization, the river ecosystem health differed among catchments. (3) Compared with water

nutrient, macroinvertebrate assemblages were more sensitive to river ecosystem health change, and macroinvertebrate assemblages were more instructive indicators for river ecosystem health assessment.

Key words: River Ecosystem Health Assessment, Water Quality, Macroinvertebrate, Haihe River Basin

Using Environmental DNA (eDNA) to Characterize the Biodiversity in an Aquatic System

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Abstract: Generally, there are many index to assess an aquatic system, such as chemical index, fish, amphibians, birds, arthropods, plants and several microorganism taxa. But the traditional biomonitoring schemes are too labour intensive and costly to handle large amounts of samples and data as it involves sorting targeted taxa. The recent development of molecular approaches allows efficient biomonitoring at large geographical scales. Using eDNA which contain a complex mixture of DNA molecules originating from organisms living in or near the sampling site (feces, mucous, gametes, shed tissues and so on), can detect the species we interested within a sample. eDNA combines with high-throughput sequencing, we can provide a wealth of information that to assess the biodiversity of an aquatic system, but less labor cost. This can be a valuable index for biomonitoring. At present, we have succeeded to detect the distribution and density of invasive crayfish at Honghe-Hani national wetland park In Yunnan. We are conducting a project to monitor the fish biodiversity of Nu river, aim to achieve reliable and efficient biodiversity monitoring in a place where unlikely achieve by traditional way.

Key words: Edna, Biomonitoring, Metabarcoding, Aquatic System

Dynamic Simulation of Urban Water Security System and Its Evolution Mechanism in Karst Area

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Abstract: The demand to global freshwater is growing, while global freshwater available for human use is limited within a certain time and space. Its security has significant impacts on socio-economic system and ecological system. Recently studies

have focused on urban water security system (UWSS) in terms of either water quantity or water quality. In this study, water resource, water environment, and water disaster issues in UWSS, were combined to establish an evaluation index system with system dynamics (SD) and geographic information system (GIS). GIS method performs qualitative analysis from the perspective of spatial dimension; meanwhile, SD method performs quantitative calculation about related water security problems from the perspective of temporal dimension. We established a UWSS model for Guizhou Province, China to analyze influencing factors, main driving factors and system variation law, by using SD method. We simulated the water security system from 2005 to 2025 under four scenarios (Guiyang scenario, Zunyi scenario, Bijie scenario and concerted scenario). The results demonstrate that: (1) the severity of water security in cities is ranked as follows: three cities are secure in Guizhou Province, four cities are situated in the basic security and two cities are insecurity from the spatial dimension of GIS through water security synthesis, and (2) the major driving factors of urban water security system in Guizhou Province include the agricultural irrigation water demand, soil and water losses area, ratio up to the standard of water quality, and the investment of environmental protection. Concerted scenario is the best solution for UWSS by 2025 in Guizhou Province under the four scenarios from the temporal dimension of SD. The results of this study provide a useful suggestion on the management of freshwater for the cities of Guizhou province in southwest China.

Key words: Driving Factor, Scenario Parameters, System Dynamics, Urban Water Security System

Phytoremediation of Cd Polluted Wetland by Arundo Donax.

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Abstract: Soil and water contamination by heavy metals has a major adverse environmental impact. The outstanding biological performance and non-food utilization of bioenergy grass possibly make Arundo donax to be the best candidate for phytoremediation of heavy metal-contaminated soil and water, but evidence is limited. A. donax is a perennial rhizomatous grass, native to the freshwater regions of Eastern Asia. Because of its high biomass, stronger adaption and unique physiological features whereby it readily absorbs and concentrates toxic chemicals from contaminated soil, A. donax is widely cultivated to yield non-food crop and bio-accumulator, especially via phytoremediation processes. Therefore, there are more and more researches have payed attention to A. donax as trace element bio-accumulator, energy forage and biocar et al. With a pot culture of simulated Cd-polluted soil-water medium, this paper studied the

capability of A. donax in accumulating these heavy metals, their distribution in the plant and their effect to physio-ecological characteristics of A. donax. Our study indicates that the amount of Cd accumulation in the soil and the vegetative organs (leaves, stems and roots) of A. donax increased with increasing Cd (from 0 to 2.5 μg/L), however, the amount of Cd in water less than 0.0001 μg/L in all treatments after 4-month cultivation. And increasing Cd concentration in soil-water medium obviously decreased stem and leaf biomass but not root biomass. Obviously, Cd stress (>0.01 μg/L) reduced the primary photochemical efficiency of PSII (Fv/Fm), potential activity of PSII (Fv/Fo) but not inhibited chlorophyll synthesis. Meanwhile, Cd application negatively influenced various photosynthetic parameters like Pn, Tr and Gs mainly in lower level Cd stress (0.01 μg/L). Nevertheless, intercellular CO_2 concentration (Ci) showed a contrary trend with Pn due to the effect of nonstomatal factors. This study suggests that A. donax was a tolerant plant species to Cd may be mainly through induced antioxidant machinery.

Key words: Arundo Donax, Antioxidant Enzymes, Chlorophyll Fluorescence, Phytoremediation

Land use/ Land cover change and its influence on floating islands in Loktak Lake in respect with biodiversity issues using Remote sensing and GIS Techniques

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Abstract: The presence of floating island (Phumdis) is the unique characteristic of the Loktak lake. Floating island plays a significant role in ecosystem services and ecological processes and function. Rapid urbanization, industrialization and demand for more resources has led to change in the landscape pattern of the Loktak lake in last three decades thereby degrading and threatening the fragile ecosystem. The aim of the present study is to assess the change in land use practice of the Phumdis during the last 38 years using remote sensing techniques. Landsat MSS images of 1977, 1988, 1999 and Indian Remote Sensing LISS III of 2015 were used to assess the LU/LC changes. The methodology adopted is the supervised classification using maximum likelihood technique in ERDAS software. Five land use class were categorized namely open water bodies, agricultural area, Phumdis with thick vegetation, Phumdis with thin vegetation and settlement. The result indicates that highest loss of land use class in Phumdis with thin vegetation (49.38 Km^2) follow by Phumdis with thick vegetation

(8.59 Km^2) while there is overall increase in open water bodies (+ 27.00 Km^2), agricultural area (+25.33 Km^2), settlement (+ 5.75 Km^2). The loss of Phumdis from the Loktak a major concern which will lead to the destruction of the only "floating National park in the world". There is a high chance for extinction of eldii dear, a keystone and other important species found in the Indo-Burma Biodiversity Hotspot.

Key words: Loktak Lake, LU/LC Assessment, RS and GIS, Human Pressure

Study on the Effects of Wastewater Treatment and Resource Utilization of Water Celery

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Abstract: Water celery is a cold-like paddy wetland plant that grows in fall and winter months. It is also a favorite vegetable in the southern China. It is generally planted in September and harvested in March. The improved variety, four-season water celery, can grow on floating bed all year round in the south and central regions in China, and continue to grow after the multiple harvests per year. In the meantime, it continues to absorb the nutrients in the polluted water body. In the end, the nutrients are removed from the water after the harvests and the water becomes clean and clear. During the fall and winter seasons, the roots are longer than stem and leaf combined, which plays an important role in microbial enrichment and the food chain. The nutrients removal effects from the roots are four times that of the stems and leaves. The floating beds rotate around its center driven by the wind. It becomes a natural aeration system. Fish without feeding, pollution treatment without chemicals, sustainable operation with full resource utilization，the improved four-season water celery provides a good solution for wastewater treatment. The treated water in the test area meets the type IV standard.

Experiment in a chicken farm shows that the water celery treatment process reduced the water turbidity greatly, the total nitrogen and total phosphorus met the standards for direct discharge or recycle use. Similar results are obtained for the wastewater treatment of a pig farmer. Because of the use of floating bed, the water celery is not contaminated by heavy metals in the soil, it is a true organic product and well received in the market. This new water celery planting technology achieved multiple successes in water treatment, landscaping, and economic value.

Key words: Wastewater Treatment, Resource Utilization, Eco-Agriculture, Water Celery

Quantifying the Effects of Impervious Surface Spatial Pattern on the Spatial Distribution of Urban Waterlogging Risk Area

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Abstract: Abstract: With the urbanization process and the climate change, urban flood has become a serious problem, especially in developing countries. Impervious surface is one major reason of urban flood, however, the research direction about spatial pattern of impervious surface mainly focused its composition, and had not understood the effects of its spatial configuration urban flood. This paper used the Pearson correlation analysis and Partial Redundancy Analysis (PRDA) to investigate the importance of the composition, configuration of impervious surface and its scales effects on urban waterlogging risk Area (UWRA) in urban local scale. The composition and configuration of impervious surface were measured by a series of landscape metrics, which were calculated based on a high-resolution land cover map. We found that (i) in view of single landscape index, at less four spatial scales(from 1km*1km to 4km*4km), the composition of impervious surface, especially in the percent cove of buildings, was more important than the configuration of impervious surface; at 5km*5km scale, the configuration of impervious surface, especially in Euclidean nearest-neighbor distance of buildings, was important than the composition of impervious surface; (ii) the combination of composition of impervious surface and configuration of pavement on UWRA had more explanatory power than the combination of composition of impervious surface and configuration of building as well as the composition of impervious surface alone in most of scales. Consequently, the impact of urbanization on UWRA can be alleviated by the way which control the relative amounts of impervious surface and optimize their spatial configuration

Key words: Urban Waterlogging, Impervious Surface, PRDA

The Effects of Environmental Factors on Ammonia Oxidation Potential of Wetland Sediments

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Abstract: The nitrifying and denitrifying microbial community, environmental factors, and ammonia oxidation potential rates (AOP) were compared between constructed wetlands and natural wetlands. There were 12 sampling sites located in four wetlands including two natural riverine wetlands and two constructed wetlands. The AOP rates in natural wetlands (0.024 mg N g $^{dw\text{-}1\ h\text{-}1}$) were higher than those in both constructed

wetlands (DN, 0.008 mg N g $^{dw\text{-}1\ h\text{-}1}$). There were higher AOP rates during summer than winter. The microbial composition was significantly different between natural wetlands and constructed wetlands. The environmental factors that relate nitrifying and denitrifying microbes include total carbon (TC), sulfate (SO_4-2), nitrate (NO_3-N) and nitrite (NO_2-N) concentrations in the water and Oxidation-Reduction Potential (ORP) in the sediment. The correlation was particularly significant between denitrifying microbe richness indices and denitrification rates. These findings are consistent with the fact that high nutrients (e.g, NH_3-N, NO_3-N and organic carbon) systems supported higher denitrifying activities.

Key words: Constructed Wetland, Nitrogen Removal, Ammonia Oxidation Potential, Denitrification

Habitat Types of Foraging and Roosting of Wintering Cranes in the Han River Watershed, Korea

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Abstract: The Korean Peninsula provides significant wintering sites or stopover sites with cranes in northeast Asia. The global population of Red-crowned Cranes (RCC), a species that is classified as Endangered on the IUCN Red List, is about 1,830 individuals. Around half of them pass the winter in the Han River Basin in the Korean Peninsula. The global population of White-naped Cranes (WNC) is about 3,700 to 4,500. Most of them make a stopover at the Han River Basin and then move to Izumi in Japan. In the Han River Basin, North Korea and South Korea are confronting each other militarily. Accordingly, this area is restricted to civilians, and the development is also limited. Therefore, the Han River Basin has optimal conditions for cranes' stable wintering. Regular wintering sites for cranes are inland areas in Cheorwon, Yeoncheon, and Paju; Janghang Wetland and Hongdo Plain in the Han River Estuary; and the Southern Tidal Flat of Kanghwa Island. Research was conducted on the wintering status of cranes from 2011 to 2016. In Cheorwon, 428 to 670 RCC individuals and 1,108 to 3,400 WNC individuals passed the winter. They used rice paddies and Samtong as their feeding sites and reservoirs and the Hantan River as their roosting sites. In Yeoncheon, 131 to 219 RCC individuals and 193 to 200 WNC individuals passed the winter. They used rice paddies and Coix lacryma-jobi var. mayuen fields as their feeding sites and riffles in the Imjin River as their roosting sites. In Paju, five to seven RCC individuals and 70 to 93 WNC individuals used rice paddies in Jangdan peninsula as their feeding sites and the Imjin River as their roosting sites. In the Han River Estuary, up to 40 WNC individuals were found. They used remaining rice

paddies as their feeding sites and new rice paddies in Jang Hang wetlands and surrounding tidal flats as their roosting sites. In the southern tip of Kanghwa Island, 14 to 24 RCC individuals used tidal flats as their feeding sites, which is different from other areas, and uninhabited islands and tidal flats as their roosting sites. Among wintering sites for cranes in the Han River Basin, Cheorwon and Yeoncheon recorded the highest stability while the Han River Estuary, which is vulnerable to development, provided the poorest stability. The southern tip of Kanghwa Island provided unique wintering sites in that it has tidal flats. Crane wintering sites in the Han River Basin can be divided in four types based on feeding and roosting sites: rice paddy-reservoir type (Cheorwon), paddy and field-river type (Yeoncheon and Paju), paddy-paddy type (the Han River Estuary), tidal flat-tidal flat type (the southern tip of Kanghwa Island). Based on the stability and size of habitats, there was difference in the population of wintering RCC individuals and WNC individuals.

Key words: Red-Crowned Cranes, White-Naped Cranes, Habitat Evaluation, DMZ

Effect of Inorganic Nitrogen Source on Population Growth of Euglena Mutabilis Schmitz from Different Habitat

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Abstract: Euglena mutabilis Schmitz is a benthic protozoa colonizing in an acidic drainage from coal or metal mining sites. E. mutabilis was reported to have high acid tolerance and accumulate heavy metals, however, ecological and genetic characteristics of the species has not been clarified yet. The habitat of E. mutabilis is a biofilm in the acidic streams contaminated with sulfuric acid as well as hyaline cells or sporangium of Sphagnum spp. I obtained five E. mutabilis populations included in algal and protozoan communities from natural habitat and investigated the ecological and genetic variation of the species; coal mine drainage in northern Kyushu, Japan, two habitats of volcanic spring and stream in central Kyushu, sporangium and hyaline cells of Sphagnum capillifolium in a fen in central Japan and in a palsa mire in northern Finland, respectively.

Isolation of E. mutabilis population was successful from the biofilm community in an acid mine drainage (pH 3.8) in northern Kyushu, then I first investigated the population growth of E. mutabilis from acid mine drainage with reference to inorganic nitrogen form in culture medium; ammonium chloride, ammonium sulfate and sodium nitrate. Saturated population density of E. mutabilis in ammonium containing medium was higher than that in nitrate containing medium and the maximum population density was obtained between 30-160 mM-N of ammonium chloride and ammonium sulfate.

Population density of E. mutabilis in medium with high concentration of ammonium sulfate reached saturated ca. 100 h (culture at 22 ℃) faster than in medium with ammonium chloride, implying that ammonium sulfate is the most suitable inorganic nitrogen source for E. mutabilis to obtain optimal growth and for isolation from natural community obtained from in situ habitat.

From the photosynthesis measurement across a pH range of 2.0–8.0, the maximum gross photosynthetic and dark respiration rates for E. mutabilis was obtained at pH=8.0, whereas the minimum rate was at 2.0-3.0. The rates of gross photosynthesis and respiration for E. mutabilis cultivated at pH 8.0 significantly declined after 3 days in culture, whereas the rates did not significantly decline after the 3 days' culture at pH<4.0. The photosynthetic and respiration rates were constant under highly acidic conditions, although the rates were lower than that under circumneutral conditions. E. mutabilis can colonize under circumneutral conditions, although the physiological stability is higher under highly acidic conditions. Thus, E. mutabilis establishes stable population under highly acidic habitats.

E. mutabilis population in Sphagnum spp. was included in communities with several algal and protozoan species; Amoebina, Testacea, Ciliatea, Bacillariophyceae, Chlorophyceae. In order to clarify the genetic variation and ecological property of these E. mutabilis strains, I investigated to achieve the pure culture of E. mutabilis from several in situ populations in Sphagnum plants. Culture in the medium with high concentration of ammonium sulfate was successful to eliminate some coexisting species. Ecological and genetic variation of E. mutabilis including populations from acid mine drainage, volcanic springs and Sphagnum plants will be discussed with reference to habitat condition.

Key words: Benthic Protozoa, Population Growth, Photosynthesis, Acid Mine Drainage

Nutrient Reduction Scenario Modeling for the Hyper-Eutrophic Lake Taihu, China

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Abstract: Decreasing excessive anthropogenic nutrient loads is the most straightforward way of mitigating against eutrophication, especially for the hyper-eutrophic Lake Taihu, China. Different nutrient reduction scenarios should be used to identify the best strategies for achieving nutrient reduction goals. Here, three scenarios (past, equality, and cost-effective) aimed at improving the current reduction strategy were applied to upstream parts of the Lake Taihu basin in 2010. An improved

practical export coefficient model for evaluating the total nitrogen (TN) and total phosphorus（TP） reduction potentials and the best management practices (BMPs) costs was developed to allow the effects of the scenarios and the total costs to be determined. All three scenarios achieved the goal of decreasing the total phosphorus load by 10.19% (406 tons), and the costs of the past, equality, and cost-effective scenarios were USD 11.09, 8.31, and 2.91 million, respectively. The costs of the past and cost-effective scenarios were USD 16.93 and 3.22 million, respectively, to achieve the goal of decreasing the TN load by 22.86% (8679 tons). The equality scenario was not sufficient to achieve the TN reduction goal, and the cost of decreasing the TN load by 8606 t was USD 23.81 million. The results indicated that the cost-effective scenario would be effective in producing the nutrient reduction goals at the lowest total cost. These methods have allowed us to perform uncertainty and reasonability analyses, and to make suggestions that could help policymakers improve the control of nutrients in the upstream regions of the Lake Taihu basin in the future.

Key words: Nutrient Reduction Scenario, Watershed Management, Reduction Potentials, Cost-Effective

Long-Term Pattern of Anthropogenic Regulation and Ecological Consequences in a Dammed Lake System of Southwest China

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Abstract: Water regulation has been increasingly practiced in many parts of the world for agricultural production, water supply and flood control. In China alone, the number of reservoirs has spiked over the last six decades, including a fair amount of dammed lakes. In the context of significant environmental and biotic changes associated with altered hydrology and anthropogenic disturbance, long-term ecosystem responses are rarely available in regulated systems due to a general lack of monitoring data. Lake Haixihai, an alpine rift lake by origin, has experienced pronounced lake regulations and drastic water level fluctuations since the 1950s. Here, we conducted multi-proxy sediment analyses aiming to reveal the limnological changes during the past two centuries. A numerical model was constructed through linking surface sediment clay component to water depth and was further applied to reconstruct the history of water level changes. Our results showed that there existed an increasing trend in water level within the context of strong hydrological fluctuation over the past two centuries. The median grain size spiked around 1957 and 1989, which corresponded to the events of lake damming and reservoir reinforcement, respectively. The sediment content of nutrient variables showed an increase over the past few decades, indicating an

accelerating trajectory of nutrient enrichment. Diatom assemblages shifted significantly in ~1957, which was consistent with lake damming as evidenced by grain size records. Diatom assemblages were dominated by planktonic taxa (i.e., Cyclotella ocellata) prior to the 1950s, but thereafter there was an increase of benthic taxa (i.e., Achnanthes minutissima). While, taxa such as Fragilaria crotonensis increased obviously but showed fluctuations synchronous with nutrient enrichment and increased lake depth. It was further indicated that nutrients were among the most significant drivers for community organization (i.e. 34.7% of the total variance), while hydrological and habitat variables accounted for 20.9% of the diatom changes with strong interaction with nutrients (8.5%). Overall, our results suggest that hydrological regulation impacted lake communities profoundly through modulating habitats directly, as well as strong interaction with stressors such as nutrients.

Key words: Hydrological Regulation, Water Level Reconstruction, Ecological Assessment, Sediment Analysis

Study on the Effects of Land Use Change on Ecosystem Service Value of the Fenhe River Basin in the Loess Plateau, China

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Abstract: Ecosystem service is the conditions and processes through which natural ecosystems and the species comprise sustain and fulfill human life or the goods and services provided by ecosystems that contribute to human welfare, both directly and indirectly. Intensive human activities can cause land use change, which can further affect regional ecosystem services and functions. The valuation of ecosystem services is conducted to reveal the ecosystem status and variable trends caused by land use change. This study focused on the Fenhe River Basin, Loess Plateau, China and studied the effects of land use change on ecosystem service value of the Fenhe River Basin in the Loess Plateau, China from 2000 to 2010. The aims of this study are to (1) evaluate the land use changes; (2) assess and map ecosystem service value and the change; and (3) evaluate the effects of land use change on ecosystem service value.

Key words: Ecosystem Service Value, Land Use Change, Fenhe River Basin

Comparison of Inorganic Phosphorus Fractions and Phosphatase Activities in Mid-Temperature Wetlands of Huihe National Nature Reserve, China

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Abstract: Inorganic phosphorus (P) fractions and phosphatase activities were measured in 20 mid-temperature wetland sediments in Huihe National Nature Reserve, China. Wet meadow (CW), as a prototype of constructed wetlands, was compared to the other three types of wetland, including river wetland (MW), freshwater lake wetland (TW) and grassy marsh wetland (XW). Results showed that: The CW wetland had higher soil organic carbon content than MW wetland and TW wetland, but the difference was not significant. This indicating that the MW wetland and TW wetland had lower or similar organic matter levels than the CW wetland. Inorganic P forms and phosphatase activities varied greatly from site to site under the different wetland types. An overall trend of the inorganic P forms was Ca-P >Oc-P >Al-P >Fe-P. Comparing the sediments under various wetlands and vegetation cover, Ca-P was, on average, larger in sediments of wetland TW. The overall median Oc-P content was 79.14 mg/kg and decreased in the order XW＞TW＞MW. Al-P was statistically higher in the sediment of wetland TW and wetland MW than in the sediment of wetland XW. The Fe-P contents in the three wetlands were much higher than in the sediments of wetland CW. Most phosphatase activities in the sediments of those three wetlands were larger than those in the sediments of wetland CW. The phosphorus content in sediment of CW was suitable for the growth of wetland plant, also it has lower phosphorus release rate when compared to river wetland and freshwater lake wetland. The results enhance our understanding of wet meadow wasselected as the prototypes in constructing wetlands in the terms of phosphorus recycle in this area under different wetland types.

Key words: Mid-Temperature Wetland, Inorganic Phosphorus Fractions, Phosphatase Activities, Wet Meadow

The Metal Contaminants Behavior in the Rhizosphere Micro Interface of Typical Karst Plateau Wetland

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Abstract: This project is based on two frontier research fields named rhizosphere micro-face and phytoremediation, in the face of multiple requirements for national

regional development and ecological environment safety, in order to promote grass sea region economic, social and environmental development in an all-round way, obtain the sustainable use of grass sea area natural resources and maximize the benefit of grass sea area natural resources/environment, our team will select karst plateau natural freshwater wetland grass sea ecosystem as the research object, and carry out a thorough research on the Cadmium(Cd)-polluted wetland system by combining multiple subjects such as ecology、botany、environmental biology classic theory/ research method and using modern precision instrument testing. Based on our knowledge accumulation of wetland ecosystem and rhizosphere micro-ecology、research system formed and research achievements, by combing in-situ investigation/sampling and in-door rhizo-box cultivation, we probe in the Cd behavior in rhizo-macro-face of Cd-polluted grass sea plateau wetland sediment, the response of root exudation, iron plaque formation and rhizosphere microbes, in order to explore the heavy metal rhizo-micro-face behavior and the key related processes, also provide theoretical basis and practical experience for similar region wetlands or different region wetlands but of the same latitude.

Key words: Metal Contaminants, Rhizosphere, Micro-Interface, Wetland

Metagenomics and Metatranscriptomics Follow-Up of Sewage Sludge Bioreactors Confirmed the Efficiency of Nitrifying Bacteria for Optimising the Wet Oxidation Process.

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Hepia, France

Abstract: Because of increasing costs of municipal sludge management (dewatering, storage, and transport to landfill), sludge withdrawal is becoming an escalating problem. As sludge treatments represent up to 50% of the operating costs of wastewater management, they can be considered as a major source of energy savings. Anaerobic digestion, the most commonly used disposal method, allows for reducing the amount of final sludge solids and enabling biogas production processes. A key point is then to improve the anaerobic digestion step and to maximize the conversion of carbon in methane. Wet oxidation is one of among such improvement methods and allows for the elimination of organic components in the liquid phase by oxidation at high temperature and pressure. It can be used as a sludge pre-treatment before entering into anaerobic digestion or as an additional treatment of the anaerobic effluent in order to destroy biologically hard degradable fractions. This process is an environmentally friendly alternative to landfilling or sewage sludge dispersion in farm fields, practices banned from many countries. Wet oxidation is also an economic alternative to incineration and

would strongly contribute to energy savings in sludge treatments and transportation.
Though highly efficient for degrading complex organic compounds, wet oxidation of sewage sludge produces effluents, which contain high ammonia concentrations. Ammonia removal is thus the crucial issue, since wet oxidation improves anaerobic digestion, but returns high concentration of ammonia, a strong inhibitor of methanogens, which in turn inhibit the production of methane.
Our project aimed to develop a novel biological process, using aerobic granules in order to remove high ammonia concentration from the wet oxidation effluent. This new process would address the major drawbacks of existing technologies, such as: price, selectivity, stability, sensitivity and process efficiency. In a first experiment, in order to maximise the genes diversity involved in the denitrification pathway in highly polluted environment, the selection of cultivable, high ammonia concentration tolerant and denitrifying bacteria was carried out from diverse samples, such as existing aerobic granules, activated sludge from coke plant, formaldehyde production plant and sediments from wet oxidation. Isolated bacteria have been genetically identified and some of them have been evaluated in vivo in 5 L experimental bioreactors using adapted activated sludge in order to confirm their denitrification activity, as well as other interesting characteristics such as flocculation capacities. Finally metagenomic and metatranscriptomic analyses were carried out on samples from experimental bioreactors in order to characterize the evolution of respective microbial population structures as well as gene expression typology, with a focus on nitrogen removal.
These analyses showed that bacterial communities adapted to the wet oxidation effluent, by moving towards an increased nitrogen metabolism, confirming that biology could be an economic alternative for ammonia elimination, allowing for reducing chemicals and energy consumption in sewage plants. The present study combined metagenomics and metatranscriptomics to assess the microbial community structure and the gene expression profiles in activated sludges, at a high sequencing depth (from 4.17 to 7.6 Gb) and revealed the abundance and expression levels of genes involved in nitrification, denitrification, ammonification, dissimilatory nitrate reduction to ammonium and nitrogen fixation processes.
Key words: Wastewater, Metagenomic, Sludge

Speciation Analysis of Arsenic and Selenium in Bottom Mud and Its Biogeochemical Cycle in Nan Ji Shan Wetland

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Abstract: Wetlands or lakes, as a kind of important natural resources, has a flood

storage, water supply, aquaculture, shipping, tourism, and maintenance of biological diversity and other functions. They play an important role in the whole economic and social sustainable development. When explore the lakes or rivers, which contains a lot of pollutant from discharges of industrial wastewater and sewage discharge, people often neglect effective protection and management them. So it causing the pollutants in the city water body and sediment concentration increased rapidly. These trace elements in the organism can not be absorbed and decomposed by themselves, but rather than through food chain transfer constant enrichment in biological body, then accumulated and magnified, ultimately affect the human life and health.

This paper studied the distribution, accumulation, migration, transformation rules and ecological effect of the trace element arsenic and selenium in water, sediment, biology in NanJiShan wetland. And discuss the source of biogeochemical of arsenic and selenium. From analysis the speciation of arsenic and selenium in water and sediment in the NanJiShan wetland, so as to study the distribution mechanism and biological accumulation effect of barsenic and selenium in the environment and biology. To evaluate the effects of environmental pollution and ecological risk, formulate the corresponding environmental standards, and the repair of environmental pollution, so it can provides a scientific basis for ecosystem recovery.

The experimental results show that the content of weak exchange state arsenic in the surface sediment change is larger (0.02 to 0.09 ug/g), with an average of 0.06 ug/g. From north to south, it is showed decrease at the beginning and then increased, and then has a large variation of the increase. Amorphous combination state arsenic and crystal shape state arsenic change is bigger (1.82 to 6.02 ug/g; 1.07 to 3.12 ug/g). It is shows that the average value is respectively 3.36 ug/g to 1.29 ug/g. From north to south, it has a tendency to gradually increase. The average of Residue state accounts for total percentage is 32.3%, represented a weak fluctuation change and relatively stable.The migration ability of arsenic is change with the seasons, water depth and vegetation. it is biggest in the summer and the content of arsenic is definitely higher.

The selenium amount has gradually increase trend from north to south west in sediment in in the NanJiShan wetland. It has a range from 0.32 to 1.21 ug/g and the average is 0.79 ug/g. The total selenium was positively correlated with organic carbon($r=0.743$, $p<0.01$).The preservation of selenium in the form of organic sulfur is easy to preserve in the redductive environment conditions.

The ecological risk is preliminary evaluated by secondary phase concentration coefficient method (SPEF). The reducing order of content is from bound-state sulfide to exchangeable to organic matter to residual to acid soluble to water soluble.

Key words: Wetland, Biogeochemical Cycle, Selenium, Arsenic, Speciation Analysis

Hydro-Ecological Regionalization and Ecosystem Management in Large Catchment Based On: A Case Study in Haihe River Basin, Northern China

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Abstract: Ecosystem management addresses trans-boundary, interdisciplinary, and multi-party issues from an ecosystem perspective, which represents a fundamental shift in managing landscapes from the purpose of natural resources production towards multiple ecosystem goods and regional sustainable development. Since ecosystem and human activities vary tremendously in heterogeneous environments, ecosystem management is to be implemented accordingly as the adaptive ecosystem management and regional sustainability asked. Thus, specific strategies pertinent to the regions are required. In this study, the Haihe River Basin in northern China with highly human-disturbance and badly water-shortage, was focused. A hydro-ecological regionalization was conducted for defining the homogeneous units that will be used for ecosystem management. In the first, the Haihe river basin was divided in six regions based on water resource availability, was then grouped 16 sub-regions by water purification capacity. After the 16 sub-regions, 73 homogeneous units were further defined after considering the effects of human activities on waster resource and water quality. Finally, the environmental issues in each homogeneous units was analyzed, and the measures on ecosystem restoration and management for sustainable development with respect to homogeneous units were proposed.

Key words: Hydro-Ecological Regionalization, Hyro-Ecological Function, Human Disturbance, Wetland Restoration and Management

The Importance of DOC from Natural Wetland Ecosystems and Its Relationship with DOC Dynamics in Fluvial

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Abstract: Dissolved organic carbon (DOC) represents a significant carbon fraction of terrestrial carbon pools. Recently, the rising aquatic DOC throughout the world is widely reported. Such information would pose a serious risk to the terrestrial carbon pools, implying a regional redistribution of terrestrial DOC. Natural wetland ecosystems, significant carbon pools in the earth, hold more DOC than the other biomes. The objective of our meta-analysis was to synthesize the roles of DOC in natural

wetland ecosystems, examine the relationship between wetland DOC and DOC in fluvial networks and analyze the controlling factors of DOC exports within wetland ecosystems and their delivery to fluvial networks. Results indicate that DOC plays a significant role in carbon cycles (i.e. greenhouse gas emissions and carbon budgets), and might be a key factor influencing other ecological parameters, such as the microorganism activity and trace element balance of a wetland. Until now, scientist has agreed well with the view that wetland DOC exerted an important role in DOC dynamics and even ecological processes of nearby fluvial ecosystems, though the quantitative relationship between aquatic DOC increasing trend and natural wetland ecosystems was difficult to provide. Finally, the controlling factors of DOC export were introduced, such as freezing-thawing, extreme events (storm) etc. Such information in our study would be a prerequisite for more precise prediction of the relationship between the future DOC trend and wetland DOC. Furthermore, our analysis clearly highlights an urgent need for policy responses to protect natural wetlands if we are to avoid the risk of losses of valuable DOC sources and potential destabilization of related ecological processes.

Key words: Wetland, Dissolved Organic Carbon, Influencing Factors, Rivers

Mangrove Species Maintains Relative Low Nutrient Resorption under Nutrient Enrichment

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Abstract: Nutrient resorption is a key plant trait of nutrient conservation strategy which is developed by slow-growing plant in adaptation to oligotrophic environment. Global pattern of the relationship between nutrient resorption and nutrient availability do not emphasize on the species with nutrient conservation strategy. We are here paying our attention to a mangrove species Aegiceras corniculatum (L) Blanco and investigate the changes of nutrient resorption efficiency under nutrient enrichment that have occurred in coast and estuary worldwide. Resorption efficiency and proficiency were calculated based on the measurement of leaf N and P in mature and senescent leaves one year following nutrient addition. Nutrient resorption efficiency of N and P did not change across nutrient gradient and was lower than the global mean value (40% vs. 50%). Nonetheless, leaf N and P contents increased with nutrient addition. Results indicate that plant changed nutrient use strategy under nutrient enrichment by reducing dependence on nutrient internal cycle, but mainly relying on the way of root uptake.

Key words: Mangrove Plant, Nutrient Resorption, Nutrient Conservation Strategy, Resorption Proficiency

Evaluation Research on Resources and Environmental Carrying Capacity of the Wudalianchi

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Abstract: Abstract: Wudalianchi, located in Heilongjiang province, has beautiful natural environment and unique humanistic environment. It is not only one of the national key scenic spots, famous tourist resorts, health resorts and popular science education bases, but also one of the first world geological parks and the Human and Biosphere Reserve of the world. With the increasing popularity of Wudalianchi, the number of tourists, convalescents and scientific researchers has been increasing year by year. Therefore, it is necessary to evaluate the resources and environmental carrying capacity of the Wudalianchi and further understand the actual situation of regional resources and environmental carrying capacity, which can provide reference and decision-making basis for the development, choice of industries and the path of the research on industrial innovation, to promote the sustainable development. Taking the eco-environmental carrying capacity, resource space carrying capacity, social environmental carrying capacity and economic ability as the target layers, a resource and environmental carrying capacity evaluation index system is constructed to adapt the development of Wudalianchi. Then, the weight of each index in the system will be determined by using analytic hierarchy process (AHP). Based on this system, the corresponding evaluation model will be established by vector analysis method. Combined qualitative with quantitative methods to evaluate the change of time carrying capacity in Wudalianchi, the trends and reasons of each target layer are analyzed. Finally, according to the carrying capacity of the score, the paper puts forward some countermeasures and suggestions to promote the healthy and orderly development of Wudalianchi.

Key words: Resources And Environmental Carrying Capacity, Wudalianchi

Observational Study of Circulation and Salt Stratification over the South Branch of the Yangtze Estuary

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Abstract: Due to highly irregular bathymetry, large freshwater discharge from the Yangtze River, strong tidal currents, large salinity gradients and strong interaction

between the river and sea waters, the hydrodynamics of China's Yangtze Estuary is very complicated. Oceanographic measurements were made over the lower part of the Yangtze Estuary (the South Branch of the Yangtze Estuary) in 2005 to examine the circulation structure and intra-tidal variability of salinity. The least-squares fit to main harmonics was made to explore the sub-tidal circulation. The observed ADCP currents were decomposed in the along-channel and cross-channel velocity to examine the spatial and temporal variability of circulation in the region. The observed study in the 2005 wet season and the 2009 dry season in different channels showed that the tidal straining effect is a major forcing mechanism on salinity stratification and sub-tidal circulation of the Yangtze Estuary. The river runoff, large horizontal salinity gradient and tidal straining resulted in the asymmetry of currents and estuarine circulation in the South Branch of the Yangtze Estuary. The tidal straining induced circulation was found to be equally important as the classical gravitational circulation in the Yangtze Estuary. This played an important role in maintaining semi-diurnal periodic salinity stratification in the region.

Key words: Yangtze Estuary, Sub-Tidal Circulation, Salinity Stratification, Tidal Straining

Coastal Exploitation Intensify Spartina Invasion in Yellow River Delta

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Abstract: Intense coastal exploitation and large-scale invasion by nonnatives are two of the most pervasive and damaging threats to the biotic integrity of coastal wetlands. Individually, these are potent forces, but it is important to consider their interactive impacts as well. In this study, we simulated the physical restriction and biotic resistence to Spartina alterniflora in the Yellow River Delta, as well as the effects of further costal exploitation, such as tidal restriction and sea reclamation on invasion procedure. Our results indicate that spartina. Spp invasion is limited by hypersaline substrate condition in low marsh and high marsh regions, whereas is inhibited by intense interspecific competition in upland and terrestrial border. Sea reclamation that break hypersaline belt in salt marshes would accelerated landward invasion of Spartina. Spp.

Key words: Salt Marsh, Species Invasion, Hypersaline Zone, Biological Conservation

Achievements and Problems of the Water Diversion Project in Heihe River Basin

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Abstract: The lower Heihe River Basin (HRB) in NW China is under severe ecosystem degradation due to increased irrigation water and resultant decreased stream flow discharged off in middle reaches. Since year 2000, the Ecological Water Diversion Project (EWDP) has been executed as an emergency water management scheme to alleviate the ecosystem disaster. In order to assess the effectiveness of the water diversion project, we assessed hydrological and ecological achievements also analyzed the potential problems after the execution of EWDP. We found the area of terminal lake expanded remarkably, the groundwater level begin to rise and greening the desert in lower reaches, which indicated the control of the deteriorated downstream ecosystem. However, local groundwater level in middle reaches declined continuously, the vegetation degradation coexisted with recovery, and the water contradiction between middle and lower reaches was sharpened, which revealed the inadequate capacity of the current water diversion scheme in achieving the rational water allocation between the economic and ecology and maintaining the stability of the ecosystem in long time period.

Key words: Water Diversion Project, Heihe River Basin

Remediation of Soil Co-Contaminated with Cd and PAHs by Growing *Xanthium Sibiricum*

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Abstract: Soil contamination with heavy metals and organic pollutants causes major ecological damage and human health problems. Here, we performed a greenhouse experiment to investigate the individual and combined effects of cadmium (Cd) and polycyclic aromatic hydrocarbon (PAH) contamination on the growth of Xanthium sibiricum, and also investigated the ability of this species to accumulate and remove Cd and to reduce PAHs over a period 75 days.The addition of PAHs to the soil significantly increased the concentration, accumulation, and removal of Cd. The reduction of PAH concentration in the soil with time was similar in the presence or absence of plants. At higher levels of Cd contamination, the rate of removal of pyrene decreased in both planted and non-planted soils; this effect might be due to the higher Cd content altering soil microbial activity. Analysis of soil dehydrogenase and polyphenol oxidase

activities showed that soil contamination had no significant effect. Our results suggest that X. sibiricum might be a suitable species for use in the phytoremediation of contaminated soils.

Key words: Phytoremediation, Cadmium, Polycyclic Aromatic Hydrocarbons, X Sibiricum

Adaptive Traits of Plants Affect Their Performance under Submergence

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Abstract: Abstract: Plants in natural habitats and farmlands are commonly subjected to submergence and this is likely to become more widespread and frequent owing to increased flooding events and water level rise caused by global climate change. Discontinuous pith cavities, partitioned by solid nodal diaphragms with very low porosity, exist in the shoots and rhizomes of many plants. To date little knowledge is available about whether discontinuous pith cavities are advantageous to the gas transport in plants, which is of much significance for plants under hypoxic stress. Taking Alternanthera philoxeroides as a model, we employed a novel experimental method to investigate the role of discontinuous stem pith cavities by blocking pith cavities and measuring the plant' responses of internal oxygen transport, stem anatomy and growth performance to partial submergence. Pith cavity blocking impeded the longitudinal gas transport in stems and reduced the O_2 partial pressure (pO_2) in pith cavities and cortices of submerged stem portions below the blocked internodes; additionally, it hampered plant growth and enhanced the adventitious root formation on submerged stems. Partial submergence alone did not affect the porosity of stem nodal diaphragms and internodal cortices, but partial submergence together with pith cavity blocking increased the cortex porosity of submerged internodes. Discontinuous pith cavities, albeit partitioned by very low porosity nodal diaphragms, is important for the internal aeration of plants thereby benefiting plant growth and enhancing tolerance to hypoxic stress such as flooding/submergence.

Moreover, plants often experience nutrient and oxygen stresses when they are submerged. It has been well reported that plants usually shift biomass allocation and produce more roots to cope with nutrient deficiency. However, it is unclear whether plants experiencing oxygen deficiency stimulate biomass allocation to roots to enhance nutrient absorption, similar to how plants experiencing nutrient deficiency behave. We investigated the responses of plants, upon partial submergence, to nutrient versus dissolved oxygen deficiency in plant growth, biomass allocation, adventitious root

production, root efficiency, and root aerenchyma formation. Both nutrient and dissolved oxygen deficiency hampered the growth of partially submerged plants. As expected, plants experiencing nutrient deficiency increased biomass allocation to adventitious roots and exhibited lower root efficiency; in contrast, plants experiencing dissolved oxygen deficiency decreased biomass allocation to adventitious roots but achieved higher root efficiency. The diameter of aerenchyma channels in adventitious roots were enlarged in plants experiencing dissolved oxygen deficiency but did not change in plants experiencing nutrient deficiency. The widening of aerenchyma channels in adventitious roots improves the oxygen status and thereby the nutrient absorption capability of roots in low oxygen environments, which enhances the tolerance of plants to submergence.

Key words: Submergence Tolerance, Discontinuous Stem Pith Cavity, Adventitious Root Production, Partial Submergence

Evaluation of Water Quality and Spatial Distribution of Water Quality in Dry Season in Dongping Lake

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Abstract: Water is an important resource for the development of the economy and has a significant influence on maintaining regional ecological balance. The quality of water environment of Lake directly affects people's health, living conditions, social and economic development. Therefore, it is of great significance to study the water environment quality.

In order to understand the water quality and the distribution of water quality factors in dry season in Dongping lake, water samples were collected from 52 sampling sites in Dongping lake in May 2016, and the nutrients and related physical and chemical indexes were determined. Firstly, single factor evaluation method is used to analyze the water quality of lake water in Dongping lake. Secondly, the spatial distribution of water quality factors in Dongping lake was studied by using spatial autocorrelation theory and GIS spatial analysis method. The study shows that the lake water of Dongping lake was weakly alkaline, brackish water and very hard, the water of Dongping Lake usually manifested the type of sulfate. Single factor evaluation showed that most of the COD and TN indicators of lake water quality in line with the III class water standards, the water quality condition in Dongping lake was worsening and the TP concentration actually came to bad V class; the distribution of water quality factors concentration space show that the pH value is low in the south and high in the north, the conductivity is high in the south and low in the north, TP performance is high in the east and low in

the west. TN, COD and salinity showed no significant change in the whole lake range. The global Moran 's I index indicated that PH, conductivity and TP had spatial autocorrelation at the entirely lake. PH, TN, TP, conductivity in the presence of significant local aggregation, but mineralization degree, electrical conductivity and COD in local abnormal value. The development of aquiculture and tourism, industrial wastewater, sewage, agriculture no-point sources and Dawen River Basin sewage flows caused the decline of Dongping lake water environment quality.

Key words: Spatial Autocorrelation, Water Quality, Moran's I, GIS Spatial Analysis

Ecological Water Purification and Restoration of Huaihe River Basin

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Abstract: Huaihe River Basin has the important strategic position in the process of social and economic development in China. Huaihe River is one of the research demonstration district of river water pollution control and comprehensive treatment technology. The main threats for Huaihe River Basin are: the heavy point and non-point source pollution, unrational river damming, shortage of water resource and ecological flow, and serious transboundary pollutions, etc.

In view of the situation that black-and-malodorous water body is lack of natural runoff, and the main incoming water is from urban sewage and industrial wastewater, we developed the technology of reinforcement and purification of wetland ecological-type river channel, parallel coupling of constructed wetlands wastewater treatment upgrades technology, river restoration and ecological water quality improvement technology and shallow aquifer infiltration technology. All these formed the river ecological water purification system. River damming, channelization and hardening have caused downstream lack of base flow and environmental flow instability. Eventually aquatic biodiversity has declined dramatically, most river ecosystems have collapsed and river self-purification capacity has reduced. On the basis of identifying river water ecological features, we developed the core technology of "water ecological restoration based on the threshold of environmental flows", which includes river ecological restoration paradigm, biological tools breeding propagation and engineering application, environmental flow regulation and ecological restoration technology for ditch rivers under normal and the extreme flow.

About 100 km demonstration project has been carried out in Huaihe River Basin. The water can reach surface water Class Ⅲ to Class Ⅳ, six functional groups including

submerged plants, emergent aquatic plants, benthonic animals, zooplankton, fish and birds have been restored and biological species has increased by about 60%.
A set of Small Watershed Water Quality Improvement, River Ecological Purification and Ecological Restoration technical system has been developed, which has been successfully applied in Jiangsu, Shanghai, Zhejiang, Fujian, Henan, Anhui, Guangxi, Inner Mongolia, Hunan and Hainan, with a total area of over 5300 ha.
Key words: Black-And-Malodorous Water Body, Ecological Water Purification, Ecological Restoration, Environmental Flow; Huaihe River Basin

Distribution of Soil Inorganic Carbon under Different Landscapes in the Lower Reaches of the Yellow River Delta

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Abstract: Soil organic carbon (SOC) and soil inorganic carbon (SIC) are important carbon reservoirs in terrestrial ecosystems, which play an important role in affecting the global climate change. Understanding the distribution of SIC and SOC storage in soil profiles is crucial for assessing regional, continental and global soil C storages. To date, little information is available about the SIC and SOC storages across various landscapes near coastal zones. We carried out a study in the lower reaches of Yellow River to investigate both the distributions of SIC and SOC and the effect of land uses. There were 31 soil sampling sites and 155 soil samples. Our data showed that SOC content decreased with depths (from 19 to 1.4 g kg^{-1}) in agricultural dryland and rice paddies, but increased with depth in non-agricultural date tree soils (from 4.2 to 17 g kg^{-1}). Interestingly, SIC content increased with depth in agricultural dryland and date tree soils (from 11 to 27 g kg^{-1}), but decreased with depth in rice paddies (from 20 to 12 g kg^{-1}). Both SOC and SIC stocks (over the 0–100 cm depth) were least in the rice paddy soils (7.5 and 22 kg C m−2 for SOC and SIC, respectively), but greatest in the data tree soils (15.5 and 28 kg C m−2 for SOC and SIC, respectively). On average, SIC accounted for 70% of the total carbon stock in this region. Our study implies that neglecting SIC may lead to underestimation of the global soil carbon stocks.
Key words: Soil Inorganic Carbon, Rice Paddy Soils, Soil Profiles, Yellow River Delta

Interactive Effects of Lead, Zinc and Copper on Growth and Physiological Responses of Mangrove Plant: Kandelia Obovata

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Abstract: Mangrove forests are one of the major coastal ecosystems in tropical and subtropical regions. Despite their enormous ecological and commercial importance, metal pollution has been widely reported in mangrove wetlands. Actually, the system has the capacity to act as a sink or buffer and immobilize heavy metals entering aquatic ecosystem, but excessive heavy metal pollution still cause a series of physiological and biochemical changes, which lead to potential ecological system risks. What's more, the information on single metal contamination research cannot reflect the biological toxicity when multiple elements are present together. Therefore, the study was conducted to quantify mixture toxicity of lead (Pb), zinc (Zn), and copper (Cu), frequently existing in the contaminated coastal wetlands, on mangrove plant Kandelia obovata. The hypothesis was that mixture toxicity of Pb, Zn, and Cu to mangrove plant can be explained by biochemical parameters. The pot experiment consisted of 27 treatments with combined three gradient concentrations of Pb [PbCl2, 0, 200 and 400 mg kg^{-1} DW], Zn [ZnCl2, 0, 300 and 600 mg kg^{-1} DW], and Cu [CuCl2, 0, 200 and 400 mg kg^{-1} DW]. After 5 months, the growth, photosynthetic parameters (including biomass, net photosynthetic rate (Pn), stomatal conductance (Gs) and transpiration rate (Tr)), osmolytes (proline content) and lipid peroxidation (malondialdehyde (MDA)) of K. obovata were determined. The results showed that compared to Zn0Cu0, extra Zn or Cu addition inhibited leaf, stem, root, total biomass, Pn, Gs, Ci and Tr under Pb stress, at least most of treatments. When Zn and Cu are added simultaneously, the tendency is changed: external Zn and Cu addition promoted these parameters at least most of treatments, especially in high Pb level. Our results also demonstrated that combined heavy metal mediated changes in MDA with different patterns between leaves and roots. Compared to Zn0Cu0, Zn or Cu addition inhibited root MDA under Pb stress, while, external Zn addition inhibited leaf MDA, while external Cu addition increased leaf MDA under Pb stress. In leaves and roots, Zn and Cu addition inhibited MDA, at least most of treatments. These results are also consistent with the growth results. Compared to Pb0Zn0Cu0 (control), the increasing Pb, Zn or Cu increased proline content under Cu0Zn0, Pb0Cu0 or Pb0Zn0 treatments in roots and leaves, at least most of treatments, which was helpful to maintain cell and tissue water balance, protect the structural integrity of membrane and mitigate the toxicity of heavy metal stress. Compared to Zn0Cu0, external Zn or Cu addition increased proline content under Pb stress in roots and leaves. Simultaneous Zn and Cu addition decreased proline content in leaves and roots (high Zn and Cu addition). In conclusion, these findings suggest that all of these parameters in plants under heavy metal stress can indicate combined heavy metal pollution and the growth of K. obovata was less inhibited under simultaneous Zn and Cu addition.

Key words: Multiple Heavy Metals, Mangrove, Growth, Physiological Responses

Aquatic Eco-Restoration and Agricultural Use for Shallow Pond and Wetland

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Abstract: According to survival mechanism and food chain principle of the plant, animal, microbes, an eco-system merging two completely processes, the aquatic eco-restoration and agricultural production, was designed and tested. This system treats polluted water without using chemicals, grows vegetables with no fertilizers. It sets a good model of sustainable operation for aquatic eco-restoration.The testing area Yidu Zengjiagang is near the confluence of the Qingjiang river and the Yangtze River. The water depth ranges from 0.8 to 2.0 m with surface area of 7 ha. The catchment area is mainly for agricultural use with an area of 500 ha. Treated but still substandard wastewater from a pig farmer with 4000 heads per year flows in the entrance of testing ponds. The wastewater first flows through a filtering area with a tephra base and plant top, then through several cascaded ponds with different depths and various combinations of fish and plants, then into a pond with submerged plants, and finally into the last pond with an inversion laminar flow aeration system. After the full process, the treated water discharges into the adjacent lake. On-line sensors for COD and TP and control devices for aeration system are installed. DO and residence time can be adjusted accordingly. More than 20 types of aquatic plants are tested, including water celery, aquatic water spinach, watercress, water chestnut, gorgon fruit, wild rice, canna, grass shrimp, etc. The results show that COD from the outflow of the test area is decreased to 40 mg/l, TP to 0.2 mg/l. Moreover, the testing area is green all year around with beautiful flowers and increased birds. The aquatic economic crops increased the income by 100,000 yuan per ha. Multiple harvests, 6-8 times a year, for water celery and water spinach increased the economic value, took out the nutrients, and stimulated the root system development and microbial food chain effect. The eutrophic material transformation ability from the roots is three times more than from the stem-leaf effect. The functions for nutrient reductions are similar for water celery and water spinach. The water celery is more effective in the winter season and harvests 20% more. But the water spinach grows faster in the summer. With the combination of difference vegetables in different seasons, an optimal result for eco-restoration can be reached. The experiment presented provides a good example not only for aquatic eco-restoration, but also for our on-going national campaign, the Construction of Beautiful Countryside. It is a good model for multi-dimensional water agriculture and eco-restoration. It is worthy of wide applications.

Key words: Aquatic Eco-Restoration, Multi-Dimensional Water Agriculture, Shallow Pond and Wetland, Aquatic Economic Crops

Disappeared Biodiversity Hotspots: Implications for Degraded Wetland Restoration

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Abstract: The majority of biodiversity conservation assessments are focusing on current biodiversity hotspots. However, the hotspots that have been transformed in less biodiversity-valuable land uses may have significant implications on wetland restoration because of the correlation between species diversity and restoration potential. This study evaluates the restoration potential of disappeared wetlands in the SanJiang Plain based on their restoration value and restorability. For this purpose, we explored a two-phrase method: first, we defined the biodiversity conservation value in disappeared wetland as restoration value, representing it via Irreplaceability (IRR), a main concept in systematic conservation planning (SCP). This was calculated in C-Plan conservation software based on potential distributions and quantitative conservation targets of wetland biodiversity features. Second, Restorability (RES) was modeled by land use, vegetation, soil, topography, and hydrology features to assess the possibility for restoration of disappeared wetlands. Our results revealed that the extent of current wetlands in the SanJiang Plain had been shrinking more than 40% over the last two decades, mostly due to the transformation of wetlands to farmlands and built-up areas. Approximately 30% of these areas had been rich in biodiversity in the past, representing high restoration value and 39% of the study area was in suitable topographic and hydrological conditions and featured favorable soil type, resulting in high restorability. Three scenarios were developed to compare effectiveness under different circumstances: (1) a restoration plan without constraints but with targets; (2) a restoration plan achieving all targets within the least area; (3) a restoration plan achieving all targets within the least area and the highest restorability. This case study proposes a system of prioritizing regional wetland restoration areas using restoration value and restorability as well as socio-economic constraints. The system can be used as guide for moderating competition between agricultural occupation and wetland restoration and can be incorporated into biodiversity conservation system.

Key words: Wetland Restoration, Historical Biodiversity Hotspot, Irreplaceability, Regional Planning

污水生态处理过程中人工湿地生物作用的研究

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Abstract:人工湿地是一种污水生物处理技术，湿地净化污水系统由于其高效、易管理和低运行费用等特点而被用于生活和工业污水处理。研究发现人工湿地对污水的净化是物理、化学及生物三重协同作用的结果，其中生物因素发挥了显著的作用。本文概述了人工湿地系统中植物和微生物在污水生态处理过程中的重要作用。人工湿地中植物是重要的功能单元，对污水净化主要为直接净化和间接净化。直接净化作用是湿地中水生植物能直接吸收利用污水中的营养物质，将废水中的氨氮合成蛋白质和有机氮作为生长过程中必不可少的物质，供其生长发育，再经收割植物从污水中去除污染物。此外，湿地水生植物还能吸附、富集一些有毒有害物质；湿地植物间接作用是指植物能将氧气输送到植物根区，为植物根区微生物生长、繁殖和降解过程中提供对氧的需求。同时湿地植物根系和根际分泌物也为不同的微生物吸附和代谢提供了合适的生长环境，也为人工湿地污水处理系统提供了足够的分解者。由于微生物对外界环境变化比较敏感，湿地微生物的种类和数量可以指示水环境的污染程度。微生物对污水污染物的降解经自身代谢活动来完成，将污水中有机污染物质降解成终极产物释放到大气中或固定于土壤、或成为湿地植物及微生物可以吸收的营养物质、或转化为对水环境无毒或弱毒的物质。水生植物与微生物之间存在着相互作用配合的关系，有效结合植物和微生物在恢复过程中的功能作用，为增强人工湿地净化的应用效能以及对水质改善和水生态系统恢复有着十分重要的意义。
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Key words:人工湿地,湿地植物,湿地微生物,污水净化

Effects of Hexavalent Chromium on Antioxidant System and Gene Expression in Marine Medaka (Oryzias Melastigma)

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Abstract: With acceleration of the industrialization and urbanization, wastewater from industry, agriculture and urban city is now posing direct threats to marine organisms and human health. Marine medaka (Oryzia melastigma) is a new promising experimental modle for marine ecotoxicology for being sensitive to the change of water and environment quality. In this study, we used the adult medaka's liver and junvenile medaka as models to explore the mechanism of marine fishes response to chromium induced oxidative stress and detoxification. Three-months adult marine medakas were exposed to hexavalent chromium at the concentration of 2.61mg/L, 5.22mg/L, 10.44mg/L, with exposure duration for 96 hours in seawater. We found the detoxifying system were activated in liver cells by testing glutathione S-transferase(GST) and NADPH P450 reductase enzymes activity. The GST activity increased with the rising hexavalent chromium concentration. The total antioxidant capacity increased after

exposure indicated the antioxidant defense system was activated. Real-time PCR results showed the key transcription factor Nrf2 of Keap1-Nrf2 system and the antioxidative enzyme gene Cu/Zn-sod, cat transcripts have no significant change, while expression level of gpx and gr were significantly down-regulated in liver. Lastly, we took advantage of RNA-Seq analysis technologies to search for Cr6+-sensitive genes and identified 20 differetially expressed genes. These results shed lights on molecular mechanisms of how marine organisms response to heavy metal exposure.
Key words: Hexavalent Chromium, Oryzias Melastigma, Antioxidant System

Ecophysiology and Nutrition Responses of Kandelia Obovata Seedlings to Sludge Discharged from Shrimp Pond

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Abstract: An outdoor pot experiment was conducted to study cumulative effects of sludge dredged from shrimp pond on ecophysiology and nutrition responses of Kandelia obovata seedlings. Four groups were set up with different kinds of substrates and finally formed 0 cm, 2 cm, 4 cm and 8 cm deep sludge over substrate surface. The experimental period was 224 days during which pigment content, photosynthetic characteristics, SOD activity, POD activity, CAT activity, MDA content, content, soluble protein content, soluble sugar content and root activity were determined. We also studied nutrient status of Kandelia obovata. Results were as follow, (1) For physiological indexes, sludge dredged from shrimp pond greatly improved pigment content and photosynthetic characteristics. SOD and POD activity showed a trend of rising first then falling, which was significantly lower in treatment 8 cm than those in treatment 4 cm, while CAT activity showed no significant differences. MDA content increased with treatment depth increasing. However, content of free proline, soluble protein, soluble sugar in leaves was lowest in treatment 4 cm. (2) In the aspect of nutrient status, Kandelia obovata leaves had higher N absorptivity, and roots had higher P absorptivity. Overall, proper amount of sludge dredged from shrimp pond was most suitable for physiological need and nutrient status. Sludge discharged up to 8cm sedimentation thickness in our experiment formed adversity stress to some extents.
Key words: Kandelia Obovata, Shrimp Pond Sludge, Physiology, Nutrient

Systematic Conservation Planning for Wetland in China: Identify Biodiversity Conservation Gap.

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Abstract: Various types of freshwater wetlands provide habitat for animals and paly other ecosystem services in China. National conservation planning for wetlands in ten major water drainages should operate with approaches of systematic conservation planning in order to harmonize limited fund and ecosystem protection. Under framework of systematic conservation planning, we developed a comprehensive wetland types map incorporating climate factor and geomorphological factor as coarse-filter surrogates of biodiversity elements, and choose the distribution focal birds as fine-filter surrogates of biodiversity elements. Then we set quantitative goal of conservation area and used software MARXAN to identify a set of areas that, with adequate protection and/ or management, might maintain the aquatic biodiversity and ecological processes representative of the ten basins. Accepting the existing reserve system as part of the plan, we found conservation gap in wetlands at national level by optimal conservation map. Then we compare optimal effect between ten basins and analyze the conservation gap pattern. The protection area of wetland is increased by 21256.54 km^2 (54.36%) in optimal conservation map comparing existing reserve map. The percentage of conservation gap of coastal wetlands is the largest while lacustrine wetlands is the minimum. Different types of wetlands distributed within ten basins have different proportion of conservation gap. The result can provide some advice for wetland conservation strategies, also can be used for further fine scale and more detailed conservation planning.

Key words: Freshwater Wetlands, Systematic Conservation Planning, Conservation Priority, Marxan

How Distribution Pattern of Soil Microbial Community Structure Driven by Water Table Gradients Lead to Different Decomposition Levels in a Shallow Floodplain Lake Wetland?

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Abstract: Wetlands decomposition may be altered by water table resulted of the hydrology regime and microtopography. The microbial community is the main mediator connecting the environmental variables and decomposition process. But how

microbial community distribution pattern is affected by water table and then influence the decomposition process is largely unknown. We performed a field decomposition experiment in a shallow lake beach of Poyang Lake wetland to explore how soil microbial community distribution pattern and soil physiochemical properties induced by water table individually and interactively affect decomposition processes. With the raising of water table gradients, abundances of total PLFAs, bacterial, and actinomyces were significantly promoted as well as activities of cellulase and ligninase. And the heterogeneity of soil microbial community distribution pattern was primarily caused by the variance of soil pH and soil texture. Soil pH changed from 4.62 to 5.05 from the lowest water table gradient（GT-A）to the highest (GT-D). And the clay and silt particle contents were declined by 4.58 -7.05% and 31.19 -34.57%, while sand content was enhanced by 117.73%-328.49%. Transformation of both soil physiochemical properties and soil microbial community composition driven by water table alternation contributed greatly to the variance of early decomposition process simulated in this study. Relatively high water table lead the remaining proportion of initial cellulose and lignin content declined by 20.84% and 27.21% after 30 days' field incubation experiment from GT-A to GT-D. Besides total PLFAs, bacterial and actinomycetes had positive effect on the decomposition processes. The variation partitioning analysis(VPA) presented results that decomposition level reflected by the remaining proportion of cellulose and lignin as well as total carbon and total nitrogen was closely related to the variance of soil chemical properties (72.03%), soil microbial community distribution pattern (52.60%) and the interaction between them (27.72%). In summary, our study indicates that the dry -wet alternative environment actually promoted the wetland decomposition process by the alternation of microbial community distribution pattern induced by soil pH and texture.

Key words: Water Table Gradient, Soil Microbial Community, Decomposition Process, Poyang Lake Wetland

Effects of Typical Land-Use Change on Soil Quality in Hainan Province

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Abstract: The demand for agricultural production and industrial materials had led to large-scale changes in the tropical land, the transformation of tropical natural forests in plantations were typical type of land conversion. In order to clarify the impact of tropical land use change on soil quality, an investigation was conducted on the effects

of four typical land use, i.e., primitive forest (VF), secondary forest (SF), pure rubber forest (RF) and rubber intercropping Alpinia oxyphylla forest (PF). The results showed that : 1) The conversion of the primitive forest into secondary forest or pure rubber forest reduced the total soil porosity, soil organic carbon, total nitrogen, available nitrogen and available phosphorus，however, soil available potassium content was significantly increased. Compared to pure rubber forest, rubber intercropping Alpinia oxyphylla forest significantly increased soil available phosphorus, but reduced soil available potassium. 2) The forest quality index of the primitive forest was 1.67, 1.84 and 2.16 times higher than that of secondary forest, pure rubber forest and rubber intercropping Alpinia oxyphylla forest, respectively. There was no significant difference between the two rubber forests. 3) Related analysis showed that litter fall and soil bulk density were significantly correlated with soil quality index, indicating that the reduction of litter fall may be an important reason for the decline in soil quality of tropical land-use change, in addition, the increase in soil compaction caused by the artificial disturbance may be another key factor. The results of this study revealed that conversion of tropical primitive forest to secondary forest or rubber forest has significantly changed the soil properties and soil quality. For agricultural production and land use management, the effective management of litter and interference activity are conducive to improving soil quality.

Key words: Land Use Change, Soil Quality Index, Soil Degradation, Interference Activity

THEME 11

Paleoecology, Ecological Dynamics and Environmental Assessment

T11-01: Wildfire Ecology and Life Evolution: From Ancient Time to Present

Pyrodiversity Can Maintain Biodiversity by Moderating Fire-Driven Fluctuations in Habitat Availability

Brett P Murphy

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Abstract: The idea that pyrodiversity begets biodiversity has shaped fire management in many fire-prone landscapes, most broadly encapsulated by the patch mosaic burning (PMB) paradigm. Under this paradigm, managers aim to reduce the grain-size of the fire mosaic, in the belief that a fine-grained, patchy mosaic is more conducive to the maintenance of biodiversity. The pyrodiversity–biodiversity concept is intuitively appealing, but has proven very difficult to demonstrate empirically, such that many researchers now argue that pyrodiversity itself does little to maintain biodiversity. However, using a case study of the semi-arid mallee region of southeastern Australia, I will demonstrate that a widely overlooked aspect of fine-grained fire mosaics is that they buffer the landscape against fire-driven reductions in habitat availability. These occur when large fires destroy large expanses of long-unburnt habitat, upon which many species may depend. This effect is most pronounced when the management objective is to maintain the persistence of species within discrete reserves, and becomes pronounced as reserve size decreases. My findings stand in contrast to numerous recent papers from this region, which have argued that a fine-grained mosaic is unnecessary. I argue that a narrow conceptualisation of pyrodiversity by some researchers has led to key outcomes of pyrodiversity (namely moderation of fire-driven fluctuations in habitat availability) to be overlooked.

Key words: Biodiversity, Fire Management, Fire Mosaics, Pyrodiversity

Fire-Adapted Traits Evolved Worldwide over the Last 100 Million Years

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Abstract: Using dated molecular phylogenies and trait-assignment techniques for such major families as Orchidaceae, Pinaceae, Proteaceae, Fabaceae, Myrtaceae, Restionaceae, Asphodelaceae and Droseraceae, we show that 1) fire-stimulated

resprouting, flowering, seed release and germination may be traced to at least 90+ million years ago (Ma); 2) fire-proneness preceded, or rarely coincided with, the appearance of fire-related traits and their continuous association with fire-prone habitats confirms that they are fire adaptations; 3) currently expressed adaptations to drought, frost and non-fire-prone habitats came later; 4) the pre-65 Ma-period was marked by the slow evolution of fire-adapted lineages with novel fire-related traits, whereas the post-65 Ma-period was marked by a further increase in the evolution of lineages with novel fire-related traits and an even greater increase in lineages with conserved fire-related traits; 5) the advent of mediterranean climates, 20-10 Ma, throughout the world appears to have further promoted the initiation of fire-adapted lineages; and 6) once adapted to fire, other constraints, such as drought, pollinators and herbivores, have been able to trigger further evolutionary events.

Key words: Fire, Adaptation, Mediterranean Climate, Cretaceous

Restricted Dispersal Determines Fine-Scale Spatial Genetic Structure of Group-Living Rodents

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Abstract: Restricted gene flow may cause positive spatial genetic autocorrelation of animal populations at fine spatial scales. The Mongolian Gerbil (Meriones unguiculatus) is a territorial, social rodent. Territoriality may create social fences to restrict dispersal or gene flow of Mongolian gerbils to a short distance. Restricted dispersal may differentiate fine-scale spatial genetic structure of populations with increasing distances (i.e., isolation by distance). Competition for mates and inbreeding avoidance may result in equal dispersal propensity and subsequently similar spatial genetic autocorrelation between the males and females of monogamous gerbils. We genotyped 327 gerbils, captured from 26 burrow systems on a 9-ha plot in northcentral Inner Mongolia of China using seven microsatellite loci. Spatial genetic autocorrelation was positive within 80 m and became negative from 80 m to 200 m, suggesting restricted gene flow. Inter-individual genetic and geographic distances were related positively, supporting the isolation by distance model. Live trapping data demonstrated equal dispersal propensities of male and female gerbils. However, male gerbils dispersed longer distances than females. Sexual differences in dispersal distance altered the spatial scales of positive spatial autocorrelation between male and female gerbils. Restricted dispersal and social organization may determine fine-scale spatial population genetic structure of social rodents.

Key words: Dispersal, Isolation by Distance, Social Rodents, Spatial Genetic

Autocorrelation

Wildfire Alters Available Soil Nutrient Composition and Stoichiometry in a Chinese Boreal Larch Forest

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Abstract: Studies of wildfire effects on soil nutrient cycling in boreal forest ecosystems are largely limited to nutrient pool and availability. However, little is known about its impacts on soil nutrient composition and stoichiometry, especially in Eurasian boreal ecosystems where wildfire is a dominant disturbance. In this study, we measured the availability and composition of 11 soil nutrient elements (nitrogen / phosphorus / potassium / calcium / magnesium /sulphur / iron / manganese / zinic / aluminium / boron), and their stoichiometric ratios in unburned control and burned sites dating 1-year-post-burn and 11-year-post-burn respectively in a Chinese boreal larch (Larix gmelinii) forest. Our results showed the greatest changes in soil available nutrient stoichiometry and composition occurred in the 1-year-post-burn site. Wildfire caused about 100% increments in soil available N:K, N:S, P:K, P:S and S:K ratios, but exerted no immediate effects on soil availabile N:P ratio, although both N and P availability showed a large increase after fire. Wildfire effects on soil available N:K, P:S and S:K ratios were significantly related to fire severity. Our detrended correspondence analysis showed that there were relatively higher abundance of element P, S, Fe, and Al, and lower abundance of element Ca, Mg, and K at the 1-year-post-burn site. In the 11-year-post-burn site, most soil nutrient stoichiometry returned to the unburned level. However, soil availabile N:P ratio became significantly higher. Our results reveal that the responses of soil nutrients and their stoichiometry to wildfire are different in direction, and often more sensitive in individual element than in their stoichiometric ratios. The soil nutrient composition at the 1-year-post-burn site was strongly correlated with fire severity, while at the 11-year-post-burn site it was correlated with environmental variables such as elevation.This study suggests that variations in fire disturbance characteristics (e.g., fire severity) are important drivers affecting soil nutrients at the short term, but environmental factors (e.g., topography) would ultimately exert stronger influences in determining soil nutrient status.

Key words: Fire Severity, Nutrient Cycle, Stoichiometry, Eurasian Boreal Forest

Fire Response to Climate Change in Chinese Boreal Forest and Its Cascading Effects on Tree Recruitment, Succession, and Landscape Dynamics

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Abstract: Boreal forests in Northeast China store 1.0-1.5 Pg C and contribute to approximately 30% of the total carbon storage in China. This region is also fire prone, with an estimated historical mean fire return interval of 30-120 years. Fire can greatly affect forest landscape structure and vice versa. It is therefore important for us to understand how climate change would affect fire regime and its cascading effects on forest succession and landscape dynamics. In this study, we examined influences of various drivers (biotic, abiotic, and human factors) and projected climate change effects on the distribution of fire occurrence using detailed fire ignition data and a novel statistical method (spatial point pattern analysis). We also used a boost regression tree (BRT) method to quantify how fire severity, interacting with site conditions and pre-fire vegetation, affected post-fire forest succession pathways. Our results showed that both current and future projected spatial distribution of fire occurrence density were strongly related to human activities, with proximity to settlements and roads and road density found to be the most important influencing factors. Compared to the current fire occurrence density (median value: 0.36 fires per 1000 km^2 per year), the median fire occurrence density was projected to increase by 30% under the CGCM3 B1 scenario and by 230% under HadCM3 A2 scenario in 2100. Our BRT analysis showed that higher fire severity generally decreased the seedling densities of both coniferous and broadleaved trees, but increased the proportion of coniferous tree seedlings. Further landscape succession and disturbance simulations suggested that the broadleaf tree species could gain its total coverage by 50% at the end of 21st century in response to the increase of fire activities induced by climate change in this region.

Key words: Fire Ecology, Boreal Forest, Landscape Dynamics, Succession

The Pivotal Role of Ancient Fires in Evolution of the Earth's Terrestrial Flora

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Abstract: Fire became a defining feature of Earth’s processes as soon as land plants evolved 420 million years ago and has played a significant role shaping the composition and physiognomy of many ecosystems ever since. The importance of fire

as a natural selection agent is gaining increased attention while it remains poorly understood. There also remains a general lack of appreciation of the roles of fire in the origin, evolution, ecology and conservation of the Earth's biodiversity. We review the literature on the presence of fire throughout the Earth's history following the evolution of land plants and examine the evidence for the origin and evolution of adaptive functional traits, biomes, and major plant groups in relation to fire. The results are: 1) fire activities fluctuated throughout geological time due to variations in climate, and more importantly in atmospheric oxygen, as these affected fuel levels and flammability (Figure 1); 2) fire promoted the early evolution and spread of the two major terrestrial plant groups – both gymnosperm and angiosperm (Figure 1); 3) fire is a key ecological process in major global biomes and has played a major role in the composition and physiognomy of many ecosystems, and shaped the structure and function of major global biomes; 4) fire has initiated and maintained the evolution of a suit of fire-adaptive functional traits since the evolution of land plants. We conclude that fire has been a fundamental agent of natural selection on terrestrial plants throughout the history of life on the Earth's land surface. We suggest that a paradigm shift is required to re-assess ecological and evolutionary theories that exclude a role for fire, and also the need to review fire-suppression policies on ecosystem management and biodiversity conservation in global fire-prone regions. Future research requires 1) comparative experiments to demonstrate the superior fitness of a particular functional trait in the presence of fire compared with other possible determining factors such as drought or infertile soil; 2) modeling how changing climates (temperature, seasonality, rainfall) and atmospheric gas levels trigger changes in fire regimes, and how these in turn trigger adaptive responses of fire-related traits, and the resultant changes in vegetation structure and function; 3) focusing on the mechanisms of the morphological, physiological and genetic transitions that enable the evolutionary switch between alternative states of fire-related traits that can be scaled up to a switch between one type of fire regime to another.

Key words: Angiosperm, Fossil Charcoal, Palaeo-Atmospheric Oxygen, Terrestrial Flora

Relative Influence of Environment Filtering and Seed Availability on Post-Fire Vegetation Recovery in a Boreal Larch Forest

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Abstract: Wildfire is one of the most important natural disturbances in boreal forests, and the rate of post-fire vegetation recovery influences carbon, water and energy

balances at various spatiotemporal scales. Seed availability and environmental filtering (e.g., topographic position, climate condition) are two major determinants on post-fire forest regeneration and recovery rate in boreal forests. Understanding the relative influence of these two determinants on post-fire recovery is of critical importance for predicting how forest ecosystem will respond to an intensified fire regime in boreal region. To this aim, we used time series of Normalized Difference Shortwave Infrared Index (NDSWIR) derived from Landsat images, and investigated how relative contribution of seed availability and environmental filtering varies with time-since-fire (TSF) and fire size in a Siberian boreal larch forest. Results showed that NDSWIR returned to pre-fire level after 10 years of burning. Seed availability, mainly controlled by fire severity, was the dominant control on initial vegetation reestablishment and recovery after fire, but its relative influence decreases as TSF increases. On the contrary, the influence of environmental filtering increases with TSF and mitigates the initial heterogeneity caused by wildfire disturbance. This suggested that the legacy effects of wildfire on vegetation would persist for decade, but the long-term succession is still controlled by environmental filtering. Analysis also showed that seed availability had stronger and longer controls on vegetation recovery with increasing fire severity and size. If future warming and intensified fire regimes manifest as expected, post-fire vegetation trajectory will be more determined by burned pattern, which may have a significant influence on forest resilience and ecosystem services in boreal region.

Key words: Fire Disturbance, Climate Change, Environmental Filtering, Seed Availability

Transcriptome Analysis of Two Radiated Cycas Species in South China Provided Some Insights to Diversifications of the Living Fossile Genus

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Abstract: Background: Cycas hainanensis and Cycas changjiangensis are endangered cycad species endemic to Hainan, China. Studies on gymnosperm's population genetics, phylogeny, evolution and speciation have been hindered by a lack of genetic resources. In this study, characterized the transcriptomes of two closely related cycas species: Cycas hainanensis and Cycas changjiangensis were characterized, and subsequent comparative genomic analysis provided some evolutionary insights in the cycad species.Results: We obtained 68,184 unigenes with N50 value of 996_bp for C.changjiangensis and 81,561 unigenes with N50 value of 983_bp for C. hainanensis. Among them, 35,512 (52%) and 36,390 (45%) unigenes for C. changjiangensis and C.

hainanensis were successfully annotated to the NCBI nonredundant protein (Nr) database respectively, and great similarityofGene Ontology (GO) classifications were observed between them. Based on 10,195 pairs of orthologs, we found that a low divergence between C. changjiangensis and C. hainanensis with a peak of synonymous substitution rate (Ks) distribution at 0.0062.Furthermore, six pairs of these orthologs were identified to be under positive selection with the non-synonymous to synonymous substitution ratio (Ka/Ks) significantly larger than 1. GO annotations of these positively selected genes was mainly involved in cellular and metabolic processes and stimulus responses, suggesting environmental adaptation may play an important role inthe divergences between the two cycad species. Conclusion: Overall, we generated substantial genomic resources and characterized the transcriptome of C. changjiangensis and C. hainanensis. Positively selected genes and gene duplication analysis provided some evolutionary insights into the diversification of cycas.
Key words: Cycas, Comparative Transcriptome, Positively Selected Genes, Gene Duplication

Species, Phylogenetic and Functional Diversity of Post-Fire Regenerations in a Forest Landscape Affected by Monsoon: The Determinants of Community Assembly

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Abstract: Post-fire forest regeneration follows a community assembly process driven by both deterministic and random processes, and can provide critical information for understanding forest responses to fire disturbance and post-fire environmental stresses. Yunnan pine forests are the most widespread conifer forest type in Southwest China, and are frequently threatened by fire disturbance. Post-fire regeneration of this forest type, however, has rarely been previously studied. In this study, we investigated the post-fire regeneration of sites burned 2, 3, 6, 12 and 30 years before, in a mountain landscape of mixed Yunnan pine forests in central Yunnan Province, China. We found very active post-fire regeneration in the burned area likely facilitated by ample post-fire rainfall in summer. Species composition of the post-fire regeneration was highly similar to the pre-fire community–the similarity between the pre- and post-fire communities was 0.530 ±0.222, while phylogenetic diversity and functional diversity of the post-fire community revealed variable temporal and spatial variations. Elevation, pre-fire community type, and slope position were the three primary factors in the variations in regeneration density and species composition, while the impact of fire severity was low. The regeneration density of Pinus species and evergreen broadleaf

species showed contrasting patterns across the environmental gradients, and the results implied that Yunnan forests are generally resilient to fire disturbance. The controlling impacts of the pre-fire community on post-fire regeneration are driven by the efficient regenerating strategies of dominant species, and are a comprehensive reflection of habitat conditions, which are primarily mediated by topographic features. Species regeneration strategies and the high resilience of the community to fire disturbance should be taken in account in fire prevention and management approaches for this forest type.

Key words: Post-Fire Forest Regeneration, Species Turnover, Phylogenetic and Functional Diversity, Community Assembly

Effects of Wildfire on Climate in the Boreal Forest Ecosystems

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Abstract: Climate warming is expected to increase wildfire activity in the boreal forest ecosystems. In return, wildfire affects climate though changes of carbon, water, and energy balance during vegetation recovery. The net climatic effect of these biogeochemical and biophysical changes varies at different spatiotemporal scales and species'fire-adaption strategies (e.g., "avoider" vs "embracer"). In North American boreal forests, previous studies have shown wildfire tends to cause a net positive radiative forcing (warming effect) immediately after fire due to pulse of carbon emission, but shift to a net negative radiative forcing (cooling effect) due to increase of albedo during vegetation recovery. However, it is still not clear how net radiative forcing will change during the postfire vegetation recovery in circumboreal forested region. In this analysis, we combined field measurement, ecosystem modeling, and remote sensing dataset to study the postfire change of net ecosystem production (NEP), albedo, evapotranspiration (ET), and assess their climatic effects under different burn severity within different forest types. Our analysis showed that reduced ET after wildfire has a positive effect on climate due to redistribution of heat flux. There is a reduction of latent heat flux and increase of Bowen ratio. As a result, net positive radiative forcing is stronger and lasts longer than only carbon emission and albedo were considered. The climatic effects of wildfire were strongest in high severity burned area of fire "embracer"-dominated forests. Our results suggested increased fire activities may have stronger positive effects than previous studies have suggested.

Key words: Boreal, Fire, Radiative Forcing, Forest

Slash Burning Stimulated Soil Heterotrophic Respiration but Only in a Short-Time in Subtropical Forest in South of China

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Abstract: Afforestation and reforestation have the potential to increase regional carbon sequestration and mitigate climate change if properly practiced. China has the largest land area in forest plantations on the globe, and most of tree plantations are located in south of China including the area of this study. In these regions, management of forest plantations often involves severe human disturbances such as clear cutting, slash burning and intense site preparation which destroys soil structure. In addition, frequent and intense rainfall and steep slopes are common in the region so that such severe disturbance often induces serious soil erosion and nutrient leaching in previous studies. Natural regeneration has been demonstrated an effective forest management to reduce soil organic carbon and nutrient loss, due to harvest residue covered on the surface soil and without further soil disturbance. However, an important but not well documented issue is the mineral soil decomposition in response to these two forest managements. In this study we examined soil heterotrophic respiration of harvest residue burning (RB) and harvest residue retention (RR) treatments in the first 3 years after tree planted in Fujian Sanming research station of forest ecosystem and global change. Both treatments had higher soil heterotrophic respiration rate in the first year than the next two years.RB had much higher soil heterotrophic respiration rate which accounted for 56% higher than in RR in the first 5 months, however, no significant differences of respiration rate were found between these two treatments after 5 months, though the 5 C higher soil temperature in RB than RR in the summer times. We conclude that the higher soil heterotrophic respiration in harvest residue burning treatments not only caused by higher soil temperature than natural regeneration, but burning also increased soil carbon availability by the expose of carbon that was protected inside of soil aggregates before burning, and enhanced soil nutrient availability after burning. All of these changes may stimulate microbial activity and increase mineral soil decomposition in the first 5 months. However, the high temperature in harvest residue burning may further accelerate recalcitrant soil organic carbon decomposition in the following time. Thus, harvest residue burning may raise both labile and recalcitrant organic carbon decomposition in subtropical forest.

Key words: Slash Burning, Harvest Residue Retention, Soil Heterotrophic Respiration, Subtropical Forest

T11-02: Historical Ecology and Climate Change

Ecological Processes of Alpine Treelines and Climate Change: An Integrative Understanding from Cell Structure to Ecosystem

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Abstract: On the SE Tibetan Plateau, there is the world's highest natural treeline and timberline, being potentially sensitive to climate change. However, it is little known about performance of nature timberline in response to climatic warming. Along altitudinal belts of Smith fir (Abies georgei var. smithii) forest on the SE Tibetan Plateau, microclimatic conditions, weekly formation and leaf phenology have been monitoring, and treeline dynamics have been reconstructed.

As observed, the mean annual temperature ranged from 0.2 to 0.8 ℃ and the mean air temperature for July at the treeline is (7.9±0.5 ℃). Based on observations from 2012 to 2014, Onset of bud swelling and leaf unfolding delayed by 17.7 ±0.6 and 18 ±0.9 days from the lowest (3800 m a.s.l.) to highest elevations (4360 or 4380 m a.s.l.), respectively. The frequency of freezing events and last freezing date were the critical factors in determining the timing of bud swelling along two altitudinal gradients, whereas onset of leaf unfolding was primarily controlled by degree-day sum. From needle unfolding to the end of needle elongation, it takes only four weeks at the upper treeline (4400 m) and 7 weeks around 3800 m. A shorter phenology period at high elevation may be a key factor in determining the upper treeline position. Cambial cell division occurs from the end of May to early August. Weekly wood formation responds to changes of the minimum air temperature.

Summer temperature reconstruction based on timberline tree rings showed a general warming tendency in the past 200 years. However, little is known about processes that control upward displacement of treelines in response to long-term warming, and whether alpine tree lines will respond quickly or not to climate warming occurring since the mid-1800s and accelerating today. Using data on undisturbed spruce and fir treeline plots located on the Tibetan Plateau between 28.4 and 38.5 ºN, we showed that climatic warming tended to promote an upward shift of alpine treelines at local and regional scales. However, upslope migration rates were controlled largely by interspecific interactions. The species interaction mechanism both helps to explain why many treelines have not advanced in response to climatic warming and highlights that predictions of treeline shifts based solely on climate may be misleading, because interspecific interactions can temper effects of climatic change. In addition, we dated the glacial movement by tree rings since the Little Ice age.

Based on stand age structure of the studied treeline plots in the TP, we found that tree recruitment increased by more than 50% across all sites in the 1950s and 1960s. Competition between adults and juveniles or seedlings at small scales intensified as density increased. Encroachment negatively affected height growth and further reduced recruitment around mature trees. Tree recruitment at the study treelines was more cold-limited prior to 1950 and shifted to a less temperature-constrained regime in response to climatic warming. Therefore, the ongoing densification and encroachment of alpine treelines could alter the way climate drives their transitions towards subalpine forests.

Key words: Treeline, Cambial Activity, Climate Change, Ecological Process

Permafrost Peatlands Dynamics during the Last Millennia in NE European Russia, Finnish Lapland and Western Canada

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Abstract: Permafrost peatlands cover vast areas in circum-Arctic regions. Since the 1980s, annual temperatures in these areas have risen by ca. 2 ℃ and warming is projected to continue. Accordingly, the large carbon store in these peatlands may therefore be threatened. Alternatively, warming may increase productivity more than decomposition and peat accumulation rates may increase. To better understand how high latitude permafrost peatlands have responded to recent warming and what might be their future fate, we carried out detailed studies of 15 active layer cores from two permafrost peatlands in NE European Russia, two in Finnish Lapland and one in western Canada. Our study methods included high-resolution testate amoeba, plant macrofossil, C/N analyses, LOI analysis, together with 210Pb and radiocarbon dating. We reconstructed changes in plant composition, hydrology, and peat and carbon accumulation rates. Our plant macrofossil and testate amoeba data suggest variations in vegetation and hydrological conditions during the last millennia. Interestingly shift to much drier plant compositions happened in all the sites at ca.1950 AD, i.e. recent warming has stimulated vegetation changes that are more marked and synchronous than those occurring for instance during the Medieval Climate Anomaly and Little Ice Age. Our preliminary results of peat and carbon accumulation rate calculation showed large variations in peat accumulation rates even within a very small area. Furthermore, a rise in long-term carbon accumulation rates was detected in most of the studied peat cores. In the future, we will apply a long-term decay model to calculate carbon accumulation rates in more detail and compare our regional data derived from different

peatlands to each other, to climate reconstructions and to measured meteorological data.

Key words: Peatland Vegetation, Hydrology, Peat Accumulation, Permafrost Peatlands

Genetic Diversity and Phylogeography of Daphnia Similoides Located in the Middle and Lower Reaches of the Yangtze River

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Abstract: Geographical pattern, climate, and environmental change have an important influence on the distribution and spread of organisms. The combination of different molecular markers can reveal more genetic diversity and phylogenetic rules of organisms. In this study, the genetic diversity and phylogenetic geography of seven populations of Daphnia similoides located in the middle and lower reaches of the Yangtze River were investigated based on the combination of mitochondrial and nuclear gene markers. The phylogenetic tree displayed a consistent topology based on three mitochondrial markers, thereby showing seven D. similoides populations that were from two different ancestors. Phylogenetic analysis based on microsatellite markers showed that seven D. similoides populations evolved in two branches. Among five populations distributed in the Yangtze River area, it can be clustered into three branches according to the geographical location. On the basis of three mitochondrial markers, nucleotide diversities (π) of D. similoides were 0.00626, 0.00119, and 0.00652, and haplotype diversities (Hd) were 0.788, 0.664, and 0.733, respectively. Fst among seven D. similoides populations ranged from 0.016 to 0.397 based on microsatellite markers. The results suggested that the combination of mitochondrial and nuclear markers can reveal more genetic diversity and genealogy of D. similoides compared with single mitochondrial marker or microsatellite marker. The D. similoides populations in the middle and lower reaches of the Yangtze River might experience a rapid growth period after the bottleneck effect, and the distribution of water systems and geographical isolation probably have important influences on the genetic differentiation of D. similoides.

Key words: Daphnia Similoides, Genetic Diversity, Molecular Marker, Phylogeography

Tracking Traces of Alien Plant Species (APS) in China

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Abstract: Alien plant species (APS) have caused substantial economic losses and ecological damage during rapid economic development and are responsible for increasing problems. Many studies have aimed to explain invasion mechanisms and the impact of individual APS, but fewer studies have systematically analyzed historical invasion processes at a nation-wide scale. In this study, we provided a newest list of APS, which includes the origins, introduction year and distributions as well as individualized information about historical APS introduction over the past 2,000 years. First, we found that 27% of the APS found in China are from South America, while 20% are from Europe, and 19% are from North America. Additionally, APS from different continents exhibit unique distribution patterns. Second, we found that 35.9% of APS were introduced between 1840 and 1949, when China was experiencing wars, and the social and natural environment changed greatly as a consequence. Finally, we found identified 9 main routes in the history of AP introduction S. We concluded that wars, human economic activities and social upheavals always result in APS invasion. We hope to provide useful information for the management and prediction of future APS introductions.

Key words: Alien Plant Species, Social Economy, Human Activities, Historical Introduction

World Ecological Modernization Since 1700

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Abstract: Humans have originated from nature, lived and developed in nature. It is by combining themselves with nature around them that humans can note their natural connection to the world, with which they pay close attention to the processes of change that affect the relationship between nature and themselves. Especially, world modernization has made significant influence on the natural environment since 1700s. Concerns about the environmental degradation and overconsumption caused by continuous population growth and societies' pursuit of indefinite economic growth make ecological modernization a strategic alternative for sustainable development. As an important aspect of modernization, ecological modernization represents a mutually beneficial coupling between modernization and the natural environment, and an

ecological transformation of world modernization. Although the ecological modernization has been put forward around 1980, the ecological effects of modernization have been in existence for about 300 years ever since the Industrial Revolution. Ecological modernization has gained increasing attention among scholars and policymakers during the last several decades internationally. While such ecological modernization theory emerged in some Western European countries such as Germany, the Netherlands and Britain in the 1980s, which is mainly based on the European experience and describes the European mode for pursuing development with economic effectiveness, social justice and environmental friendliness. The Second Modernization Theory proposed by Chinese scholar Chuanqi He is an integration and expansion of the classical modernization theory, post-modernization theory and other new modernization theories within a global civilization scope, which successfully solves the theoretical dilemma of classical modernization and post-modernization theories. The present article aims at analyzing world ecological modernization (1700—2015) according to the Second Modernization Theory, in order to find out the long term trends and world frontiers of ecological modernization.

Key words: Ecological Modernization, Second Modernization Theory, Quantative Analysis

Instability of the Spatial Patterns in Forest Resilience over the Tibetan Plateau

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Abstract: Rising temperatures are expected to increase the intensity and frequency of extreme droughts, which have substantial impacts on the resilience of forests. Lack of data about the properties of forest resilience to past extreme droughts limits the ability to model response of forests to future drought events. Here we use a large tree-ring database on the Tibetan Plateau to quantity the spatial patterns of forest resilience to three extreme droughts in the past. We hypothesize that the forest resilience is spatially instable through time. The trees that survived past extreme droughts provide an opportunity to examine the trajectory of tree growth responding the droughts, and are therefore suitable for testing the hypothesis. The tree-ring database consists of 1176 trees from 40 sampling sites locating between 27°27′ - 37°23′ north latitude on the Tibetan Plateau. The elevation of these sites ranges from 2600 to 4700 meters above sea level. The average age of the tree samples is 331 years. We calculated indices of forest resilience, resistance and recovery for each event of extreme droughts. We found that the spatial patterns of forest resilience change from one event to the other. Forests that

are most resistant to droughts have lower resilience, and vice versa. The trade-off between tree resistance and resilience is related to the age of trees. Our results suggest that the current spatial pattern of forest resilience may not be representative of the forest response to future extreme droughts. The age and the experience of forests to past droughts are important factors determining the spatial response of forests to droughts.
Key words: Extreme Droughts, Forest Resilience, Tree Ring, Tibetan Plateau

Tree Rings as Records of Changes in Air Quality and past Impact of Human Activities on Environmental Conditions

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Abstract: Air pollution is one of the most important problems related to industrialisation and is of major concern to societies for its effects on the environment and on human health. In the past two decades, the attention of science and society has been particularly focused on the effects of particulate pollution. In rapidly industrializing regions of the world, particulate pollution is a serious environmental problem that is influencing air quality and human health, along a similar trajectory to that previously experienced by currently developed nations.

Monitoring atmospheric pollution in industrial areas is essential to infer past levels of contamination and to evaluate the impact for environmental health and safety. However, the first stations measuring air pollutants were installed during the 1980s, and data currently available in most regions cover at best the past 30 years. We hypothesize that the chemical composition of tree-ring wood can be used for monitoring spatio-temporal variability of air pollutants and fine particles, to extend air quality data back in time.

Tree rings can be used as indicators of the environmental (not only climatic) conditions in which trees have been growing, e.g., to reconstruct the impact of air pollution, because their chemical and physical characteristics depend on the environmental conditions in which they grew. The concentration of chemical elements in tree rings has been studied using a combination of dendrochronological and chemical methods, i.e., dendrochemistry, for example, for tracing changes in nutrient availability in declining forests. However, uncertainty surrounds the use of dendrochemistry to monitor air

pollution impacts and its temporal resolution scale. While some encouraging results have been reported in acidification studies, the actual suitability of dendrochemistry to provide unbiased evidence of the impacts of trace metal pollution has been questioned, although it seems that many of the problems can be overcome by appropriate investigation designs. Moreover, the effect of particulate pollution on plants is still largely unknown and in trees almost unexplored.

We analysed tree rings formed in different years and close to different pollution sources, using standard dendrochronological methods, tree-ring stable isotopic (13C, 18O, 15N) analyses, radiocarbon analyses (14C), chemical analysis using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), and computer-tomography imaging and chemical microanalysis at the synchrotron. We found changes in the chemical composition of tree-ring wood related to changes in air quality and air pollution episodes and trends.

In this talk, we will give a short review of relevant dendrochemical studies, suggesting possible reasons why many have failed to provide annual-resolution information. We will use case studies close to an asbestos factory, a steel factory and Mount Etna, an active stratovolcano in Italy, to show that changes in the chemical composition of tree-ring wood, measured using high-resolution LA-ICP-MS, enabled us to reconstruct past air pollution episodes and trends. Moreover, we will provide evidence that nanoparticles deposited on tree leaves are taken up through stomata and transported through the phloem in the xylem of trees.

Key words: Dendrochronology, Air Pollution, Tree Rings, Particulate Matter

Monitoring the Climate Change and Its Impact on Mangrove Distribution over Sundarban Region of India

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Abstract: The largest natural low-lying mangrove ecosystem in the world is situated in the Sundarban delta region, which is situated on the bank of river Ganges in between the India and Bangladesh with a spatial coverage of around 9,600 square km. For its large coastal mangrove eco-system this area is very much suitable for the living habitat of forest dependent livelihoods. In this study we have emphasized the impact of climate change (both natural and anthropogenic scenario) on the mangrove over the Sundarban region by considering multi-source (satellite and real observation) climate parameters and the mangrove coverage from available sources and developing the climate-mangrove interactive relationship by finding out its trend value and Pearson correlation coefficient. It is being observed that the mangrove coverage shows a

decrease trend in the present decade compared to past because of climate change i.e. increase in Temperatures, coastal storms, rise in sea level, high humidity and poor rainfall (particularly in the monsoon period) etc. This analysis shows that due to climate change the mean sea level rise, increase in temperature and low rainfall along east coast of India resulting reduction in mangrove population. This study will help the researchers to understand the climate change and its impact on the coastal biodiversity particularly on mangrove ecosystem.

Key words: Mangrove Ecosystem, Sundarban, Wetlands, Climate Change

Ecosystems and Climate Change in British Columbia, Canada over 60000 Years

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Abstract: British Columbia's complex topography, climates and ecosystems offer an excellent opportunity to investigate the relationship between climate change and ecosystem responses. Several climatic changes have caused dramatic ecosystem responses. Today repeated climatic gradients support diverse vegetation types over short geographic distances. Mild and rainy coastal climates nurture the most extensive temperate conifer rainforests in the world. Arid grassland and scrub and dry conifer forests occupy southern rain shadow climates and are replaced eastward by damp conifer forests related to coastal ecosystems. Northward, increasing cold and continental climate inland of the coast supports conifer forest with progressively increasing boreal character. With higher elevations at all latitudes damp moist conifer forests of spruce, pine and fir replace lowland ecosystems and grade in diverse parkland and alpine herbaceous vegetation.Cool climates before 60,000 years ago supported subalpine conifer forests on the outer coast. Not far inland alpine vegetation occurred. Warming after 60,000 years ago led to a succession of ecosystems similar to that after the last glacial maximum, beginning with pine forest/parkland under cool dry climates followed by mixed conifer forest of spruce, western hemlock and mountain hemlock under cool moist conditions. Later wide-ranging spruce forests with sedge wetlands occurred west and east of the coastal mountains under cool and very moist climates. Widespread northern hemisphere cooling about 31,000 years ago brought on tundra of grasses and herbs and lowering of the tree line to sea-level. Following the global glacial maximum, conifer forests and parkland occurred for several thousand years possibly during the time of maximum ice extent in BC which was out of phase with other regions of the world.Recovery following glaciation included a repeat of the sequence of pine forest and parkland and mixed conifer forest on the coast. Inland of

the coastal mountains in the rain shadow, widespread grassland and Artemisia vegetation occurred at high elevation and spread to lowlands. Younger Dryas cooling was reflected by alder thickets along the coast until sharp northern hemisphere warming at 11,700 years ago. In southern British Columbia Holocene warming supported extensive steppe ecosystems and dry forests. These were gradually replaced by moister conifer forests throughout the region with modern ecosystems arising in some places in the late early Holocene and in other places in the late mid Holocene at the same time as human land management began to affect the landscape especially by the use of fire.The ecosystem-climate interactions of the Late Pleistocene demonstrate both rapid and gradual climate and ecosystems changes and steeping and relaxing of climatic gradients. In light of the past responses of ecosystems to climate change, there will be widespread unprecedented geographic shifts and reorganization of ecosystems as the climate warms during this century.

Key words: Pollen, Stratigraphy, Climate Change, Late Pleistocene, Forests, Steppe, Canada

Environmental Geography and Dynastic Cycles of Ancient China

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Abstract: History of ancient China is characterized by cyclic rise and fall of dynasties as opposed to more steady transitions in the history of ancient Europe. This study is to provide an explanation for such divergence on the basis of difference in the environmental geography and resultant land systems between ancient China and ancient Europe. Located on the east end of the Eurasian continent, the land of China is subject to much more frequent and severe climate disturbances, such as hurricanes, floods, and droughts. China is also in closer proximity to the great steppe, which made it more vulnerable to nomadic invasions. To effectively face such challenges it would require large scale human cooperation led by a strong centralized political power. This condition may have led China to becoming an agrarian society of small independent land-holding farming governed by a centralized bureaucratic system. Such form of economic and political system could serve to maximize human population carrying capacity and tax revenue, as well as to maintain an unrivaled central political power. Historically imperial rulers of most dynasties were committed to establishing and maintaining a good level of land equalization and to discourage land concentration, especially at the time when a new dynasty was established, which typically led to quick population growth. However, under private land ownership during most stages of ancient China, land concentration would inevitably evolve as a natural consequence of population growth, unequal capabilities, and unequal opportunities among people, as

well as stochastic natural and economic disturbances. Land concentration would then lead to increasing inequality in surplus sharing, which would in turn result in an increasing proportion of people displaced from farmland and, consequently, a decreasing human carrying capacity, which could eventually lead to political instability and even collapse of the dynasty. Such cyclic transition from land equalization at the beginning of each dynasty to land concentration at the end of the dynasty underlies the cyclic rise and fall of dynasties. A mathematical model is developed where land equalization and concentration is used as a variable driving change in human carrying capacity and, subsequently, dynamics of proportions of independent farmers and people displace from land.

Key words: Environmental Geography, Dynastic Cycles, Land System, Carrying Capacity

T11-03: Eco-cultural Solution of Global Island Issues

Conflicts in Conservation and Regeneration of Korean Fir Forests Disturbed by Roe Deer on Mt. Hallasan, Jeju Island, Korea

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Abstract: Korean fir (Abies koreana), an endemic tree species growing on higher altitude of Mt. Hallasan National Park, Jeju Island, confronts with the threats of decline from two ecological phenomena; the dieback of the old trees and the disturbed regeneration of the young trees (seedlings). As the evidences for the regeneration of seedlings of Korean fir being disturbed by roe deer are accumulating, the prevention of the grazing of the seedlings by roe deer is one of the key factors in the conservation and the restoration of Korean fir forest in a long-term basis. Conflicts in the restoration of the Korean fir forest through natural regeneration and the conservation of roe deer on the island which has been protected since 1980s are the dilemma in the management of the nature and the forest of the UNESCO Biosphere Reserve on the island. In the presentation, ecological models for the sustainable management and for the promotion of the natural regeneration of the Korean fir forests are suggested based upon the different scenarios on the management of the forests. Ecological solutions are discussed in addressing the eco-cultural conflicts in the conservation and the regeneration of Korean fir forests disturbed by roe deer on Mt. Hallasan, Jeju Island, Korea.

Key words: Eco-Cultural Conflicts, Disturbed Regeneration, Korean Fir Seedlings, Grazing by Roe Deer

Hydrological Disaster Risk Assessment on Climate Change in Arid Region

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Abstract: Due to the influence of global climate change and human activities, natural disaster especially on hydrological disasters, in urban area is becoming more and more serious. So the research mainly study hydrological disaster risk assessment in arid region based on the traditional mathematics probability theory, system theory, fuzzy mathematics theory, by means of quantitative research, analysis technology and method as the means such as principle companent analysis, fuzzy mathematics, AHP method,

GA-PP model and Monte Carlo method. This study discussed the type, composition and characteristic of hydrological disaster based on systematic analysis of the structure of arid region system. We analyzed the composition and characteristics of hydrological disaster risk system from disaster factor hazard, hazard-bearing bodies vulnerability, exposure and disaster formative environments, and proposed the method and technological process of risk assessment of hydrological disaster risk assessment in arid region. After further investigating the the hydrological disasters and disaster risk formation mechanism, we construct the risk assessment theory frame, index system, method and the model, and we calculate the risk rank and draw the corresponding risk figure by means of GIS. This study provides the general procedure and calculation method of systematic analysis and decision, and it can be seen from the model calculation conditions that it is universally applicable for sorting and assessment problems in arid region. The results can also enrich and develop our hydrological disaster risk management theory basis and method system, and has very important scientific value and realistic meaning on building better security protection system to achieve hydrological disaster prevention, mitigation and disaster management as well as socio-economic stability and sustainable development in the arid region.
Key words: Arid Area, Risk Assessment, Hydrological Disasters, Climate Change

Vegetation Zonation along Altitudinal Gradient on Mount Tabunan Forest Landscape, Cebu Island, Philippines

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Abstract: Vegetation distribution along altitudinal gradient on Mount Tabunan was done to determine ecosystem structure and dynamics. Quadrats were established at various elevations and a total of 288 taxa were recorded representing 133 genera and 68 families. Cluster and ordination analysis revealed four vegetation zones along the altitudinal gradient: Zone 1: Ficus – Ophiorrhiza Zone (514 masl), Zone 2: Artocarpus Zone (580 masl), Zone 3: Shorea – Homalomena Zone (650 – 653 masl), and Zone 4: Artocarpus – Pometia – Elatostema Zone (655 – 675 masl). Regression analysis revealed that micro-terrain, temperature and soil attributes dictated the vegetation zonation. Surprisingly, some lowland dominants (Artocarpus) were observed to encroach and dominate in higher elevations which is the case on Mount Pulag, Mount Akiki, Mount Mayon and Mount Makiling, all from Luzon Island, Philippines as well. Evident anthropogenic disturbances should be minimized or totally stopped in order to protect and conserve Mount Tabunan with its indigenous and endemic biodiversity. Biodiversity education, ecological valuation, local community zoning, establishment of

biodiversity corridor and strict law enforcement are among the proposed sustainability measures.

Key words: Altitudinal Vegetation Zones, Biodiversity Hotspot, Mount Tabunan, Cebu Island

Discussion of Differences in Sun-dried Salt Field and Eco-cultural Resources Utilization in Jeungdo and Shineuido, Shinan County, Republic of Korea

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Korea

Abstract: The purpose of this study is to discuss the differences in the sun-dried salt industry, the utilization of surrounding landscape, and ecoculture resources for the two representative areas of Shinan county. Shinan county has huge tidal flat areas which shows salt filed landscapes and it is based on reclamation of tidal flat areas. Especially, among them, Jeungdo there is the largest single company of sun-dried salt production. Shineuido is engaged in the work related to the salt production about half of the total population of the area. Therefore, these two area show the important role in Shinan county for sun-dried salt production. In addition, the islands were divided in several parts and these areas was reclamation therefore, these two islands chosen for study areas. After the conversion of the items from mineral to food, active production activities such as reused the closed salt field through various supports are being carried out. In this reality, many people are trying to enjoy ecotourism such as UNESCO Biosphere Reserve, Ramsar Wetlands, and Slow City, which are making various attempts to increase the added value of sun-dried salt and utilize the landscape around the sea and the ecocultural resources of the island. On the other hand, Shineuido is very vulnerable to external factors because the production of sun dried slat is the main income and income diversification is not done. In addition, it is difficult to diversify income by attracting visitors due to lack of various infrastructure. In this context, it is concluded that diverse attempts should be made to utilize more active local ecocultural resources and draw out excellent resources based on the success stroies of Jeungdo.

Key words: Island, Eco-Cultural Resources, Tidal Flat

How Do We Acknowledge Indigenous Knowledge and Practice in 21st Century Concerns?

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Abstract: The recent 2016 IUCN Congress in Honolulu, Hawaii, highlighted the inextricable linkages between language, culture and nature, and the threats that indigenous peoples face in a changing world. Both global and local threats impact on biocultural knowledge systems. For example, climate change is a major threat globally, yet relatively little research examines how biocultural systems will be affected by climate change. Using two New Zealand plant species that have high cultural value to the indigenous Maori people - a wetland sedge used for weaving that has a wide distribution, but distinct regional value; and a regionally distributed, but widely valued medicinal plant, we created climate change models with an integrated cultural context that show how harvesting practices will likely be impacted by projected future species ranges. In a second example, we show how mismatches between harvesting and species status, consolidated in national frameworks, can result in barriers to cultural practice, as can a lack of incorporation of indigenous values and practices in ecological restoration projects. Collaborative management strategies between scientists, government agencies and practitioners, can strengthen biocultural resilience by applying scientific tools to create evidence-based decision making. These actions should improve biocultural assessments, and help mitigate global impacts on biocultural knowledge systems.
Key words: Ecological Restoration, IUCN, Indigenous Peoples

Community Led Conservation and Restoration of Biodiversity on Private Land, Hoteo Catchment, New Zealand

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Abstract: New Zealand's most threatened lowland ecosystems and species lie primarily on private land. The social, cultural, economic and ecological successes and challenges of community led conservation work are discussed. An example of an initiative led by farmers in the Hoteo Catchment to protect indigenous biodiversity on private land is discussed. Landowners lead this model for protection of biodiversity on private land for landowners, and work with the indigenous community (iwi) and a variety of agencies for support. The value of this approach and working strategically at the grass roots is discussed. The aim is to develop an ecological corridor of biodiversity protection and restoration (predator control) in the Hoteo, from the east coast to the west coast of the North Island of New Zealand, within a sustainable farming landscape. Innovative methods are being used including crowd funding, rural networks and workshops and working with local schools. Key factors include being flexible,

community led, responsive to local needs, maintaining trust with the local community and iwi, monitoring outcomes, and ensuring funding goes to ‘on the ground work’.
Key words: Community Conservation, Private Land, Island Ecological Corridor

Biocultural Diversity in Island Landscape Ecology

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Abstract: Island study is the emerging global issue in climate change and biodiversity. Moreover, island has diverse unique cultural legacy but they also diminished according to urbanization and socio-economic development.
Bioculture is formed, developed and changed through the space of landscape (Hong et al. 2014). Landscape diversity, which creates both biodiversity and cultural diversity, addresses the space of human survival that is closely linked to traditional life based on natural resources. Areas such as important protected areas and sanctuaries that are emerging all over the world are where wisdom about use of biological resource is reflected in the regime of culture in human's old history. Today's concept of diversity of life includes not only existing biodiversity but also cultural diversity such as awareness, value and wisdom of nature (see UNESCO Declaration on Cultural Diversity). Research on biocultural diversity is beyond the scope of a specific field of study, and interdisciplinary research is urgently needed. When viewing a topic of adaptation for humans and nature, the ecological imagination and the humanistic imagination are like the two sides of a coin that can be gathered in one keyword 'human being'. Although interest in the island is growing, there is a lack of in-depth research on the island's identity and environment. Convergence research is needed to integrate research results on previous research and accumulated facts and interpretations in various fields.
Key words: Island Ecosystem, Biocultural Diversity, Global Issue, Sustainable Development Goals

Commitment of Ecologists on the Island Environmental Policy in a Case of Yakushima Island, a World Heritage Site, Japan

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Primate Research Institute, Japan

Abstract: Yakushima Island was designated in UNESCO World Natural Heritage List in 1993. There had been a long controversy of conservation of the forest or logging timbers over several decades among conservationists, Kagoshima Prefecture, two

towns of Yakushima (Yaku Town and Kami-yaku Town), Japanese Agency of Environment which was in charge of National Park that accounts 42 % area of the island, and Japanese Agency of Forestry which owns over 80 % area of the island. Lacking of proper platforms to discuss numerous issues concerning to the conservation and sustainable development of the island, we established newly "The Society of Yakushimaology" in 2013. The ideas which characterizes the society as an academic one are as follow: 1) the society should be based on academic achievements that have accumulated and are accumulating in the island by professionals as well as non-professional knowledge producers; 2) the society is not to obtain the conclusive answer for the controversial issues, but to share information and to discuss deeply about them among stakeholders; and 3) everyone joins the society based on an individual aspiration, not as a representative of any sector, and everyone should be treated equally at the meeting. Up to now, there are 105 registered supporters: 53 are Yakushima residents and other 52 are non-residents. As an example of local knowledge-based adaptive governance, the Society provides a platform in a proactive way organized by a set of knowledge produces, knowledge translators and knowledge users with many different disciplines to give out some options for different kinds of environmental problems in the island. The Society can organize a conference for considering on a particular issue to find out a solution. Also, the Society can send a proper specialist to knowledge uses when the direction of the solution is agreed. Several issues at a deadlock have mobilized by an aid of the Society. In this paper, I present a role of this highly localized academic society which produces and uses the combination of local and scientific knowledge toward an adaptive change of the island.

Key words: Local Governance, Consensus Building, Globally Universal Values, Stakeholder

THEME 12

Agroecology, sustainable agriculture and rural development

T12-01: Ecological Agriculture and Forestry: Environmental Sustainability, Food Safety and Increased Productivity

Agroecological Practices Using Biodiversity and Diversification for the Provision of Goods and Services in Agriculture

Alexander Wezel

Isara, Germany

Abstract: Agricultural production should provide sufficient food for the world's population while being economically beneficial for farmers, environmentally friendly, and socially acceptable. In addition, the basic food commodities should also be available at affordable prices for low-income people without impairing the quality. The foundations of this agriculture are the different practices farmers apply for crop and livestock production. Here agroecological practices play a crucial role as they try to valorise in the best way possible ecological processes and ecosystem services by integrating them as fundamental elements in the development of agricultural practices in different farming systems. Many agroecological practices already exist around the world, and are applied to different degrees in different regions, under various climatic conditions. They are used a lot in organic agriculture, but are also increasingly developed and implemented under conventional agriculture, although still at smaller scales.

This talk will show the large diversity of agroecological practices: A focus will be on agroecological practices using biodiversity and diversification of cropping systems with the aim to valorise ecosystem services and reduce external inputs. Some examples will be presented, among them diversified rotations, producing natural enemies in the field, using natural habitats for conservation biological control, and relay intercropping and cover crops for weed control and as habitats for natural enemies and pollinators. The potential use of these agroecological practices for future agriculture will be also evaluated, but also which challenges this might bring to farmers for the adaptation or redesign of their cropping and farming systems. Finally, the situation of the agroecology development in EU and in France will be illustrated. France is the only country in Europe which has a special policy for agroecology.

Key words: Agroecology, Agroecological Practices, Ecosystem Services, Biodiversity Management

Herbicide-Pesticide Free Innovative Forest Management: The Quebec Experience

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Abstract: Ecological forestry is akin to ecological agriculture in the sense that both aim to achieve long-term sustainable productivity of desirable crops while maintaining ecosystem health. Like industrial agriculture large-scale intensive forest management relies on extensive use of herbicides and pesticides that are harmful to the environment. After forest harvesting and planting desirable tree seedlings, herbicides are often used to release planted seedlings from competition in order to create productive monoculture of trees. These monospecific forests are susceptible to insects and pests and hence the use of pesticides. This form of forest management imparts negative effects on biodiversity, non-timber forest products, wildlife, stream water quality and human wellbeing. The question is, are there better ways to manage forests without using harmful chemicals? In this presentation I shall highlight the pros and cons of industrial forest management based on latest research. Citing the example of herbicide-pesticide free forest management of Quebec, Canada that was implemented in 1999 to accommodate public pressure I shall demonstrate how innovative harvesting (careful logging) site preparation, silviculture (microsite planting) and ecological forest tending it is possible to maintain forest productivity, conserve biodiversity, stream water quality and other ecosystem values.

Key words: Ecological Forest Management, Careful Logging, Brush Sawing, Microsite Planting

Effects of Ducks Excrement on Rice Growth and Methane Emission in Rice-Duck Farming System

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Abstract: In South China, an ecological model in agriculture called rice-duck farming system was used extensively, which is proved to be efficient in the control of pests and weeds in paddy fields. The rice-duck farming system was developed from Chinese traditional practice of raising ducks in paddy fields. This ecological model gains more attention for its significant effects to mitigate methane emission of paddy fields compared to the conventional rice cultivation. In order to clarify the effects of the distribution of duck excrement in root zone on growth and methane emission of rice in rice-duck farming system, an experiment was carried out using rice variety of

Huanghuazhan and excrement of mud duck. Three treatments with excrement addition were designed including excrement near roots (NR), excrement far from roots (FR), and excrement near and far from roots (NFR) and control without addition of excrement (CK), which reflects the diverse distribution of duck excrement in root zone of rice in rice-duck farming system. The changes of plant height, biomass, root activity, chlorophyll content and methane flux were measured. The results showed that the plant height of rice was significantly increased in NR, FR and NFR treatment compared with CK. The plant height growth rate of rice was significantly higher than that of CK at 24 days, and NR, FR and NFR treatments showed high plant growth coefficient compared with CK. The aboveground biomass in treatments of NFR and FR was significantly increased compared with CK. The root biomass of rice in NFR, FR and NR was significantly higher than that of CK, while the biomass of rice in FR was significantly higher than that of NR and NFR. The root / shoot ratio in FR was significantly higher than that of control. There was no significant difference in the water content of the aboveground part of rice in NFR, FR and NR after adding the duck excrements. Compared with the control, the chlorophyll content of rice leaves in NFR was significantly increased, and the root activity of rice in NFR was significantly enhanced compared with CK. The methane emission flux in NR and FR was significantly lower than that of the control at day 24, and there was a significant difference in methane emission flux between NR and NFR. Ducks excrement may play an important role in the process of methane emission in rice-duck farming system.
Key words: Rice-Duck Farming, Ducks Excrement, Methane Emission, Rice Growth

Mitigating China's N, P_2O_5 and Irrigation Water Inputs for Staple Food by Potato as Staple Food

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Abstract: Potato will become a kind of staple food under China’s government target of 30% of potato consumed as staple food in 2020. It will generate what benefits to China is urgently needed for studying. In present study we analyzed the historical change in Chinese urban and rural resident’s staple food and potato consumption from 1980 to 2012; estimated the potential effect of potato staple food on rice and flour consumption in different scenarios in 2020, namely business as usual (BAU), potato completely substitute for flour (30S0R+100F), 50% potato substitute for rice and others substitute for flour (30S50R+50F) and potato completely substitute for rice (30S100R+0F); finally evaluated the possible effect of potato staple food on chemical fertilizer N, P_2O_5 and irrigation water inputs for three crops and the planting of early rice and winter

wheat in different scenarios. The results showed that, per capita potato consumption will change from 7.7 and 14.5 kg $^{yr-1}$ to 7.1 and 11.6 kg $^{yr-1}$ for urban and rural residents during 2012–2020, respectively, but mostly fresh vegetables. Per capita more 2.9 and 4.7 kg potato per year will enter staple food diets in 2020 under our government's target, accounting for 2.6% and 3.1% of the weight of per capita rice and flour in urban and rural areas. Potato staple food is expected to reach 5.2 Tg, accounting for 3.1% of total rice and flour consumption in 2020, equals to substitute for 4.2–8.5 Tg wheat grain and 5.1–10.1 Tg rice grain in different substitute scenarios. The reduction in rice and wheat grain means we can decrease 5.5–11.2% of winter wheat sowing on the North China Plain or 12.4–24.6% of early rice sowing. In addition, total chemical N, P_2O_5 inputs and irrigation water for three crops can be reduced by 0.2–0.3 and 0.1–0.2 Tg and 1.8–4.6 billion m3 in different scenarios relative to BAU, the saved irrigation water equals to 4.0–10.3 million people's comprehensive water use in 2015. But the above benefits closely rely on our government's incentive policy and advocacy, and the acceptance of potato food products of the public in China.

Key words: Potato Staple, Substitute Ratio, Resources Use Efficiency, Chemical N, P_2O_5 Inputs and Water Use

Examining Spatially Varying Relationships between Soil Contamination and Landscape Patterns at Multiple Scales Using Geographically Weighted Regression

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Abstract: Soil contamination combines point- with non-point source pollution. Trace metals in the smoke and water could be migrated and eventually accumulated to agricultural soils through atmospheric deposition and waste water irrigation. During the migration of trace metals among different landscapes (i.e. a mosaic of patches varied in size, shape and arrangements), their accumulations were influenced by landscape patterns. Previous studies found that soil contamination and landscape patterns varied spatially and were scale-dependent; however, most of these studies were carried out on a single scale and used the conventional multivariate analyses (e.g. correlation analysis, ordinary least squared regression-OLS) that ignored the issue of spatial autocorrelation. To move forward, this presentation studied spatially varying relationships between agricultural soil trace metal contamination and landscape patterns at three block scales (i.e. 5km×5km, 10km×10km, 15km×15km) in the Pearl River Delta (PRD), south China, using geographically weighted regression (GWR). We found that GWR was more effective in exploring spatial relationships compared with OLS across multiple

scales, and the explanatory power of GWR model increased with the scale studied. GWR results showed that despite a few negative correlations, more positive correlations were found between soil contamination and different aspects of landscape patterns of water, urban land and the whole landscape (i.e. the proportion, mean patch area, the degree of landscape fragmentation, landscape-level structural complexity, aggregation/connectivity, road density and river density). Similarly, more negative correlations were found between soil contamination and landscape patterns of forest and the distance to the river and industry land ($P<0.05$). Furthermore, majority of significant correlations were located in the western PRD of high soil contamination with minor exceptions across scales, implying that landscape planning and management could be helpful for reducing the contamination levels of agricultural soils.

Key words: Trace Metal Contamination, Landscape Structure, Geographically Weighted Regression, Pearl River Delta

Optimization of Straw Mulching and Related Parameters in Growth of Young Walnuts (Juglans Regia) with Response Surface Methodology

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Abstract: Optimization of straw mulching is an effective conservation tillage tool to utilization waste resource and reduce environmental pollutions. In order to determine optimum levels of pattern, distance and quantity of straw mulching, a field experiment was carried out by using the Box–Behnken central design (BBD) combined with response surface methodology (RSM). The treatments were designed based three independent variables: pattern of straw mulching, distance of straw mulching and the quantity of straw mulching. Furthermore, tree height (THW) and net photosynthesis rate (NPR) were measured as response variables in a full quadratic polynomial model. ANOVA results showed that models were significant, expressing ideal relationships between independent and dependent variables. The optimum conditions of response variables(THW, NPR) were determined with the pattern of straw mulching of mixed rice straw and rapeseed straw(mixed pattern) respectively with a straw mulching distance of coverage the whole quadrat (all n), and the quantity of straw mulching of 3 kg/m2 (low level) respectively. The observed data were in close agreement with the predicted value (desirability = 1) based on the model. The optimal schemes of straw mulching combination can provide guidance for predicting growth and potential yield

of Walnut (Juglans regia), but a more practical experiment should be carried out for more exact results.

Key words: Walnut, Straw Mulching, Response Surface Methodology, Growth

Experimental Warming Effects on N_2O Emission and Related Soil Microbes under Conventional Tillage and No-Tillage Farmlands

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Abstract: Although numerous warming experiments have examined effects of elevated soil temperature and soil-drying induced by warming on nitrous oxide (N_2O) flux, the impacts of warming on N_2O flux and the underlying microbial drives under semi-arid farmland remain unclear. A manipulative warming experiment was established in 2009 under conventional tillage (CT) and no-tillage (NT) farmlands of North China Plain (NCP) to determine warming effects on soil N_2O flux, soil moisture, microbial biomass nitrogen (MBN) and abundances of ammonia-oxidizing archaea (AOA), ammonia-oxidizing bacteria (AOB) and denitrifier functional genes (amoA and nirS), as well as soil inorganic nitrogen (N, NH_4+-N and NO^{3-}-N) contents. Our study showed that warming did not affect annual N_2O emission in CT or NT fields. Differential seasonal responses of N_2O emission to warming might be responsible for the no significant differences between warmed treatments and un-warmed treatments. In March 2015, CT fields with warming significantly decreased N_2O emission and MBN compared with CT fields without warming after fertilization following irrigation events, but the stimulatory effects of warming on them were observed in June 2015. This indicated that N_2O emission responses to warming might be mediated directly through change in soil microbial biomass rather than soil moisture. Overall, warming significantly decreased the abundances of nitrifiers in CT and abundances of denitrifiers in both CT and NT farmlands, respectively. We further concluded that long-term warming along with the continuous fertilization in NCP resulted in the shift in microbial process and accumulations of soil inorganic N contents and thereafter decreased crop yields.

Key words: Climate Warming, N_2O Flux, Different Tillage Systems

Impacts of Moisture on Soil Carbon and N_2O Emissions in Agricultural Soil in Northwest China

Fan Zhang, Yiping Wu, Linjing Qiu

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Abstract: Human activities and climate change have substantial effects on soil ecosystems, especially in arid and semi-arid regions. The historical changes of soil carbon and nitrogen storage in Northwest China were investigated using a process-based biogeochemical model. The SOC storage (0-50cm) reduced slightly from 1.25 PgC over the 1980s and stabilized at 1.23 PgC in the 1990s, and the regional N_2O emissions was relatively low. The correlation analysis indicated that available water played a key role in controlling cropland SOC dynamics and N_2O emissions. The regional SOC and N_2O emissions increased along the moisture gradient and were higher in areas with humid climate, because high annual precipitation increased crop productivity, particularly in rain-fed cropping systems. We found irrigation played a crucial role in maintaining the SOC content in areas with low precipitation and the enhanced irrigation capacity could substantially elevate the SOC storage in the semi-arid domain. Also, the water condition is one of the restrictive factors on N2O emissions. Although decreased soil moisture in arid and semi-arid regions may inhibit the increasing trend of N_2O emissions, reducing the N loss by improving the the N fertilizer efficiency is still the most effective way to inhibit N_2O emissions.
Key words: Soil Carbon, Nitrogen, Moisture

Shoot and Root Biomass Allocation for Different Maize Densities in a Plastic-Mulched Dryland Cropping System

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Abstract: In rain-fed cropping systems with rainfall scarcity where crops land is often mulched to retain soil moisture is practiced, effective use of soil water in increasing quantitative production of profitable biomass is a good concept. This experimental study was aimed at understanding effect of density of maize (Zea mays L.) that cropped in ridge-furrow covered with plastic film land on distribution the quota between shoot and root biomass. five treatments were studied (springs, 2014 and 2015) at the Chinese northern west semi-arid region: medium density planted in bare-land (BMD), lower density in mulched ridge-furrow land (MLD), medium density in mulched ridge-furrow (MMD), higher density in mulched ridge-furrow (MHD), and extra-higher density in mulched ridge-furrow (MXD); full mulching with a polyethylene film was adopted;

plant population (plant/hectare) in MLD, BMD/MMD, MHD, and MXD were 35, 45, 65, and 72 thousand, respectively. Plastic mulching and increased density increased the shoots' biomass significantly, so over the two seasons, BMD was lower than MLD, MMD, MHD, and MXD by 28%, 35%, 52%, and 61%; however, it was higher than them in root to shoot ratio (r/s) respectively by 37%, 34%, 48%, and 6.0%. Increased density promoted the growth of shoot portion more than roots; therefore, MMD had 11%, 19% more r/s, compared with MHD, MXD, respectively. During early vegetative stages, growth rates of shoots and roots in BMD were significantly lower. Within the range of studied densities, the higher densities showed lower r/s and produced more aboveground biomass and grain yield. According to the study findings, improving maize grain yield by understanding the increase in plant biomass allocation to the shoots compared to roots and prompting the shoots' portion that is allocated to grains is suggested.

Key words: Ridge-Furrow System, Plastic Film Mulch, Loess Plateau, Maize

Insights in the Mechanism of Proliferation on Special Microbes Mediated by Root Exudates in Radix Pseudostellariae Rhizosphere under Continuous Monoculture Regimes

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Abstract: Radix pseudostellariae (Radix Pseudostellariae L.), belonging to the Caryophyllaceaeis family, is one of the most common and highly demanded Chinese medicines, which contains polysaccharides, ginseng saponins, flavonoids, cyclic peptides, amino acids and trace elements. High-quality Radix pseudostellariae is mainly produced in ZheRong, Fujian province in southern China, where the soil and climate conditions are the most favorable for its growth. However, consecutively monocultured Radix pseudostellariae are prone to severe diseases, which may result in reduced biomass, especially of tuberous products. This phenomenon is known as replanting disease or soil sickness. More than 70 % of medicinal plants, especially tuberous root medicinal plants, are reported to be attacked by various replanting diseases. Therefore, replanting disease incidence has resulted in a tremendous hurdle to obtain maximum agricultural production of Radix pseudostellariae. The root exudates of R. pseudostellariae can deteriorate the microbial community in the rhizosphere, including hosting specific pathogens at the expense of beneficial microorganisms. We found the effect of phenolic acids and organic acids were invoked as a driver of the changes seen in the rhizosphere soils. Then we study the effects of an artificially applied root exudates (organic acids, phenolic acids) of Radix pseudostellariae, on

Radix pseudostellariae seedling growth, rhizosphere soil microbial communities, and soil physicochemical properties. The deep pyrosequencing and qRT-PCR analysis demonstrated that the treatment of phenolic acids significantly decreased the relative abundance of Trichoderma, Penicillium, Pseudonocardiales, Xanthomonadales, Streptomycetales, Micrococcales, Gemmatimonadales. And the organic acids had significantly negative effect on the relative abundance of Pseudonocardiales and Streptomycetales, which significantly increased the abundance of Fusarium, Xanthomonadales, Micrococcales and Gemmatimonadales. The non-invasive micro-test technique analysis indicated that the root exudates increased the H+ efflux in the pathogenic fungi (Fusarium oxysporum and Talaromyces helicus) and decreased the H+ efflux in the beneficial fungi (Trichoderma harzianum), which creates an acid environment for the proliferation inhibition of beneficial bacteria and build-up of specialized plant pathogens. This study explains the reasons why the root exudates are able to mediate a microflora shift and structure disorder in continuously monocultured Radix pseudostellariae rhizosphere soil.

Key words: Radix Pseudostellariae, Replanting Disease, Root Exudates, Non-Invasive Micro-Test Technique

Spatial-Temporal Changes in Evapotranspiration Based on Crops Planting Patterns in Xinjiang during 1960-2010

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Abstract: Evapotranspiration (ET) is the important process of hydrological cycle in croplands of dry areas. Recently, the significant cropland expansions and crop planting pattern changes due to intensive human activities (land clearing, irrigation) had already influenced water budget in arid regions of Northwest China. Therefore, accurate ET estimation is fundamental to determine water management and allocation. However, a number of studies have focused on calculating ET by field measurements, water balance, empirical approaches or remote sensing models. But they did not consider the effects of long-term changes in cropland area and planting pattern on agricultural water consumption. The spatial datasets of planting pattern including three major crops (wheat, maize and cotton) in Xinjiang during 1960-2010 were built by integrating agricultural statistics at county-level and cropland area maps extracting from LULC product. Thereafter, the actual ET of croplands was estimated by FAO Penman-Monteith (P-M) equation and total ET (TET) of each basins was calculated through GIS technique. The results showed that (1) the cropland areas kept continual increase and increased by 90.9% in Xinjiang during 1960-2010. Since 2000s, economic

crop (cotton) instead of grain crop (wheat and maize) has dominated the planting structure of oasis cropland. From 1960 to 2010, about 72.2% of basins showed increased trends of cotton planting proportion, while 77.8% and 55.6% of basins experienced decreased trends of wheat and maize planting proportion. It also found that cotton planting proportion quickly raised in Southern Xinjiang and wheat planting proportion rapidly reduced in Northern Xinjiang. (2) The TET of three crops added by 47.85%, and the largest contribution came from cotton, followed by corn and wheat during 1960-2010. From 2000s, cotton instead of wheat became the most important parts of agricultural water consumption. It implied that the changes of cultivated areas and planting structure would impact the spatial-temporal distribution of ET and composition of TET in arid region of Xinjiang.

Key words: crop planting patterns, evapotranspiration, cropland, Xinjiang

The Responses of Soil Microbial Activities to Oil, Lead, Cadmium and Their Combined Contaminations

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Abstract: With rapid agricultural development and industrialization, oil, heavy metal and their combined contaminations caused by the wide use of oil and heavy metals get worsened, posing increasing threats to environments and human beings. We therefore set up a laboratory experiment to explore the effects of oil, lead, cadmium and their combined contaminations on soil microbial activities by simulating soil contamination. There were 4 treatments in this experiment: soil (S) as the control, 000 mg ŀkg^{-1} oil contaminated soil (SP), 500 mg ŀkg^{-1} lead and 50 mg ŀkg^{-1} cadmium contaminated soil (SH), 000 mg ŀkg^{-1} oil, 500 mg ŀkg^{-1} lead and 50 mg ŀkg^{-1} cadmium combined contaminated soil (SPH). Compared with the control, the peaks of basal soil respiration in SH, SP, SPH were increased by about00.99%, 36.61% and 25.80%, respectively. The basal soil respiration was enhanced to the greatest extent in SH, suggesting a strongest impact of heavy metal contamination on basal soil respiration. Soil microbial biomass carbon (Cmic) was also enhanced in SP and SPH with that of SP showing the most increase at 90.25% compared to the control. In contrast, Cmic was decreased in SH. In addition, various soil enzymes had different responses to soil contamination. Among them, the activities of FDA hydrolase and dehydrogenase were enhanced in SP. While the activities of urease and catalase were also enhanced in SP and SPH, they were inhibited in SH. These results show that there is intense interaction in the effects of oil, lead and cadmium on soil microbial activities.

Key words: Combined Contamination, Soil Microorganisms, Soil Enzyme Activity

Study on Rhizosphere Ecological Characteristics of Radix Pseudostellariae Monocultured for Different Years

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Abstract: Radix pseudostellariae is a perennial tonic medicinal plant, having high medicinal value. However, Consecutive monoculture of this plant in the same field results in serious decline in both yield. In this study, a three-year field experiment was conducted to identify typical growth inhibition effects caused by extended monoculturing of R. pseudostellariae. DGGE analysis was used to demonstrate changes in the structure and composition of soil Fusarium and Pseudomonas community along a three-year gradient of monoculture. The results indicated that prolonged monoculture significantly increased levels of Fusarium spp., but decreased levels of Pseudomonas spp. Quantitative PCR analysis confirmed a significant increase in Fusarium oxysporum, but decline in Pseudomonas spp. Furthermore, Abundance of beneficial Pseudomonas spp. with antagonistic activity against F. oxysporum was lower in extended monoculture soils. Phenolic acid mixture at a ratio similar to that found in the rhizosphere could promote mycelial growth of pathogenic F. oxysporum while inhibiting growth of the beneficial Pseudomonas sp. CJ313. Moreover, plant bioassays showed that Pseudomonas sp. CJ313 have a good performance that protected R. pseudostellariae from infection by F. oxysporum.Overall, this study demonstrated that extended monoculture of R. pseudostellariae can alter the Fusarium and Pseudomonas community in the rhizosphere, leading to relatively fewer beneficial microorganisms and relatively more pathogenic and toxin-producing microorganisms, which is mediated by the root exudates.

Key words: Radix pseudostellariae, Fusarium, Pseudomonas, Phenolic acid

One Year Experiment of Understorey Regrowth Improves Ecosystem Services in Monoculture Rubber Plantations

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Abstract: Use of herbicides to control understory regrowth is a common practice in rubber plantations, but this often increases the risk of soil erosion. However, the impacts of understory management practices on soil quality and ecosystems functions are poorly understood. In this study, we conducted two treatments: allowing the understory to regrow (understory regrowth) and removal of understory vegetation (current practice) for one year. We measured soil erosion, latex yield and soil respiration throughout the year, and investigated soil microbial communities at the beginning of the experiment and after one year using phospholipid fatty acid (PLFA). The results showed that soil loss under current practice was 8 times greater than understory regrowth. The amount of soil organic carbon and nitrogen due to erosion was 4 times larger in current practice, compared to understory regrowth. Latex yield was not significantly different for the two treatments. After one year, understory regrowth had enhanced relative abundance of fungi, the ratio of fungi to bacteria and soil invertebrates. Since the year of the experiment was drier than normal, soil respiration and soil microbial biomass were reduced in both treatments. Our findings indicate that a change in management of rubber plantations could drastically reduce soil erosion and improve soil health. Therefore, we suggest that understory restoration or inter-cropping with economically valuable plants may enhance ecosystem sustainability in monoculture rubber plantations without negatively affecting latex production. Further studies are needed to investigate the long-term effect of understory regrowth on latex yield as well as ecosystem services

Key words: Ecosystem services, Restoration, Rubber plantation, Understory vegetation

Effects of Different Straw Residue Incorporation on Soil Weed Seed Bank

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Abstract: Straw residue incorporation has been widely used as the most important way to realize the effective utilization of straw resource, and it may affect the soil weed seed bank. To study the effects of long-term straw residue incorporation on seed density and biodiversity of soil weed seed bank, a field experiment with different amount of straw residue buried in different soil depths was conducted in Nantong experimental station, Jiangsu province.

There were 4 treatments in the experiment, including no straw residue as control, full amount of straw returned to the 20cm soil layer, full amount of straw returned to the 40

cm soil layer, half amount of straw returned to 20cm soil layer. In total, 22 weed species were recorded in soil seed bank (0-25cm), belonging to 13 families. The results show that full amount straw residue had the most obvious effects: 1) it significantly increased or tended to increase seed density and species richness of soil weed seed bank, particularly in the middle (5-15cm) and lower (15-25cm) layer, hence 2) the vertical distribution of soil weed seed quantity along soil depths was more uniform. Half amount straw residue treatment had only minor impact on soil weed seed bank, and the depth of the straw residue incorporation had almost no effect. Our results suggest that the key factor that affects the structure and diversity of soil weed seed bank is the amount of straw residue, rather than the depth of returned straw residue.

Key words: Straw residue incorporation, Weed seed bank, Community structure, Species diversity

Rice-Water Spinach Intercropping Enhance Silicon Uptake, Plant Resistance and Biomass Production of Rice

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Abstract: Intercropping is a sound agricultural practice for crop production, pest control and nutrient utilization, but aquatic crops (e.g. rice) intercropping is relatively rare. Silicon plays an important role in rice production and plant resistance. Depletion of bioavailability silicon in paddy soil due to crop absorption can decrease rice yield. So far there is limited study about the influence of intercropping on silicon uptake of rice. In the present study, rice was intercropped with water spinach to evaluate the effects of intercropping on yield, pest control and Si absorption of rice through three different experiments. Experiment 1 was a field trial of two years/four seasons (early and late seasons in 2014, 2015), which included five treatments: rice monoculture, water spinach monoculture and rice-water spinach intercropping (2:2, 3:2 and 4:2). The results showed that rice-water spinach intercropping (2:2, 3:2 and 4:2) significantly increased rice yield per unit area by 77.5%~120.6%, 64.9%~80.9%, 37.7%~56.0%, and land equivalent ratios were 1.05-1.16, 1.06-1.20, 1.01-1.15, respectively. In addition, rice-water spinach intercropping could reduce the incidence levels of rice sheath blight by 39.8%～68.8% and leaf folders by 36.7%～56.0%. More importantly, intercropping significantly increased the absorption and content (increasing rate 9.8-52.6%) of Si in rice leaves at ripening stage. Experiment 2 was conducted in greenhouse through setting three root barrier treatments (no barrier, mesh barrier, solid barrier) under rice-water spinach intercropping conditions, to prove if there are root interactions between rice and water spinach which promotes Si uptake of rice. It was found that Si

content in rice stems and leaves in no barrier treatment were highest, followed by mesh barrier and solid barrier. And the phenomenon was more obvious when rice plant was closer to water spinach.Experiment 3 was a pot experiment which included two Si treatments (Si application or not) with three planting patterns (rice monoculture, water spinach monoculture and rice-water spinach intercropping). The results showed that, in the case of no Si application, compared with rice monoculture, rice-water spinach intercropping significantly increased Si content of rice plant, and the Si content in stems and leaves was increased by 35.9% and 29.7%, respectively. However, there was no difference among three planting patterns under Si application condition. Regardless of Si application, the concentration of soil available silicon, active silicon and water-soluble silicon had significant difference among the three planting patterns, but no difference for soil amorphous silicon, organic bound silicon and Fe-Mn bound silicon. Compared with rice monoculture, rice-water spinach intercropping significantly increased the concentration of water-soluble silicon in soil, thereby facilitating the absorption of silicon for rice.Our study suggested that rice-water spinach intercropping exhibits yield and pest control advantage for rice and promotes the absorption of silicon in rice through increasing Si availability in soil.

Key words: Rice, Intercropping, Silicon, Production

Accumulation and Distribution of Calcium and Magnesium in Oat and Their Effects on the Uptake of Sodium, Potassium, and Chloride Ions

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Abstract: Calcium and magnesium are not only important nutrient elements, but are also related to the structure and functions of soil, especially the saline alkali soil. When used for phytoremediation, oat plants can uptake large amounts of salt ions from saline-alkali soils. This study aimed to explore calcium ion and magnesian ion concentration and accumulation in relation to salt ion uptake and soil quality. The accumulation and distribution of calcium and magnesian ions in plant organs was studied for six oat varieties (Bayou^{-1}, Baiyan^{-2}, Baiyan^{-7}, Huawan^{-6}, Huazao^{-2} and Pin^{-16}) at four growth stages. The results showed that calcium ion concentration and accumulation (kg $^{ha\text{-}1}$) across plant organs ranged from 3.4 to 12.1 and 2.6 to 6.3 while those for magnesian ion ranged from 1.7 to 5.3 and 1.5 to 3.3 Among varieties, the concentrations (6.8 to 7.2 g kg^{-1} for calcium ion; 3.1 to 3.6 g kg^{-1} for magnesian ion) and accumulations (3.3 to 5.3 kg $^{ha\text{-}1}$ for calcium ion; 1.9 to 3.1 kg ha^{-1} for magnesian ion) varied significantly. Significant variations also occurred among the four growth

stages with calcium ion concentration ranging from 4.7 to 12.1 g $^{kg-1}$ and magnesian ion concentration from 3.0 to 3.9 g $^{kg-1}$, with a peak at delayed harvest stage. However, the highest accumulation (kg $^{ha-1}$) occurred at maturity (5.6 for calcium ion and 3.5 for magnesian ion). The concentrations of calcium and magnesian ions varied in the order root > leaf > pannicle > stem while their accumulation varied in the order leaf > pannicle > root > stem. The calcium ion concentration was several times higher than magnesian ion. Depending on variety, the ratio [calcium ion/magnesian ion] increased from elongation (heading stage) (1.2 to 1.9 times) to delayed harvest stage (2.9 to 3.2 times). A significant partial positive correlation was found among concentrations of calcium ion and magnesian ion, chloridion. The magnesian ion showed significant positive correlations with potassium ion and sodion. The prospect of using oat treated with calcium and magnesium fertilizer to reduce soil alkalinity (sodium adsorption ratio, exchangeable sodium percentage) should be studied further.

Key words: Oat, Calcium & Magnesium, Salt Ions, Phytoremediation

Interspecific Root-Root Interactions Are Drivers of Overyielding, Efficient Nutrient Utilization and Improved Soil Fertility in Intercropping

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Abstract: Intercropping advantages are mainly derived from interspecific interactions, including above- and below-ground complementarity, competition and facilitation. There were lots of research on interspecific interactions on above-ground parts, but relatively limited on below-ground interactions between intercropped species. The aim of the study was to examine role of interspecific root-root interactions in overyielding and efficient nutrient utilization of inercropping.

Both field and greenhouse experiments were conducted to determine yield and nutrient acquisition advantages by adding sparingly soluble and organic P in soils, interspecific root-root interactions by root barrier, N complementarity by natural or enriched isotope abundance methods. Soil fertility parameters were determined in long-term field experiments.

There are significant productivity advantages of intercropping in various legumes/cereals and cereals/cereals intercropping. One-thirds to 100 percentage of intercropping advantages are contributed to root-root interactions. There are two main mechanisms underlying the interspecific root-root interactions, facilitation and complementarity. The interspecific facilitation is that some crop species mobilize unavailable forms of one or more limiting soil nutrients (such as phosphorus, iron and

zinc), and improve phosphorus, iron or zinc nutrition for themselves and neighboring non-mobilizing species by releasing acid phosphatases, protons and/or carboxylates, and phytosiderophores into the rhizosphere, respectively. When intercropped with legumes, cereals usually have more root competitive to soil mineral nitrogen, and lead to reduction in soil mineral nitrogen, which facilitates to nodulation and biological N2 fixation of associated legumes. The root-root interactions maintains soil fertlity on a relative fertile soil and enhances soil fertility on a poor soil under contineous overyielding.

Our results highlight that interspecific root-roo interactions below-ground play an important role not only in overyielding and nutrient acquisition, but also maintaining or enhancing soil fertility. The mechanisms underlying the root-root interactions include interspecific facilitation on sparingly-soluble soil nutrients and complementary utilization of soil and atmosphere nitrogen in legumes-based intercropping.

Key words: Intercropping, Root-Root Interactions, Nutrient, Sustainability

Biodiversity Used in Rice Production in South China

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Abstract: Biodiversity used in rice production is both a traditional practice and conventional practice in Southern China. Biodiversity used in rice production today can be categorized in (1) intercropping and relay cropping such as intercropping of two different rice varieties, intercropping rice with lotus, and intercropping rice with water spinach, (2) rotation such as rice rotation with winter green manure, rice rotation with winter potato, (3) co-culture with animals such as rice co-culture with duck, fish, shrimp and frog, and (4) landscape arrangement such as field ridge plant species design, flowering plant and trap plant design for the landscape.If suitable technique is used to adjust the relationship among different species for their compensation or competition, the biodiversity used in rice production not only can reduce and even eliminate chemical fertilizer and pesticide used, but can also increase field productivity. The suitable policy to reduce economic externalization and to encourage biodiversity used in rice production is further discussed.

Key words: biodiversity, rice, South China, intercropping

Characterization of Overwintering Behavior and Site of Riptortus Pedestris (Hemiptera: Alydidae) in the Laboratory Experiment and Field Sampling

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Abstract: Due to its extreme weather condition, winter is a harsh season for insects. Therefore, proper selection of overwintering site is critical for insects to survive. However, there have been only a handful of studies conducted to address overwintering ecology of insects. Riptortus pedestris, is a major agricultural pest on leguminous plants and tree fruits. However, there is only anecdotal information about overwintering behaviors and sites of this species. Therefore, we conducted laboratory experiments and field sampling to study overwintering ecology of R. pedestris in South Korea.

In the laboratory settings, we conducted two separate experiments first to identify overwintering structure preference by adult R. pedestris and analyze their spatial distributions in the preferred structure. To identify the habitat preference, adults were exposed to three potential overwintering structures (rock, rotten wood, and leaf litter) for 3 hours. Among the tested structures, R. pedestris almost exclusively showed overwintering behavior in leaf litter. ($P < 0.001$; Fisher's exact test). In the second experiment, R. pedestris were released in an indoor arena filled with leaf litter for 24 hours. Locations of overwintering adults were individually marked and analyzed using Spatial Analysis by Distance IndicEs (SADIE). The spatial analysis indicate that most overwintering R. pedestris were solitarily distributed in the test arena.

To locate and characterize overwintering site of adult R. pedestris, field sampling was conducted in South Korea in the winter of 2015 and 2016. We divided South Korea in four climate zones based on the Korea Meteorological Administration data. Then, we selected a high-elevation mountain (> 800-m altitude) and low-elevation forest area (< 200-m altitude) adjacent to agricultural landscape in each climate zone. We randomly collected leaf litter samples from 1-m2 grids at every 100-m altitude in the mountains or every 50-m distance in the low-elevation areas. From the 2-yr sampling, we examined a total of 132 samples and found 12 overwintering R. pedestris from 12 samples; only one sample was located in the high-elevation mountain.

Based on these results, we conducted a targeted sampling in the third year, in which low-elevation (< 200-m altitude) forested landscapes with thick deciduous leaf litter were selected adjacent to soybean fields. We selected a total of 8 sampling sites and sampled 40 leaf litter samples as described above. From the samples, we found 11 overwintering R. pedestris from 9 samples.

To summarize, our study indicates that adult R. pedestris solitarily overwinter in the

leaf litter. In the field survey, most overwintering R. pedestris were found in leaf litters adjacent to the crop production field. This study provides the first empirical data sets which address overwintering behavior and structure of R. pedestris and preferred overwintering landscapes. This critical information will serve as a solid foundation to develop proactive control methods and sustainable management programs for R. pedestris.

Key words: Riptortus Pedestris, Overwintering, SADIE, Pest Management

Nitric Oxide-Induced Regulation of Growth, Ion Homeostasis, Photosynthesis and Mitigation of Salt-Induced Oxidative Stress in Mangrove Species, Kandelia Obovata

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Abstract: We investigated the role of nitric oxide (NO) in regulating ion accumulation, improving growth and photosynthetic parameters and in reduction of oxidative stress in 2-month-old Kandelia obovata seedlings grown under 1.5 and 3.0% NaCl solution for further 2 months. To observe the role of NO, 100 μM sodium nitroprusside (SNP) was used as NO donor, while same dose of Hemoglobin (Hb) and N-nitro-L-arginine methyl ester hydrochloride (L-NAME) were used as NO scavenger and NO synthase (NOS) inhibitor, respectively. The results showed that 1.5% salinity did not affect the seedling growth but 3.0% salt decreased root length and shoot length. Both salt concentrations markedly increased the Na+ content but decreased the K+ and therefore the ratio of K^+/Na^+ decreased. The content of Ca^{2+} and Mg^+ decreased only at 3.0% salinity. Importantly, these effects of NO were reversed by specific scavenger and NOS inhibitor. Low (1.5% NaCl) salinity did not show any negative effect on photosynthetic parameters, rather it improved some parameters compared to control. Higher salinity (3.0%) decreased chlorophyll content (SPAD value), net photosynthetic rate (Pn), stomatal conductance (gs), internal CO_2 concentration (Ci), maximum quantum yield of PSII (Fv/Fm), photochemical quenching (qP), the actual quantum efficiency of PSII (ΦPSII), Non-photochemical quenching (NPQ) and electronic transport ratio (ETR) also. Salt stress also decreased transpiration and water use efficiency and increased couple of oxidative stress markers i.e. lipid peroxidation and H_2O_2 content where results were prominent only at 3.0% NaCl. Exogenous NO had little effect in improving such photosynthetic parameters and decreasing oxidative stress. However, specific scavenger and NOS inhibitor clearly reversed these effects that indicated that endogenous NO has obvious role in enhancing photosynthesis and maintaining antioxidant defense in mangroves.

Key words: Salinity, Nitric Oxide, Signaling, Mangrove

The Response of Main Crop Potential Productivity to Land Use Change: A Case Study in Western Jilin, China

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Abstract: The impact of land use change on main crop potential productivity is one of the most important topics in the research of land use/cover change and its effects. Western Jilin, located on the edge of an ecotone in northern China, and its land use have changed dramatically in recent decades, with significant impact on grain potential productivity. This study evaluated main crop potential productivity in different conditions and analyzed the response to land use change based on land use data, meteorological data and statistical data by using the Global Agro-ecological Zone model. Results showed that (1) crop potential productivity of Western Jilin in 2010 was 19.12 million tons, an increase of 34.8% over 1975 because of changes in land use and in climate; (2) due to land use change, crop potential productivity in the study area increased between 1975 and 2000, however, it decreased between 2000 and 2010; (3) conversion in type of land use and an increase in irrigation percentage caused grain potential productivity to increase by 0.70 million tons and 3.13 million tons respectively between 1975 and 2000; between 2000 and 2010, grain potential productivity had an increase of 0.17 million tons due to the increase in cultivated area, but it decreased by 1.88 million tons because the irrigation percentage declined from 36.6% to 24.7%. Therefore, increasing investment in agriculture, improving land quality and increasing the conversion rate of grain potential productivity to actual production would be a better choice for ensuring national food security and achieving sustainable land use.

Key words: Potential Productivity, Land Use Change, GAEZ, Western Jilin

Environmental Evaluation of Rice-Frog Co-Cultivation in Shanghai Suburbs, China

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Abstract: The serious water pollution and pesticide residues in conventional farming leads to the development of eco-agricultural cultivations. In Shanghai Zizaiyuan Agricultural Development Company Limited (Co.Ltd.), rice-frog co-cultivation was

practiced from 2009. In order to evaluate its influences on the environment and the income of the farmers, we examined the loss of nitrogen and phosphorus through leaching and runoff, the soil quality and the rice production every year from 2013. Our four years' results showed that compared to the conventional farming, the rice-frog co-cultivation had advantages as follows: (1) the nitrogen loss decreased 16.1%-23.3%; (2) the soil bulk density decreased by 9.8% -13.1%, but increase the soil water storage by 6.2% - 12.3%; the soil total organic carbon (TOC), alkali-hydrolyzable nitrogen (AN) and available phosphorus (AP) also increased separately by 23.0%, 34.7% and 11.8% on average; the soil microbial biomass carbon (SMBC) and soil microbial biomass nitrogen (SMBN) increased by 17.3% and 28.5% averagely, the quantity of soil bacteria increased by 16.1%-20.7%, followed by fungi (9.5%-19.8%) and actinomycetes (1.4%-6.4%); the activity of soil microbes also brought the improvement of the activity of soil enzymes like urease, protease and sucrase; (3) low rice production but high economic benefit . However, we should also raise the alarm of the potential phosphorus pollution due to the large amount of phosphorus in the organic fertilization used in rice-frog co-cultivation. Developing more nutrient-balanced organic fertilization such as vermicomposting might be a solution. In conclusion, the rice-frog co-cultivation has advantaged in inducing the nitrogen water pollution, improving the soil quality and bringing the economic benefits. It could be advocated all over the country as one of the ecological cultivation. Meanwhile, more attention should also be paid in the potential phosphorus pollution.

Key words: Rice-Frog Co-Cultivation, Soil Quality, Nitrogen and Phosphorus Loss, Rice Production

Effects of Sewage Sludge Amendment on Soil Bacteria Community Structure in Three Subtropical Plantations

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Abstract: Recycling sewage sludge as soil amendment in subtropical plantations has become one available option because of its abundant organic matter and nutrients. However, due to the uncertain contaminant, the impacts of sewage sludge amendment on soil microorganisms are still unclear. In this study, a field experiment was conducted to investigate the effects of sewage sludge amendment on soil bacteria community structure via 16S rDNA sequence in three subtropical plantations in South China, Eucalyptus urophylla (EU); Schima superba (SS) and Pinus elliottii (PE). Four treatments were established, including litter remain, litter remain with sewage sludge application, litter removal and litter removal with sewage sludge application. Our

results showed that the highest relative abundance of soil bacteria at phylum level was Proteobacteria (EU>SS>PE), while at genus level was Rhodoplanes (PE>SS>EU). However, there was no significant difference in soil bacteria community structure among three plantations. However, the sewage sludge treatment significantly affected the phylum of Acidobacteria, Actinobacteria, Bacteroidetes, Gemmatimonadetes and Verrucomicrobia in EU plantation, Gemmatimonadetes in SS plantation, and Cremarchaeota and Acidobacteria in PE plantation, suggesting that the effects of sewage sludge addition on soil bacteria might vary with the plant species. But there were no interactive effects of litter and sewage sludge on the soil bacteria community structure in our study. Whether litter removal or not had no significant effects on the relative abundance of soil bacteria at phylum or genus levels in this study. However, the sewage sludge amendment significantly decreased the relative abundance of soil bacteria at phylum or genus levels in the three subtropical plantations, indicating that contaminants in sewage sludge may alter the soil bacteria community structure to some extent. Therefore, our research suggests that when the sewage sludge is used as soil amendment in plantations, more attentions should be paid to the uncertain effects on the soil microorganisms. This study provides a new perspective on the potential response and feedback of plantations to sewage sludge amendment.

Key words: Sewage Sludge, Community Structure, Soil Bacteria, Ecological Forestry

The Research on the Evaluation System of Agro-Ecology Security in Hubei Province

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Abstract: Purpose：Setting up the Evaluation System of Security, in order to provide important practical reference for the benign operation of ecosystem and the sustainable development of regional economy, as well enrich the ecological evaluation method of quantitative analysis, and optimize the Hubei ecology and agriculture ecology theory system, then realize the Hubei provincial ecological environmental advantage of quantity.method :According to the regional ecological, economic and social development of Hubei regional ecology, the county-level cities as a basic unit of evaluation, applying AHP, using three aspects: pressure on agricultural resources,quality of agricultural ecological environmental, and renovation and construction of agricultural resources and ecological environment protection ability, to design Agro-ecology Security evaluation model of Hubei.Result: firstly, the overall condition of Hubei agro-ecological security is relatively good. the 92 contestants rural area counties and cities: 21% of them belong to insecurity countries (the security factor

1＜U 1.5);40% of them belong to relative security countries; 26% of them belong to relative insecurity countries; 13% of them belong to insecurity countries. Secondly, the areas in the northwest of Hubei province, such as Xiangyang, Shiyan, Shen Nongjia, these three areas have adequate light and heat; the agricultural modernization level is higher. The gross power of agricultural machinery and agricultural output value accounted for 21% of the whole province. The regional economy has made a great contribution to the agricultural ecological security, and the overall security level of Agro-ecology Security is higher.Thirdly, in the 22 contestants counties,there isn't security counties; there are 9 relative security counties, 7 relative insecurity countries , and 6 insecurity counties .Fourthly, insecurity counties account for about 36.5% of the contestant insecurity counties among the whole province. the midday areas of Hubei, such as Jingzhou and Tianmen, the agriculte natural conditions are better, but the rural economic strength is lower. It's a big threat that the weather is dry in autumn and winter .Conclusion: for Hubei, on the basis of relieving contradiction between population and land, reducing the pressure of agricultural resources and environment, strengthens the construction of ecological and agricultural ecological environment education; sets up the national sustainable development. In view of the the agricultural ecological security problems caused by natural environment, we have to take active measures and solve these problems in time.

Key words: Evaluation System, Agro-ecology, Environment

Sewage Sludge Compost Fertilization in Municipal Garden: Effects on Mangifera Communis Growth and Heavy Metal Accumulation

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Abstract: Garden utilization is a new way to dispose and reuse sewage sludge (SS). But the impact of heavy metals on soil environment and plant growth remains a problem. We studied the dose-response effects of SS (volume fractions 0， 15%, 30%, 60% and 100%) on cultivation substrate properties, Mangifera communis seedling growth and heavy metal accumulation in pot experiments. The results showed that SS application decreased bulk density and increased aeration, pH and nutrient contents of cultivation substrates, but also increased their heavy metal contents. SS significantly promoted the height and diameter growth and biomass of M. communis seedlings, and the optimum dose of SS was 30%. The contents of Cu, Zn and Cd in roots, stems and leaves increased with the amount of SS, while the content of Pb increased first but then decreased with SS dose, and the highest Pb content appeared in the 30% treatment. Concentrations of heavy metals in roots of Mangifera communis were higher than that

in stems and leaves. SS application significantly increased the accumulation of Cu, Zn and Cd, whereas no significant effects occurred to Pb. After the cultivation experiment, 88.6%~ 98.4% heavy metals were left over in the substrate, but the heavy metal contents of all treatments except 100% SS were below environmental quality standards for soils (Level II) in China. This study shows that SS can be safely used as garden substrates as long as the dose of SS is kept in a reasonable range.

Key words: Sewage Sludge, Mangifera Communis, Biomass, Heavy Metal

Effects of Long-Term No Tillage on Gross Soil N Transformations in the Black Soil in Northeast China

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Abstract: No tillage (NT) is a common conservation tillage practice to enhance soil C sequestration. However, to date, the understanding of NT impact on soil N transformations is still very limited. In this study, a 15N tracing experiment was carried out to investigate the effects of 14 years NT treatment on soil gross N transformation rates, and elucidate the mechanisms how long-term NT affect soil N availability and maize yield, and the risk of N losses from soil in NT systems in black soil in China. The total gross N mineralization rates in the top 5cm of the NT soil was more than 3 times higher than in the 5-15cm soil layer ($P<0.01$), and was also significantly higher than in the same layers of the conventional tillage (CT) ($P<0.05$). However, total gross N mineralization rates in of CT in 5-15cm were significantly higher than in the top 5 cm in 0-5 cm layer soil in CT ($P<0.05$). The total gross NH^{4+} immobilization rates in NT were almost negligible compared to CT leading to significantly higher net mineralisation rates in the long term NT treatment and higher N supply for crop (maize) production. Highest gross autotrophic nitrification rates were observed in the top 5cm layer soil in NT, which was significantly higher than that in CT ($P<0.05$). However, heterotrophic nitrification was with 0.02 to 0.11 mg N kg^{-1} very low in NT, and also significantly lower than the rates in CT (average rate of 0.80 mg N kg^{-1}). Ratios of autotrophic nitrification to NH^{4+} immobilization rate, and N_2O emission in NT were significant higher than in CT. Soil N_2O emission rates were positively correlated with autotrophic nitrification rates. Thus, long-term NT treatment compared to CT can enhance the internal mineral N supply for maize production, and then improved maize yield, but at the same will increase the risk of NO^{3-} leaching and N_2O emission. Our results suggest that nitrification inhibitors applied according to precipitation, and suitable fertilizer management using controlled release fertilizer and supplying N

below the soil surface can be an effective tool to reduce N loss and N_2O emission from black soil under NT system.

Key words: No Tillage, Gross Nitrogen Transformation, 15 N Tracing Technique, N Loss

Preference of Riptortus Pedestris (Hemiptera: Alydidae) 2nd Instar Nymph on a Gut Symbiont, Burkholderia Sp., in Laboratory Conditions

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Abstract: Insects take various advantages in survival, growth, and reproduction by harboring symbiotic bacteria. Insect pests can gain fitness benefits from symbiotic relationship that may ultimately inflict elevated damage on agricultural crops. Therefore, it is important to understand the biology between the host and symbiont, and its implications for pest management.The bean bug, Riptortus pedestris (Hemiptera: Alydidae), is one of the most notorious pests on leguminous crops in East Asia, especially South Korea and Japan. This pest injures bean pods and tree fruit by feeding on plant sap. Recent studies have revealed an interesting symbiotic relationship between R. pedestris and its gut symbiont Burkholderia sp. as an ideal model system for insect-microbe symbiotic relationship. These studies demonstrated that insect can get several fitness benefits such as increased fecundity, shorter development period and larger body size from harboring the symbiont. Furthermore, it was also shown that the Burkholderia sp. symbiont was not vertically transmitted and R. pedestris 2nd instar nymphs were able to acquire the symbiont from the soil. However, a detailed mechanism of how R. pedestris finds and acquires Burkholderia symbiont in the nature is still unknown.In order to address symbiont acquisition mechanism, we examined whether R. pedestris 2nd instar nymph has preference on Burkholderia sp. in laboratory conditions. We conducted a series of dual-choice experiments with the Burkholderia symbiont treatment (rifampicin-resistant mutant strain RPE75) and untreated control. In the first choice experiment, the approaching frequencies of nymphs (100 individuals / arena) to the symbiont or control were measured in plastic cages (465 x 290 x 260mm) (D x W x H). In the test, there was no significant difference in the preference of R. pedestris between the two treatments (P = 0.8088). Also, to investigate the behaviors of a single nymph (its first choice, approaching frequency to each treatment, and residence time on the treatment), we conducted second dual-choice experiment in which a single individual was

video-recorded for 12 hours in a smaller plastic cage (353 x 210 x 120mm). Again, in the solitary condition, no significant differences were found in any of the recorded behavioral traits between the two treatments (P = 0.6013, P = 0.3424, and P = 0.4168, respectively).In summary, there was no detectable difference in the preference of R. pedestris 2nd instar nymph on Burkholderia symbiont versus untreated control in the current laboratory choice settings. Further study will test response of R. pedestris on volatile chemicals from Burkholderia in the Y-tube olfactometer system. In addition to laboratory assays, we will expand choice experiments in semi-field conditions in which the symbiont will be presented in more natural settings.

Key words: Bean Bug, Insect-Microbe Relationship, Symbiosis, Choice Experiment

Relatonship between Flavonoids Content in Alfalfa and Pea Aphid Behavior

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Abstract: Alfalfa (Medicago sativa L. (Fabaceae)) is an important crop used as feed for livestock. One of the most serious pests of alfalfa is the pea aphid (Acyrthosiphon pisum Harris). In addition to the nutritional components (proteins and carbohydrates) that are important in the use of alfalfa and other plants as animal feed or food supplements, the plants produce a variety of secondary metabolites. Many of them help to protect the plant against herbivores. Flavonoids are a group of secondary metabolites found in most families. They are known to have important physiological functions in plants by protecting them against biotic stresses. The aim of the study was to revealed, identification, quantification and determination of an influence of the flavonoids content on the pea aphid and examined the effects of selected flavonoid glycosides on pea aphid behavior. Liquid chromatography (HPLC) was used to determine the flavonoid profiles and their concentration in aerial parts of three alfalfa cultivars. The performance tests and population parameters were used to determine the influence of the plants on aphid growth and development. Electrical penetration graphs (DC EPG) were used to monitor the feeding behavior of the pea aphid on studied plants. It was shown correlation between the concentration of flavonoids in the alfalfa plants and pea aphid behavior. This finding may indicate the importance of flavonoids as nutritional compounds.

Key words: Fabaceae, Flavonoids, Pea Aphid

Organic Rice and Fishery Cooperation System- a New Integrated Aquaculture and Agriculture System

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Abstract: The world's natural fisheries resources have already been facing a severe recession, and the current aquaculture is not sustainable. In general, the world's agriculture and aquaculture are manifested as distinct characteristics of oil agriculture. Rapid population growth produces a double challenge to ecology and food. Newly efficient and sustainable ecological agriculture, animal husbandry and aquaculture will present in the form of integrated aquaculture and agriculture (IAA). China's paddy field farming has a history of 1,000 years, the paddy field farming system has been a new development in the last 20 years, and achieved rapid development and progress. The emergence of such as Panjin crab and rice cooperation, Qianjiang lobster model, Zhejiang Qingtian paddy field fish farming, paddy fields mixed loach, eel and other forms. However, these paddy fields are in the form of polyculture (continuous or symbiotic) of paddy fields, and the rice system is not in parallel with each other or in series with other farming systems to form a better IAA or IMTA form. The One of the main reasons is that rice farming should take in account rice production, often using certain fertilizers and pesticides. The use of rice as a prerequisite for the IAA to achieve no fertilizer, pesticide production, in fact, is the cultivation of organic rice production, so as to high-quality role for fish farming or other high-density farming system emissions pollution treatment used, eventually combined into an IAA farming system.The organic rice farming system and other aquaculture systems are combined into one IAA farming systems in parallel. The complex ecological farming implement the new model will achieve revolutionary advances in aquaculture, integrated together fisheries science, ecology principles, multi-trophic aquaculture theory to achieve a paddy field-based fisheries objectives. This system was named Organic rice and fishery cooperation system which achieved efficient, ecological, water conservation, organic, and many other targets for aquaculture. The system includes four core technology, the ecosystem water cycle technology, complex ecosystem building technology, precision farming technology, Integrated Pest Management （ IPM ） technology. Final experimental farm of 700 acres, formed into one mode of 0.20 Million kilograms (bait fish), output 0.30 Million kilograms plant and 0.15 Million kilograms of animal. In short, the Organic rice and fishery cooperation system not only to achieve a higher income, but also to obtain higher ecosystem services, ecological agriculture will play to maximize the comprehensive functionality, is a new form of complex ecological cycle of agriculture, combined blue revolution with green revolution, integrated innovation and sustainable agricultural development in the form.

Key words: Organic Rice and Fishery Cooperation System, Integrated Aquaculture-Agriculture

Modeling the Effects of Planting Density on Wood Productivity and Carbon Sequestration of Populus Dehoides Plantations in Northern Jiangsu, China

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Abstract: It is essential to evaluate how forest management practices influence wood productivity and carbon uptake of managed forest in the context of climate change. In order to quantify the response of forest to different planting density, a process-based model, TRIPLEX-Management, was improved to simulate the effects of planting density on the carbon cycle of Populus dehoides plantations. Natural mortality was set to be zero so that the stand density in the model can be fixed as same as the initial planting density. The modified model was then tested against observational data for Populus dehoides subjected to different stand density in northern Jiangsu, China. The model evaluation indices showed a dense agreement between observations and simulations. To get a better agreement, the carbon allocation component was then improved using evolution-based methods. We tested two different allocation strategies: optimal response (OR) model and game-theoretical optimization (GTO) model. We found that both allocation models can improve the prediction results and a OR model predicts similar allocation to a GTO model under the younger (<12) stands regardless of the planting density suggesting that the high planting density with a shorter rotation length to some extent could have high wood productivity but not necessarily high carbon sequestration.

Key words: Wood Productivity, Carbon Uptake, Model, Planting Density

An Overview on Payments for Watershed Ecosystem Services in China and Other Countries

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Abstract: The payment for watershed ecosystem services (PWES), as a policy instrument for compensating externality of watershed ecosystem/environmental services, has gained policy importance in China the past two decades. Many scholars and researchers contributed to conceptualizing policy framework, developing the

operational mechanisms as well as compensation standards for PWES. This article reviews 28 PWES schemes piloted in China and other 10 countries, with particular emphasis on successful cases pertaining to convert land use patterns such as Converting Paddy Land to Dry Land Program (PLDL) and Sloping Land Conversion Program (SLCP) implemented in China. Through comparing different cases, the authors attempt to answer the following questions: In which ecological and institutional contexts were these schemes established and how did they work? What about actual efficiencies and impacts of these piloted schemes? Which scheme worked better in certain ecological, socio-economic and institutional contexts? Based on the case studies, the authors draw following conclusions for Chinese PWES: (i) To set up acceptable standard for PES program, it is necessary to estimate the economic and social costs of household livelihoods; (ii) Multi-stakeholder negotiation mechanism on PWES including intermediaries such as local government, NGO/NPOs, village committees, user associations should be considered; (iii) ES, as non-market services, should acquire positive externalities to accomplish optimal win-win pattern concerning both environmental goals and livelihoods of the native resource users.

Key words: Payment For Watershed Eco-Services, Case Study, Mechanism,

Ecological rice farming in the planting areas of southeast China

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Abstract: Fujian province is located in the southeast of China and considered as the main rice cultivation region with ample heat and abundant rainfall resources in southern China, it is considered as the sites suitable for the development of organic agriculture. In this study, we have explored a suitable agroecological cultivation model for rice in the planting area of middle part of the Fujian province. In this model, the endemic reed, calamus, rushes and other local aquatic plants were transplanted to build a healthy aquatic plant purification ecosystem. The seeds of Chinese milk vetch or rape crop were grew in the winter and then to be cut and mixed in soil as green manures in March, which effectively increase the content of organic matter in soil. The rice varieties with different genetic backgrounds, which are suitable for local environmental conditions, were screened, and mixed cultivation of different rice varieties was implemented to achieve the diversity of rice plantation. This cultivation method effectively prevented the outbreak of rice diseases, especially against the rice blast, showing the control rates by 81.1% ~ 98.6%. In addition, the study showed that this farming practice performed in terms of stronger resistance to lodging and 6.5% ~ 9.7% higher grain yield than conventional cultivation with single cultivar in the research base. Additionally, a special cropping system of ratooning rice was implemented, which

increased the genetic diversity in the rice field habitat, and making the rice field system more resistant to pests and diseases, thereby greatly reducing pesticide application rates in rice fields. Moreover, the field management adopted mixed trapping plantation such as the Vetiveria zizanioides, the coreopsis, and the soybean grown together on the ridge to achieve effective control over pests in the paddy fields. Most importantly, the study introduced the third-party certification body to give the good agricultural practice certification to normalize each link of the production process and tried to build an innocuous ecological environment to coordinate the relationships between rice production and environment protection. Our case of this agroecological rice farming brings economic, ecological and environmental benefits, which enriches the practice of agro-ecological production in the southeast of China.

Key words: Rice, Agroecology, Sustainable Agriculture, Biodiversit

Study on the Community Dynamics of Xylophagous Insects According to the Thinning History in Larch (Larixkaempferi) Forest in South Korea

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Abstract: Xylophagous insects, attacking weakened trees, have a potential to be a threat to forests due to increase in stressed trees by climate change.Thinning can either mitigate the risk of xylophagousinsects by eliminating weakened trees, or act as a disturbing factortostress trees.Therefore, this study was investigated to the community dynamics of xylophagous insects according to the thinning history in larch (Larixkaempferi (Lamb.) Carr.), one of major artificial planting species, in South Korea.Four study sites – thinned in 2010, 2012spring, and 2012autumnand has never been thinned at least recent 5 years (control) – were selceted and surveyed from 2013 to 2015. 12-Lindgren funnel trap with bubble-cap lures(Ipsenol, Ipsedienol) wasusedwith 5 replicates at each site and composition and density of xylophagous beetles were surveyed biweekly to thinning.Diversity index was initially low after thinning, but gradually increases and becomes similar to control site after 3-4 years later. On the contrary, the dominance index was high after thinning, but gradually decreases.The density of Ipssubelongatus, the first dominant species,is very high in immediately after thinning, which seems to have an effect on the diversity and dominance index. The fraction of genus Ipswithin Scolytinaewasover 90% and their dominancy was maintained up to 1-2 years.3-4 years after thinning, the dominancy of genus Ips decreases.Based onthe indicator species analysis, eight species of Scolytinae including genus Ips were found to be indicatorsfor immediately-thinning larch forest, 7 of them

were bark beetles.The indicator values of Ipssubelongatus, I.acuminatus, and I. sexdentatus were 55.8 (p = 0.0002), 65.7 (p = 0.0002), and 48.2 (p = 0.0286), respectively. In the control site, three species were found to be indicators and all of them were ambrosia beetles. Therefore, 3-4 years after the thinning, the outbreak risk of genus Ipscould bereduced, but the community composition was notthe similar to that of control site.

Key words: Xylophagous Insects, Thinning, Larch Forest, Community Index

Transcriptome Analysis of Pseudostellaria Heterophylla in Response to the Infection of Pathogenic Fusarium Oxysporum

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Abstract: Pseudostellaria heterophylla (P. heterophylla), an herbaceous perennial, belongs to Caryophyllaceae family and is one of the Chinese herbal medicine with high pharmacodynamic value. The specialized forms of pathogenic fungus Fusarium oxysporum f.sp. Heterophylla (F. oxysporum) in rhizosphere soils of P. heterophylla plays an important role in consecutive monoculture of P. heterophylla. In this study, F. oxysporum was used to infect the tissue culture plantlets of P. heterophylla to study the responding process at three different infection stages by using RNA-sequencing. We obtained 127,725 transcripts and 47,655 distinct unigenes by de novo assembly and obtained annotated information in details for 25,882 unigenes. The Kyoto Encyclopedia of Genes and Genomes pathway analysis and the real-time quantitative PCR results suggest that the calcium signal system and WRKY transcription factor in the plant-pathogen interaction pathway may play an important role in the response process. Moreover, we also found that the stimulation of F. oxysporum may result in the accumulation of some phenolic acids in the plantlets and the population explosion of F. oxysporum in rhizosphere soils. Our studies have partly revealed the molecular mechanism, which can be helpful in unraveling the role of F. oxysporum in consecutive monoculture problems of P. heterophylla.

Key words: Consecutive Monoculture Problems, Transcriptome, P. Heterophylla, F. Oxysporum

No Evident Correlation between Veterinary Antibiotic Degradation Ability and Resistance of Isolated Efficient Degradation Microorganisms for Doxycycline

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Abstract: Currently, used microorganisms to degrade antibiotic faced great challenges because the resistance in the degradation process is not known. This study observed the changed of resistant gene during antibiotic degradation by 5 different microbial and discuss the relationship between veterinary antibiotic degradation ability and the antibiotic resistance genes generated by microorganism. The results showed that there was no evident correlation between the DOX degradation ability and resistance of isolated efficient degradation microorganisms. Escherichia sp. and Candida sp. were the most efficient strains at degrading DOX (92.52±0.33% and 91.63±0.50%, respectively), and their tetracycline resistance genes showed a relatively low risk of antibiotic resistance in a 7-day experiment. Moreover, the tetM of the ribosomal protection protein genes carried by these 2 preponderant bacteria was 5 orders of magnitude greater than that carried by other isolates for the overall experiment ($P<0.05$). Pearson's correlations between the Ct/C0 of DOX and Tet resistance genes of 3 isolates, except for Escherichia sp. and Candida sp., showed remarkable negative correlations ($P<0.05$), which was mainly because tetG had an obvious increase during DOX degradation. Therefore, we supposed that Escherichia sp. and Candida sp. might be considered ideal microorganisms for engineering environmentally friendly bacteria.
Key words: Doxycycline, Degradation Ability, Resistance, Degradation Microorganisms

Bacillus Stearothermophilus Reduces Ammonia Emissions in Layer Manure Composting

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Abstract: To reduce ammonia emissions during layer feces composting, batch experiments were conducted by adding Bacillus stearothermophilus using an aerobic composting reactor with sawdust as a bulking agent. The results show that ammonia emissions were mainly occurred in warming and the beginning of high-temperature period during composting. The ammonia emissions in control were significantly higher than treatment with 5.33 g/kg initial Bacillus stearothermophilus. The application of Bacillus stearothermophilus can accelerate the rate of temperature increase and

significantly decrease pH in high-temperature periods; MiSeq System Sequencing results find that the addition of Bacillus stearothermophilus changed the bacterial community structure under warming and high-temperature periods during composting, increased the relative abundance of lactic acid bacillus, and improved the relative abundance of nitrification bacteria. These might be resulted in the lower pH and high nitrification and could be the reason for the low ammonia emission in Bacillus stearothermophilus treatments.
Key words: Layer Manure, Composting, Ammonia, Bacillus Stearothermophilus

Impact of Grass Barrier on Runoff, Sediment and Nutrient Loads from Maize Fields in Northeast China

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Abstract: The most of the reservoirs are threatened by high nutrient inputs and eutrophication caused by runoff from agriculture in the Mollisols region of northeastern China. Vegetative filter strips（FS）adjacent to a streamside is one of the measures which can reduce non-point pollution. Recently, narrow grass barrier（B）(proximately 1.2 m), planted on the contour, have been used as a conservation measure.It may be more acceptable to farmers because they occupy much less land than FS. However, most studies have been conducted in the laboratory. Little work has been conducted to evaluate the field performance of grass barrier. The purpose of this paper is to examine essential design criteria which influence the effect of barrie.The experimental site was established in the Xingmu Erosion and Environment Research Station of the Soil and Water Conservation Institute of Jilin Province, China. Six study plots with an area of 5 m x 20 m each with maize production, and middle and lower part with a narrow grass hedges area of 1m x 1m (four plots) and no grass barrier (two reference plots), respectively, were used in two slopes. The dominant plant species of the B were alfalfa [Medicago sativa L] and green bristlegrass [Setaira viridis (L.)Beauv.] Surface runoff from the plots was led through inlet pipes to measuring stations with a tipping bucket system equipped with a mechanical counter and a datalogger. The water samples are analysed according to Chinese standards. The results show significantly higher removal efficiency (in %) from 5° plots compared to 3°; however, the SS retention is almost equal in the different slope. Grass barrier can receive particle runoff over several days without a significant decrease in their removal level. Retention efficiency between spring and summer and autumn varied depending on the measured parameter (runoff, SS, total phosphorus and total nitrogen), and there were no significant differences in removal efficiency between summer and autumn. In general, narrow grass barrier was

more effective during summer and autumn due to higher vegetation density and developed root system and therefore higher trapping efficiency of sediment particles and particle-bound nutrients and uptake of nutrients in the vegetation. The results show significant differences between alfalfa barrier and green bristlegrass barrier regarding their retention efficiency for nitrogen and phosphorus. Alfalfa barrier is an effective trap for particles and particle bound nutrient in different slopes. Average removal efficiency for the experimental period was 45%, 66%, 47% and 52% for runoff, sediment, TN and TP, respectively in this grass barrier type. There was higher retention efficiency for particles than runoff in grass barrier. Thus, this technology is suitable for soil and water conservation of the drinking water source area.

Key words: Design Criteria, Nutrient and Particle Removal, Retention Efficiency, Vegetative Filter Strips

Transcriptomic Analyses for Responses of Saponin Accumulation and Its Heterogeneity in Main Roots of Panax Notoginseng to as Stress

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Abstract: Saponin is the key medicinal composition of P. notoginseng, which is one of important traditional herbal medicines in the genus of Panax in China. The underlying genetic basis of saponin regulation under As stress is not elucidated. The contents of saponin (R1, Rg1, Rb1), relative key enzyme squalene synthase (SS) in main roots of P. notoginseng under different As treatment concentration (As5+: 0, 20, 140 mg/kg) were deterimined at early flowering stage. Meanwhile, candidate genes involved in saponin were identified based on the transcriptomes of P. notoginseng roots compared using RNA sequencing (RNA-seq). The results showed that saponin (R1, Rg1, Rb1) contents and accumulation rates increased and SS activities decreased with increase in As treatment concentrations. Genes relating to As stress showed distinct patterns, with genes encoding environmental information processing and terpenoid metabolism. Metabolism processing associated with saponin metabolism was identified. Genes of key enzymes relating to the pathways of saponin biosynthesis were identified, including relative genes: CYP71D444 and CYP73A100 for conversion from protopanaxadiol to protopanaxatriol, UGTPg25 for glycosylation and PnSE2 for oxidosqualene. The results indicate that expression patterns of As-regulated transcript in P. notoginseng would be instrument in revealing the genetic networks that govern saponin biosynthesis under As stress.

Key words: Panax Notoginseng, As, Differential Expressed Genes, Saponins

Effects of Soil Amendments on Labile Organic Carbon and Soil Enzymes Activities in Upland Red Soil

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Abstract: To resolve the problems of low fertility and productivity in upland red soil in Jiangxi Province, a field long-term experiment was conducted to study the effects of soil amendments (biochar and calcium peroxide) on soil labile organic carbon fractions and soil enzymes activities associated with carbon cycling in upland red soil. The experiment included nine doses of CK (control), C_0Ca_1, C_0Ca_2, C_1Ca_0, C_2Ca_0, C_1Ca_1, C_1Ca_2, C_2Ca_1, C_2Ca_2. C_0, C_1 and C_2 included the doses of 0, 758 and 1515 kg•hm^{-2}•a^{-1} biochar, Ca_0, Ca_1 and Ca_2 included the doses of 0, 61 and 121 kg•hm^{-2}•a-1 calcium peroxide, respectively. The results showed that, Biochar of single application and combined application of biochar and calcium peroxide were beneficial to increase the contents of organic carbon and labile organic carbon fractions in upland red soil, and the effect was greater than calcium peroxide of single application. The soil organic carbon under C_2Ca_0, $C_2Ca_1$and C_2Ca_2 treatments increased significantly. Biochar and calcium peroxide significantly increased the soil labile organic carbon fractions. The content of microbial biomass carbon average increased by 45.22% in C_1Ca_0 treatment, dissolved organic carbon increased by 21.34% in C_1Ca_2 treatment, particulate organic carbon increased by 20.72% in C_1Ca_0 treatment, labile organic carbon increased by 22.19% in C_2Ca_2 treatment. Biochar and calcium peroxide index had a better results to improve carbon management index that average increased by 11.09% and 14.07% in 0—10 cm and 10—20 cm soil layer, respectively. The enzyme activities were promoted with the addition of the biochar in upland red soil, and the effects of the 0—10 cm soil layer was more obvious than 10—20 cm soil layer. The combined application (C_2Ca_2) significantly improved amylase activity, cellulase activity and β-glucosidase activity in upland red soil. The C_1Ca_1 treatment significantly improved invertase activity in upland red soil. Therefore, the biochar and calcium peroxide can effectively improve labile organic carbon fractions and soil enzymes activities associated with carbon cycling in upland red soil, and the combined application of biochar and calcium peroxide was more helpful to soil improvement.

Key words: Soil Amendment, Upland Red Soil, Labile Organic Carbon, Soil Enzymes

Predicting Phenological Changes of Monochamus Alternatus and Monochamus Saltuarius, Vector Insects of Pine Wilt Nematode in Korea, Under the Influence of Climate Change Using Phenology Model

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Abstract: Climate change has led to an advance in phenology of many insect species. Predicting the phenological change of insect pest to climate change can make us possible to evaluate the impact of climate change as well as to determine the optimal timing for control of the pest. Pine wilt disease caused by the pine wood nematode, Bursaphelenchus xylophilus (Steiner and Buhrer) Nickle, is a serious invasive pest for pine trees in many countries, including South Korea, Japan, China and Europe. The Japanese pine sawyer, Monochamus alternatus (Hope) and long-horned beetle, M. saltuarius Gebler are vectors of pine wood nematode in South Korea. In this study, future phenology of both two insect vectors was simulated using their phenology model based on climate-change data of the scenario RCP (Representative Concentration Pathway) 4.5 and 8.5, and then the phenological changes by climate change were quantified. Our results showed that the median dates of emergence of M. saltuarius and M. alternatus were advanced on a national scale during the 2020-2050 in both scenarios. The median dates of emergence of M. saltuarius in 2020 predicted by RCP 4.5 and 8.5 scenarios were May 26 and May 29 and predicted those dates in 2050 year were May 26 and May 18, indicating that the median dates of emergence in 2020 and 2050 were similar (RCP 4.5) and advanced by 11 days (RCP 8.5), respectively. In the case of M. alternatus, the median date of emergence for RCP 4.5 and 8.5 were advanced by 9 (from July 7 in 2020 to June 29 in 2050) and 12 days (from July 4 in 2020 to June 23 in 2050), respectively. Therefore, further studies on the climate change driven changes in two insect vectors and planning and development of adaptive management strategies will be required.

Key words: Climate Change, Pine Wilt Disease, Vector Insect, Phenological Change

Timing and Concentration Effects on the Defense Response of Maize Seedlings after Application of Salicylic Acid to Leaves

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Abstract: Five salicylic acid concentrations (0.1, 0.5, 1.0, 2.5 and 5 mmol•L^{-1}) were

applied to the leaves of maize 5422 seedlings (Zea mays) for 3, 12, 24, 48 and 72 h. Then the contents of direct defense substances (DIMBOA and total phenol) and activities of four defense-related protective enzymes (Polyphenol oxidase, peroxidase, Superoxide dismutase, Catalase) were investigated for the treated part (leaves) and non-treated part (roots) of seedlings, so as to explore whether there were timing and concentration effects in the defense response of leaves and roots after the maize seedlings treated with salicylic acid. The results showed that salicylic acid application to the leaves could directly affect the defense response in leaves. Salicylic acid of 0.5-2.5 mM significantly increased the defense substances contents and protective enzymes activities in 12-24 h. Besides, salicylic acid application to the leaves could also indirectly affect the defense response in roots. After the application of 2.5 mM salicylic acid to the leaves of seedling for 24-48 h, the defense substances contents and protective enzymes activities in roots were obviously enhanced. The results suggested that exogenous salicylic acid application to the leaves of maize seedlings had some timing and concentration effects to the defense response in both the leaves and roots. However, the indirect induced effects in the roots were weaker than the direct induced effects in the leaves. The time for the roots to start the defense response was also later than the leaves.

Key words: Zea Mays, Salicylic Acid, Defense Response, Timing and Concentration Effects

Fall Nitrogen Application Is a Proper Choice to Increase Perennial Grass Seed Yield in Leymus Chenisis Grassland

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Abstract: As dominant species in natural grasslands, perennial grasses have been considered as promising plants to restore the degraded grassland and establish new grassland in margin region. Nitrogen fertilizer application could dramatically facilitate seed productivity increase in annual cropping system. However, researches about how to increase seed productivity in perennial grassland and how about the relationship between N derived benefits and its potential loss to environment during seed production is still uncertain. We conducted a lysimeter 15N experiment in Leymus chenisis grassland, aiming to: (1) clarify impact of nitrogen application timing and rate on seed yield and N-recovery/loss rate; and (2) develop a simple method to evaluate seed production and N-loss simultaneously.

We established a full factorial experiment in a lysimeter facility with two factors: N application timings [fall (post-fruiting vegetation stage, early August) and spring

(regrowth stage, early May, respectively], and N application rates [0 kg N ha–1 (control), 56 kg N ha–1 (low N) and 112 kg N ha–1 (high N), respectively] for a total of 6 treatments combinations. Four replications per combination of treatments were designed, for a total of 24 plots. Dry 15N-labeled urea (10.15 % atom15N abundance) was manually applied to the soil surface and then watered with 5 L m-2 of water to dissolve it. Each lysimeter was a cylindrical metal tank (65 cm deep and 50 cm in diameter). The lysimeters were filled with monoliths (soil with plant cover) of artificial Leymus chinensis grassland obtained in spring of 2012.

Seed yield was significantly higher under fall nitrogen application than under spring nitrogen application. The maximum seed yield (138.63 kg ha^{-1}) was under fall nitrogen application with high rate, which was 294% higher than no nitrogen fertilizer. The significantly positive effects of nitrogen fertilizer on seed yield under fall nitrogen application were largely due to the positive effects of nitrogen application on inflorescence number in the next year. The ratio of seed yield increment (difference between nitrogen fertilizer application and no fertilizer) to nitrogen loss was 80.7% higher in fall nitrogen application than in spring nitrogen application. When nitrogen was applied in fall, the ratio was 16.9% greater under high nitrogen rate than under low nitrogen rate. The overall trend of the ratio was consistent with seed yield value.

In conclusion, seed yield of Leymus chenisis increased more significantly under fall nitrogen application than under spring nitrogen application. Seed yield increment to N-loss ratio is an effective approach and can assess the nitrogen benefits and risks simultaneously during perennial grasses seed production in semi-arid regions. We concluded that, fall nitrogen application with high rate is a proper choice to get higher seed yield with relatively less nitrogen loss to the environment.

Key words: Seed Yield, Lysimeter 15N, N Loss, Leymus Chenisis

Measuring Agricultural Production Efficiency under Climate Change Mitigation Constraints

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Abstract: With the increase of greenhouse gas emissions in the atmosphere, global greenhouse effects has intensified, thus contributing to climate change and a series of environmental and ecological problems, and has a dramatic impact on human well-beings. While agriculture is contributing to the global climate change by means of increasing gases emission in the atmosphere; the climate change in turn affect the agricultural production by altering the growth, yield as well as the nutritional quality of crops. In this paper, we calculated carbon sequestration and carbon emissions from

agroecosystem and analyzed their spatial-temporal distribution in Hebei Province during 2000-2010. By adopting a parametric directional distance approach, we then measure agricultural production efficiency under the constraints of climate change mitigation during 2000-2010, which considering the net carbon emission from agroecosystem as an undesirable output. For further analysis, we explore the influencing factors (temperature, precipitation, natural disaster, etc.) of the low-carbon agricultural production efficiency by using Tobit model. The research results provide significant references for developing sustainable, climate-resilient and adaptive agriculture to maintain the productivity of agroecosystem under changing climatic conditions.

Key words: Agroecosystem, Carbon Emission, Agricultural Production Efficiency, Climate Change Mitigation

Soil Microbial Community Structure and Catabolic Activity Are Significantly Degenerated in Successive Rotations of Chinese Fir Plantations

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Abstract: This study examined the hypotheses that soil microbial community composition and catabolic activity would significantly degenerated by consecutive monoculture in Chinese fir plantations. The phospholipid fatty acids (PLFA) combined with community level physiological profiles (CLPP) methods were used to assess the variations of soil microbial community in the first rotation Chinese fir plantation (FCP) , the second rotation plantation (SCP) and the third rotation plantation (TCP). The total content of PLFA biomarkers was highest in FCP, followed by SCP, and TCP was the least detected. Conversely, the fungi/bacteria ratio significantly increased in the SCP and TCP soils. The average well-color development (AWCD) values significantly decreased in consecutive monoculture plantations (FCP > SCP > TCP). However, the sum of AWCD values of amino acids, carboxylic acids and phenolic compounds were higher significantly in the SCP and TCP soils than FCP soils, suggesting that the microflora feeding on acids gradually became predominant in the continuous monoculture plantation soils. Soil nutrient content play an important role in shaping microbial communities, and soil C/N ratio was one of the most important factors to soil microbial diversity. Both the PLFA and CLPP results illustrated that the long-term pure plantation pattern exacerbated the microecological imbalance in the rhizospheric soils of Chinese fir, and markedly decreased the soil microbial community diversity and metabolic activity.

Key words: Soil Microbes, Community Composition, Consecutive Monoculture, Chinese Fir

Aquaculture and Water Quality Maintenance in Nansi Lake, China

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Abstract: Objective: In order to evaluate the effects of fishery culture on the water environment of Nansi Lake, the differences of water temperature, pH, total nitrogen, total phosphorus and chlorophyll a in natural fishing area, temporary no-fishing zone and fence culture zone were analyzed. Aquaculture on the surrounding waters, combined with public visits and fishermen to visit the questionnaire results, with a view to the fisheries production, management and scientific research departments to provide the basis for the Nansi Lake waters economic, social and environmental coordination and development of practical significance and guiding value.

Methods: Three water samples were collected from Nansi Lake, three times each time, natural fishing area, temporary fishing area and fence culture area. Five parallel sampling points were set in each water sample, and pH and water temperature were measured in situ. , Laboratory analysis of total nitrogen, total phosphorus and chlorophyll a content. Questionnaires were divided in fishermen visits and public visits.

Research result: 1) The water temperature of Nansi Lake varied significantly among different seasons, but there was no significant difference in the same seasons. There was no significant difference in pH and TP between different seasons and seasons. The content of total nitrogen in water was significantly different among different seasons, and the total nitrogen content in fishery area was significantly higher than that in seasons. Chlorophyll a content in water was significantly different in different seasons, and the content of chlorophyll a in the same seasons was significantly lower than that in natural catching area.

2) The total nitrogen content of water, natural fishing area for the IV-inferior V class water, purse seine and temporary fishing area are inferior V class water. The total phosphorus content of the water, natural fishing areas and temporary fishing areas are Class III water, purse-seining area for the IV-V class of water. Water content of chlorophyll a, natural fishing area and temporary fishing season are V-inferior V class water, aquaculture area for the IV-bad V class of water.

3) It is estimated that Nansihu aquaculture production value of about 1.5 billion yuan, while the aquaculture area of water up to about 400,000 yuan, can keep the breeding project.

Key words: Nansi Lake, Aquaculture, Fence

The Utilization of Fungi Waste in Large-Scale Broilers Breeding

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Abstract: At present, looking for a cheap substitute of antibiotics has been paid great attention and become a new research focus in the large-scale feeding of broiler chicken. This experiment was conducted to study the effect of dietary fungi waste on the production performance, the mortality rate and the blood biochemical indexes of broiler. A total of 4550 one-day AA+ broilers were divided randomly in 5 groups with 7 replications. The diets containing five levels of FW (0%, 2%, 4%, 6%, 6% alternating weekly) during the total experimental period of 42 days. The results showed that there was no significance difference for production performance among the groups but the mortality rate was significantly reduced ($P<0.05$) in supplemented group than control. At day 21, supplementation of FW (2%, 6%，6% alternating) significantly decreased ($P<0.05$) the serum total fat. At day 42, dietary supplementation of FW significantly decreased （$P<0.05$）serum total cholesterol and low density lipoprotein(LDL).

Key words: Fungi Waste, Broiler, Production Performance

T12-02: Ecosystem Services and Management of Agricultural Heritage Systems

Study of the Zoning Planning of Agriculture Heritage Sites

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Abstract: Agricultural Heritage is a series of living and multifunctional agricultural production systems. With the governments' increasing attention to the traditional culture promotion and integration of three industries, agricultural heritage has become an important carrier and new development engine for rural development along with agro-biodiversity and cultural diversity conservation.

The conservation and development planning of agricultural cultural heritage is not only the guide for the protection of heritage systems, but also the important basis for the sustainable development of Agriculture in heritage sites.This planning is different from the master plan of protected areas such as World Heritage and National Park because local farmers and their livelihood are key sector to maintain authenticity of agricultural heritage.And the planning of agricultural heritage cannot be simply considered as a rural planning or agricultural industry planning as agricultural heritage site is also an type of historical and cultural heritage site. In this paper, the zoning planning, an important approach to balance the relations between protection and utilization, is introduced to agricultural heritage.This research first analyzes the zoning systems in World Heritage and National Parks aboard as well as the situation and problems in planning of agricultural heritage in China. Then the author establishes a zoning planning system of agricultural heritage, which integrates the protection zoning based on resources values and sub-zoning based on multi-functions.The management requirements for the protection and development of heritage resources in each region are also put forward.

Key words: Agriculture Heritage, Zoning Planning, Protection and Development

Preliminary Analysis of Seasonal Growth Rhythm of Timber Volume for Rubber Clone Reken 525 and Correlation with Meteorological Factors

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Abstract: The timber volume of rubber tree clone Reken 525 was studied based on periodic and pointing observation method. Artificial timber plantation productivity is an important part of plantation ecosystem. A Richard equation was formulated to describe the main timber volume growth dynamics of rubber clone Reken 525. An area correlation analysis was done according to the closeness of the observed parameters to the dynamic curve on the gray system composed of the main timber volume growth increment and the meteorological factors including aerial temperature, precipitation and solar radiation hours that exerted influence upon the main timber volume growth. The results showed that the growth increment displayed a distinct alternation of "slow - fast - slow - fast - slow" rhythm. Main timber volume response fitted the Richards equation quite well. The growth course of the main timber volume might be partitioned in three periods of time by the sequential clustering analysis, namely pre-growing(1-5 m), fast-growing(6-10 m), late-growing stage(11-12 m)，respectively. Fast-growing period mainly fasten on rainy season and timber volume growth of Reken 525 of the whole year did not rest period. The tray correlation analysis revealed that precipitation had the most significant influence while solar radiation hours had the least impact on main timber volume growth of 5 year old timber/latex clone Reken 525. Combined with the timber volume of rubber tree and its phenology，scientific and reasonable management configuration of water，fertilizer and light agricultural resources could realize the fast-growing and high-yielding rubber tree.
Key words: Brazil Rubber Tree (Hevea Brasiliensis), Timber Volume, Growth Rhyth, Gray Correlation

Optimizing Ecosystem Services of Rice Paddy Fields in Taiwan

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Abstract: Agricultural food supply sustaining human existence can be considered as national security strategic materials. In addition to offer food supply, agricultural ecosystems can also serve other ecosystem services, including support, regulation and culture services. Mechanistic understanding of interactions among agricultural ecosystem serveries under climate change is the cornerstone for both current and future developments of sustainable agriculture. We conducted a three-year project to continue the previous project "Agricultural long-term ecological research and application" in 2006 for entering the second stage of searching adaptation strategy under climate change. We developed state-of-the-art technologies to quantify main ecosystem functions to fill the research gap of the first stage and established an integrated assessment method for ecosystem services; in practice, we will quantify effects of

climate change, practices of sustainable and conventional farming methods, and crop rotation on ecosystem services in paddy fields. This quantified information would help us to optimize the management strategy, and also to construct the adaptive strategies to mitigate climate change. In this project, we primarily quantified the carbon and nitrogen cycles, crop disease and pest control, biodiversity, crop productivity, and soil fertility, as well as conducted overall integration of ecosystem services and valuation analysis in paddy fields. We quantified the capacity of greenhouse gas emissions, carbon sequestration, and nitrogen leaching (cycle), as well as determined the relationships among agricultural biodiversity, ecological functions, and ecosystem services. We tested the following hypotheses: (1) Rice paddy fields are carbon sinks rather than sources; (2) Amount of greenhouse gas emissions from paddy fields varies with climate change and farming; (3) Amount of carbon sequestration in paddy fields varies with climate change and farming; (4) Amount of nitrogen leaching in paddy fields varies with climate change and farming.

Key words: Agricultural ecosystems, Greenhouse gas emission, Carbon sequestration, Nitrogen leaching

Sustainable Development of Red Soil Upland Ecosystem in South China

Guoqin Huang

China

Abstract: Red soil upland is an important agricultural soil resource in South china. The development and utilization of upland red soil resources in South China, realize the sustainable development of upland ecosystem, not only have the important practical significance for the realization of sustainable development of agriculture in the southern region, but also to ensure the strategic significance of significant and profound healthy and steady development of agriculture and rural ecological system of the whole country.

At present, the sustainable development of red soil upland ecosystem in southern China is facing a series of production constraints, which seriously hinders the agricultural high yield and farmers' income increase. Including these outstanding production limiting factors: (1) acid. Acid Red Soil Upland South, affecting crop growth; (2) thin. Barren soil in upland red soil, lack of fertilizer significantly; (3) sticky. Physical properties of red soil sticky, dry bad, heavy soil, is not conducive to farming; (4) plate. Upland red soil easily cause soil compaction, tillage, crop root growth and development; (5) drought. Annual precipitation of red soil in southern China is abundant, but the distribution is very uneven, there are serious seasonal drought, especially in the annual

summer and autumn season, prone to drought and autumn drought, the end of the year, the crop yield is extremely unfavorable; (6) erosion, often due to erosion in upland red soil caused serious soil erosion, the so-called" The red desert "; (7) poison. In recent twenty years, due to excessive use of chemical fertilizers and pesticides, as well as manure, garbage, industrial waste" and "improper disposal", causing serious environmental pollution from upland red soil, red soil containing many kinds of poisonous and harmful substances, especially this is a heavy metal content exceed the standard, poses a serious threat to food security, food safety red soil area.

In order to realize the sustainable development of red soil upland ecosystem, it is necessary to take active and effective measures and measures to solve these problems: (1) to strengthen ecological construction. To carry out afforestation, improve red soil area forest coverage, improve the overall regional ecological landscape; (2) to carry out environmental remediation. Find out the cause of red soil pollution source, resolutely remediation; for contaminated soils, to take various measures to repair (such as physical remediation measures and chemical remediation measures and biological remediation measures, etc.) to repair as soon as possible; (3) to improve water conditions. To strengthen the construction of basic farmland in red soil area, improve upland red soil water conditions fundamentally; (4) to optimize crop distribution. According to the principle of agricultural tridimensional layout in Hilly Red Soil in southern mountain area, optimization of red soil upland crop layout, realize the three-dimensional layout, variety, planting fine and high output; (5) to plant nourishing-land crops. According to the characteristics of the soil barren upland red soil, as much as possible planting Chinese Milk-vetch, radish, beans, peas, rapeseed, soybean and other "pioneer show", "nourishing crops"; (7) to implement crop rotation and fallow. To have been seriously polluted, not suitable for planting edible crops in red soil upland farmland, fallow rotation should be applied to completely, "restore" and "repair", can be re used; (8) to establish the long-term mechanism. In the long run, in order to ensure the sustainable development of red soil upland ecosystem, it is necessary to establish the appropriate regulations and systems for the use of red soil upland in accordance with the relevant laws and regulations of the country.

Key words: Red Soil upland, ecosystem, sustainable development

Design and Functioning of an Information System for Dynamic Management of Rural Ecological Assets

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Abstract: In recent years, the assessment and management of ecological assets including natural resources and ecosystem services have been a hot spot in the fields of ecological economy, natural resources management, land utilization and sustainable development. Because ecosystem services assessment didn't entered the market, it tends to be ignored easily in the economic and market decisions. There have already been some powerful and widely applied software platforms such as ARIES model (artificial intelligence for ecosystem services) developed by the University of Vermont in the United States, SolVES model (social values for ecosystem services) developed by the US Geological Survey (USGS) and Colorado State University and InVEST model (integrated valuation of ecosystem services and between) developed by the natural capital project in the Stanford University. However, the established methods and software tools for ecological assets assessment were mainly based on the datasets from regional, basin and other large administrative or natural management units. Few models and software tools were adapted to assessment and management of ecological assets at village scale of rural areas. Nowadays, it is critical to develop a management tool for ecological assets at village scale in China to prevent loss of ecological assets during the rapid urbanization and industrialization. Taking Fanggan village which located in Shandong Province, as a case, we proposed an indicator framework by binding ecological assets with specific land use types. We also modified some indicators in the existing assessment methods to meet the requirements of ecological assets assessment at the small scale. Adapting to the needs of assessing and managing ecological assets at village scale, we further developed the Information System for Dynamic Management of Rural Ecological Assets (DyMREA). The software was based on Windows7/8/10 system and developed by C++ programming language. Five functional modules including village management, data input, asset calculation, asset inquiry and asset prediction were designed in the software. By setting village information, account period and datasets, the system can produce a full account list of ecological assets for the targeted village, trace the change of ecological asset values across account periods and predict the possible changes of ecological assets under different development planning scenarios. We used the data of Fanggan village to test all functions of the software and found that the DyMREA platform is a practical and powerful tool for assessment and management of ecological assets at village scale. We also discussed the application prospects and the problems which should be figured out in the future.

Key words: Rural, Natural resources, ecosystem services, land use

1-An Analysis on Crops Choice and Its Driving Factors in Hani Rice Terraces

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Abstract: Honghe Hani Rice Terraces System is one of the Globally Important Agricultural Heritage Systems (GIAHS) sites approved by Food and Agriculture Organization (FAO) in 2010. The system of forest-village-paddy-river in Hani terrace, which had formed over 1300 years in history, has multiple values, including ecological value, economic value and cultural value. However, in recent years, with the development of modern agriculture and tourism, the cultivation practices for high yield and uniform variety cropping, brings in serious problems there, such as ecological problems and food security problems. From the viewpoint of farming behavior, we conducted our surveys to learn about the local crop economic input-output, cultivated land resource, rural household information and local natural resources. Participatory Rural Appraisal (PRA) were used for gaining the information in Yuanyang County, Yunnan Province. And Seemingly Unrelated Regression (SUR) were used to test the theoretical result in the individual peasant household level. Then, this paper summarized the status quo of crop cultivation structures and analyzed their driving factors in Hani terraces fields. The results showed as follows：1）In the 41.23 hm2 available cultivated land referred in survey, the plants order by its total cultivated area are hybrid rice, maize and fruit which rank top three in all corps. As the regional traditional crop, the cultivated area of the terrace red rice is only 12.04% of total available cultivated land referred in survey. 2）The local rural farmer prefer hybrid rice to the terrace red rice, due to much higher economic benefits. Thus, there were more cultivate areas for hybrid rice, compared to the terrace red rice. In addition, the terrace red rice is mainly cultivated in the land with poor situation, with low quality and high altitude. Furthermore, maize is also widely cultivate there for both food and feed. 3）The economic benefit of crop, the quality and altitude of arable land have great influence on the choice of alternative crops, such as hybrid rice and red rice. As for individual peasant household, their characteristics and resource endowment have influence on choosing different corps to varying degrees. The family population and the altitude of cultivated land are positively correlated with the behavior of planting the terrace red rice at the 1% significance level, while the number of cooperatives is negatively correlated with the behavior of planting the terrace red rice at the 1% significance level. The conclusions of this paper showed that the decrease of the traditional crop is becoming a kind of trend in Hani terrace fields, especially for individual peasant household. If things continue this way, it would threaten the stability and sustainability of Honghe Hani Rice Terraces System.

Key words: Agricultural heritage system, Crops Choice, Hani Rice Terraces, Seemingly Unrelated Regression

A Dynamic Eco-Compensation Standard for Hani Rice Terrace System in Southwest China

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Abstract: Agricultural land does not only provide food and fiber, which is important for food security for human beings, but also provides various non-market commodities for export or public use. However, there are also numerous negative impacts of paddy production on the environment. Thus, to encourage farmers to engage in ecological or organic agriculture to provide more ecosystem services, it is necessary to pay farmers for their losses when they alter their cultivation practices. However, most current standards of ecological compensation for paddy cultivation are calculated by separate factors, such as the cost of ecosystem conservation, value of ecosystem services, or willingness to accept eco-compensation. As such, a standard is difficult to achieve for all the stakeholders and there is a lack of operability due to neglected factors. Thus, this study was conducted in the Hani Terrace, which was designated as a Globally Important Agricultural Heritage Systems (GIAHS) in 2010 and World Heritage in 2013, and we calculated the standard of paddy eco-compensation based on the subjective decision-making characteristics of individuals and paddy ecosystem characteristics. This study is based on the opportunity cost that ecosystem services supply with a goal of determining the supply curve for ecosystem services. First, through observation and sample testing, we compared the differences in the value of ecosystem services supplied by two production modes: conventional mono-cropping (use of chemical fertilizers and pesticides) and fish cultivation in rice fields (using half amount of fertilizers and no pesticides). Second, from the perspective of the microeconomic decision-making of individual farmers, we investigated the space distribution of opportunity costs for supplying paddy ecosystem services. Third, from the perspective of the macroeconomic behaviors of farmers, we investigated the relationship between the compensation standard and the eco-environment benefits willingly provided by the farmers. Finally, we combined famer willingness and the opportunity cost of ecosystem services, and the capacity of the majority to build an ecological-restoration oriented eco-compensation standard for the paddy system. The results indicated that the proportion of farmers converting their mode of production increased with the increase in the compensation payment. When the compensation payment amounted to 3,000 yuan hm-2, the conversion ratio of cultivation practices reached 35.74%, the added

value of ecosystem services was 80.77 × 104 yuan $^{hm-2\ a-1}$, and the required compensation funds was 91.04 ×104 yuan $^{a-1}$. When the compensation payment was as high as 9,000 yuan hm-2, almost all farmers (97.12%) were willing to convert their mode of production; the added value of ecosystem services was 219.49 × 104 yuan $^{hm-2\ a-1}$ and the required compensation funds were 273.13 ×104 yuan $^{a-1}$.

Key words: Ecological Compensation, Ecosystem Services, GIAHS

A Study on the Investigationof Wild Edible Plants of 4 Main Ethnic Groups in Lahu-Va-Blang-Dai Autonomous County of Shuangjiang

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Abstract: Lahu-Va-Blang-Dai Autonomous County of Shuangjiang was became a agricultural heritage site of Nationally Important Agricultural Heritage Systems (NIAHS) in 2015. And Shuangjiang owns rich wild edible plants and relevant traditional knowledge. This research used the ethnobotanical "5W+1H" mathod and key informant interviews to investigate and study the traditional knowledge of wild edible plants of the 4 main ethnic groups in Shuangjiang. Through the survey, 68 species of wild edible plants which belongs to 63 different families and 63 genera were recorded. Of these plants, 5 species are used as grain, 51 as vegetables, 15 as fruits, 7 as medicinal food, 6 as condiments, and 1 spiecies is used for brewing vinegar. The habits of using wild plants in the food culture of the 4 main ethnic groups affect each other, although each group maintains and develops their own particular food culture. And the using habits of wild edible plants have obvious regional features. The number of people who eat different wild edible plants have differences, 12 plants have less consumption. The traditional knowledge of wild edible plants is facing a great crisis, so the local government shall organize relevant personnel to investigate, record, study and protect the traditional knowledge. And due to the number of certain wild food plants is gradually decreasing, the local government and person like the "Headman" who has a certain influence in his ethnic group shall encourage local residents to protect the wild food plants. Meanwhile the government shall organize relevant personnel to carry out thorough investigation of the distribution of wild edible plant resources. And to do germplasm resources protection for some wild food plants which have less quantity.

Key words: Agricultural heritage sites, Ethnobotany, Lahu-Va-Blang-Dai Autonomous County of Shuangjiang, Traditional knowledge

Underpinning the Resiliency of Agricultural Heritage Systems, Smallholders, Family Farmers and Indigenous Communities

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Abstract: This research aims to build a systematic monitoring and evaluation system for GIAHS. The primary goal of this research is to investigate and evaluate current situations of the GIAHS sites and to assess the resilience of the GIAHS systems. An assessment framework and a set of indicators were developed to address the needs of smallholders, family farmers and indigenous communities to assess their agricultural heritage system resilience. Data related to human, social natural, physical and economic capitals were collected by conducting field research and sending questionnaires at Hani Rice Terraces in Yunnan (HRT) and Rice-Fish Culture in Qingtian of Zhejiang (RFC). The result was compared with the original data collected before the two sites being launched as GIAHS. Through systematically analysing and comparing the data, the socio-ecological resilience of GIAHS systems can be assessed and discovered.

Key words: Resilience, GIAHS, Hani Rice Terraces in Yunnan, Rice-Fish Culture in Qingtian of Zhejiang

Effects of Nematode-Microbe Interactions on Carbon Stability in the Black Soil

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Abstract: The interactions between soil fauna and microbe on soil carbon dynamic are the key scientific issues for clarifying the driving factors and potential mechanisms in soil carbon sequestration. We investigated whether nematode-microbe interactions affect soil carbon dynamics in the black soil of Northeast China. An incubation experiment was set up and 13C-enriched maize residues were used to trace the C flow through soil biota and soil organic carbon during a 150-day incubation (18 ℃) period. Soil cores were pre-defaunated by 8 kGy gamma radiation to eliminate all soil fauna while leaving the microbial biomass largely intact. Half of the irradiated cores were treated as nematode-microbe interactions by re-inoculating the entire soil nematode populations extracted from bulk soil and the other half were treated as only microbes. During incubation, soil CO_2 flux and organic carbon fractions (dissolved organic carbon, microbial organic biomass) were analyzed. The results showed that compared

with only microbe treatments, the addition of nematodes significantly changed the flux of CO_2 and the contents of organic carbon fractions in a begin short incubation period, and these effects were weaken over time.

Key words: Nematodes, Microbes, Soil Organic Carbon, Interactions

Assess the Roles of GIAHS Site in On-Farm Management of Agrobiodiversity in China

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Abstract: The purpose of this study is to discover the status of farming management in GIAHS sites in China, analyse the linkages between agriculture heritage conservation and on farm management, and identify good practices and models for promoting agrobiodiversity utilization and ecosystem services increasing in GIAHS sites. By conducting field surveys at Aohan Dryland Farming System, this study aims to understand the local agriculture heritage and its linkage with agrobiodiversity on farm management. The research focuses on compiling data in agrobiodiversity and related social and economic status in Aohao. Finally, though analysing the data, this study accesses the ecological, social and economic benefits of GIAHS sites and identify the good practices and mechanism influencing agro-biodiversity on-farm management. Moreover, this study also provides policy suggestion on enhancing the roles of GIAHS in terms of on-farm management of agro-biodiversity.

Key words: GIAHS, Agro-Biodiversity, Aohan Dryland Farming System, On-farm Management

Assess the Role of Folk Religions in the Sustainable Development of GIAHS Systems

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Abstract: This study explores a vernacular method of interpreting and safeguarding GIAHS in two ethnic counties in China. By studying folk religions as it has been applied within GIAHS sites, this study discovers the role of folk religions in safeguarding and managing GIAHS sites and the modern manifestation of folk religion in contemporary society. Based on ethnographic materials collected at Congjiang in Guizhou Province and Honghe in Yunnan Province, this study argues that folk religions

constantly effort to construct the meaning of inheritance and safeguarding the GIAHS within the community. This study also provides suggestions on enhancing the roles of folk religions in terms of the sustainable development of GIAHS.

Key words: GIAHS, Folk Religions, Sustainable Development, GIAHS Conservation

The General Framework for the Monitoring System of Important Agricultural Heritage Systems in China

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Abstract: As traditional agricultural production systems inherited so far, important agricultural heritage systems are valuable resources and common wealth for heritage sites and the whole world. How to conserve and develop these valuable resources is an important task for heritage sites after successful designation. The fundamental role of monitoring in the conservation and management of agricultural heritage systems and the requirement of related policies and regulations on it has made the designing and implementation of the monitoring system of agricultural heritage systems become a key question that needs to be addressed at present. This paper built a general framework for the monitoring system of agricultural heritage systems and elaborated the dynamic monitoring from the perspectives of monitoring range, content, method and data management. Based on this, the paper selected 24 items as the regular monitoring items in the annual report, which covered four functions of agricultural heritage systems (ecological conservation, economic development, social maintenance and cultural inheritance) and two major aspects of management measures (capacity building and publicity, demonstration and diffusion). The results can not only provide specific guidance for the implementation of the monitoring of agricultural heritage systems, but can also lay a foundation for the evaluation of the conservation and management of agricultural heritage systems in the near future.

Key words: GIAHS, China-NIAHS, Monitoring System, General Framework

Development of a Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI) for Assessing the River Health in an Agricultural Region, China

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Abstract: The development of biological indicators is an effective measure for assessing the health and function of rivers. This study aimed to construct a benthic macroinvertebrate index of biotic integrity (B-IBI) and evaluate the river aquatic ecosystem health of the plain river network areas of the basin of Lake Chaohu, an agricultural region in China. Reference and impaired conditions were determined based on landuse, physical and chemical criteria. Five of initial 50 candidate metrics were selected for the final B-IBI using a stepwise procedure, i.e. total number of taxa, percentage composition of the pollution-tolerant, percentage composition of filterers, biotic index and simpson index. The B-IBI scores was obtained by combining all the core metric scores using their quartile range, and was classified to five rating categories (excellent, good, fair, poor and very poor). Our B-IBI was significantly related with habitat conditions ($P<0.05$), but negatively related with nutrient states ($P<0.05$), and successfully distinguished reference from impaired conditions. Classification and regression tree analysis (CART) was used to link the different degrees of B-IBI results with specific environmental variables and the threshold values. The combination of B-IBI and water quality index could be a more comprehensive evaluation of the water ecosystem health.

Key words: Bioassessment, Anthropogenic Disturbance, River Health, The Basin of Lake Chaohu

The Manifestation of Culture on the Labor Supply and Demand Balancing in Hani Rice Terraces System

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Abstract: With more than 1300 years of history, the Hani Rice Terraces System is the masterpiece of local indigenous inhabitants, as well as the valuable wealth and precious cultural heritage. Such a traditional social-economic-ecological complex system in the mountain area is maintained mainly by labor force. This paper focus on the relationship of labor supply and demand and how the culture was performing on balancing the differences of labor supply and demand in different seasons. We collected the data of the number of the labor force by field research during 2010-2012 in Baohua Town, where located in the core area of Hani Rice Terraces System. Assessed the quantity of labor supply and demand, this study accounted the differences between the labor supply and demand in different seasons. Then it explored the habits and behaviors how people do to balance that differences. The results showed that the number of labor supply was rich in the slack season, when it was lack in the busy season. However, Hani people

made a way to balance the labor supply and demand by Hani culture.

Key words: Relationship of the Labor Supply And Demand, Cultural Machanism, Hani Rice Terraces System

Analysis of the N & P Sequestration in the Main Vegetation Types of Qin Lake Wetland

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Abstract: Wetland soil is a significant pool of nitrogen (N) and phosphorus (P) sequestration in the wetland ecosystem in which aquatic higher plants plays an important role. Field sampling and indoor analysis were conducted in two main vegetation types (common reed community & common reed + cattail community) of Qin Lake wetland to enhance our understanding of the immobilization of N & P in the soil. Organs biomass of common reed & cattail, N & P contents and reserves and their impacts on soil N & P contents were analyzed and the results showed that (1) Consumption effect of Qin Lake wetland on soluble N & P was observed. (2) Common reed could enhance the efficiency of N enrichment in wetland soil (below 30cm soil layer) and it is much higher in common reed + cattail community. (3) Leaf N:P of common reed and cattail in this study were significantly higher than the average value of domestic plant leaf due to P limitation occurring in Qin Lake wetland in the aquatic plant growth. (4) Common reed would consume soil P when cattail would offset this phenomenon because of the different mechanism response to P limitation. Therefore, the configuration mode of common reed + cattail could improve the efficiency of N & P sequestration of the wetland soil.

Key words: Phragmites australis (Cav.) Trin. Ex Steud., Typha latifolia L., Nitrogen, Phosphorus

Effect of Grain-For-Green Project on Farmers' Operation Modes on the Loess Plateau of China

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Abstract: Since the large-scale implementation of “Grain-for-Green” project initialed by Chinese central government in 1999, the eco-economy systems have been significantly changed. This is especially true on the Loess Plateau, where the local environments and eco-economy systems are sensitivity to land use change. The

farmers' operation modes of peasant household as a unit are more susceptible to the impact of this project. In this study, questionnaire survey and statistical yearbook were used to collect the data about farmers' production and operation activities. The compositional dominance, structural dominance and stability index were selected as analysis indices to explore the changes of farmers' operation modes. Results of this study showed that due to this project, part of traditional sloping farmland unsuitable for farming had been converted to grassland. The decrease of farmland promoted the traditional agriculture transforming to characteristic planting, and increasing labor export. Meanwhile, the increase of grassland had promoted the development of breeding industry. These changes transformed the farmers' operation modes from the traditional and single management to compound management. The source of income expanded and farmers' income increased associated with the changes of farmers' operation modes. Results of investigation indicated that the farmers' income had close correlation with operation modes. This study also found that the relatively higher income level of farmer's operation mode is "labor export + characteristic planting", the middle income level of farmer's operation mode is "labor export + characteristic planting + breeding industry", and the relatively lower mode is "labor export + traditional agriculture + breeding industry". The proportion of labor export, characteristic planting, traditional agriculture, and breeding industry determines the farmers' income level. Combined with the analysis of structural dominance and stability index, the mode of "labor export + characteristic planting + breeding industry" is regarded as more reasonable than other two modes. This mode can have positive effect on promoting the sustainable development in eco-economy at watershed scale on Chinese Loess Plateau.

Key words: Loess Plateau, Grain-For-Green Project, Farmers, Operation Modes, Compound Management

WORKSHOP

W-01: How Ecologists Can Contribute to the Work of IPBES, the Intergovernmental Platform on Biodiversity and Ecosystem Services

The Foundations of the Intergovernmental Platform on Biodiversity and Ecosystem Services

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Abstract: Accelerating environmental problems, including the degradation of ecosystems, loss of biodiversity and associated ecosystem services, required new ways of communicating scientific results to policy makers. IPBES is the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services, which is an initiative of governments to follow the success of IPCC (the Intergovernmental Panel on Climate Change) in biodiversity and ecosystem services. IPCC provided reliable scientific knowledge in appropriate format and way to policy makers, which changed environmental policies around the World. IPBES also aims to provide an efficient way to inform policy makers on the consequences of biodiversity loss and ecosystem degradation on human well-being. Novelty of IPBES compared to previous global initiatives, like Millennium Ecosystem Assessment is that it is an intergovernmental body, members are governments only, thus, results of IPBES activities are already in the hand of policy makers (although high level publications have been already published). IPBES goes beyond multidisciplinarity and considers different knowledge systems (e.g., academic, indigenous traditional ecological knowledge systems). The integrative nature of IPBES is conceptualized in the IPBES conceptual framework, which was developed over several workshops and consultations to involve as broad range of expertise as possible. The framework puts society and institutions in the middle as it is the major target where IPBES intend to have an impact. The work programme is based on the conceptual framework and aims to conduct several thematic, regional/global and methodological assessments. IPBES assessments are not research, but collection and critical evaluation of already existing knowledge. Therefore, IPBES is a key body for the global environmental policy, but different from those bodies well known for ecologists. We need a learning process to understand how it works, and how our ecological knowledge can contribute to the IPBES work, how the process can be monitored and how involvement is possible.

Key words: Science-Policy Interface, Global Environmental Policy

Governance Dilemma and Socioecological Factors Influencing Sustainable Provision of Ecosystem Services in Mt Marsabit Forest Kenya

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Abstract: Loss of key ecosystem services undermines the ability of the biophysical environment to sustain people and their livelihoods. The effects of different anthropogenic drivers acting singly or in combination have been shown to slowly but gradually disrupt provision of vital ecosystem goods and services. The situation in Mt. Marsabit forest ecosystem is further complicated by the management regime being a multi-stakeholder protected area system (PA). The existing governance structure and the prevailing policy and legislative framework seem inappropriate to address the continued degradation of the Mt. Marsabit ecosystem. This study seeks to assess how different actors and systems interact and how they influence sustainable provision of Mt. Marsabit forest ecosystem services. The specific objectives are to: (i) determine how prevailing socioeconomic dynamics interact with ecological processes to affect provision of ecosystem services on Mt. Marsabit; (ii) evaluate governance dilemma in Mt. Marsabit socio-ecological system; and (iii) develop appropriate governance strategy model for Mt. Marsabit protected area (PA). A mixed method study design shall be adopted where both primary and secondary data sources will be used. This research is relevant in three aspects namely: a) contribution to the development of a common understanding, through exploration and explanation of governance outcomes; b) contribution to discussions and examination of crucial themes of the paradigm of co-management; and, c) contribution to policy ideas and innovative policy alternatives in a given area. As governance research, it will examine the manifestations of interactions between the state and non-state actors.

Key words: Governance, Ecoystem Services, Protected Areas, Biodiversity,

Regional Assessments of Biodiversity and Ecosystem Services in the IPBES Process: The Europe and Central Asia Assessment as an Example

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Abstract: A central mandate of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is to conduct assessments on biodiversity and ecosystem

services. IPBES assessments are of two types: thematic and regional. Thematic assessments are global treatments of important issues such as pollination, land degradation, sustainability etc. Regional assessments focus on larger politically defined units roughly corresponding to continents. This presentation uses the example of the Europe and Central Asia assessment to demonstrate the general logic and structure of regional assessments. Each regional assessment has a common structure originating from the conceptual framework of IPBES. Chapter 1 sets the scene by providing general information on the context, target audience, key questions, approaches and methods and a roadmap for the rest of the assessment. Chapter 2 describes Nature's contributions to people and quality of life, as well as the status and trends of these contributions. Chapter 3 synthesises the status, past and current trends and future dynamics of biodiversity and ecosystem services and discusses the effects of biodiversity trends on ecosystem services. Chapter 4 describes the main direct and indirect drivers of change in biodiversity and ecosystem services, their status, and past and future trends. Chapter 5 offers an integrated and cross-scale analysis of interactions of the natural world and human society, whereas Chapter 6 lays out the options for governance, institutional arrangements and public decision making. Regional assessments are expected to play an important role in developing and implementing regional, international and national policies on biodiversity and ecosystem services.

Key words: Status and Trends, Drivers and Pressures, Forecast and Scenario

Recent Progress in the IPBES Work Program

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Abstract: Recent progress in the IPBES work program

After 2 years established, the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service, IPBES, set out a 5 years work for the period 2014–2018. The ambitious first work programme of IPBES with a sequenced set of deliverables was approved by second Plenary of IPBES and now it is the third year of implementation. During the 4 years, thousands of scientist consist of three task forces with technical support units are working on eight deliverables in term of methodological, thematic and integrated assessment as well as capacity building around the four objective of IPBES on biodiversity and ecosystem service. The talk will give the detail on progress of the eight assessments and other deliverables. The learns learned and challenges during the four years of implementation for the first working programme, as well as the outlook for the second work programme will discuss in the speech.

Key words: IPBES, The First Work Programme

The Future of IPBES: The Finalization of the 1st Work Programme and the Development of the 2nd Work Programme

Youngbae Suh

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Abstract: The 1st work programme of IPBES for 2014-2018 is structured to implement the goals and functions of the Platform along four cross-cutting objectives: 1) strengthen the capacity and knowledge foundations of the science-policy interface to implement key functions of the Platform, 2) strengthen the science-policy interface on biodiversity and ecosystem services at and across the subregional, regional and global levels, 3) strengthen the science-policy interface with regard to thematic and methodological issues, and 4) communicate and evaluate the Platform activities, deliverables and findings.

Recent significant outcomes of IPBES are the first two assessments of pollinators, pollination and food production, and scenarios and models of biodiversity and ecosystem services, which were delivered in 2016. In coming years, more assessment reports are coming: Land degradation and restoration, and four regional assessments of biodiversity and ecosystem services of Africa, the Americas, Asia-Pacific, and Europe and Central Asia to be delivered in 2018, and global assessment of biodiversity and ecosystem services to be delivered in 2019. The initiation of three pending assessments on the sustainable use of wild species, invasive alien species, and diverse conceptualization of multiple values of nature are delayed and will be discussed in the Plenary of 2018, which will be subject to the availability of sufficient funds. As part of the 1st work progarmme of IPBES, a review of the effectiveness of the administrative and scientific functions of IPBES is mandated with the aim of informing action by the Plenary related to the implementation of the 1st work programme and the 2nd work programme.

In the Plenary of 2017 at Bonn, Germany, it was agreed that the time frame for the 2nd work programme should be considered in the context of 10-year horizon, the Sustainable Development Goals, the Rio conventions, other biodiversity-related conventions, and other biodiversity and ecosystem service processes. It was also requested that the 2nd work programme should reflect the implementation of the four functions of the Platform based on the results of the review of the Platform. The initial draft elements for a framework for a rolling work programme, including a potential structure, guidance on a call for requests, a process for receiving and prioritizing requests, and preliminary estimates of cost and human resource needs, was requested to be developed for the consideration by the Plenary, which will be held on 18-24 March 2018 in Medellin, Colombia.

Key words: IPBES, 1st Work Programme, 2nd Work Programme, Assessment

ESC

ESC-01：城市景观与生态安全

Spatial Analysis of Heavy Metals Contamination of Shallow Groundwater in Relation to Urban Sprawl and Intensive Agricultural Development

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Abstract: Groundwater is an important source of drinking water in suburban districts and rural areas. Impacts of urban expansion and intensive agricultural development in Rural-Urban Fringe on the groundwater quantity and quality have become increasingly evident. We took a typical area of Shenbei district of Shenyang city as a case, seven kinds of heavy metals in shallow groundwater were evaluated using the traditional statistical and geostatistical methods to analyze the level of groundwater contamination and their spatial variability. The main objectives are to identify preliminarily contaminants sources and to provide a scientific basis for land use planning and groundwater management in this area and other similar areas. The results showed 1) contamination level of Fe and Mn were higher, spatial distribution of them were wide; Cd and Hg distributed mainly in urbanized four towns; Pb distributed mainly in centralized farming areas; and As was related in larger local chemical companies; 2) Fe and Mn showed strong spatial heterogeneity which mainly from structural factors, Cd, Pb and Hg showed moderate spatial heterogeneity, As showed weaker spatial heterogeneity, the latter fours mainly from random factors of human activities; and 3) there are similar sources of Fe and Mn, As and Mn as well.

Key words: Spatial Variability, Heavy Metals, Shallow Groundwater, Urban Sprawl

NDVI-based Vegetation Variation and Its Responses to Climate Change and Anthropogenic Activities in and around Large Cities of China

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Abstract: Although the vegetation variation and its driving forces (environmental changes both climatic and anthropogenic) in global and regional scales have been frequently studied, it is unclear the response of vegetation to climate change and

anthropogenic activities in urban and suburban areas. Based on meteorological data, urban size data and SPOT-VGT NDVI dataset, we first selected 71 large cities in China and divided the regions in and around each city in three zones (Z1: urban central area, Z2: urban expanding area, and Z3: suburban area)(Fig. 1). Then the spatiotemporal variations and driving forces (including temperature, precipitation and urbanization) of growing season NDVI (G-NDVI) in those three zones during 1998-2012 are investigated. The results showed that: (1) G-NDVI of 71 cities (including the mean G-NDVI in Z1, Z2 and Z3, namely NDVIZ1, NDVIZ2 and NDVIZ3) present large differences in spatial distribution and temporal variation. The range sizes of NDVIZ1, NDVIZ2 and NDVIZ3 of 71 cities in 2012 are 0.27, 0.32 and 0.38, respectively (Fig. 2). The ranges of trend rates of NDVIZ1, NDVIZ2 and NDVIZ3 during 1998-2012 are -0.095-0.086, -0.122-0.061 and -0.082-0.092 per decade, respectively (Fig. 3). (2) The values of NDVIZ1 in 71 cities are relatively minor, and the interannual changes of average NDVIZ1 are insignificant (Fig. 4). (3) However, the average NDVIZ2 of 71cities presents a significant decreasing trend with the rate of -0.013 per decade ($P<0.1$) during 1998-2012 (Fig. 4). (4) The average NDVIZ3 of 71cities presents a significant increasing trend with the rate of 0.016 per decade ($P<0.1$) during 1998-2012, which is mainly attributed to precipitation change rather than temperature change. Because a great deal of land resources (e.g. forest and farmland) would be displaced by urban expanding (Imhoff et al. 1997, Du et al. 2015), in the current study, hence most cities display decreased G-NDVI values in urban expanding area (Z2) over the last 15 yrs. However, most of the smaller cities and larger cities present positive trend rates for G-NDVI in Z1 and Z2. This may be related to the slower increasing urban size in smaller cities and the reasonable policy for planning and managing urban greenspace in larger cities in the process of urbanization (Sun et al. 2011).Consequently, it is reasonable to assert that the vegetation variation in urban and suburban areas predominantly is related to precipitation amount and anthropogenic activities.

Key words: Vegetation Variation, Large City, Climate Change, Anthropogenic Activities

Towards Climate-Sensitive Urban Design-The Potential of Ground and Roof Greenery

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Abstract: The combined effects of rapid urbanization and global climate change have triggered numerous urban environmental problems, of which urban heat island effects and urban flooding can be considered as the most acute. Green roof provides a potential

solution for these issues by vegetating the existing barren roof surface, which is particularly meaningful for compact cities with extreme shortage of buildable land and limited ground-level green spaces. Many previous studies analyzed the microclimatic and hydrological impacts of a single-type and small-size experimental green roof under one particular weather condition. This study aims to evaluate and compare the effectiveness of five typical types of green roofs with different size, plant species and soil depth for different weather conditions. The five experimental green roofs, namely grass, bare soil, vegetable land, small-size and large-size sky gardens were installed on five office buildings of an industrial park in Nanjing city. Firstly, the daily dynamics of air temperature differences between the green roofs and a control bare roof at 10 cm and 150 cm heights above the roof surface were studied. Secondly, two of the five roofs, representing respectively the extensive and intensive roof greening, were selected for stormwater runoff analysis for four rainfall types. Results indicate that on a typical summer sunny day, green roofs can reduce the air temperature by up to 5.3℃ at 10 cm height above the roof surface, and 2.5℃ at 150 cm height. On cloudy and rainy days, some green roofs can even elevate the air temperature. The air temperature reduction effect is the highest on large-size sky garden, and decreases from grass, small-size sky garden and bare soil to vegetable land. The stormwater runoff reduction is closely related to plant and soil configuration and rainfall type. The sky garden can reduce runoff by 50.8%、78%、100% and 100% respectively for extremely heavy, heavy, middle and light rainfall events. The equivalent values for the extensive green roof are 24.3%，58.6%，98.2% and100%, respectively. The above findings can shed light on green-roof design and management for cities at similar climate zones as Nanjing.
Key words: Urban Heat Island Effects, Urban Flooding, Green Roofs

Tscape in Residential Areas on the Cultural Services of Green Spaces, Using Zhengzhou as a Case Studyhe Effects of Cultural Land

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Abstract: Cultural services of residential green space play an important role in the physiological and mental health of the residents, including recreational services, cultural services, spiritual services and aesthetic services. Rich in variety and reasonable distribution of cultural facilities, can provide residents with comfortable place of activities. Then, how these cultural landscapes affect green spaces' cultural services? In this study, we firstly chose 35 residential areas, and used questionnaire survey to evaluate cultural services, and then we used field survey to quantize the level of cultural landscape. Our results showed that the greater the per unit areas of cultural

landscapes, the residents' satisfaction of recreational-entertainment services are higher. Second, the better cultural landscape could obviously prolong the time of residents to participate in cultural activities, and responsively increase the residents'satisfaction of cultural services. Further, people in the medium or more cultural landscapes in residential areas give more positive evaluation to the aesthetic services. Thirdly, much more cultural landscape can better alleviate the pressure of the residents then other residential areas with less cultural landscapes. Finally, the residential areas with better-level and medium-level of cultural landscapes could remarkably increase residents' sense of belonging and satisfaction of green spaces in residential areas than other areas. Therefore, we suggest increasing the areas of cultural landscape could determinately improve cultural services of green spaces in residential areas.

Key words: Residential Area Evaluation, Residential Green Space, Cultural Services, Quality Of Life Measurement

The Development of Alien and Invasive Taxa List for Regulation in South Africa

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Abstract: The process of developing regulatory lists of alien and invasive taxa should be based on scientific evidence through an objective, transparent and consistent process. Here we review the development of the lists for the South African National Biodiversity Management Act (NEM: BA) alien and invasive species regulations.

Lists published in the national Government Gazette were compared and assessed for changes in the taxa listed and their status from 2009-2014. Minutes from expert workshops convened to inform the listing were reviewed and relevant information like the criteria for listing taxa were extracted from the minutes.

Three draft versions were published in the Government Gazette for public comment before the final list was published in August 2014, coming in force in October 2014. This list was further amended in May 2015.

The main goal of the NEM: BA Alien and invasive species list was to document species known or suspected to have considerable negative impacts on natural ecosystems, or congenerics of such species. The process endeavoured to get engagement with academics, conservation experts, managers and various stakeholders through inclusion either actively in workshops or through a public commenting process to achieve shared governance. A scoring tool based on the likelihood of invasion versus the impact of invasion was recommended for evaluating the risk of a species, but rarely used. We conclude with some recommendations for future refinements in the process.

Key words: Invasive Species, Alien Taxa, Regulation, Management

Risk Assessment and Zoning of Flash Flood Disaster in Southeastern Region

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Abstract: China has suffered from heavy causalities and property losses due to flash floods. Recently, with the increase in population, economic growth, extreme climate events and global climate change, the occurrence of natural disasters has also exhibited an increasing trend. Natural ecosystems had important disaster risk reduction functions. This study selected the Southeastern Region as the study area, and set the flash flood watershed, with 10-50 square kilometers of small watershed of the flash flood disaster, as the basic research unit. This study used the methods of principal component analysis and gray analysis to identify the impact factors such as geological topography, precipitation conditions, ecological characteristics and socio-economic factors that affected the occurrence of flash flood disaster, and formed the main influencing indexes of flash flood disaster in the southeastern region. The assessment method was used to evaluate and divided the risk of flash flood disaster in the southeastern region, and the results of the zoning were analyzed by using the disaster frequency and disaster loss data, and the spatial layout and optimization of the urban residential area were put forward. The risk assessment and zoning of flash flood disaster was a kind of effective non-engineering measures for flood prevention and mitigation, which can provided effective protection for scientific decision-making and people's hedging by the relevant departments, and provided water conservancy department flood control standards and planning flash flood disaster control construction to provide a reliable basis for urban construction and planning to provide scientific guidance.

Key words: Flash Flood Disaster, Ecosystem-Based Disaster Risk Reduction, Ecosystem Service, Risk Assessment and Zoning

Research on the Dynamic Distribution of Pinus Densata Soil Seed Bank in Milin

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Abstract: Abstract: By the sample survey method, we have researched the dynamic distribution pattern of Soil Seed Bank of pinus densata in Milin, where have good

growth of A, B, C three stands. The results showed that: (1) the storage of seed bank soil in the A, B, C stands were 533.33±10.69 grain/m2, 516.67±10.26 grain/m2, 358.33±11.02 grain/m2, respectively, which showing a high degree of aggregation distribution pattern; (2) In the horizontal direction, more than 80% of the seeds distributed in the crown width, while a small amount of seeds out the crown width due to the external force; (3) In the vertical direction, about 60% of the seeds will storage in the surface litter layer temporarily when the seeds of pinus densata falls, and then some seeds will slowly down to the soil. Through the study on the dynamic distribution of the pinus densata soil seed bank, hope can provide the basis data for the development and updating of pinus densata forest.
Key words: Pinus Densata, Soil Seed Bank, Dynamic Distribution, Milin

Land Development Suitability Assessment of the Pingtan Island Based on Ecological-Economy-Industry Comprehensive Analysis

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Abstract: the purpose of this paper is to establish a appropriate evaluation method for development suitability evaluation and zoning of the Pingtan Island. The methods used include Geographical Information System(GIS), Analytic Hierarchy Process(AHP) and Cluster Analysis(CA) based on natural, economic and industrial information. Results show that the suitable, restrictive and inappropriate development areas were 112.19km^2,107.48 km^2 and 61.87km^2, respectively, accounting for 39.85, 38.17 and 21.98 percent of the island; 11 towns were divided in two categories in accordance with proportion of appropriate, restrictive and inappropriate area; Towns in central plains region (Category 1) were suitable for the development of farming and agricultural products processing industry, while coastal towns (category 2) were suitable for the development of fisheries and tourism. Conclusion is that development evaluation method based on Ecological - Economy - Industry comprehensive analysis can be used for the Pingtan Island.
Key words: Ecological-Economy-Industry Comprehensive Analysis, Development Suitability, GIS-AHP-CA Method, Pingtan Island

全球城市不透水面导致土壤碳库损失

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Abstract: 当前全球超过 50%的人口生活在城市中，未来全球的城市规模及人口将持续增大，城市不透水面积将不断增加，预计到 2030 年城市人口将超过 60%。城市化过程中大量的不透水面引起土壤封闭，阻断或减弱土壤与大气圈、水圈和生物圈的物质能量交换，导致土壤生物地球化学过程和生态功能发生深刻的变化。本研究假设：不透水面阻断新鲜有机物底料的输入，而土壤中的有机碳持续分解，这将导致不透水面封闭的土壤有机碳碳库持续下降。目前已有调查研究表明不透水面封闭的土壤有机碳含量下降 40-60%之间，但仍然不清楚全球尺度不透面到底导致多少土壤碳库损失。为了评估工业革命以来全球城市化过程对全球土壤碳库损失影响。本研究基于 HYDE 数据、灯光遥感数据构建了全球 1900-2015 年的城市不透水面时间序列。为应对城市土壤的高度空间异质性，我们将城市土壤划分为四种类型：原位直接封闭土壤、表层土移除后封闭土壤、正常开放土壤、有外来土加入的开放土壤。利用 DLEM 模型分别模拟了四种城市土壤类型碳循环的时空变换过程。研究表明全球城市土壤因城市不透水面封闭约损失 2-5Pg C，模拟的不确定性主要来至不透水面积和碳库储量的估算。
Key words: 不透水面, 城市土壤, 碳循环, 模拟

Study on the Regulation and Construction of Urban Landscape Pattern for Sustainable Development of Water Environment

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Abstract: Urban subsystems compose of a sustainable city which should have the characteristics of healthy development of the subsystems and harmonious relationship among the subsystems. A healthy aquatic ecosystem is the foundation of sustainable development of urban economy and society. However, at present, urban areas are threatened by aquatic ecosystem destruction and water environment deterioration at varying degrees. This study demonstrates the relationship between sustainable city and water environment and proposes an approach to building sustainable city by regulating urban landscape patterns to promote healthy development of water environment, which based on the theory and method of sustainable development and landscape ecology. The new approach that water environment sustainable development is operated to implement of urban sustainability from subsystem scale to whole city scale is brought forward to building sustainable city. This study verified this approach from a case study in Xiamen. We chose Yundanghu Watershed, Maluanwan Watershed and Xinglinwan Watershed as research objects. We studied the spatial relationships between landscape metrics and water quality indicators using Geographically Weighted Regression model (GWR) and predicted the water environment effects caused by the change of urban

landscape patterns in the future using Regional Nutrient Management model (ReNuMa), and added sponge city for further discussion. Our study indicates that the regulation of landscape patterns should be conducted in effective buffer zones which is the key method to improving urban lake water quality. Furthermore, this study will contribute to better understanding and implementation of sustainable city construction.
Key words: Sustainable City, Urbanization, Water Environment, Urban Landscape Pattern

Effect of Urbanization on Soil Organic Carbon Fractions and the Carbon Management Index in Remnant Evergreen Broad-Leaved Forests of Pearl River Delta

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Abstract: To explore effects of urbanization on soil organic carbon fractions and the carbon management index, which can help to reveal the response of forest soil quality under the background of urbanization, soil collected from six remnant evergreen broad-leaved forests in Pearl River Delta were investigated; there in three are the urban forests (botanical garden, Baiyunshan and Maofengshan) and the other three are the suburb ones (Heshan, Conghuashimen and Dinghushan). Soil samples were collected from the first two soil layers (0-10 and 10-20 cm) of these forests and analyzed total organic carbon (TOC), readily oxidizable organic carbon (ROC) and non-readily oxidizable organic carbon (NROC). Results showed as follows: (1) TOC content in the urban forests was significantly lower than that of the suburban forests ($p<0.05$), a pattern mainly derived from significantly higher soil ROC and NROC content in the urban than in the suburban forests. (2) In the surface soil (0-10 cm), soil carbon activity and carbon activity index in the urban forests were significantly higher than those in the suburban forests ($P<0.05$). In the sub-surface soil layer (10-20 cm), the pattern was also observed but the difference was not significant in both indices between the urban and the suburban forests ($P>0.05$). (3) At the two soil layers investigated, the suburban forests contained significantly higher soil carbon index and carbon management index than the urban forests ($P<0.05$). Our results suggest that urbanization can increase soil organic carbon activity in the remnant evergreen broad-leaved forests and is consequently detrimental to the C sequestration and fertility maintenance in soils.
Keywords: soil organic carbon; soil organic carbon fractions; carbon management index; urbanization

Key words: Soil Organic Carbon, Soil Organic Carbon Fractions, Carbon Management Index, Urbanization

Urban Ecological Security Assessment Based on Entropy Weight Method, Taking Shanghai Xuhui District as an Example

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Abstract: With the acceleration of urbanization, a series of ecological problems such as population expansion, traffic congestion, environmental damage, air pollution, and energy shortage seriously restrict the sustainable development of city, and influence urban ecological security. Focused on urban ecological security problems, we took Shanghai Duhui District as an example and adopted the entropy weight method to assess the urban ecological security during 2010-2016 under the under the guidance of "pressure-state-response" model. First, the index data of Xuhui District between 2010 and 2016 were processed and calculated by entropy weight method. Second, assessing the urban ecological security in Xuhui District from 2010 to 2016 based on pressure state response model. The results showed that the ecological security of Xuhui District during 2010-2016 was in unsafe condition. The evaluation results are objective and scientific, which can not only provide an efficient evaluation method for solving the urban ecological security, but also be able to understand the development of the city's status to provide a basis for working out the next development strategy.

Key words: Shanghai, Entropy Weight Method, Urban Ecological Security, Assessment

Soil Bacterial Community Composition across Land-Cover Types in Urban Areas: A Case Study in Beijing, China

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Abstract: The expansion of urbanization has become the main agent of disturbance in urban areas, and such variation has effects on soil bacterial communities, which play important role in global biogeochemical cycles. In the present study, we performed an investigation of the bacterial abundance, diversity and composition across land-cover types in urban areas. Soil samples were collected in five distinct land-cover types, i.e. shrub coverage (Euonymus japonicas), lawn (Festuca arundinacea), roadside tree (Sophora japonica), permeable pavement (brick with a hole in the middle) and impervious surface (asphalt). The soil bacterial abundance, diversity and composition were addressed using high-throughput sequencing of the bacterial 16S rRNA gene. We found that Proteobacteria, Actinobacteria, Acidobacteria, Bacteroidetes, Chloroflexi, Gemmatimonadetes and Firmicutes were the predominant phyla in urban areas, and the

relative richness of these phylum was distinct across land-cover types. Land-cover changes directly altered bacterial diversity and community composition, and indirectly affected the abundance of specific phylum through transforming soil physical and chemical properties. Land-cover type and Cu were the most important driving factors affecting bacterial diversity, and the community composition was significantly correlated with Zn, Cu, NH^{4+}, NO^{3-} and land-cover type. This suggested that the large differences in bacterial community across land-cover types result from complex environment factors.

Key words: Bacterial Community, Land-cover Type, Environmental Factors, Urban

Potential Range Expansion of the Invasive Galinsoga Quadriradiata under Future Climatic Change

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Abstract: Galinsoga quadriradiata Ruiz & Pav., which is an annual herbaceous plant originating in Central and South America, has already become a harmful and widespread agricultural invasive weed in China. It is estimated that this weed may expand in new ranges with favorable climate conditions, and knowledge about the spatial distribution of this species can provide important information for preventing measures. Increasing evidence suggests that the changing climate remarkably affect the invasion process of exotic plants. However, it is still unclear that how will the changing climate affect the expansion of G. quadriradiata in China. This research aimed to study the effects of climate change on the future geographical distributions of G. quadriradiata in China. We built Maximum entropy model (MaxEnt) to predict the potential distribution areas of G. quadriradiata under current and future (2030s, 2050s and 2080s) climate background, using 6 least correlated predictor variables which were chosen from 29 climatic (the combinations of 7 General Circulation Models (GCM) and 4 scenarios of Representative Concentration Pathways (RCP) of CO_2 emission) and non-climatic (altitude) environmental variables. The 391 records were used as occurrence data to build MaxEnt prediction models which was collected from database and published papers. Finally, the MaEent prediction model obtained a high accuracy of statistically significant AUC value of 0.960. The model predicted that high suitable areas for G. quadriradiata mainly located in the provinces of Zhejiang, Taiwan, Sichuan, Guizhou, Guizhou and Shaanxi. Its potential suitable area is larger than its current distribution in China. Unexpectedly, under the background of climate change, its suitable area in China tends to contract in the future (2030s, 2050s and 2080s); in general, its suitable area tends to disappear in South and East China, however, expends

in Northeast China (Liaoning, Jilin, and Heilongjiang). Overall, by the end of the century, its suitable area will be reduced and move northward in China. The results suggest that G. quadriradiata has high invasion potential, however, to some extent, the ongoing climate change would inhibit its expansion in China. Our prediction results will provide guidance for taking rapid response and mitigation measures of G. quadriradiata.

Key words: Biological Invasion, Climate Change, Potential Suitable Area, Galinsoga Quadriradiata

Assessment and spatiotemporal variation of landscape biodiversity based on InVEST model and remote sensing technology in the Bailong River Watershed, China

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Abstract: Biodiversity is the material foundation and the environment guarantee that people need for their survival and development, and has four levels: molecular, species ecosystem and landscape. The identification and understanding of the spatiotemporal variation of biodiversity in the landscape levels is not only an important part of regional biodiversity monitoring and assessment, but also the first step in the formulation and implementation of the protection scheme. The Bailong River Watershed of the Gansu Province (BRWGP), one of the most abundant biodiversity regions in China, is located in the transitional ecotone along the Tibet Plateau, Loess Plateau, and Qinba Mountains. The BRWGP was selected as a case to analyze the spatiotemporal heterogeneity of biodiversity. Inclusion of three assessment indicators (habitat quality, vegetation net primary productivity, and landscape state index) enabled the construction of a comprehensive index system of biodiversity spatial patterns and application of spatial differentiation analysis under the landscape geography perspective. Our goal was to revise the biodiversity evaluation module of the InVEST model and demonstrate biodiversity spatial patterns on a grid cell. The results indicated that biodiversity had obvious spatial pattern variations in the BRWGP, and the areas with higher biodiversity were mainly distributed in the national nature reserve and forest, while the relatively poor biodiversity areas distributed in the valleys of the BRWGP between Zhouqu-Wudu-Wenxian, the valley of Minjiang in Tanchang County and alpine mountain snow regions. During the period of 1990-2010a, biodiversity was high and increasing, the area proportion of higher biodiversity (important areas) increased form 16.74% to 26.02%. Meanwhile, the high growth area of biodiversity change was

concentrated in the ecological engineering zone and forest districts, while biodiversity reduction area located in the region of human activities intensively and frequently, such as cultivated area, urban and rural areas.

Key words: Biodiversity, Habitat Quality, Invest Model, Spatiotemporal Change

Study on Effects of Carbon Emission by Land Use Patterns of Inner Mongolia

Yue Wang, Feng Li

China

Abstract: With the rapid growth of the national economy, the impact of carbon emissions on the global carbon cycle has become a hot issue of national attention. The rise of the temperature, rising sea levels and other environmental problems are mostly caused by human activities, human beings can change the pattern of energy consumption and then change the amount of carbon emissions by changing the patterns of land use. In this paper, by using three high resolution remote sensing interpretation of 2000, 2005 and 2010, analying the change of Inner Mongolia main types of land use and its impact on carbon emissions found that:(1) reduced arable land of 113.7 km^2, woodland and grassland area, respectively, compared with 2000 increased by 649.74 km^2 and 2940.94 km^2, construction land increased most,1787.96 square kilometers;(2) compared to 2000s,carbon emissions growth rate in 2010 as high as 533.53%,the role of carbon sinks can absorb 40.77 percent of carbon emissions in 2000, but can only absorb 9.83% in 2010. Based on carbon emissions and per capita GDP in Inner Mongolia from 2000 to 2014 to carry on the fitting analysis found that each district cities in Inner Mongolia were "inverted U" curve inflection point on the right side of a downward trend, in line with the theory proposed by Kuznets. Through the above analysis, this paper provides suggestions for the Inner Mongolia Autonomous Region low-carbon land use and sustainable economic development.

Key words: Land Use, Carbon Emission, Carbon Intensity per Unit of GDP, Energy Consumption

Variations in Land Surface Temperature and Cooling Efficiency of Green Space in Rapid Urbanization: The Case of Fuzhou City, China

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Abstract: Rapid urbanization has caused significant land cover change (LCC) as well

as changes in the land surface temperature (LST). However, the crucial land dynamic process, which could significantly contribute to the increase in LST and aggravation of the urban heat island (UHI) effect, remains poorly understood. Additionally, a strategy to optimize the most significant decreased land cover type in order to maximize the cooling effect is still lacking. Therefore, in this study, we selected the rapidly urbanizing and 'hottest' city in China, Fuzhou, as a case study. Two algorithms were selected to compare and obtain reliable LST data. A land use transfer matrix was used to detect critical contributions leading to the LST variations. The concept of cooling efficiency (CE) and threshold value of efficiency (TVoE) are also proposed, defined, and calculated. The results show that LST values increased with increasing proportion of built-up land and sharply decreasing proportion of green space. Areas where LST differences exceed 4℃ cover 93% of the areas where green spaces decreased. Additionally, the LST variation is not only associated with the dominant land cover types but is also affected by the land cover transfer pattern and dynamics. Finally, we have calculated the TVoE of green space in Fuzhou city to be 4.55 ±0.5 ha. This finding implies that when Fuzhou municipality implements urban/landscape planning, a green space area of 4.55 ± 0.5 ha is the most efficient to reduce the heat effect. This study extends the current understanding of LCC dynamics and LST variation. The concepts of the CE and TVoE are meaningful for landscape planning practice and can be used in other cases.

Key words: Land Cover Change, Land Surface Temperature, Land Use Transfer Matrix, Cooling Efficiency

Urban Ecological Security Assessment and Forecast of Typical Cities in the Guangdong-Hong Kong-macao Bay

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Abstract: The newly proposed planning of Guangdong-Hong Kong-Macao Bay brings more opportunity and also challenges. The ecological security status of typical cities in Guangdong-Hong Kong-Macao Bay was focused on in this paper. The evaluation indicators of urban ecological security were first established by concerning the performance of natural, social, and economic subsystems. The information entropy method was applied to determine the weights of different indicators. And the urban ecological security evaluation and forecast model was constructed based on fuzzy comprehensive method and stepwise regression method Subsequently, the dynamic changes of ecological security for different cities were compared and analyzed, by taking Guangzhou, Macao, Hong Kong, Shenzhen, and Zhuhai as the cases. s Some

suggestion was also proposed for safe development of the Guangdong-Hong Kong-Macao Bay in the future.

Key words: fuzzy Comprehensive Method, Urban Ecological Security, Guangdong-Hong Kong-Macao Bay, Evaluation Model

ESC-02：海洋生态文明：科学、管理与实践

Taxonomic notes on Family Bougainvilliidae (Anthomedusae) from South China Sea

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Abstract: A total of 42 species of family Bougainvilliidae were identified, of which are a new genus, two new species, and one new combination. Based on previous reports (Xu and Zhang, 1978; Li and Chen, 1991; Xu and Huang, 1994, 2006; Xu et al., 2008; Du et al., 2012) and recent records of the authors, there are 42 medusa species and 7 genera of Bougainvilliidae in South China Sea (Table 1). The purpose of this study is to describe the one new genus of medusa, two new species, and one new combination.

Table 1 List of species presented on the family Bougainvilliidae in South China Sea (N: northern of SCS, M: median of SCS, S: southern of SCS)

Class Hydroidomedusa Claus, 1877	
Subclass Anthomedusae Haeckel, 1879	
Order Filifera Kühn, 1913	
Family Bougainvilliidae Lüthen, 1850	
Genus Bimeria Wright, 1859	
Bimeria vestita Wright, 1859	N
Genus Bougainvillia Lesson, 1830	
Bougainvillia aurantiaca Bouillon, 1980	S
Bougainvillia bitentaculata Uchida, 1925	N S
Bougainvillia britannica (Forbes, 1841)	N S
Bougainvillia chenyapingae Xu, Huang & Guo, 2007	N S
Bougainvillia frondosa Mayer, 1900	N
Bougainvillia fulva A. Agassiz & Mayer, 1899	N M
Bougainvillia longistyla Xu & Huang, 2004	N
Bougainvillia muscus (Allman, 1863)	N S
Bougainvillia niobe Mayer, 1894	N
Bougainvillia papillaris Xu, Huang & Guo, 2014	N
Bougainvillia paraplatygaster Xu, Huang & Chen, 1991	N
Bougainvillia platygaster (Haeckel, 1879)	N
Bougainvillia vervoorti Bouillin, 1995	N
Genus Koellikerina Kramp, 1939	
Koellikerina bouilloni Kawamura & Kubota, 2005	N

Koellikerina constricta (Menon, 1932)	N	
Koellikerina diforficulata Xu & Zhang, 1978	N	
Koellikerina fasciculata (Péron & Lesueur, 1809)	N	
Koellikerina heteronemalis Xu, Huang & Chen, 1991		N
Koellikerina multicirrata (Kramp, 1928)		N
Koellikerina octonemalis (Maas, 1905)		N S
Koellikerina staurogaster Xu & Huang, 2004		N
Koellikerina taiwanensis Xu, Huang & Chen, 1991		N S
Genus Nemopsis L. Agassiz, 1849		
Nemopsis bachei L. Agassiz, 1849		N
Genus Nubiella Bouillon, 1980		
Nubiella alvarinoae (Segura, 1980)*		N S
Nubiella apapillaris Xu, Huang & Wang, sp. nov.		M
Nubiella claviformis Xu, Huang & Lin, 2009		N
Nubiella crassocanalis Xu, Lin & Guo, 2012		N
Nubiella globogona Wang, Guo & Xue, 2012		M S
Nubiella globosa Lin, Xu & Huang, 2012		S
Nubiella intergona Xu, Huang & Lin, 2009		N
Nubiella macrogastera Xu, Huang & Lin 2009		N
Nubiella macrogona Xu, Huang & Guo, 2009		N S
Nubiella medusifera Huang, Xu, Lin & Guo, 2012		N
Nubiella oralospinella Xu, Huang & Guo, 2009		N
Nubiella papillaris Xu, Huang & Guo, 2009		N
Nubiella paramitra Xu, Huang & Guo, 2007		N
Nubiella sinica Huang, Xu, Lin & Chen, 2009		N S
Nubiella tubularia Xu, Huang & Guo, 2007		N
Genus Pachycordyle Weismann, 1883		
Pachycordyle conica Kramp, 1959		N
Genus Paranubiella Xu, Huang & Lin n. gen.		
Paranubiella atentaculata (Xu & Huang, 2004) n. comb.		N
Paranubiella nanhaiensis Xu, Huang & Guo, sp. nov.		S

Taxonomic Account

Family Bougainvilliidae Lütken, 1850

synonyms (see Calder, 1988: 12): Bougainvilleae Lütken, 1850: 29 (emended to Bougainvilliidae by Allman, 1876); Hippocrenidae McCrady, 1859: 158; Nemopsidae L. Agassiz, 1862: 345; Dicorynidae Allman, 1864: 366: Atractylidae Hincks, 1868: 87; Bimeridae Allman, 1872: 294; Margelidae Haeckel, 1879: 68; Lizusidae Haeckel, 1879: 80; Thamnostomidae Haeckel, 1879: 84; Pachycordylini Cockerell, 1911: 77; Lizziinae Russell, 1953: 144; Clavopsellidae Thiel, 1962: 249

Bougainvilliidae Bouillon et al., 2006: 126–127; Schuchert, 2007: 196–197; Xu et al.,

2014: 200–201

Diagnosis. Medusa bell-shaped; mouth circular, with simple or dichotomously branched oral tentacles inserted distinctly above mouth rim, ending in nematocyst clusters; four radial canals and circular canal; marginal tentacles solid, either solitary or in clusters, borne on 4, 8, or 16 tentacular bulbs; gonads on manubrium, either forming a continuous ring or in adradial, interradial, or perradial position; adaxial ocelli absent or present.

Remarks. In contradistinction to most taxonomic systems in current use, family Bougainvilliidae medusa included the genera: Bougainvillia Lesson, 1830, Chiarella Maas, 1897, Koellikerina Kramp, 1939, Lizzella Haeckel, 1879, Lizzia Forbes, 1846, Nemopsis L. Agassiz, 1849, Nubiella Bouillon, 1980, Pachycordyle Weismann, 1883, Silhouetta Millard & Bouillon, 1973, Thamnostoma Haeckel, 1879 (Kramp, 1961; Bouillon and Boero, 2000; Bouillon et al., 2006; Xu et al., 2014). Although the genus Lizzella Haeckel, 1879 is regarded as unrecognizable. Haeckel (1879) erected the genus Lizzella for Lizzella octella Haeckel, 1879 (= type species for the genus). Lizzella octella is not well characterized and Uchida (1927) referred it to a young Spirocodon saltatrix (Tilesius, 1818) (Family Polyorchidae). This ambiguity renders the genus doubtful and useless. The genus Lizzella should therefore not be used anymore. Also the other species included in this genus by Haeckel, Lizzella hyalina (Van Beneden, 1866), is a doubtful species (Schuchert, 2007).

Furthermore, Lizzia blondina Forbes, 1848 is here thought to be more closely related to the Rathkeidae Russell, 1953 than the Bougainvilliidae. This decision is primarily based on the 16S polygeny, but there is also a potential synapomorphy shared by Lizzia blondina and Rathkea octopunctata (M. Sars, 1835). Both species resemble each other so closely (symmetry, size, form, manubrial peduncle, medusae budding from the interradial manubrium wall) that they are easily confounded, although these traita are difficult to see as synapomorphies. The genus Lizzia was usually included in the Bougainvilliidae (Russell, 1953) due to the presence of perradial oral tentacles. This vies was thereafter adopted in virtually all important subsequent works (e.g. Kramp, 1961; Bouillon et al., 2006). It was generally asserted that oral tentacles of Lizzia originate above the mouth like in Bougainvillia, which is not true. A closer examination shows that the position and attachment of oral tentacles of Lizzia blondina are slightly different from those found in the Bougainvilliidae. They become free at the level of the lips and not at some distance above the rim. They are also attached very obliquely and remained adnate to the manubrium accompanied by underlying vacuolated gastrodermal cells (Fig. 1A). The same situation is also found in Rathkea species (Fig. 1B). The genus Lizzia should therefore be removed from the Bougainvilliidae and transferred to the Rathkeidae based on results from 16S sequence data (Schuchert, 2007).

Above mentioned, the family Bougainvilliidae (medusa) thus comprises the following

previously known genera. Additionally, the new genus Paranubiella is proposed (see Tab. 2).

Fig. 1 Comparison of oral tentacles in three species
A. Lizzia blondina oral region in side view, not the origin of the oral tentacles very close to the margin of the manubrium (from Schuchert, 2007); B. Rathkea octopunctata enlarged mouth region in perradial view (from Russell, 1953)

Table 2 The key to the genera of Bougainvilliidae medusae

1	without tentacular bulbs, lacking mouth	Pachycordyle Weismann, 1883
-	with tentacular bulbs, with mouth	2
2	4 tentacular bulbs	3
-	8 or more tentacular bulbs	8
3	without developed tentacles per bulb	Paranubiella Xu, Huang & Lin, n. gen.
-	with developed tentacles per bulb	4
4	more than one tentacles per bulb	5
-	one tentacle per bulb	6
5	besided filiform tentacles also club-shaped or capitate ones	Nemopsis L. Agassiz, 1849
-	all tentacles identical in structure	Bougainvillia Lesson, 1830
6	oral tentacles branched	Thamnostoma Haeckel, 1879*
-	oral tentacles simple	7
7	tentacular bulbs with ocelli	Sihouetta Millard & Bouillon, 1973
-	tentacular bulbs without ocelli	Nubiella Bouillon, 1980
8	8 tentacular bulbs, these subdivided by cleft	Chiarella Maas, 1897*
-	8 tentacular bulbs, not subdivided by cleft	Koellikerina Kramp, 1939

Key words: Anthomedusae, Bougainvilliidae, South China Sea

Chinese Grassland Dilemmas - Working with What You Have

David Kemp

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Abstract: China has almost 400m ha of grasslands, which have historically sustained much livestock production. Most of this grassland is in northern and western China at varying altitudes up to 6000m with, mostly summer rainfall varying from 50-500mm, but growing seasons restricted to 3-4 months over summer and winters are very cold. Today, much of that grassland is degraded to varying degrees. Some 16m herder household livelihoods are dependent upon these grasslands. Since 1950 the total pressure from livestock, estimated as sheep equivalents (SE), has increased four-fold.

National average stocking rates have increased from 0.6 to nearly 2.5 SE/ha. Over-grazing results first in the botanical composition shifting to less palatable grass and semi-shrub species and then as grazing pressures increase plant cover is lost and erosion increases. Species changes are within the suite of native species present in the grassland. The big dilemma is how to rehabilitate these grasslands, while sustaining the millions of traditional herders who depend upon them. Long-term enclosures do not often show a restoration of the most desirable species, grassland states have changed. In general herders are left with a change in state that is less productive than applied decades ago, but which can sustain profitable livestock production if they reorganise the way livestock are managed. In this paper, we will discuss the strategies we have used to identify how to resolve the dilemma of improving grasslands and improve herder household incomes, and show results from the large program of collaborative research. Solutions lie in a systems approach involving rethinking Government Policy, market reform, herder training to improve per head animal performance and business skills, reducing stocking rates by 50% and using knowledge on grassland herbage mass and monitoring key species to reduce consumption rates of the grassland.

Key words: Grasslands, Grazing, Systems, Policy

Effect of Nonylphenol on Reproductive Toxicity in Intergeneration Zebrafish

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Abstract: Nonylphenol, arising from the degradation of nonylphenol ethoxylates, is a highly cost effective surfactant usd in industrial, commericial and household applications. NP is exogenous estrogen, which can bind to estrogenic receptors like endogenous estrogen mimics. Meanwhile, NP has potential to interfere with hormonal regulatios and homeostasis, and consequently cause health effects in aquatic organisms and humans. Therefore, we aimed to the effect of long-time exposure of NP on three generation zebrafish. NP significantly inhibited the length and weight of zebrafish in three generations. With the increasing generations, the inhibition effect was increased. Moreover, low concentration of NP had a potential toxic effect, as the 20 $\mu g \cdot L^{-1}$ of NP inhibited the length and weight in F2 generation zebrafish. Meanwhile, NP could lead to teratogenicity and lethality in zebrafish. Teratogenicity was observed in 2 $\mu g \cdot L^{-1}$ of NP in F3 generation zebrafish. This phenomenon explained that NP has a strong genetic toxic effect through three generations. The long-term exposure of NP inhibited the fertilization rate and hatching rate in zebrafish. The fertilization rate and hatching rate significantly decreased in the high treated group, but greatly improved in F2 generation.

NP could interfered the regulation of reproduction genes and estrogen receptor gene in HPG axis. The main genes of reproduction (ghrh2, lh, fshr, lhr, esr1, cyp19a1a) abnormally regulated for exposure to NP.

Key words: Nonylphenol, Zebrafish, Reproduction Toxicity, Intergeneration

The Systematic Conservation and Restoration Planning for Ecosystem Services in Yellow River Delta Wetland

Fangwen Zhou

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Abstract: The existing conservation and the restoration planning doing in isolation makes it inefficient and the wetland degradation pattern no corresponding to the planning in the Yellow River Delta wetland. More, the conservation and the restoration lack of comprehensive systematic planning for various ecosystem services besides the biodiversity. So the potential restoration area was assured by degradation and the reclamation pattern with the ENVI and ArcGIS software and the ecosystem services containing habitat quality, carbon storage and the water purification were simulated by InVEST model (Integrated Valuation of Ecosystem Services and Trade-offs) to find the hotpots as the conservation and restoration planning objects. Then the systematic conservation and restoration planning was analysised by the systematic conservation planning tool Marxan model.

Key words: Systematic Conservation Planning, Wetland, Restoration

Response of Marine Phytoplankton Community Structure, Composition and Its Change to Climate Change

Heyang Li**,** Ying Zheng

Third Institute of Oceanography, State Oceanic Administration, China

Abstract: Through the field mesocosm experiment, we have studied on response of composition and variation of phytoplankton community structure on climate change. The response characteristics of phytoplankton community structure to different temperatures and CO_2 concentrations in the Western Pacific Ocean were studied. Results show that Synechcoccus is very sensitive to climate changing factors especially water temperature, they have strong response. Prochlorococcus was the most sensitive to high temperature, rise of 3 degrees temperature resulted in the abundance decreased 92%. This study is worthy of further research.

Key words: Marine Phytoplankton Community Structure, Climate Change, Ecological

Response

Taxonomic notes on Family Bougainvilliidae (Anthomedusae) from South China Sea

Mao Lin

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Abstract: A total of 42 species of family Bougainvilliidae were identified, of which are a new genus, two new species, and one new combination. Based on previous reports (Xu and Zhang, 1978; Li and Chen, 1991; Xu and Huang, 1994, 2006; Xu et al., 2008; Du et al., 2012) and recent records of the authors, there are 42 medusa species and 7 genera of Bougainvilliidae in South China Sea (Table 1). The purpose of this study is to describe the one new genus of medusa, two new species, and one new combination.

Table 1 List of species presented on the family Bougainvilliidae in South China Sea (N: northern of SCS, M: median of SCS, S: southern of SCS)

Class Hydroidomedusa Claus, 1877	
Subclass Anthomedusae Haeckel, 1879	
Order Filifera Kühn, 1913	
Family Bougainvilliidae Lüthen, 1850	
Genus Bimeria Wright, 1859	
Bimeria vestita Wright, 1859	N
Genus Bougainvillia Lesson, 1830	
Bougainvillia aurantiaca Bouillon, 1980	S
Bougainvillia bitentaculata Uchida, 1925	N S
Bougainvillia britannica (Forbes, 1841)	N S
Bougainvillia chenyapingae Xu, Huang & Guo, 2007	N S
Bougainvillia frondosa Mayer, 1900	N
Bougainvillia fulva A. Agassiz & Mayer, 1899	N M
Bougainvillia longistyla Xu & Huang, 2004	N
Bougainvillia muscus (Allman, 1863)	N S
Bougainvillia niobe Mayer, 1894	N
Bougainvillia papillaris Xu, Huang & Guo, 2014	N
Bougainvillia paraplatygaster Xu, Huang & Chen, 1991	N
Bougainvillia platygaster (Haeckel, 1879)	N
Bougainvillia vervoorti Bouillin, 1995	N
Genus Koellikerina Kramp, 1939	
Koellikerina bouilloni Kawamura & Kubota, 2005	N
Koellikerina constricta (Menon, 1932)	N

Koellikerina diforficulata Xu & Zhang, 1978 N
Koellikerina fasciculata (Péron & Lesueur, 1809) N
Koellikerina heteronemalis Xu, Huang & Chen, 1991 N
Koellikerina multicirrata (Kramp, 1928) N
Koellikerina octonemalis (Maas, 1905) N S
Koellikerina staurogaster Xu & Huang, 2004 N
Koellikerina taiwanensis Xu, Huang & Chen, 1991 N S
Genus Nemopsis L. Agassiz, 1849
Nemopsis bachei L. Agassiz, 1849 N
Genus Nubiella Bouillon, 1980
Nubiella alvarinoae (Segura, 1980)* N S
Nubiella apapillaris Xu, Huang & Wang, sp. nov. M
Nubiella claviformis Xu, Huang & Lin, 2009 N
Nubiella crassocanalis Xu, Lin & Guo, 2012 N
Nubiella globogona Wang, Guo & Xue, 2012 M S
Nubiella globosa Lin, Xu & Huang, 2012 S
Nubiella intergona Xu, Huang & Lin, 2009 N
Nubiella macrogastera Xu, Huang & Lin 2009 N
Nubiella macrogona Xu, Huang & Guo, 2009 N S
Nubiella medusifera Huang, Xu, Lin & Guo, 2012 N
Nubiella oralospinella Xu, Huang & Guo, 2009 N
Nubiella papillaris Xu, Huang & Guo, 2009 N
Nubiella paramitra Xu, Huang & Guo, 2007 N
Nubiella sinica Huang, Xu, Lin & Chen, 2009 N S
Nubiella tubularia Xu, Huang & Guo, 2007 N
Genus Pachycordyle Weismann, 1883
Pachycordyle conica Kramp, 1959 N
Genus Paranubiella Xu, Huang & Lin n. gen.
Paranubiella atentaculata (Xu & Huang, 2004) n. comb. N
Paranubiella nanhaiensis Xu, Huang & Guo, sp. nov. S

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Above mentioned, the family Bougainvilliidae (medusa) thus comprises the following previously known genera. Additionally, the new genus Paranubiella is proposed (see

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A. Lizzia blondina oral region in side view, not the origin of the oral tentacles very close to the margin of the manubrium (from Schuchert, 2007); B. Rathkea octopunctata enlarged mouth region in perradial view (from Russell, 1953)

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3 without developed tentacles per bulb Paranubiella Xu, Huang & Lin, n. gen.
- with developed tentacles per bulb 4
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- one tentacle per bulb 6
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- all tentacles identical in structure Bougainvillia Lesson, 1830
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8 8 tentacular bulbs, these subdivided by cleft Chiarella Maas, 1897*
- 8 tentacular bulbs, not subdivided by cleft Koellikerina Kramp, 1939

Key words: Anthomedusae, Bougainvilliidae, South China Sea

Euphilomedes Biacutidens (Ostracoda, Myodocopida, Philomedidae), a New Species from China Sea

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Abstract: Ostracods are one of the major groups of marine benthos, inhabit virtually all oceanic environments worldwide and in total 31 species have been recorded in genus Euphilomedes Kornicker, 1967. In the present study, we describe a new species Euphilomedes biacutidens collected from the Taiwan Strait and South China Sea. E. biacutidens sp. nov. differs from the related species of the genus Euphilomedes in having a unique combination of the characteristics of spines on carapace, filaments on sensory seta, arrangement of setae on tip of first antenna, numbers of setae on

appendages, claws on fifth limb, teeth on comb of seventh limb and furcal claws. It is particularly obvious that it has bifurcated and pointed ventral corner of rostrum, two spines on posterior margin of right valve, a row of teeth along the inner margin of article 3 of endopod of second antenna, and some long claws instead of setae on fifth limb.

Key words: Taxonomy

Phenolic endocrine-disrupting compounds in the Pearl River Estuary: Pollution characteristics of water body, biota and sediment

Qi Chen, Dong Sun, Shunshan Duan, Panpan Diao

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Abstract: Three phenolic endocrine-disrupting compounds, 4-nonylphenol, 4-tert-octylphenol and bisphenol A, were determined in water, sediment and biota (fish, shrimp and mollusk) collected from sites along the Pearl River Estuary, China. The 4-nonylphenol, 4-tert-octylphenol and bisphenol A concentrations ranged from 1.20-3352.86 ng/L in the water, <0.17-20.80 ng/g dw in the surface sediment and <1.49-237.12 ng/g dw in the biota. The concentrations of 4-nonylphenol were higher than those of 4-tert-octylphenol and bisphenol A in the water, sediment and organisms. Moreover, the bioconcentration factors (BCFs) and biota-sediment accumulation factors (BSAFs) of 4-nonylphenol and bisphenol A were calculated, and were found to be higher for 4-nonylphenol and in demersal organisms. To assess co-exposure to phenolic endocrine-disrupting compounds, the 4-nonylphenol equivalent was employed to evaluate the potential risks to aquatic organisms and human health, and the results indicated a low risk. The sedimentation rates and pollution history of 4-nonylphenol, bisphenol A are reported. Four core samples from different locations were collected and analyzed. Sedimentation rates were determined by 210Pb and 137Cs dating method and found to range from 0.18-2.90 cm/a, the result showed that CRS sample dating model is applicable for recording the endocrine pollution in the last 90 years. The sedimentation rates increased from 0.18 to 2.90 cm/a. Besides the concentrations of 4-nonylphenol and bisphenol A increased in last 50 years since the economic development in China, varied between 0.33-47.91 ng/g and <1.49-22.28 ng/g respectively.

Key words: Phenolic Endocrine-Disrupting Chemicals, Aquatic Environment, Bioaccumulation, Sedimentation Rates

Wetland Changes Affected by Coastal Reclamation: Cases of China's Major Deltaic Regions

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Abstract: There is increasing evidence that coastal reclamation shifts the ecosystem services of natural wetlands. However, in regional scale most studies are based on area net loss, and either new gain or the diverse change caused by reclamation has rarely been measured. In addition, hardly any studies have investigated the different direction of shifts and factors affecting them. Here, using collected data on the loss, gain and net change areas in four major deltaic regions in China from 1978 to 2014, it was showed that original accreting deltas shifted their growth with no change, net loss and net gain. Findings implicated that coastal reclamation was unlikely the independent driver of the change of natural wetlands. However, the area of wetland loss showed positive linear correlation to reclamation area. These relationships were significantly explained by the combination of spatiotemporal geographic distribution and land-use type of reclamation. Although the coastal reclamation contributed the most loss of tidal flats by directly occupation, the potential impacts on the surrounded natural wetlands by disturbing the normal succession and strengthening effects from other disturbance such as sea level rise, sediment, coast erosion and subsidence, could not be neglected. Furthermore, the alarming results highlighted that different land-use type occupied in different geographic location with different reclaimed mode could largely effect the potential impact. This highlights the need for an spatiotemporal pattern planning considering where each land-use type suit in conservation, restoration and compensation actions to mitigate the impacts of coastal reclamation.

Key words: Coastal Reclamation, Wetland Loss, Reclamation Mode, Integration Approach

中国主要入海河流污染物和赤潮发生的关系

Weibing Guan

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Abstract: 陆源污染依然成为沿海发生赤潮的主要诱发因子，为此根据中国海洋环境公报数据（2002-1015），分析研究了中国主要入海河流污染和所属海区的赤潮发生关系。渤海近年赤潮发生次数和面积分别在 10 次和 4000 平方公里左右；渤海三个主要河流入海污染总量都在变小；氮磷比基本上在 10 上下波动，而碳氮比呈现在 50 左右的稳定的波动，总体呈下降趋势。黄海从 12 次降到只有几次赤潮事件，发生面积从 2011 年最高的 4242 平方公里降到近年的几十平方公里；

氮磷比在 5-10 左右，呈一点下降趋势，碳氮比在 25 左右，呈下降趋势。东海赤潮从 80 次连续降低到只有几次，发生面积从 2005 年 19270 平方公里降到只有 1000 平方公里；同期长江口的 COD 入海量从 200 万上升到 600-800 万吨；总氮在显著上升，总磷在下降，相应的氮磷比上升到 10 左右，碳氮比下降到 4 左右。东海其它主要河流污染总量中，总氮和总磷都在下降，但是氮磷比则有所上升。南海赤潮次数变化不大，还是 10 多次，但近 5 年赤潮发生面积有所上升。其中珠江口总氮变化不大，总磷有所下降，氮磷比上升，发生面积和次数有高低波动。北部湾几条大河污染总量中总氮总量变化不大，总磷总量有所增加，氮磷比下降，这和北部湾赤潮发生呈一定增加趋势是一致的。总之、中国陆源入海污染物中的总氮、总磷，再加上大量的有机物(COD)，对近海生态系统产生复杂的影响。加大入海河流的监测广度和深度，形成长期固定的监测网络，有利于了解入海营养物质和近海富营养化的关系。要在流域内大力发展有机生态农业，减少面源污染；加大正确的湿地保护或发展湿地有机农业。控制沿河、沿海城市污水排放，尤其是要化工业的无序发展；更要保护河口及邻近海区生物资源。该研究将为赤潮预报提供另外一种视角，也是从流域整体角度对中国近海海洋生态系统的保护措施。

Key words: 入海污染物,碳氮磷,赤潮,海洋生态

滨海入侵植物互花米草的地理变异与遗传分化

刘文文 张宜辉

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Abstract: 经过近 40 年的扩散和入侵，互花米草（Spartina alterniflora）已经成为中国沿海滩涂分布面积最广和危害最为严重的外来入侵植物之一，对海岸带滩涂资源的利用、保护和管理提出了挑战。为研究互花米草在入侵地中国大范围入侵的机制，我们在 2012 和 2013 年，沿纬度调查了北起天津塘沽南达广东雷州的野外中国互花米草的营养生长和有性繁殖相关的生物学性状。2013 到 2015 年，我们又通过在低（20.9 o N，23.9 o N）、中（28.3 o N）和高纬度（38.0 o N）设置四个同质种植园，验证了遗传和环境因子及其交互作用对互花米草表型地理变异的效应。在野外，我们发现互花米草的营养生长和有性繁殖都随纬度有显著的变异。跨纬度多地同质种植园实验表明，互花米草株高和植株密度的地理变异很大程度上是由表型可塑性导致的，而结实率的沿纬度线性增长趋势不仅在较高纬度的同质种植园中保持，而且线性趋势的斜率随着同质种植园所在的地理纬度的增加而升高，验证了遗传和环境交互作用对繁殖性状的效应。2016 年野外调查结果显示高纬度样地互花米草实生苗的密度达到低纬度样地的 200 倍，预示高强度的繁殖体压力可能导致了繁殖性状在高纬度区域的遗传分化。鉴于互花米草在不同纬度的入侵机制存在差异，其防控策略要因地制宜。

Key words: 纬度梯度,表型可塑性,遗传分化,同质种植园

跨区域海湾环境合作管理机制研究

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Abstract: 近年来，海洋经济迅猛发展，海湾利用活动更加频繁，同时海湾环境也遭受到了严重的破坏。海湾有其特有的资源和服务功能，也存在环境的复杂性和脆弱性，所以加强海湾环境管理尤为重要，区域合作管理是解决海湾环境污染的重心和主要途径。本文梳理了四个区域的环境合作管理机制：缅因湾，波罗的海，厦门湾和杭州湾。从跨国合作和国内合作两个层次分析了各海湾环境管理框架、内容和文书，比较了不同区域的环境合作管理机制的特点和异同。为我国国内的海湾环境跨区域合作管理以及与国外海湾环境合作管理提供借鉴。

Key words: 波罗的海,缅因湾,环境合作管理,海湾环境

中英两国海洋环境保护法律体系比较与借鉴

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Abstract: 环境保护是我国的一项基本国策，而海洋作为环境的重要组成部分，必然成为了环保政策强化的重点。从上个世纪末至今，沿海人口快速增长，海洋产业和开发发展迅速，海洋环境遭到破坏，所以加强海洋管理、完善海洋环境保护法律体系迫在眉睫。海洋环境保护的立法工作在整个海洋环境保护中显得尤为重要，是所有海洋环境保护工作的依据，其科学性和操作性关乎整个海洋环境。经过近半个世纪的发展，我国的海洋环境保护法律逐步完善，但是仍然存在许多问题，英国是欧洲大陆西北海岸外的一个大西洋岛国，近岸海域油气、渔业等海洋资源非常丰富。在海洋环境保护管理方面也比较先进，本文梳理了中国和英国海洋保护法律体系，提出了国内海洋保护法律的存在的问题，凝练了英国海洋环境保护的立法特点，以及向英国法律体系的借鉴，为海洋环境管理者提供决策的参考和依据。

Key words: 英国海洋保护,海洋政策,借鉴

ESC-03：动物生态与濒危物种保护

Effects of Raising Geese in Corn Field on the Soil Physical and Chemical Properties, Weed Diversity and Maize Growth

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Abstract: This research was based on experimental plot of Zhangmai, Nyingchi County, studying effects of raising geese in cornfield (RGC) and conventional processed cornfield as Control (CK) on biodiversity of weeds in farmland ecosystem, physical and chemical properties of soil and growth of maize by contrast, it aimed at the description of the state of the field and the study of the intermediate state.

The results showed that: 1) RGC had 19 species of weeds holding a maximum of compositae which was higher than CK of 9 kinds of weeds. The total weed density in API was 15.42 times as much as that in CK, showing a significant difference ($P>0.05$; $n=9$). It's also noted that in RGC, the distribution of the dominant weed was considerably large, dicotyledonous angiosperm and annual & biennial (DA) was much higher than the other five functional groups. In terms of diversity, the Shannon-Wiener diversity index in RGC was 1.76, the CK is 1.67, which was no significant difference($P>0.05$; $n=9$); The Simpson diversity index in RGC was 0.77, the CK is 0.76, which was no significant difference($P>0.05$; $n=9$); But the Pielou and Margalef of CK were higher than RGC, the Pielou of CK is 0.80, the RGC was 0.69, which was no significant difference($P>0.05$; $n=9$); The Margalef of CK was 2.82, the RGC was 2.41, which was no significant difference($P>0.05$; $n=9$); 2) Soil moisture of RGC was 1.27% higher than CK, which was not a significant difference($P>0.05$; $n=9$); 3) With the deepening of soil, the compactness of RGC and CK soil gradually increased, and RGC had a significant effect on soil compactness; 4) The content of nitrogen and available K of CK were 86.48 and 161.07 mg/kg, 2.67, 28.66 mg/kg higher than RGC ($P>0.05$; $n=15$), but the content of available K in RGC was 120.98 mg/kg , 1.14 times as much as CK which was 106.25 mg/kg($P<0.05$; $n=15$), the content of available phosphorus in RGC was 120.98 mg/kg, which was 1.14 times higher than that of control($P>0.05$; $n=15$). The conclusion: RGC treatment increased the number, species and biomass of weeds in farmland system, improved biodiversity, reduced soil compaction, increased soil water content and soil nutrient content, and affected maize plant growth.

Key words: Geese, Corn Fields, Weeds, Biodiversity

Comparison of 5 Aging Structures for Pareuchiloglanis Kamengensis

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Abstract: This study analyzed asteriscus otolith, lapillus otolith, sagittal otolith; vertebra and opercula in the application of age determination for Pareuchiloglanis kamengensis (Jayaram, 1966) to choose the most suitable materials for the age determination. Results show that: the opercula with blurry and few annulus were not suitable for age determination; asteriscus otolith and sagittal otolith cannot be observed annulus directly and their structure are thin and cannot be rubbed , so they all not suit for age determination; The age determination result ranged from 2 to 19 by the vertebrae, and 2 to 20 by the lapilli otolith, the mean age were 10.28 and 10.91; the consistency of the two readings were 69.70% and 75.35%; IAPE were 6.5% and 3.9%; the annulus in lapilli otolith are more clearly than in vertebrae, especial age older than 10. Considerate these data lapilli otolith are the most suitable aging material for P. kamengensis.

Key words: Pareuchiloglanis Kamengensis, Age Determination, Otolith, Vertebrae

Population Genetic Variations and Phylogeography of Cultrichthys Erythropterus

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Abstract: In order to understand genetic resources of Cultrichthys erythropterus, genetic diversity and population differentiation of Cultrichthys erythropterus in jiujiang, anqing, Nanchang, wuhu, fuyang, dianshanhu, cangnan, jinhua and qiandao lake were analyzed using mitochondrial D-loop sequences. 13 variation sites were observed and 20 haplotypes were defined in 143 samples sequences. Analysis of fixation index (Fst) showed that there were many significant genetic differences among the populations. The number of the lowly differentiated and undifferentiated populations is comparable to the number of the differentiated population .Genetic diversity showed that all the populations were characterized with high haplotype diversity and low nueleotide.. Analysis of molecular variance (AMOVA) of the nine populations showed that the genetic variance mainly presented in individuals within populations. Neutrality test and Mismatch distributions of all populations indicated that population outbreak and population expansion may have occurred in qiandao lake population and jinhua population in history, while other populations showed no obvious population expansion.

Key words: Cultrichthys Erythropterus, Mtdna Contral Region, Phylogeography

Diel Variation of Two Filter-Feeding Carps in Catches Captured by Trammel Net in Gehu Lake of Jiangsu Province in China

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Abstract: In order to reveal the diel variation of the catch per unit effort (CPUE) of two filter-feeding carps such as silver carp (Hypophthalmichthys molitrix) and bighead carp (Hypophthalmichthys nobilis), the fishes were monthly sampled at 4-h intervals using benthic trammel nets from April to November in Gehu Lake of Jiangsu Province in China. A total of 16 fish species was collected and cluster analysis showed that the species numerical composition did not differ monthly. The catches were mainly consisted of silver and bighead carp, number per unit effort (BPUE) of which accounted for 60.3 and 17.0 percent of the total catches, respectively. Wilcoxon matched-pairs signed-ranks test revealed that the NPUE of the two carps differed significantly, but they significantly and positively correlated. NPUE of silver carp differed markedly among different time intervals and the diel difference was also found for bighead carp. The catch peak occurred at the intervals within 06:00 to 18:00, and the peak time was contingent on species and month. Silver carp catch peaked at interval of 6:00-7:00 in April, October, and November, 22:00-23:00 in May and August, and 2:00-3:00 in July and September. The catch of bighead peaked at interval of 6:00-7:00 in April, September, October, and November, 12:00-13:00 and 18:00-19:00 in July, 22:00-23:00 in August, and 2:00-3:00 in May. The body length of all the catches ranged from 20.0 cm to 50.0 cm, accounting for 89.9 percent of total catches. One-way analysis of variance (ANOVA) indicated that the both carps differed in body length between months.

Key words: Gehu Lake, Trammel, Catch per Unit Effort, Diurnal Variation

The Effect of Algae Cultured with Different N:P Ratios on Nitrogen and Phosphorus Excretion of Two Freshwater Shellfishes

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Abstract: Three algae were cultured in culture media with seven N: P ratios, and their

concentration of nitrogen and phosphorus were investigated. The nitrogen and phosphorus excretion rate and excreted ratio of two freshwater shellfishes (Corbicula fluminea and Anadonta woodiana) fed on those algae were measured. The nitrogen contents and N: P ratios of Microcystis aeruginosa, Chlorella vulgaris, and Scenedesmus obliquus linearly increased as the increasing level of the N: P ratio of culture medium. The nitrogen increase rates of the latter two were larger than that of the former and the increase rate of tissue N: P ratio of C. vulgaris were higher than those of M. aeruginosa and S. obliquus. The tissue phosphorus content of M. aeruginosa and C. vulgaris decreased with increasing the N: P ratio of culture medium, with the higher decline rate of the former than that of the latter. However, the content of phosphorus of S. obliquus did not change with increasing the N: P ratio of culture medium. One-way analysis of variance showed that the body contents of nitrogen and phosphorus of the two freshwater shellfishes did not change after fed with three algae cultured in different N: P ratio of culture medium. The mass-specific excretion rate of nitrogen and phosphorus for A. woodiana was 0.161 and 0.061 $\mu g \cdot mg^{-1} \cdot h^{-1}$, which for C. fluminea was 0.103 and 0.030 $\mu g \cdot mg^{-1} \cdot h^{-1}$, respectively. The excretion rate of nitrogen and phosphorus for the both shellfishes increased with increasing tissue nitrogen and phosphorus content of them.

Key words: Phytoplankton, Corbicula Fluminea, Anadonta Woodiana, Excretion of Nitrogen and Phosphorus

Research on Spectrum of Grassland Community in Lhasa River Basin

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Abstract: Using a portable spectrometer ASD Field Spec measured the spectral reflectance curve of main constructive species in the Lhasa River Basin, degradation indicator species and grassland communities with different degradation degree. The results showed that: the spectral characteristics of the poisonous plants (Stellera chamaejasme, Astragalus strictus and Ligularia lapathifolia) responsed of fencing basically the same, and the reflectivity outside fence was higher than that of inside fence, while the spectral reflectance of Ceratostigma minus outside fence at red band was higher than inside fence. The reflectivity at the near infrared band of the poisonous plants outside fence was significantly higher than that of the same plant in inside fence. The plant of outside fence was affected by grazing and drought， its spectral reflectance was closed to the spectral reflectance of bare soil at the visible range, while the plant community of inside fence has the basic characteristics of the vegetation spectrum. The reflectivity at the near infrared band was closely related to the biomass of the grassland community, which reflects the degree of grassland degradation and the reflectivity was

showed as not degraded > moderate degradation > severe degradation. In addition, the water absorption valley at 1400nm can reflect the degradation Degree, the depth and width of the moisture absorption valley were showed as not degraded > moderate degradation > severe degradation.

Key words: Lhasa River Basin, Vegetation Community Spectrum, Spectral Characteristics, Inside and Outside Fence

Study on Interspecific and Intraspecific Allelopathy of Pinus Thunbergii, Pinus Densiflora and Pinus Tabuliformis

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Abstract: The photosynthetic pigments (chlorophyll a, chlorophyll b, carotene and anthocyanin) and organic acids (citric acid, oxalic acid and malic acid) of the seedlings of Pinus thunbergii, Pinus densiflora and Pinus tabuliformis were studied by the water leaching solution of Pinus thunbergii, Pinus densiflora and Pinus tabuliformis. The results show: 1) The water leaching solution of Pinus thunbergii had no significant effect on Pinus thunbergii, Pinus densiflora and Pinus tabuliformis. 2) The water leaching solution of Pinus densiflora had significant effect ($P<0.05$) on Pinus thunbergii and Pinus densiflora, and had no significant effect on Pinus tabuliformis. 3) The water leaching solution of Pinus tabuliformis had significant effect ($P<0.05$) on Pinus densiflora and Pinus tabuliformis, and had no significant effect on Pinus thunbergii. 4) In this study, the promoting allelopathy of Pinus densiflora and the inhibitory allelopathy of Pinus tabuliformis were very significant ($P<0.05$), but the allelopathy of Pinus thunbergii was not significant.

Key words: Pinus Thunbergii, Pinus Densiflora, Pinus Tabuliformis, Allelopathy

Comparison of Intestinal Index between Silver Carp and Bighead Carp Captured in Gehu Lake of Jiangsu Province, China

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Abstract: Interspecific comparisons of alimentary tract morphology indicate that differences in feeding habits are reflected in gut dimensions. These differences are generally considered to represent evolutionary responses to diet quality. Silver carp (Hypophthalmichthys molitrix) and bighead carp (Hypophthalmichthys nobilis) both

are filter-feeding fish; silver carp consume primarily phytoplankton and bighead carp large quantities of zooplankton. Up to now, several comparisons on intestinal index between these two carps cultured in pond, cage, or pen have been conducted. Four intestinal indices including relative gut length (RGL), Zihler's index (ZI), relative gut mass (RGM), and relative gut content mass (RGCM) were compared between silver carp and bighead carp captured in Gehu Lake in Jiangsu Province of China. For both carps, gut length significantly and positively correlated with body length, and gut content mass and gut mass correlated with body mass, respectively. Isometric growth of gut with body length was found for the both carps. The positive relationships between RGL or ZI and body length or mass and negative relationships between RGM and body length or mass were found for silver carp, and the negative relationships between RGM or RGCM and body length or mass were detected for bighead carp. All the four indices of silver carp were significantly larger than those of bighead carp, which is in agreement with the results of more phytoplankton consumed by silver carp (65%) and zooplankton by bighead carp (73%). No significant differences in RGL and ZI for silver carp and ZI for bighead carp were found among seasons. However, RGM and RGCM for silver carp and RGCM for bighead carp in spring and autumn were larger than in summer. Meanwhile, bighead carp had larger RGM in spring than in spring and autumn, and larger RGL in spring than in summer. Our results showed that the differences in the above four intestinal indices between the two carps may reflect their adaption to food composition.

Key words: Gehu Lake, Intestinal Index, Silver and Bighead Carp, Silver and Bighead Carp

Study on the Influence of the Three Gorges Dam on Macroinvertebrates in the Tributaries

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Abstract: Macroinvertebrates are important component of aquatic ecosystem, and its appearance or disappearance can accurately reflect the impact of disturbance in the river. The construction of Three Gorges Dam causes significant changes on the aquatic ecosystem, including water depth, current velocity, water temperature, dissolved oxygen and so on. However, the upstream reaches of the tributaries are not affected by impoundment, therefore, that may play an important role in the conservation of macroinvertebrates. Based on these, scientific assumption was put forward: the Three Gorges Dam causes hydrological situation changes and then lead to the macroinvertebrates habitat changes, compared with the upstream reaches of the

tributaries which were unaffected by impoundment, the macroinvertebrates density and biomass will be reduced and the diversity will decrease in the area affected by impoundment. In order to explore the impact of impoundment on macroinvertebrates community in the tributary and the role of tributaries in macroinvertebrates resources protection, a field investigation was carried out in four tributaries (Lixiang river, Yulin river, Quxi river and Longhe river) in July 2015. Lixiang river and Yulin river were not affected by impoundment, but the downstream reaches of Quxi river and the downstream reaches of Longhe river were affected by impoundment during this period. The results showed that a total of 655 macroinvertebrates belonging to 59 species were collected, among which, there were 40 macroinvertebrates (4 species) in the affected area, and the dominant species were Macrobrachium nipponensis, which accounting for 57.5%. The community structure and diversity of macroinvertebrates were significantly affected by impoundment. The biomass of macroinvertebrates in the affected area was significantly lower ($P<0.05$) than the biomass in the unaffected area, but the density of macroinvertebrates was no significant difference between affected area and not affected area. Shannon-Wiener diversity index, Margalef richness index and Simpson diversity index of macroinvertebrates in the unaffected area were very significantly higher ($P<0.01$) than that in the affected area, however, the Pielou evenness index hadn't significant difference. Canonical correspondence analysis (CCA) was conducted for macroinvertebrates and environmental factors, the results indicated that depth, current velocity, water temperature, dissolved oxygen, specific conductance and nitrate concentration were the important environmental factors which significantly influence the distribution of macroinvertebrate assemblages. The depth was the most important environmental factors for macroinvertebrates community structure and diversity. The results almost validated our scientific assumption and we concluded that the macroinvertebrates community structure and diversity could be affected by impoundment and the tributaries play an important role in the conservation of macroinvertebrates.

Key words: Macroinvertebrates, Three Gorges Dam, Community Structure, CCA

ESC-04：生态遥感与应用

Estimating Mangrove Canopy Chlorophyll Content with Proximal and Remote Sensing

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Abstract: Chlorophyll content is an important biophysical parameter that reflects the physiological state of vegetation and environmental stresses. It is affected by seasonality, species, submerged conditions. The seasonal variations in mangrove chlorophyll content have been studied by remote sensing, but they do not take in account the impact of submerged conditions. Therefore, the present study aimed to explore the variations in mangrove canopy chlorophyll content (CCC) of different submerged conditions, species and seasons by remote sensing. First, the submerged conditions were obtained by combining Landsat8 images with tidal data, in which the mangroves were successfully divided into two submerged conditions: often flooded area (OFA) and rarely flooded area (RFA). Then, the green chlorophyll index (GCI) was considered as the optimal index (R2 = 0.7635) representing mangrove CCC. Finally, the changes of mangrove GCI were analyzed. We found that the distribution difference of mangrove GCI was significant between OFA and RFA for all test species and seasons, with mangroves growing better in RFA. The distribution of mangrove GCI between Avicennia marina and Kandelia candel had the largest difference in autumn especially in OFA. Furthermore, the distribution difference of GCI between summer and the other three seasons were significant as compared to the insignificant distribution difference observed between winter and spring for any of the submerged conditions and species, such that mangroves grew better in summer.

Key words: Mangroves, Canopy Chlorophyll Content, Proximal Sensing, Remote Sensing

Impacts of Vegetation Species and Rainfall Types on Runoff and Soil Loss Based on the Slope Plot Experiment on the Loess Plateau, China

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Abstract: Surface runoff and soil loss from 2008 to 2016 related to vegetation species and rainfall types in the Wangdonggou catchment on the Loess Plateau, China were

analyzed. The following results were found. (1) Mean annual runoff depth and mean annual erosion modulus of grassland and shrubland were lower than that of woodlands, with 2.40 mm and 4.98 t/km^2 for grassland and 3.33 mm, 6.20 t/km^2 for shrubland, respectively, in comparison to woodlands which had the higher amounts with averages of 4.29 mm and 23.78 t/km^2. Significant quantitative differences of runoff and soil loss were detected among the seven woodlands, the runoff depth and erosion modulus ranged from 14.67 mm and 382.65 t/km^2 for P. orientalis to 3.66 mm and 10.29 t/km^2 for R. pseudoacacia. (2)Based on the depth, duration and concentration index (the proportion of maximum 60-min depth to individual rainfall depth), 43 rainfall events were classified in three rainfall types. Rainfall type A is events of low amount (15.4 mm), short duration (156 min) and high rainfall concentration (92.3 %).Rainfall type B is events of medium amount (28.0 mm), medium duration (540 min) and medium rainfall concentration (44 %).Rainfall type C is events of high amount (43.3 mm), long duration (984 min) and low rainfall concentration (17.9 %). The sensitivity of runoff and soil loss to the rainfall types differ. The values of the mean runoff coefficient and the mean erosion modulus in the different rainfall types were ordered as follows: Rainfall type A> Rainfall type B> Rainfall type C. (3) The relationship between sediment yield and runoff under different rainfall types was expressed as a power function. These results suggest that grassland and shrubland (H.rhamnoides) with high vegetation coverage have remarkable effect on soil and water conservation in contrast to artificial woodlands with incomplete vegetation layers. Moreover, grassland is superior to shrubland and woodlands in soil hydrophysical properties which influenced runoff and soil erosion. In addition, more attention should be paid to rainfall type A with its role in runoff and soil erosion.

Key words: Vegetation Species, Rainfall Types, Runoff and Soil Loss, Loess Plateau

Monitoring the Spatial Change of Vegetation Phenology in Xiangjiang River Basin Based on MODIS Vegetation Index Time-Series Data

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Abstract: As an important component of terrestrial ecosystem, vegetation plays an important role in global material and energy cycles. Vegetation phenology is an intuitive and sensitive indicator of seasonal and interannual changes of vegetation. Its occurrence time can reflect the response of terrestrial ecosystem to climate change and ecological environment change. In this study, based on a sixteen-day constrained view angle maximum value composite (CV-MVC) MODIS vegetation index time-series data from 2001 to 2013, we use the filter of Savitzky-Golay to rebuild the time-series of

vegetation index (EVI), and then adopt the dynamic threshold method to extract the spatial patterns of vegetation phenology in Xiangjiang river basin. After analysis the pattern of three phenology metrics (start of growth season, end of growth season and length of growth season), we find the vegetation growing season is from early April to late October, and the average length of growth season is range from 130 days to 170 days. The spatial pattern of the start of season is delayed from south to north; however the end of season is delayed from north to south. In this case, the length of growth season expressed significantly extended trend from north to south. The analysis of the changes indicates that in the past 13 years, the start of season expressed an observably advance trend, and the end of season is significantly delayed, thus cause the length of growth season extended. The analysis of the changes indicates that the increased temperature in the Spring and Autumn, and artificial forest planting engineering in Xiangjiang river basin make signification role in promoting the changes of vegetation phenological variation.

Key words: Vegetation Phenology, MODIS Time-Series Data, Vegetation Change

Changes of the Five Holly Lakes in Tibetan Plateeau Due to Climate Change Affected by Glacier and Permafrost Cover, from 1977 to 2014 Using Remote-Sensing

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Abstract: Lakes with permafrost cover are highly sensitive to changes in climate, especially in Tibetan Plateeau (TP) in the past decades. The high inland-drainage lakes are representative of the climatic regime on the TP and have not been significantly affected by human activities, which make an ideal place to study lake changes induced by climatic changes. This paper thus aimed to examine the spatially variable responses of typical Tibetan lakes to climate change affected by glacier and permafrost cover by mean of remote sensing and climatic records. Based on satellite remote sensing images (Landsat TM, ETM+ and OLI) obtained in 1977, 1990, 2000 and 2014, we have detected the changes of the five holly lakes (Qinghai Lake, Nam Co, Siling Co, Zhari Namco, Tangra Yumco) in TP. Our analyses documented a total area of 752 km^2 growth of the five holly lakes, with the Siling Co expanding by 42.2% with the largest increase area of 702 km^2.The glacier in the two watershed boundary where the five lakes located in retreated from 11389 km^2 in 1977 to 8987 km^2 in 2014, with a melting rate being 649 km^2 per 10 years.Climate drought index (CDI) and annual mean air temperature (MAAT) also suggested an remarkable spatially and temporal changes during the corresponding periods. TP has experienced an apparent warmer and wetter climate,

increased lake area, decreased glacier area, and degraded permafrost in the past decades. Combination of water recharge from wetter climate and melted glacier contributed to increased lake area, was dominated in the periods of 1990~2000 and 1977~2014, when the increases in lake area during 2000~2014 can be related to adequate water recharge from melted glacier although drier climate reduced some lake extent and water supply. Differently, drier climate transcend glacier retreat documented the decreased lake area during 1977~1990, and permafrost degradation contributed to decreased lake area in multiple watersheds in different periods by means of causing to the disappearance of impervious layer and further induced infiltration of surface water. Abundant data in this study and the finding about spatially variable responses of the five holly lakes to climate change affected by glacier and permafrost cover is critical to the assessment of ecology and environment on the TP.
Key words: Holly Lake Change, Glacier Retreat, Permafrost Degradation, Climate Change

新安江土地利用变化及其对水质的影响

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Abstract:为了了解土地利用变化对新安江水质的影响，本文综合运用遥感解译，马尔柯夫转移矩阵和相关性分析的方法，揭示新安江流域 2007-2015 年的土地利用变化规律，运用 ArcGIS 的水文、空间分析功能，将流域划分为 5 个子流域，并分析各子流域的土地利用变化对水质的影响。结果表明：新安江土地利用类型以林地、耕地、水域及建筑用地为主，其中林地是最主要的土地利用类型。2007～2015 年，土地利用类型变化主要为林地、耕地及建筑用地，主要表现为林地、耕地向建筑用地的转化。林地与各种水质指标呈显著负相关，建筑用地与各种水质指标呈显著正相关。该研究对揭示流域尺度下土地利用空间格局变化对新安江水质的影响奠定基础，并为制定该流域水环境治理提供更科学依据。
Key words:新安江流域,土地利用,水质,相关性分析

Discussion on Some Issues of Ecological Barrier

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Abstract: Ecological barrier is an important part of national ecological security strategy in the construction of ecological civilization. Ecological security is the goal of ecological barrier construction, and ecological barrier is the protection of ecological security. Many scholars have discussed the ecological barrier theory and method from

different aspects valuably, and they all think ecological barrier is located in specific places and it is an ecological security system that has a protective function. But because of the complexity and particularity of the ecological barrier, the concept，type and characteristics of the ecological barrier remain in development in recent years. On the basis of summarizing previous research, from the horizon of the ecosystem service theory, the ecological barrier is considered to be a multiple ecological system with clear protection and defense object, which are improved artificially. It usually distributes in closed or semi-closed form in the transitional areas. There is a definite spatial span in it. Ecosystem services can be improved by it, and it promotes the ecological security of areas or country. It has the following characteristics: (1) protection: defending negative ecosystem services or protecting positive ecosystem services; (2) gradient: ecological barriers of different grade is established according to the importance of protected areas or the severity of the negative ecosystem services; (3) directivity: there is obvious direction in ecological barrier; (4) dynamics. It also can be classified as positive service protection type, negative service protection type and degraded service restoration type according to the barrier object. In the two ecological barriers and three shelters of China, North-eastern forest belongs to the first type, and the northern desert prevention, Chuan-Dian –the Loess Plateau ecological barrier and hilly terrain of southern China belong to the second type. Qinghai- Tibetan Plateau ecological barrier belongs to the third type. The research can provide a scientific basis for the ecological protection and restoration.

Key words: Ecological Barrier, Ecological Security, Ecosystem Services, Two Ecological Barriers and Three Shelters

Remote Sensing Based Observation of Wetland Losses in Sanjiang Plain, China

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Abstract: With the background of global change, wetland has great sensitivity and vulnerability. In order to investigate losses of wetlands in Sanjiang Plain, China, the wetland ecosystem pattern in 2000 and 2015 were rebuild based on satellite images from Landsat TM, ETM+, and OLI. Results indicated that wetland area for Sanjiang Plain in 2000 and 2015 was observed to be 9369.26 and 6860.70 square kilometers, respectively. Most of the disappeared wetlands were converted to cropland. Based on the changing trends of wetland, climate, and human factors, human activities were the leading driving forces for the losses of wetland.

Key words: Wetlands, Remote Sensing, Sangjing Plain

基于SolVES模型的关中—天水经济区生态系统文化服务评估与分析

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Abstract: 近年来人类对生态系统服务需求持续增加，生态系统文化服务的评估逐渐成为研究热点。本文应用 Social Values for Ecosystem Services (SolVES)模型基于在关中-天水经济区获取的社会调查数据和环境指数数据生成五种社会价值指数地图（VI 地图）和总和的社会价值指数地图来评估该区域内生态系统的文化服务。结果表明：审美价值在秦岭山脉等高海拔地区和城市公园分布区更高；娱乐价值在更低海拔、更平坦、距离道路与水源更近的区域较高；文化与历史价值集中在文化底蕴深厚的城市地区；精神价值在与城市距离更近交通更便利的高海拔区更高。本文初步评估与分析了关中-天水经济区内主要的生态系统文化服务的分布，并对模型的在大范围区域应用的敏感性进行探讨。对于研究生态系统服务的评估和发展具有重要意义。

Key words: SolVES 模型,生态系统,文化服务,空间分析

Measurement of Ground Damages in Mining Areas Based on High-Resolution Remote Sensing Images: Integrating Techniques of Interpretation Knowledge Base, Multiple Masks, and Fuzzy Recognition

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Abstract: Due to the on-going exhausting of coal resource in eastern China in the 21st century, the center of coal development is gradually being transferred to arid and semi-arid West China, where ecosystems is quite fragile. In the past ten years, more than ten large coal production bases, where each annual output reached over one hundred million tons, were established with the areas ranged from several hundreds km^2 to more than one thousand km^2. The high-strength top-coal-caving technology was adopted in all the new bases but it caused extensive ground damages such as surface subsidence, ground fissures, landslides, and ground water dried-up. The attentions to these damages impacting on ecological vulnerability are increasingly being paid to, thus it is essential to develop an eco-monitoring strategy and related technology for full-scale and sustainable monitoring in the large areas. This paper developed the information extraction technology of the extensive ground damages and built up the remote sensing interpretation knowledge base for different ground destruction types based on worldview^{-2} (0.5m- resolution) satellite images, taking the mining area (about 420 km^2) in the Nanjiao District, Datong City, Shanxi Province as a case study.

Contrasted the field survey data of fissures, landslides and collapses such as back wall, slip mass, leading edge, provenance, transportation zone, accumulation zone, etc. investigated in April, 2013, with the remote sensing images on the same date, the image features of ground damages were extracted including the colors, textures, shapes, distribution characteristics and adjacent vegetation conditions, based on which the base of interpretation features was built. On this basis the key techniques of information extraction were developed based on the Gram-Schmidt image fusion algorithm, the region of interest delineation, the multiple masks method, and the fuzzy recognition algorithm, integrating in an IDL program. The application of the techniques to the mining area in 2013 indicated that the rate of commission error was 10% and the rate of omission error was 8% with the overall accuracy 92%. Further, the ground damages of the mining area in 2015 were measured from the remote sensing images dated in January, 2015. The results showed that there were 284 ground fissures, 154 ground collapses (10,720 m2 in total) and 5 landslides (24,237 m2 in total). The research indicates that it is feasible to monitor ground damages in large mining area by high-resolution remote sensing technology, and the remote sensing interpretation base could contribute to the recognition of the ground damages, and the strategy integrating the multiple masks method with fuzzy recognition algorithm was effective.
Key words: Ecological Monitoring, Ground Damages Measurement, Coal Mining Area, Multiple Masks

Study on Allelopathic Effect of Water Extract of Highland Barley Root on Lamiophlomis Rotata

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Abstract: The effects of water extract of highland barley root with different leaching time on germination of lamiophlomis rotata seeds were studied by random zone method with lamiophlomis rotate seeds as experimental material. The aim of this study was to elucidate whether leaching solution of highland barley root promotes or inhibits germination of lamiophlomis rotate, so as to provide a theoretical basis for rotation cropping of lamiophlomis rotate and gramineous plants. The results showed that: different leaching time of water extract of highland barley root has different effects on germination of lamiophlomis rotate. With the lengthened leaching time of leaching solution, first time of germination, germination rate, germination potential, germ length and variation coefficient of lamiophlomis rotate seeds tended to be first promoted and then inhibited. The germination rate of 1.5h- leaching by water extract of highland barley root was the highest, which was 36.67% and11.34 percentage points higher than

that of CK. And variation coefficient of the treatment was smaller and the most stable. Germination time is shortened by 1.67 d compared with CK. The germination rate of 2.5h leaching was the lowest at 18.67%, 6.66 percentage points lower than that of CK. And germ length was 8.60 mm shorter than that of CK, demonstrating inhibition. Therefore, leaching of1.5 h is the most beneficial to germination of lamiophlomis rotata seed when it is treated with water extract of highland barley root for different leaching time.

Key words: Leaching Solution, Highland Barley Root System, Allelopathy

Study on Dynamics of Habitat Suitability for Waterfowls from 1990 to 2015 in the Ecological Function Zone of Sanjiang Plain

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Abstract: Based on the land cover data classified from landsat TM/ETM+/OLI and $HJ^{-1}B$ in 1990, 2000, 2010 and 2015 by Remote sensing (RS) and geographic information system (GIS), combining the system of the habitat suitability assessment and an integrated entropy and analytic hierarchy process (AHP) method to set reliable weights for each factor, the habitat suitability index (HSI) and their changes were assessed for the ecological function zone of the Sanjiang Plain, and driving forces of changes were analyzed. Results showed that the best habitat suitability for waterfowls distributed mainly in coastal Heilongjiang River, Naoli River, Ussuri River, Muling River and Xingkai Lake where there was abundant water. Because lots of wetlands were reclaimed and degeneration, its area decreased by 3.24% from 1990 to 2015. The good habitat suitability for waterfowls distributed mainly in Raohe County, from decreasing 1990 to 2000 and increasing from 2000 to 2015. The abundant increase by 8 916.35 km^2 of paddy fields in Hulin County and Fuyuan County made them become main adding regions of the good habitat suitability in 2010 and 2015. The fair habitat suitability for waterfowls distributed dispersedly, increasing from 1990 to 2000 and decreasing from 2000 to 2015. The distribution of the poor habitat suitability for waterfowls was coincident to croplands and waters, increasing by 6.69% from 1990 to 2000 and decreasing by 3.12% from 2000 to 2015. Land cover changes were the main factor to impact on the habitat suitability for waterfowls. Increases of population and economy and the drying and worming climate in the ecological function zone of the Sanjiang Plain made the habitat suitability for waterfowls decline. The establishment of nature reserves is crucial to protect habitat for waterfowls.

Key words: Habitat Suitability, Biodiversity, Remote Sensing Dynamic Monitoring, Ecological Function Zone

Determination of Three Components of the Cultivation Morchella in Gannan Plateau

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Abstract: Method of community ecology is used in the analysis of subalpine shrub–grass communities in semi-arid valley of Lhasa to prevent vegetation's degradation effectively. The results showed that there are 67 species of vascular plants belonging to 27 families and 48 genera in the shrub-grass communities. The analysis of geographical elements, families and genera demonstrates that the shrub-grass communities is temperate clearly. The physiognomy of the shrub-grass is mainly decided by the nanophanerophytes with deciduous, simple and entire leaves through analysis of both life form and their leaf characteristics.This area is characterized by the hemicryptophytes, nanophyll, herbaceous, simple leaves and entire leaves; and it has the quality of the high, frigid and arid in Tibetan Plateau. Based on the characteristics of the shrub-grass communities, their ecological restoration is also discussed.
Key words: Valley Of Lhasa-River, Vascular Plants, Geographical Elements

Applied Analysis for Canopy Multi-Parameter Retrieval of Winter Wheat Using Hyperspectral Vegetation Index

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Abstract: Leaf area index, chlorophyll and nitrogen are important indicators for assessing crop growth and directly affect the biological and physical processes of vegetation. Hyperspectral remote sensing inversion of LAI, chlorophyll and nitrogen has the advantages of low consumption, rapidity and non-damage. At present, the study on Hyperspectral remote sensing inversion of crop parameters mostly concentrate on single parameter, lack of multi-parameter comprehensive inversion. With winter wheat for example to study the impact of quantitative model inversion of center wavelength, band width, SNR, and analyze the sensitivity and effectiveness of spectral index for inversion of LAI, chlorophyll and nitrogen content with quantitative models, as well as the comprehensive of hyperspectral remote sensing inversion for typical parameters. The study area is located in Beijing Xiaotangshan Agriculture Demonstration Base. The spectral data and LAI, chlorophyll, nitrogen content data cover the whole reproductive cycle of winter wheat in 2001, 2002. Select 10 vegetation index, Which can overcome the influences of soil background vegetation indices are SAVI, OSAVI, and others are DVI, MSR, RDVI, NDVIg_b, RVI, MSAVI, NDVI, and CHIrededge. By

calculating coefficient of determination R2 between LAI, chlorophyll, nitrogen content and the index of different center wavelength respectively, get each index optimum center wavelength for inversion. The result showed: DVI was the best vegetation index for LAI inversion with the center wavelength of 768nm and 732nm, band width of less than 5nm, SNR>70DB; MSR was the best vegetation index for chlorophyll content inversion with the center wavelength of 768nm and 736nm, band width of less than 5nm, SNR>70DB; NDVIg_b was the best vegetation index for nitrogen content inversion with the center wavelength of 500nm and 454nm, band width of less than 5nm, SNR>70DB; (2) SAVI could simultaneously invert LAI, chlorophyll and nitrogen content when the wavelength are 761-802nm and 714-721nm; (3) OSAVI could simultaneously invert LAI and chlorophyll content when the wavelength are 764-782nm and 726-729nm, simultaneously invert LAI and nitrogen content when the wavelength are 761-782nm and 713-720nm; (4) MSAVI, DVI, RDVI and NDVI could simultaneously invert LAI and chlorophyll content within a certain wavelength range, while the suitable wavelength for inversion of LAI and nitrogen content had no intersection, as well as chlorophyll and nitrogen.

Key words: Hyperspectral Inversion, Winter Wheat, Vegetation Index

Study on Flora Spectra and Physiognomy of Subalpine Shrub–Grass Communities in Semi-Arid Valley of Lhasa

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Abstract: Method of community ecology is used in the analysis of subalpine shrub–grass communities in semi-arid valley of Lhasa to prevent vegetation's degradation effectively. The results showed that there are 67 species of vascular plants belonging to 27 families and 48 genera in the shrub-grass communities. The analysis of geographical elements, families and genera demonstrates that the shrub-grass communities is temperate clearly. The physiognomy of the shrub-grass is mainly decided by the nanophanerophytes with deciduous, simple and entire leaves through analysis of both life form and their leaf characteristics.This area is characterized by the hemicryptophytes, nanophyll, herbaceous, simple leaves and entire leaves; and it has the quality of the high, frigid and arid in Tibetan Plateau. Based on the characteristics of the shrub-grass communities, their ecological restoration is also discussed.

Key words: Valley Of Lhasa-River, Vascular Plants, Geographical Elements

基于面向对象的城市不透水面提取方法研究

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Abstract:近年来，城市化不断加快，促使大量建筑物迅速崛起，其中，城市的不透水表面是研究城市扩展和城市热环境中典型的地物要素之一。不透水表面(Impervious Surface)，被定义为一种水不能快速入渗到地表以下的人工覆盖类型，包括道路、停车场、建筑物屋顶以及广场等。不透水表面的变化对地表温度升高形成的城市热岛效应有着巨大影响。城市不透水面包含的类型多样、复杂，如何提取有用信息，是当前学术界研究的热点和难点。

本研究以吉林省长春市为研究区域，采用高空间分辨率遥感影像 SPOT 7 为数据源，在面向对象分类技术支持下，充分利用影像中的各种特征信息，并采用决策树、贝叶斯、K 最邻近、支持向量机、随机树等五种模型对长春市不透水面信息进行提取，通过精度评估，最终获得高效、准确的不透水面信息提取方法。根据 Ridd 提供的 V-I-S 模型的基础上，将长春市的土地覆被类型分为植被、不透水面和水体三种。

研究结果表明：决策树分类提取得到的不透水面边界信息较为准确，但是，由于不同的特征变量对影像分类的辅助作用不同使得水体和植被的边界提取不够准确，尤其是水体与植被的交界处。贝叶斯分类提取得到的植被边界信息较为准确，但是，不透水面的边界提取不够准确。K 最邻近分类不能充分利用影像对象信息，如影像对象的上下文信息，而且选择过多特征作为特征空间会造成分类速度下降，并降低了分类精度，使得提取的不透水面与植被的交界处，类别之间有混淆。支持向量机提取得到的不透水面效果较好，但是不能对高分辨率遥感影像的空间信息进行充分利用，植被的提取不够准确，被错分为不透水面的较多。随机树模型提取得到的不透水面的效果较好，提取信息很准确，其主要原因是在大的、高维数据训练时，不容易出现过度拟合且速度较快。综合以上几种模型，随机树分类方法得到的精度最高，最适合对 SPOT 7 影像进行不透水面提取。

Key words:不透水面,遥感

Assessment of the Impact of Urban Expansion and Climate Change on Net Primary Productivity in Guangzhou, China

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Abstract: Net primary productivity (NPP) is a key parameter and indicator of ecosystem services, and can reflect variations in response to climate changes and human activities. Identifying the relative contributions of urban expansion and climate changes to NPP variation is important for understanding the impact of human and

natural variables on the carbon cycle at the local, regional, and even global scale. This study applied MODIS-250 m NDVI products to drive the CASA model for analysis of the variation in NPP from 2001 to 2013 in the Guangzhou metropolitan area and its five regions, and quantify the impacts of climate changes and urban expansion in the spatiotemporal scale. The results showed that the mean NPP declined from 807.45 gCm-2 in 2001 to 719.84 gCm-2 in 2013 in Guangzhou, and it was especially significant in the central, southern, and northern regions ($p < 0.05$) due to intense human activities. A significant negative correlation between the scope as well as the intensity of urban expansion, and the mean NPP was identified in five regions. Although local weather changes had an important influence on NPP in wooded areas (e.g. in the northeastern region), the comparative results proved that urban expansion resulted from human interferences, and not weather fluctuations, was the foremost factor influencing the regional reduction in NPP. Results in this study are helpful for understanding and evaluating ecosystem change mechanism in urban regions.
Key words: Net Primary Productivity, Urban Expansion, Human Activities, Climate Change

定量评价人类活动对净初级生产力的影响

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Abstract: 以人类活动为主导的城市扩张和土地覆被变化对城市生态环境产生了重要影响，并与气候变化共同影响植被净初级生产力（NPP），但目前从时空尺度上脱离气候干扰仅以人类活动为主导因素来定量分析其对植被 NPP 影响的研究尚不充分．本研究以广州市为研究区，利用 CASA 模型估算 2001-2013 年实际净初级生产力（NPPact），结合 CHIKUGO 模型估算得到的潜在净初级生产力（NPPp）计算因土地覆被变化导致的 NPP 损失（NPPlulc），并建立相对贡献指数（RCI） 定量分析和评价在城市扩张过程中人类活动对 NPP 的影响． 结果表明：2001-2013 年间，广州总体及其 5 片区 NPPact 和 NPPlulc 分别呈减少和增加趋势，并存在明显的空间差异性；RCI 呈明显增加趋势，东北片区 RCI 值最低，为 0.31，表明气候变化是其 NPP 变化的主要原因，其他 4 个片区的 RCI 值均高于 0.5，说明 4 个片区人为干扰严重，人类活动是其 NPP 减少的主导因素；广州市及其 5 片区的 RCI 变化斜率均大于 0，人类活动对植被的干扰逐年增强，北部片区 RCI 变化斜率值最大（0.693），人为干扰增加趋势最明显．
Key words:实际净初级生产力,净初级生产力损失,人类活动,相对影响指数

Evaluating CASA Estimates of Forests Carbon Budgets Using Eddy-Covariance and Biometric Methods

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Abstract: Subtropical forest ecosystem plays a crucial role in the global carbon cycle. However, there is a gap in our understanding of carbon fluxes in the tropical/subtropics ecosystem of Southern Asia. The eddy-covariance (EC) micro-meteorological technique and the ecology-based biometric methods (BM) are the primary methodologies to quantify CO_2 exchange between terrestrial ecosystems and the atmosphere (net ecosystem production, NEP) with the ecosystem respiration. Moreover, with precisely observation advantages of the two methods that are generally used to evaluate carbon estimates model with satellite data input. Herein, we show that EC and BM provide different estimates of NEP, and comparative NPP estimates with CASA model. Then，the study investigated daily NEE using EC data of Ding Hu flux tower and BM data within its footprint from 2005-2010 in Southern China. Meanwhile, NPP estimates using CASA model here was compared and explored the uncertainty source. The analysis results are as follows:

(1) The Maximum Light Use Efficiency εmax in DHS flux tower was fitted as 0.747gC•m-2.With the other parameters remain same, CASA estimated NPP in a total of 1003.971 gC•m-2, which relative error is 19.25% compared by the flux NPP observation value 1243.317 gC•m-2.The research also found εmax had obvious response to seasonal variance. So four seasonal εmax fitting values were input to CASA model for season NPP estimates which shown year's relative error of 12.27%.So the seasonal simulation value of εmax can effectively improve the accuracy of NPP estimation of CASA. Moreover, the water vapor was attributed as the main cause between seasonal NPP variance.

(2) CASA model run 5000 times using Monte Carlo method which input random value within the Normal distribution of parameters PAR, FPAR and Temperature. The simulation of daily NPP has a normal distribution N (3.093, 3.192), which means the daily mean of NPP estimates is 3.093±1.787gC•m^{-2}•day^{-1}, similar with the observed value of 3.435±1.517 gC•m^{-2}•day^{-1} in DHS Flux tower.

Because the limitation of EC flux tower, the future work may carry with biometric methods to further assess and evaluate spatial or inter-annual variance of NPP, especially the Maximum Light Use Efficiency in Southern Asia subtropics forest.

Key words: NPP, Eddy-Covariance (EC) Flux, Maximum Light Efficiency, Uncertainty

Rapid Assessment on the Efficacy of Wetland Conservation System in China Based on GIS

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Abstract: Wetland conservation of China faces the problems of priority of conservation. The protection efficacy of wetland conservation is essential to underpin scientific basis decisions by government and managers. From national scales, basin scales and conservation scales(1990-2008), we applied systematic conservation planning and GIS to rapid assess the wetlands conservation efficacy, the approaches we developed were based on quadrant analysis and paired t-test. Results showed: (1) During the 19 years, the total area of wetland in China had reduced by 15.51%, coastal wetland reduction rates were the highest, 27.22%. followed by marsh wetland, 21.06%. The overall protected proportion was not high, the marsh wetland and lake wetland was higher. (2)The areas of better efficacy were mainly distributed in western China, such as the Northwest Rivers Basin and the Upper Reaches of Yangtze River. The areas of worse efficacy were mainly distributed in eastern China, such as the lower reaches of the Yangtze River and coastal area. (3)The wetland annual variance ratio in 92 conservations of China had a significance difference with that of the basin units, the efficacy of the overall conservation system was poor.

Key words: Systematic Conservation Efficacy, Wetland Ecosystem, Conservation Planning, GIS

The Effect of Landscape Patterns Evolution in Puzhehei Karst Lake Wetland Lake Littoral Zone on Water Quality

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Abstract: The lake littoral zone, an important ecotone that is a transitional area between land and lake, is an important part of a healthy lake ecosystem. The evolution of landscape pattern in the lake littoral zone will have an important impact on wetland water quality.Therefore, studying the key littoral zone landscape factors that affect karst wetland water quality changes is of great importance in understanding the process and the underlying mechanism about how landscape patterns impact on karst wetland water quality. Taking Puzhehei karst lake wetland as the study area, based on Landsat remote sensing images and the collected water quality monitoring data from 2005, 2007, 2009, and 2011, we studied the influence of landscape pattern indices of Puzhehei karst lake

wetland littoral zone on water quality through delineating the buffer region scale and using the correlation and redundancy analysis. The results showed that the littoral zone landscape patterns were quite different in different buffer zones. The impact of water quality on land use type and landscape pattern indices in the low flow period was greater than that in the high flow period; the landscape patterns have different effects on the quality of karst lake wetland at different buffer zone scales. Individual landscape indices can better reveal the influence of landscape patterns evolution on water quality in Puzhehei karst lake wetland, accompanied by the increased buffer zone distances. Among them, CONTAG, COHSION, and SHEI values had great influences on the water quality, and AWMPFD showed a significantly negative correlation with water quality parameters. The effects of other landscape indices on water quality were not obvious. Among them, the impacts of ED and AI values on water quality were gradually weakened. LPI value was closely correlated with water quality when buffer region distance less than 300 m. Beyond this, the effect of SHDI on water quality was still uncertain. Additionally, most water quality parameters had a good correlation with the land use type area, and wetland area proportion is the main index to characterize the water environment quality of karst lake wetland.
Key words: Karst Lake Wetland, Landscape Index, Correlation Analysis, Redundancy Analysis

基于 BBNs 的水源涵养服务的空间适宜性研究

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Abstract:水源涵养服务是陆地生态系统重要的服务之一，本文以渭河流域关中-天水经济区段（简称“渭河流域关天段”）为研究区，基于贝叶斯网络建立了水源涵养服务网络模型，预测 2050 年不同土地利用情景及其水源涵养服务量（简称“水源涵养量”），对研究区水源涵养服务的空间适宜性做出评价。结果表明：（1）保护情景下的水源涵养量最高，达 8.05×〖10〗^8 t，其次是计划情景，为 7.94×〖10〗^8 t，开发情景最低，为 7.82×〖10〗^8 t 。（2）水源涵养服务的关键影响因子是降水、土地利用和蒸散发,水源涵养量最高状态对应的关键影响因子状态集合是：｛降水=1, 土地利用=2, 蒸散发=2｝，研究区适宜水源涵养的区域主要分布在秦岭山脉沿线和北山山系。结合贝叶斯网络模型研究水源涵养服务随土地利用变化的适宜性环境条件，对渭河流域关天段水源涵养生态环境建设、水资源开发、土地治理具有重要的现实意义。
Key words:水源涵养,生态系统服务,贝叶斯网络,空间适宜性

ESC-05：污染生态过程及生态系统健康与修复

Effects of Herbicide from Agricultural Drainage with High Salinity on the Reed Wetlands in Western Songnen Plain, China

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Abstract: Agricultural non-point pollution and wetlands degradation for lack of water are two difficult problems in ecological environment in Western Songnen Plain, China. An effective way to solve these problems is to utilize the water resources of farmland drainage and to purify drainage by engineering wetland. Understanding the effect of herbicide residues from agricultural drainage on wetland system and its dissipation process under high salinity are important to the ecological conservation, restoration and utilization of wetland.

To investigate the resistance and purification mechanisms of reed wetland to Bensulfuron Methyl (BSM) under salt stress, in-situ combined with laboratory simulated experiments were executed with sexual and asexual reproduction of reeds, on the basis of investigation in irrigated area in the Western Songnen Plain. The sorption of BSM in soil was investigated by the sorption isotherms from sorption experiments with pure minerals and humus. An experiment was completed by using a special designed rhizobox where reeds were grown in a soil spiked with BSM to investigate rhizosphere effects on the dissipation of BSM, the soil in the rhizobox was divided in several millimeter separating compartments at various distances from the root surface. Hydroponics experiments elucidated the effect of BSM on reed exudate under salt stress.

Our study indicates that the application of sulfonylurea herbicides in the paddy field could cause herbicides residues (1.68~3.77μg/L) in agricultural drainage in Yueliangpao irrigation area. The removal rate of BSM (0.05mg/kg~0.50mg/kg) is over 65% by saline reed wetland (Na+ 25mmol/l) after 90 days, the lower BSM concentration is more efficient.

The response of reed seeds were closely related to the membrane permeability of seed under stress. The seed germination rate, germination uniformity, germination rate and vigor all were inhibited by salt stress (Na+ 50mmol/l), and the BSM (0.05mg/l~0.50mg/l) could alleviate this inhibition, but the inhibition function weakened gradually along with the increasing BSM concentration; the influence on reed buds were little, and BSM at low concentration could also alleviate the inhibition reed height and biomass under salt stress.The soil microbial biomass carbon and nitrogen were inhibited, which the inhibition rate ＞20%, and BSM could improve the

invertase activity though it was not obvious. In general, the entire reed wetland ecosystem showed some tolerance to BSM under salt stress.

The dissipation rate of BSM was closely related to the distance from the reed root, the dissipation gradient of BSM followed the order: near-rhizosphere ＞root compartment ＞far-rhizosphere soil zones. The most dissipation of near-rhizosphere of BSM was at about 2mm from root zone rather than dense root system with most exudate of root zone. The exudate of root of near-rhizosphere highly accelerate the dissipation of microbe and invertase activity.

The induction of BSM and salt stress strengthened the secretion of total organic carbon (TOC), total sugar and the amino acid from reed root, and the induction function enhanced gradually along with the increasing BSM concentration. Simultaneously, effects of BSM and salt to the root system of wetland reed were antagonistic in the total sugar significantly.

Key words: Phragmites Australis, Wetland, Bensulfuron Methyl, Salty

Thermal Evolution Offsets the Synergism between Nano-Pollution and Global Warming and Drives yhe Effects on Body Stoichiometry

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Abstract: Global warming not only challenges the ability of organisms to adjust to higher temperatures, but also their ability to deal with pollutants. This is because many pollutants are more toxic at higher temperatures. While thermal evolution may offset the negative effects of warming, whether it may also undo the increased toxicity of pollutants at higher temperatures has never been tested. Besides effects on life history, effects on body stoichiometry [particularly the C (arbon): N (itrogen): P (hosphorus) composition] are important as these may link effects at the organismal level to ecosystem functions through nutrient cycling. In the present research, we studied combined effects of warming and exposure to nano-ZnO in the waterflea Daphnia magna, and tested for thermal evolution and its ability to offset the higher toxicity of ZnO at higher temperatures. Daphnia clones were resurrected from two periods from the same lake differing in temperature (old period: ca. 1955-1965, recent period: ca. 1995-2005) and were exposed to nano-ZnO at 20 ℃ and 24 ℃ for a whole generation. After their second clutch was released, the key life history traits (age at maturity, fecundity and intrinsic population growth rate), stoichiometry (C, N and P contents) and related physiological biomolecules (RNA: DNA, proteins, sugars and lipids) were examined. Results showed nano-ZnO decreased the intrinsic population growth rate (‘r’) at 24°C but not at 20°C, indicating a strong ZnO × temperature synergism, but this

was only in the old population. In sharp contrast, this synergistic effect was no longer present in the recent population, which indicates thermal evolution not only improved the ability to deal with the higher temperature, but also offset the synergism between nano-ZnO and warming (Figure 1). Similarly, nano-ZnO decreased the RNA: DNA ratio at 24 ℃ but not at 20 ℃ and only in the old population, while this synergism was not observed in the recent population. This indicates that thermal evolution could offset the synergism between nano-ZnO and warming also at the physiological level (Figure 1). In addition, exposure to nano-ZnO increased the P content and decreased the N: P and C:P ratios only at 24 ℃ in the recent population (Figure 2). Changes in body stoichiometry may have important consequences that may scale up to nutrient cycling in ecosystems. We provide the first experimental evidence that a higher toxicity to pollutants (here nano-ZnO) at higher temperatures may be offset by thermal evolution. In other words, we demonstrated evolution of the synergistic interaction between a pollutant and warming, which has been ignored in the ecological risk assessment of pollutants in a warming world.

Key words: Rapid Thermal Evolution, Body Stoichiometry, Global Warming, Synergism

Effects of Nitrogen Deposition on Major Understory Plant Nutrients and Rhizosphere Processes in Chinese Fir Plantation of Subtropical China

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Abstract: Nitrogen (N) deposition is a major environmental issue that attracts the attention of researchers and the public. The effect of N deposition on nutrient cycling in forest ecosystem is one of the research hotspots in global change ecology. Compared with the tree in the upper canopy, the understory plant has faster nutrient turnover rate and is more sensitive to environmental change. However, few studies focused on the response of the understory plant nutrient cycling to the N deposition. In this study, three dominant understory species in the Chinese fir plantation, which were dichotoma Bern (DIB), Lophatherum gracile (LOG) and Melastoma dodecandrum (MED), were chosen after 4-years in situ N addition treatment (10 g N m^{-2} a^{-1}) and the understory species with no N addition treatment were control. In growing season, richness and evenness of the three dominant understory species were investigated. And we collected rhizosphere and bulk soils, plant organs separated by aboveground and underground parts to measure nonstructural carbohydrates, N and phosphorus (P) variables and enzymatic activity. Our results showed that aboveground biomass of DIB and LOG decreased after N deposition, while no significance effects of N deposition on richness and

evenness of the three understory species were found. Aboveground and belowground organs N concentrations of understory species increased, but the soluble sugar concentration of DIB and MED decreased after N deposition. Moreover, no significant effects of N deposition on P concentration of DIB and LOG and on aboveground organs N/P of all understory species were detected. In addition, N deposition increased the NO^{3-}-N and NH^{4+}-N concentrations in rhizosphere and bulk soil of all understory species, and increased the activities of β-glucosidase, N-acety$^{l-\beta}$-D-glucosaminidase and leucine aminopeptidase in LOG rhizosphere and bulk soil. Therefore, the nonstructural carbohydrates and biomass of understory species decreased while plant N concentration and soil available N increased after N deposition. Our results indicated that the growth of understory species was limited by light availability, but not regulated by soil nutrients, which according to our previous research that N addition promoted the growth of Chinese fir plantation and decreased the light availability in understory. Our results suggest that thinning might be helpful to develop ecological function of understory plant in the Chinese fir plantation in N deposition area

Key words: Nitrogen Deposition, Understory Plant, Rhizosphere Effect, Ecological Stoichiometry

Effects of Hydrological Processes on Diatom Biomass in a Drinking Water Source Reservoir, China

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Abstract: To understand the effects of hydrological and climatic factors on the phytoplankton community structure in reservoirs, the monthly phytoplankton biomass and community structure, and the related nutrient concentrations were surveyed during 2009 to 2016 in Shahe Reservoir, Liyang, China. The daily rainfall, water level of the reservoir, and the daily temperature data were alalysis to reflect the hydrological information. It was found that the diatom always caused significant decrease of transparency during May, and sometime last to August. The intencity and time of heavy rain will influence the phytoplankton structure. The residential time of water in reservoir is a useful factor interpret the phytoplankton biomass and structure. It is important to consider the hydrological information for water quality management in reservoirs.

Key words: Diatom Bloom, Reservoir, Hydrological Processes, Drinking Water Source

Effects of Arsenic Contamination on Speciation of Phosphorus in the Sediments of Yangzonghai Lakeshore Wetland

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Abstract: Yangzonghai lakeshore wetland which located in Yunnan, China was selected as the research object. The contents and spatial distribution characteristics of total arsenic (TAs), total phosphorus (TP) and each speciation of inorganic phosphorus were analyzed, and the correlation analyses between contents of arsenic and organic matter and each speciation of phosphorus were conducted. It was showed that the contents of TAs in the sediments were near the level III value of environmental quality standard for soils, which showed significant accumulation in the surface layer of sediment, and reduction effects of arsenic could be noticed by lakeshore wetland. The contents of TP in the sediments were affected by the manners of upstream human disturbance, and the contents of TP in the sampling belt under the comprehensive disturbance of farmland and village showed the highest values (604.13 mg/kg). The contents of TP also showed significant accumulation in the surface layer of sediment and reduction effects of phosphorus could be also noticed by lakeshore wetland. Apatite-P was the dominant component among all the speciation of inorganic phosphorus, whereas the contents of the rest speciation of phosphorus (including active dicalcium-P and octacalcium-P, potential-release alumina-P and iron-P, and inert occluded-P) were relatively lower. Both of the contents of arsenic and organic matter in the sediments had marked effects on the speciation of phosphorus, which was related to the competition effects of adsorption to the sediments between arsenic and phosphorus and also the changes of environmental factors in the sediments.

Key words: Arsenic Contaminated Sediments, Speciation of Phosphorus, Lakeshore Wetland, Environmental Risks

Study on Photosynthetic Characteristics and Water Use Efficiency of Four Species of Woody Seedlings in Rare Earth Backfilling

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Abstract: Plant suffered arid and high temperature stress in rare earth backfillings with bared ground surface and seriously dry and heating environment, especially during the seasonally drought, which threats plant survival. Four kinds of woody seedlings, Liquidambar formosana, Schima superba Gardn. et Champ. and Eucalyptus growing around rare earth backfillings and Cinnamomum Camphora widely spread in Jiangxi

Province, were chosen, and response mechanisms of photosynthetic characteristics and water use efficiency (WUE) to arid and high temperature stress under arid and humid environment were discussed in this study. The results showed that: under arid stress (soil water content was about 2%), the photosynthetic rate (Pn), stomatal conductance (Gs) and tranpiration rate (Tr) of four plants did not show obvious fluctuation with photosynthetically active radiation (PAR) and air temperature (Ta), and the above parameters was lower remarkably than that in humid condition (soil water content was about 15%). However, the WUE showed the opposite value, much higher than humid condition. Under wet condition, there was a decrease in Gs and Tr of Cinnamomum Camphora and an increase in Tr of the other plants with an increase in Ta, indicating that the four seedlings take different strategies to survive in high temperature condition. Compared with Liquidambar formosana, Schima superba Gardn. et Champ. and Eucalyptus, Cinnamomum Camphora had the highest WUE under arid and humid conditions. In conclusion, the four plant seedlings enhanced their WUE to resist arid stress, and Cinnamomum Camphora possess better advantageous in rare earth backfillings than the other seedlings.
Key words: Rare Earth Backfillings, Arid Stress, Water Use Efficiency

荒漠植物花棒根际 AM 真菌生态地理分布研究

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Abstract: 摘要：为探究 AM 真菌在荒漠中的自然分布状况，沿花棒（Hedysarum scopariumis）天然分布带，在内蒙古、宁夏、甘肃选取 7 个典型荒漠样地，采集花棒根际 0-30cm 土层样品，基于孢子形态学分类研究 AM 真菌物种地理分布规律。共分离鉴定 AM 真菌 6 属 42 种。结果表明，不同样地间 AM 真菌群落结构差异显著，环境对 AM 真菌群落具有重要影响。西北荒漠带由东到西随干旱程度加剧，AM 真菌种丰度、孢子密度、Shannon 指数逐渐降低。AM 真菌同一样地不同种属、不同样地同一种属的孢子密度和 Shannon 指数各有不同。孢子微观形态由东到西颜色加深、孢子壁变厚，且表面纹饰也有细微变化。相关性分析表明，AM 真菌种丰度、Shannon 指数和孢子密度与土壤水分极显著正相关，Shannon 指数和孢子密度与土壤有效磷显著正相关；种丰度与碱性磷酸酶显著正相关，与总球囊霉素显著正相关。可见，水分主导下的土壤环境变化的综合作用在整体上影响并决定着荒漠生态系统中 AM 真菌的地理分布，由东到西 A M真菌物种多样性虽趋显著下降，但长期的自然进化则使 AM 真菌主要通过强化繁殖与产孢的策略提高其生存与抗逆能力。
Key words: AM 真菌, 荒漠环境, 空间分布, 超微结构

Effect of Photosynthetic Structure Ratio on Plant Submergence Tolerance

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Abstract: It is well known that plants have many structures like the leaves, the stem, the roots and so on. Some structures can be used for photosynthesis to produce organic matter for plant needs, these structures are called photosynthetic structures (leaves) .The others parts called non-photosynthetic structures (branches and stem and below-ground parts). If a plant has a high photosynthetic/non-photosynthetic (P/NP) structural content, it could have more nutrients and energy reserve. Furthermore, the high nutrient content and energy level can increase the plant's tolerance to external stresses and subsequent possible damage. Hemarthria altissima is a species, which has high submergence-tolerance, and can be used to the vegetation restoration in the water-level-fluctuating zone in the Three Gorges Reservoir Region. It is found that the Hemarthria altissima can survival at certain elevations on the river banks, depending on the plant's status; at the same time, it is observed this species can live very well on the low elevation when they are young and have lower density, but the species only can survival higher elevations with increasing growing years and higher density. So we set the following question: Why is the survival elevations of the Hemarthria altissima moving towards the higher elevations with the increasing growing years In the field sites, we investigated that the younger plants growing on the lower elevation always had a lower density, with large number of leaves and short stem length, the older plants growing on the higher elevation always had a higher density, with small number of leaves and long stem length, it is indicated that the plants growing on the different elevation has different photosynthetic/non-photosynthetic (P/NP) structural ratio, the plants on the lower elevation have higher P/NP ratio, the plants on the higher elevation have lower P/NP ratio. So we formed our hypothesis: the plants with higher P/NP ratio have higher flooding tolerance comparing to the plants with lower P/NP ratio. To test our hypothesis, we had cultivated two-group plants with different P/NP ratio of Hemarthria altissima. The high P/NP ratio (the mass ratios) was 14.92 %, low P/NP ratios was 4.43 %. Then these plants were submerged in 5 m deep and completely dark water for 160 days. After the treatment, the results showed that the complete submergence had a strong inhibition on the growth of two kinds of treated plants. In the high P/NP treated group, the maximum percentage of died leaf length was 16.58 %, and the maximum percentage of died stem length was 5.09 %; by contrast, in the low P/NP treated group, the maximum percentage of died leaf length was 24.6 %, and the maximum percentage of died stem length was 11.22 %. In high P/NP group the

percentage of died stem length was 18.29 %; in low P/NP total length of the main stem died was 42 %. For the stem biomass, the reduction ratio of high P/NP plants of 27.79 %, contrasting, it was 51.51 % of low P/NP plants. Our experimental results confirmed our hypothesis very well, that the P/NP ratio affects the plant's submerge tolerance. High P/NP plants showed slower death rate compared to low P/NP plants. In conclusion the plants with high P/NP ratio can survival longer time comparing to plants with low P/NP ratio. And our new findings will help us to understand the submergence tolerance of plants deeply.

Key words: Photosynthetic Structures, Submerge Tolerance, Elevation

Short-Term Vegetation Succession after Ecological Restoration of Slopes in the High-Cold Region of China

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Abstract: With the rapid economic, scientific, and technological development, human activities and disturbance to natural environment are dramatically increasing, such as mining and expressway building. Undoubtedly, these will damage ecosystems and generate a large number of uncovered and unstable slopes. Since these slopes can be dangerous, it is of great importance to restore them, especially in the high-cold region. Thus, ecological restoration work is facing serious issues and urgently needed. Unlike other regions, the extremely low temperatures in this region hinder plant growth, because of diseases and the harsh environment.In the present study, we choose the Arun Banner as the study area, and the main objective is slopes that is restored in last several decades. We also aimed to understand the vegetation successional stages, the community similarity and determine the soil-plant relationships by analyzing the plant communities', Margalef index, Shannon-Weiner index, Pielou index, Jaccard index, and soil data.The results indicate that: 1) several local species invaded in artificial slopes after 3-10 years, such as Astragalus membranaceus。Now, the key species has became Elymus dahuricus, Artemisia annua, Agropyron mongolicum，the auxiliary species are Taraxacum mongolicum, Artemisia argyi and etc. 2) obvious differences were observed between the vegetation communities and similarity indices of shady and sunny slopes. the vegetation community state of shady slope is far better than that of the sunny slopes. 3) the soil water content maybe the key element to vegetation growth and community composition. It indirectly effects soil total nitrogen， soil available phosphorus and organic matter content can promote the development of plant communities. To sum up, the vegetation succession trend is positive，community structure is gradually closer to natural one. Meanwhile, this study can provide a basis

for improving optimize species configuration, prevent secondary degradation problems, and provide a theoretical basis for future conservation and management measures in the high-cold region.

Key words: Slopes, Vegetation Succession, Vegetation Community, Community Similarity

Growth Strategies of Woody Seedlings/Saplings Impeded by Dense Dwarf Bamboo in an Old Deciduous Broad-Leaved Forest

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Abstract: Adaptive strategy is thought to reflect evolutionary responses to habitat. Crown architecture shows remarkable variability and plasticity, both of which are difficult to predict. Plants in the dense understory may acquire different growth strategies to adapt to the light-limited condition. In this study, we investigated the seedlings demography (establishment and survival) and attempted to describe the adaptive strategy (measured from crown size, shape, leaf and branch variables) of woody species impeded by dense understory Fargesia decurvata in an old deciduous broad-leaved forest in in Jinfo Mountain National Nature Reserve, Southwest, China. We hypothesized that saplings grow in different light environments would present different growth strategies. Two field experiments were set up to test the hypothesis. Results showed that there were fewer seedlings established and a higher mortality rate in the plot with dense dwarf bamboo understory. The most plausible explanation was that the light levels are too low for long-term survival of seedlings with dwarf bamboo shading. Saplings from the shaded environment had greater changes in crown area and crown width scaling given their plant heights, stem diameters, and branch numbers. Leaf inclination of saplings trended to be more horizontal in the bamboo shaded environment, comparing to saplings free from bamboo shading, but the significant differences only were observed at the bottom position. We considered that shade-grown saplings took the “lateral-growth strategy” to adapt to the light-limited condition. Meanwhile, branches of those saplings took the “conservative strategy” by produced less annual leaves but maintained more total leaf numbers at a given length of the whole shoot. Saplings free from bamboo shading had larger crown areas, deeper crown, and more first-order branches in terms of the crown absolute size, presenting the “vertical-growth strategy”.

Key words: Seedling Establishment, Adaptive Strategy, Leaf Morphology, Dwarf Bamboo

Characteristics of Phytolankton Functional Groups and their Relationship with Environmental Factors in Shanghai Dianshan Lake

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Abstract: Dianshan lake is one of the main drinking water source of Shanghai. In order to explore the characteristics of phytoplankton functional groups and their relationalship with environmental factors of Dianshan lake, phytolankton and water samples at 11 sampling sites were collected from January, 2015 to December, 2016. The results showed that there were 26 functional groups in Dianshan lake, and the dominant functional groups were B, C, D, F, H1, J, Lo, M, MP, P, TB and W2. The dominant groups were C, W2 and Lo in spring; M, MP and J in summer; P in autumn; C and P in winter. Water in Dianshan Lake with eutrophic standing, the Stephanodiscus belongs group C formed blooms in spring, it was associated with high dissolved oxygen and low transparency in spring; and the Microcystis belongs group M formed blooms in summer, it was associated with high temperature and trophic in summer. RDA analysis revealed that dissolved oxygen (DO), transparency (SD), water temperature (WT), pH and precipitation (Pre) were the main impact factors on the phytoplankton functional groups composition and distribution in Dianshan Lake, followed by total phosphorus (TP) and chemicaloxygendemand (CODMn). Groups B, C and D were positively related with dissolved oxygen (DO), and dissolved oxygen (DO) was the main environmental factor that limited the growth of B, C, and D groups. Groups Lo, W2, MP, P, F, J and M were positively related with water transparency (SD), temperature (WT), pH and precipitation (Pre), and these groups were significantly positively correlation with pH. In addition, precipitation was also an important factor affecting the distribution of phytoplankton functional groups in Dianshan Lake.

Key words: Phytolankton, Functional Groups, Dianshan Lake, Environmental Factors

Community Structure of Macrozoobenthos and Its Relationship with Environmental Factors in Lake Dianshan

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Abstract: A survey on macrozoobenthos was conducted seasonally and 12 aquatic physicochemical parameters were monitored monthly to reveal the community characteristics of macrozoobenthos and their relationship with environmental factors at 11 sampling sites in the Lake Dianshan from 2014 to 2015. A total of 47 macrozoobenthic species including 4 species (9% of total) of Oligochaeta, 4 species

(9%) of Polychaeta, 6 species (13%) of Crustacean, 18 species (38%) of Chironomid larva, 12 species (26%) of Mollusca were identified. The dominant species were Corbicula fluminea (IRI=41.26), Tylorrhynchus heterochaetus (5.23), Propsilocerus akamusi (3.17)、Limnodrilus hoffmeisteri (2.37)、Corophium volutator (2.1)、Nephtys oligobranchia (1.92)、Laonome triangularis (1.92)、Propsilocerus taihuensis (1.43). Density and biomass of Propsilocerus akamusi and Limnodrilus hoffmeisteri showed significant spatial and seasonal changes. Monte Carlo's test indicated SPC、Wt、TN、CODMn and DO were the key factors that significantly influenced the distribution and community structure of macrozoobenthos. The environmental variables could well explain the changes of main macrozoobenthic species.

Key words: Lake Dianshan, Macrozoobenthos, Spatial Distribution Pattern, Environmental Factors

Ecology Stability Assessment by GAHP and Fuzzy Mathematics on Mining Waste Dump

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Abstract: Aiming at the problems such as soil biota simplification, vegetation degradation, poor ecological self-maintenance and weak ecological stability in the process of ecological restoration of open pit, an ecological stability assessment index system was established with the method of GAHP. The index system consists of 6 factors and 20 correlative indexes, among which the six factors included soil physical properties, soil pollution, soil nutrition, slope and vegetation. The weight matrix of elements layer and correlative indexes was calculated by GAHP method, concluding that the maximal elements which influenced waste dump ecological stability were slope, soil nutrition and vegetation. The results also showed that the slope length, soil moisture content, organic matter and vegetation coverage were the most important factors for the ecological stability of the waste dump. With the help of membership function and fuzzy matrix established by fuzzy mathematics, along with the membership matrix from weight matrix, the situation of the waste dump ecological stability was evaluated. The result showed that the evaluation method was worthy to be popularized and applied since it was easy to use and the assessment accorded with the fact.

Key words: Ecological Stability, GAHP, Fuzzy Mathematics, Waste Dump

Regression Analysis between Planktothricoides Biomass and Environmental Factors in Urban Rivers from Shanghai City, China

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Abstract: The filed investigation data in summer from 36 urban rivers in Shanghai City were used to explore the relationship between Planktothricoides which can form cyanobacteria bloom and its environmental factors, by using generalized additive model (GAM) method. The results showed that the biomass of Planktothricoides significantly increased when the water temperature ranged between 25 and 35 ℃ and the pH values ranged between 6.5 and 9.5. Contrarily, Planktothricoides didn't show significant correlation with total nitrogen and total phosphorus when the concentrations ranged from 0.04 to7.33 mg/L and from 0.04 to 4.10 mg/L, respectively. It may indicate that the high concentration of nutrients in Shanghai rivers was no longer the restricted factors for the growth of Planktothricoides. Furthermore, significantly positive correlation were observed between rotifer, protozoan and cladocera with Planktothricoides，while the latter showed a negative correlation with copepod. This correlation pattern between zooplankton and planktothricoides may be explained by the abundance of small sized edible algae in the water column and the tolerance capability of different sized zooplankton to filamentous cyanobacteria.

Key words: Cyanobacteria Bloom, Planktothricoides, Generalized Additive Model (GAM), Urban Rivers

Adaptive Traits of Plants Affect Their Performance under Submergence

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Abstract: Plants in natural habitats and farmlands are commonly subjected to submergence and this is likely to become more widespread and frequent owing to increased flooding events and water level rise caused by global climate change. Discontinuous pith cavities, partitioned by solid nodal diaphragms with very low porosity, exist in the shoots and rhizomes of many plants. To date little knowledge is available about whether discontinuous pith cavities are advantageous to the gas transport in plants, which is of much significance for plants under hypoxic stress. Taking Alternanthera philoxeroides as a model, we employed a novel experimental method to investigate the role of discontinuous stem pith cavities by blocking pith cavities and measuring the plant' responses of internal oxygen transport, stem anatomy

and growth performance to partial submergence. Pith cavity blocking impeded the longitudinal gas transport in stems and reduced the O_2 partial pressure (pO_2) in pith cavities and cortices of submerged stem portions below the blocked internodes; additionally, it hampered plant growth and enhanced the adventitious root formation on submerged stems. Partial submergence alone did not affect the porosity of stem nodal diaphragms and internodal cortices, but partial submergence together with pith cavity blocking increased the cortex porosity of submerged internodes. Discontinuous pith cavities, albeit partitioned by very low porosity nodal diaphragms, is important for the internal aeration of plants thereby benefiting plant growth and enhancing tolerance to hypoxic stress such as flooding/submergence.

Moreover, plants often experience nutrient and oxygen stresses when they are submerged. It has been well reported that plants usually shift biomass allocation and produce more roots to cope with nutrient deficiency. However, it is unclear whether plants experiencing oxygen deficiency stimulate biomass allocation to roots to enhance nutrient absorption, similar to how plants experiencing nutrient deficiency behave. We investigated the responses of plants, upon partial submergence, to nutrient versus dissolved oxygen deficiency in plant growth, biomass allocation, adventitious root production, root efficiency, and root aerenchyma formation. Both nutrient and dissolved oxygen deficiency hampered the growth of partially submerged plants. As expected, plants experiencing nutrient deficiency increased biomass allocation to adventitious roots and exhibited lower root efficiency; in contrast, plants experiencing dissolved oxygen deficiency decreased biomass allocation to adventitious roots but achieved higher root efficiency. The diameter of aerenchyma channels in adventitious roots were enlarged in plants experiencing dissolved oxygen deficiency but did not change in plants experiencing nutrient deficiency. The widening of aerenchyma channels in adventitious roots improves the oxygen status and thereby the nutrient absorption capability of roots in low oxygen environments, which enhances the tolerance of plants to submergence.

Key words: Submergence Tolerance, Discontinuous Stem Pith Cavity, Adventitious Root Production, Partial Submergence

The Landscape Optimization of Ningjiang Basin Based on the Method of Spatial Principal Component Analysis and Minimum Cumulative Resistance Model

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Abstract: The paper was based on the theory of landscape and ecology,we chose

Ningjiang River Basin as the research area. This paper chose 210m as the appropriate grain size which can better calculate the landscape index for the land use map of Ningjiang Basin .The factors such as soil types, land use types, altitude, slope, soil erosion, distance from settlements, SHEI as the constraint conditions. According to the minimum cumulative resistance mode l(MCR) and spatial principal component analysis(SPCA),the landscape resistance surface was constructed. The results showed that (1) the main ecology sources are lack of link. and the landscape resistance of Ningjiang basin was high.(2) The ecology risk was generally high, the area of generally ecology risk district was 523.99km^2 ,being the largest and accounting for 36.8% of the research area. (3)Setting the aim of decreasing the ecological risk of Ningjiang basin, this paper selected the forestland the area of which was over 100hm2 ,and selected water area ,whose area was over 20hm2 as the eco-source. With points，lines and surfaces being interlaced，a regional ecological network was constructed，which was consisted of 15 ecological corridor，19 ecological nodes，a large ecological source region and a plurality of small area source region，and could effectively improve the ecological stability level in the study area, and provide scientific basis for the landscape optimization.

Key words: Ecological Optimization, Minimum Cumulative Resistance, Ecological Network, Ningjiang Basin

Phage-Host Associations in a Full-Scale Activated Sludge Plant: Potential Impacts of Phage Predation on Treatment Performance

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Abstract: The activated sludge process is one of the most important biotechnological applications for wastewater treatment. Free viral particles (mainly phages) are approximately ten-fold more numerous than bacterial cells in the process, and consequently the bacterial diversity and abundance could be continuously regulated by phages. To date, however, little is known about the phage-host interactions in such important and complex biological wastewater treatment systems. Additionally, sludge bulking is notorious in the activated sludge treatment process, which adversely affects sludge settleability in secondary clarifiers and is always accompanied by dramatic changes in bacterial community compositions and functions. Despite a huge number of bacteriophages present in sludge systems, the response of viral communities to sludge bulking is unknown. In order to explore the phage-host associations in activated sludge processes, the viral and bacterial communities in an activated sludge plant under different sludge conditions (sludge volume index (SVI) of 180, 132 and 73 mL/g) were

examined in this study by high-throughput sequencing of viral metagenomes and bacterial 16S rRNA genes. Despite a sampling interval of about 10-months, the two bulking sludge samples had more similar bacterial and viral communities, reflecting an ecological resilience of microbial communities in the activated sludge plant, and suggesting that changes of the viral and bacterial communities closely correlate to each other. Specifically, overgrowth of Candidatus Microthrix parvicella led to the filamentous bulking, but few corresponding viral contigs were identified. By contrast, the sludge viromes were characterized by containing numerous contigs associated with Candidatus Accumulibacter phosphatis, which is known to play important roles in phosphorous removal in biological sewage treatment systems, suggesting abundant relevant phages in the sludge viral community. Such phage-host abundance distributions were largely consistent with the "Kill the Winner-Cost of Resistance" model. Notably, while nitrifiers (mainly in Nitrosomonadaceae and Nitrospira) significantly declined along with sludge bulking, their corresponding viral contigs were identified more frequently and in higher abundance in the bulking virome. While sludge bulking can lead to the washed out of non-filamentous bacteria including nitrifiers due to the deflocculation of activated sludge, our findings suggest that phage-mediated lysis might also contribute to the loss of nitrifiers during sludge bulking.

Key words: Phage-Host Association, Activated Sludge Wastewater Treatment, Viral Metagenome

A Preliminary Study of Periphyton Community Succession in Winter Landscape Water

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Abstract: In January 2015, landscape water of Shanghai Ocean University conducted a 30-day survey sampling. The results showed that the 4 classes including 37 genus and 65 species of periphyton were detected; attached to 69% of the total number of species of periphyton, the dominant species of diatoms are Nitzschia acicularis, Synedra ulna and Melosira granulate; the dominant species of Chlorophyta are Stigeoclonium sp. and Ulothrix sp.; the dominant species of Cyanophyta are Phormidium sp. and Oscillatoria sp.; The density of periphyton at artificial substrate is from 1.13×103cells/cm2 to 5.00×105cells/cm2 and the peak of density appeared the 27 days; The density of diatoms at artificial substrate is from 1.10×103cells/cm2 to 3.00×105cells/cm2 and the peak of density appeared the 25 days The chlorophyll a content is ranging from 2.33μg/L to 717.61μg/L; The range of Shannon-weaver diversity index is between 2.16

and 4.24. In the course of the experiment coupon, diatoms attached starting from the first day in dominant position. At the four days, the dominant species of Chlorophyta began to appear. At the five days, the dominant species of Cyanophyta began to appear. The end of the experiment, Xanthophyceae were emerged.
Key words: Artificial Substrate, Periphyton, Community Succession, Environmental Factors

不同生活型蚯蚓对污泥处理的效果研究

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Abstract: 蚯蚓对污泥的处理净化能力一直是研究的热点，对不同生活型蚯蚓的处理差异研究也逐渐的引起了人们的注意。研究报道了三种不同种蚯蚓接种处理后污泥的净化效果。28 天的培养实验表明：接种蚯蚓能提高污泥的 pH 值，减少污泥中有机物的含量，特别是体型较大的威廉环毛蚓和杜拉蚓。接种蚯蚓减少了污泥中全氮、全磷、全钾的含量，深层种杜拉蚓显著降低了污泥中全氮和全磷含量，较对照处理分别减少了 14.3%和 10.3%。接种威廉环毛蚓的处理较对照处理能显著增加水解性氮和速效钾的含量。接种杜拉蚓的处理吸收重金属的效果最佳，Cr 和 Cu 含量均显著低于对照处理，威廉环毛蚓次之，但优于赤子爱胜蚓。结果显示，在大部分的项目中，杜拉蚓和威廉环毛蚓的作用效果是要优于赤子爱胜蚓，但是这种优势并不是全部显著的。总之，蚯蚓有助于净化城市污泥，实现污泥的资源化利用，同时，不同生活习性的蚯蚓对污泥净化效果也会有着一定的不同。
Key words: 污泥, 威廉环毛蚓, 杜拉蚓, 赤子爱胜蚓

Effects of Planting Densities on Ulmus pumila Growth and Soil Physico-chemical Properties of Seashore Saline-alkali Land in Jidong

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Abstract: In order to uncover this effects of planting density on Ulmus pumila growth and soil physico-chemical seashore of salt-alkali land properties in Jidong and to find optimal planting density and further build demonstration of eco-ecological afforestation in seashore salt-affected land,the Ulmus pumila seeding planting experiments of 3 densities (space and row space such as 1m×4m,2m×4m and 3m×4m)were designed in Yanshan county of Hebei province throught investigating some indexes of plant growth and soil physico-chemical properties such as

DBH,biomass of Ulmus pumila and soil bulk density,moisture capacity,porosity, pH and the contents of organic matter,nitrogen,phosphorus,potassium and comprehensively evaluating the effect of soil fertility improvement with different pianting densities.The results show that:(1)The 2m×4m planting density was better than other two densities for tree growing.The values of mean DBH, aboveground biomass, underground biomass and root cap ratio were biggest under the 2m×4m density,which were 29.13 mm,1604.2 g,519.8 g and 0.302 respectively.(2)The average soil bulk densities of the 3 planting densities were significantly lower than that of CK ($P<0.05$).With the large of planting density the soil bulk density is lower. (3) CK soil water-holding capacity was poorer.While the nature water capacity, field moisture capacity, Capillary moisture capacity and saturation moisture capacity under the 3 planting densities were increased, and that increases with the increase of planting density. 1m×4m and 2m×4m densities had best improving effects, which 3 water-holding capacity indexes were significantly higher than that of CK($P<0.05$). (4) These means of soil total porosity,non-capillary porosity, capillary porosity and which all were at the 2m×4m planting density were maximum.What's more the total porosity and capillary porosity were significantly higher than CK ($P<0.05$).(5)2m×4m density had best reducing effects on pH and soil pH and total salt content, which average were significantly lower than that of CK($P<0.05$).(6)Soil total potassium, available potassium, hydrolysis nitrogen,total phosphorus contents of every planting densities were higher than CK. The means of above 4 nutrient contents under the 4x2 planting density were significantly higher than that of CK($P<0.05$), which were 13.74 $g•kg^{-1}$,781.97 $mg•kg^{-1}$,23.03 $mg•kg^{-1}$,0.70 $g•kg^{-1}$ respectively.(7) The comprehensive evaluation value of soil fertility in 3 planting density treatments were higher than CK.The largest was 0.560 under 2m×4m density, 3m×4m density times,1m×4m density minimum. Comprehensive consideration, for the result of this study, 2m×4m density is the optimal planting density for the improvement of seashore Saline-alkali Land in Jidong.

Key words: Salt-Alkalli Land, Electrical Conductivity, Vegetation Rehabilitation, Comprehensive Evaluation

Potential Ecological Risk of Heavy Metals in Cultivated Soil along an Urban-rural Gradient of Black Soil Region in Northeast China

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Abstract: Black soil region of northeast China, as one the few black soil resources in the globe, is mainly distributed in Songnen plain and Liaohe Plain. It is provided with

soil with high fertility and superior agricultural conditions. Agricultural production of black soil region in China has been playing a crucial part in national grain supply and stabilization of grain prices. However, rapid urbanization in northeast China since the introduction of revitalizing the old industrial base of northeast is seriously challenging the agricultural production of this region, urban area is sprawling at the expense of cultivated land loss and environmental degradation. Therefore, evaluating heavy metal (HM) pollution of cultivated soil and understanding its spatial variation law under impacts of urban sprawl is significant for the conservation of black soil resources. A suburb of Changchun Kuancheng District located in the narrow black soil region with evident rapid urbanization process was taken as the study area, and a total of 137 cultivated soil samples were collected and eight elements were analyzed (As, Hg, Cd, Pb, Cr, Ni, Cu, Zn). Single contamination index and potential ecological risk index were used to evaluate HM pollution status along a cultivated urban-rural gradient of black soil area in northeast China, and principal component analysis (PCA) and spatial analysis were performed to analyze impact factors of the pollution and measure its spatial variation law. The results indicate the following:1) Mean concentrations of As, Hg, Cd, Pb, Cr, Ni, Cu, Zn were as high as 1.13, 1.28, 1.59, 1.16, 1.48, 1.45, 1.60 and 1.42 times their background values, and there is a slight accumulation tendency for HMs in suburban cultivated soil. PCA results of single contamination indexes indicate that accumulation of As, Cr, Ni, Cu, Zn are closely associated with the first principal component, which explained 45.0% of the total variance; accumulation of Hg, Cd, Pb are closely associated with the second principal component, which explained 30.64% of the total variance. 2) 69.51% of total cultivated land area (7675.86ha) were at low potential ecological risk and 30.49% (3366.21ha) were at moderate potential ecological risk, which indicates potential ecological risk of HMs for cultivated land use in the suburb. 3)Lanjia County where is a cluster of industrial manufacturing and long-standing rural settlements and Yitong river catchment which has been reported to be HM-polluted for several times are hot spots for higher potential ecological risk.
Key words: Cultivated Land, Metal Pollution, Urbanization, Black Soil Region

Mature Community Structure of Periphytic Ciliate in Scenic Water and Its Relationship with Environmental Factor

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Abstract: The mature community structure of periphytic ciliates in scenicwater of Shanghai Ocean University was investigated by using the method of direct observation in vivo and protein silver staining, and analyzed the correlation between them and

environmental factors in January-December, 2015. The result showed that a total of 51 kinds of periphytic ciliates were identified and belong to 12 orders. The planktonic, vagile and sessile ciliate species account for 18%, 33% and 49%, and Peritrichida was the dominant group, followed by Pleurostomatida; Cyrtophorida, Trichostomatida, Hymenostomatida and Protostomatida were rare groups; the others were belonging to common groups in the identified ciliates. The average annual density of the periphytic ciliate was 127.29cell/cm2, and the lowest density was 24.27cell/cm2 in February, and the highest density was 248.57cell/cm2 in May. The RDA (Redundancy Analysis) and the Pearson correlation analysis showed that transparency (SD), water temperature (T), dissolved oxygen (DO) and specific conductivity (Spc) had considerable effects on the periphytic ciliates density, which main environmental factors were causing the seasonal distribution discrepancies of the periphytic ciliates in scenic water. In addition, this study showed that the glass slide method can be used as a supplementary method to monitor water quality of scenic water.

Key words: Scenic Water, Periphytic Ciliate, Mature Community, Environmental Factor

荒漠花棒丛枝菌根真菌共生特征及地理分布

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Abstract: 2015 年 7 月沿西北荒漠花棒天然分布区，自东向西，选取内蒙古鄂尔多斯、磴口、乌海、阿拉善，宁夏沙坡头，甘肃民勤、安西 7 个样地，采集 0-30cm 土层花棒根际土样和根样，研究了花棒 AM 真菌定殖结构特征和地理分布规律及其与环境因子的相关性。结果表明，花棒根系能被 AM 真菌高度侵染形成 I-型丛枝菌根，AM 真菌不同结构定殖率为菌丝>泡囊>丛枝。西北荒漠带由东向西随干旱程度加剧，AM 真菌定殖率总体趋于上升，而 AM 真菌孢子密度总体趋于下降。易提取球囊霉素和总球囊霉素占土壤有机 C 平均百分比分别为 17.4%和 53.4%，说明球囊霉素是土壤有机碳库的重要来源和组成部分。主成分分析表明，土壤温湿度、磷酸酶、脲酶、有机碳是影响样地间差异的主要土壤因子。相关性分析表明，AM 真菌总定殖与土壤湿度和有机碳显著正相关，与土壤温度和酸性磷酸酶显著负相关，孢子密度与土壤湿度、磷酸酶和球囊霉素显著正相关，与土壤温度和 pH 显著负相关。说明 AM 真菌能与花棒形成良好共生关系，且具有与环境相适应的地理分布格局，水热环境所导致的土壤特性变化综合影响并决定 AM 真菌共生特征和生态地理分布，AM 真菌定殖结构和分泌的球囊霉素可有效评估荒漠土壤环境。

Key words: 丛枝菌根, 定殖分布, 土壤因子, 西北荒漠

Accumulation and Subcellular Distribution of Cadmium in Salix Variegate

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Abstract: Cadmium (Cd) is one of the most phytotoxic heavy metals. Being highly water soluble and readily taken up by plants, it has significantly negative effects on plants. As the same time, plant produced a number of detoxification mechanism to resist Cd stress. With large biomass and fast growth rate, Salix variegateis a promising phytoremediation candidate for Cd contaminated area. Its strong tolerant capacity to Cd has been widely reported, nor its detoxification mechanisms at cellular scale. To further understand the mechanisms involved in the Cd detoxification, the Cd content of S. Variegate in different organs and subcellular factions has been studied in this research. A hydroponic experiment with different Cd concentrations were conducted, including 0 mg•L^{-1} (CK), 2 mg•L^{-1} (T1), 10 mg•L^{-1} (T2), 20 mg•L^{-1}(T3) and 50mg•L^{-1}(T4).We determined the Cd content of S. variegate indifferent organs on the day of 18d and subcellular factions on the day of 0d, 6d, 12d and 18d after the experiment began. The results showed that: (1)The Cd contents of each Cd treatment in S. variegate roots were much higher than in their stems and leaves, which indicated the Cd content from root to shoot was restricted by accumulation effect of S. variegate root, so decreased the Cd toxicity in cell organelles of S. variegate shoot.(2)Either the experimental duration or treatment affected the Cd subcellular distribution in S. variegate significantly. The Cd concentration increased with the increase of Cd concentration in the treatment and prolonged time. However, the increase of the Cd concentration in cell wall and cytoplasm supernatant were far more than those in cell organelle. The Cd concentrations in different subcellular fractions were following the sequence of cell wall > cytoplasm supernatant >cell organelle. These results indicated that cell wall binding and vacuolar compartmentalization are important in the detoxification mechanism of Cd in S.variegate leaves, while the former one is dominant. (3) With the same duration, compared to CK, the Cd concentration in the cell wall increased significantly under low Cd concentration treatment, while the cell wall Cd concentration and the percentage of that in the whole cell showed a decreased trend with the increase of Cd stress, and that in cytoplasm supernatant increased significantly. These results indicated that the effect of cell wall binding declined while compartmentalization enhanced significantly under medium and high Cd concentration treatment, which is a kind of tolerance mechanism of S.variegate under high Cd stress. (4) With prolonged time, the percentage of cytoplasm supernatant Cd in the whole cell increased, while that of cell wall Cd declined gradually, demonstrating that the effects of cell wall binding decreased while compartmentalization increased gradually with

time increasing. (5)The increasing of Cd concentration in the subcellular fractions of S.variegate caused by the interaction of time and treatment was greater than the effect caused by either time or treatment. Thus, it could be concluded that the effect of cell wall binding and vacuolar compartmentalization are more significant when time and Cd treatment interact.

Key words: Cadmium, Salix Variegata, Subcellular Distribution, Compartmentalization

Study on Non - point Source Pollution Risk Area and Pollution Path Identification in Wuhua River

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Abstract: Non-point source pollution is one of the most important water environment problems. It is the key to identify potential risk zones and risk paths in the process of non-point source pollution. Taking the Wuhua River Basin in Guangdong Province as an example, the topographic wetness index and Runoff Curve Numbers were chosen to study the yield characteristics of the underlying surface of the basin which were used to build the resistance surface, and the high pollution load were considered a source. Based on the minimum cumulative resistance model, this study visualize and analyze the high risk area and pollution path of non-point source pollution in Wuhua River Basin. The results showed that there is a big difference in the yield of the underlying surface. The low runoff area was mainly concentrated in the southwest, and the high runoff area was x - shaped strip distribution in the basin. Under the influence of surface runoff, with the increase of distance, the non-point source pollution area of Wuhua River Basin is decreasing from the high pollution load to the surrounding area. In addition, the farmland has short-distance path pollution, and the construction land has long Path pollution, according to different circumstances to take different governance measures. The results prove that it is reasonable to use the method of ecological flow to identify the pathways of pollutant migration with surface runoff. This study provides a new idea for the non-point source pollution risk area and the identification of risk path. Source pollution control lay the theoretical basis.

Key words: Non-Point Source Pollution, Risk Zone Identification, Risk Path Identification, Minimum Cumulative Resistance Model

Removal of Endocrine Disruptors BPA Erythrina Peroxidase

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Abstract: Currently,the BPA is one of the most widely used industrial compounds, the phenolic compounds is the one of important members of Endocrine disruptors (Endocrine Disrupting Chemicals, namely the EDCs) .Since 1980s ,a series of studies have shown that BPA has estrogen effect and biological toxicity to aquatic organisms and human cells. EDCs have characteristics of bioaccumulation, utility lasting and extremely low physiological response and so on, the conventional technology of water treatment is very difficult to sweep away the EDCs .Nowady, eliminating the bisphenol A mainly adopts biodegradation, adsorption and photocatalytic degradation of chemical and physical methods of enzyme degradation in the environment. due to the method of degradation of peroxidase has the advantages that high efficiency, mild reaction conditions has been widely concerned. Based on our previous study found that coral tree leaves have higher activity of peroxidase, the peroxidase can play an important role in phenolics biodegradation ways. for exploring the application prospect of coral tree leaf peroxidase in the removal of EDCs in water, to develop its economic value, we surveyed the coral tree leaf peroxidase of EDCs chemicals BPA removal effect and reaction conditions in the water. The results showed that the enzyme on the BPA removal was 99.7% after three hours, and the best PH range of removal ability is 7-9, the temperature of 30-50 ℃, the optimum substrate concentration is 300 u, the best ratio of the concentration of H_2O_2 / BPA is 5.

Key words: Peroxidase, Tung, Bisphenol A, Temperature

Could Bighead Carp Be Used to Control the Overgrowth of Phytoplankton in Eutrophic Waters?

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Abstract: Silver carp(Hypophthalmichthys molitrix) and bighead carp(Aristichthys nobilis) are the most common in China, and have the largest production than other fish in the world, has been widely used in lakes for enhancement, restoration and management of water ecological environment, but still have disputed. Bighead carp, especially, is considered the main feeding planktonic animal, in eutrophic water operated, is considered to be reduced or prohibited, instead, silver carp on phytoplankton. Therefore, we carried out the experiment using bighead carp alone in

Shao Jia breeding farm in Qiandao Lake in Zhejiang province, China. Experiments were conducted with three density gradients, low-density (LF), medium density (MF) and high density (HF), as well as control groups for algal-control. The experimental results show that the bighead carp stocking can inhibit the growth of phytoplankton (especially cyanobacteria), at the end of the experiment, especially, chlorophyll concentration of control group was 108.97μg/L, treatment groups, LF, MF, HF and chlorophyll concentration were 50.26μg/L, 37.75μg/L, 53.08μg/L, respectively. And chlorophyll concentration of control group was significantly higher than that of treatment groups (P=0.002. P=0.001, P=0.003), LF, HF group higher than MF but not significantly (P=0.370, P=0.278), the best algae control effect was achieved under medium density; the total phosphorus of NF in the control group was 0.161mg/L, significantly higher than treatment groups, and MF group had the lowest TP, 0.069mg/L. There is no significant difference among TN of the experimental groups. At the end of the experiment, the effects of nitrogen to phosphorus of bighead carp stocking in the water were obvious, and MF group was significantly higher than that of NF group. Therefore, from the experiment results, the changes of the nutritional status and algae in water environment after bighead carp stocking were observed, and the existence of optimal stocking density, in order to provide a reference for water environment remediation and disposal of the filter feeding fish selection and stocking density.

Key words: bighead carp, eutrophication, blue green algae, optimum density

Characteristic of Filtration Rate by Anodonta Woodiana and Its Ability in Improving Water Quality

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Abstract: Filtering on phytoplankton by filter-feeding mussels can increase the transparency and improve water quality. However, mussels can also release nutrients, and enhance the release of phosphorus from sediment, thereby deteriorating the water quality. So the filtration rate on phytoplankton and release rate of nutrients by mussels are the key steps in affecting the water quality. Characteristic of filtration rate and the nutrients release of Anodonta woodiana were studied. Results showed that in clear water, the filtration rate by mussels was low with limited effect on water quality, while in eutrophic conditions, the filtration rate was high, which increased the transparency and improved water quality. The filtration rate of young mussels was generally higher than the adults. The highest filtration rate appeared in spring and the lowest was in summer for both the young and adult mussels. In addition, mussel increased the total

nitrogen, ammonium and total phosphorus significantly, but did not change the concentrations of soluble reactive phosphate. This study indicates that local mussel can be useful in improving water quality at early stages of the degraded ecosystem restoration, but, mussel alone may have limited effect on improving water quality in clear water during the late stages of the restoration.

Key words: Filter-feeding Mussel, Benthonic Animal, Nutrients, Water Quality Improvement

西北荒漠花棒根际土壤微生物群落多样性研究

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Abstract: 为了监测与评估干旱与半干旱沙地土壤沙漠化情况，必须了解荒漠土壤资源和土壤微生物群落的空间变化。本试验于 2016 年 7 月选取中国西北 7 个典型荒漠样地，采集花棒（Hedysarum scoparium）0-30cm 土层根际与非根际土壤样品，采用磷脂脂肪酸（PLFA）和 Biolog Eco-Plate™方法探讨了土壤微生物群落空间变异特征。结果表明，土壤微生物群落具有明显空间分布特征。7 样地微生物群落结构和功能多样性差异显著。微生物群落代谢活性由东向西减小，而微生物群落结构变化不明显。土壤微生物总 PLFA，真菌，细菌，放线菌以及 G+与 G-细菌含量民勤样地最高。16: 0, 18: 1ω7c, 16: 1ω7c, 18: 1ω9c 和 10Me16: 0 是各样地的共优势 PLFA。主成分分析（PCA）显示，土壤脲酶，有机碳和湿度是影响微生物群落的主要土壤因子。结构方程模型（SEM）表明，不同样地直接显著影响土壤微生物群落组成，并通过影响土壤因子而间接影响土壤微生物结构和功能。本研究为进一步了解土壤微生物变化规律及其在干旱生态系统重建中的作用提供了依据。

Key words: 土壤微生物, 空间变化, 花棒, 荒漠环境

ESC-06：稳定同位素生态学研究与应用

Exacerbated Nitrogen Limitation Ends Transient Stimulation of Grassland Productivity by Increased Precipitation

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Abstract: The projected increases in precipitation may enhance plant productivity and carbon storage in water-limited ecosystems. However, the existing evidence for the precipitation control on grassland plant productivity comes primarily from observational studies along natural precipitation gradients or from short-term manipulative experiments. The effects of long-term increased precipitation on grassland productivity are poorly understood. In the world's largest remaining temperate grassland, we found that experimentally increased precipitation enhanced net primary production, soil available nitrogen and foliar nitrogen concentrations during the first six years, but it ceased to do so in the following four years, unless nitrogen was simultaneously added with water. The enhanced 15N natural abundance of plant and soil in later years indicates increased nitrogen losses, thus exacerbating nitrogen limitation and ending the stimulation of productivity by increased precipitation. Our study demonstrates that the long-term response of grassland ecosystems to increased precipitation will be mediated by nitrogen availability. These results also point to a shift from co-limitation by water and nitrogen early to perhaps limitation by nitrogen only later in this temperate grassland, highlighting significant variations in the type of resource limitation induced by climate change.

Key words: 15N Natural Abundance, Climate Change, Net Primary Production, Nitrogen Losses

J200 激光质谱联用元素分析仪在绘制植物叶片的元素三维空间分布图中

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Abstract: 利用J200 激光质谱联用元素分析仪快速测量3个新鲜灌木叶片样品中元素 Mg、Ca、Be、Sr 等的不同元素不同层次的空间分布变化情况；还分析了健康叶片（样品 2）和发黄叶片（样品 3）两个不同的叶片元素空间分布情况，结果发现 Mg 在绿色健康的叶片中的含量高于 Mg 在非健康发黄的叶片中的含

量； Sr 的元素分布正好相反。K、Rb 含量在叶脉较高，而 Sr 元素分布在叶片。
Key words:元素分析，叶片，植物重金属，元素分布

Floral Diversity between Organic and Chemical Farming

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Abstract: Diversity depends on numerous factors counting management approach, inputs used in the farming and system of integration. This biodiversity based study was accomplished in Tetulia Upazila under Panchagarh district in Bangladesh with a view to discern the floral diversity connecting organic and chemical tea farms. Both chemical and organic tea farms were selectd for the study. Four sites (Two sites from organically managed tea farms and two sites from chemically managed tea farms) were selected for the study to explicit the differences between two farming approaches. The key instruments were administered leading field observation, interview and survey of quadrates. The tested hypothesis reflected significant floral diversity in organic tea farms as contrasting to conventional tea farms. Both young and mature tea confirmed greater diversity in organic tea farms. On the source, rainy season reflected greater floral diversity in both farms contrasting to summer. Once more, in the rainy season, organic farms represented high diversity than conventionally managed tea farms. Increased species with higher number of individuals were recorded from organic tea farms. In case of both tea farms the young tea demonstrated higher species diversity due to low canopies closer. This finding demonstrated the impact of organic farming approaches. This approach ensures more stable and sound ecosystems in supporting the species. However conventional farms have displaced organic farms few years back. Once upon time the whole system or farming approaches were under organically managed farming systems. There is no risk in organically managed tea farms except contamination of neighboring field. The ultimate benefits of organic farms make high profit margin with environmental benefits in relation to diversity, low insect infestation, environment (soil, air and water), animals and human health.
Key words: Ecology, Organic, Diversity, Biodiversity

Carbon and Oxygen Isotopic Signatures Reveal a Decoupling Between Stomatal Conductance and Photosynthetic Capacity Exposed to an Ozone Concentration Gradient

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Abstract: Based on measurements of stable isotopic signatures δ18O and δ13C in leaves of Platanus orientalis, Robinia pseudoacacia, and two poplar clones (Populus×euramericana cv. '74/76' and P. deltoides cv. '55/56' ×P. deltoides cv. 'Imperial') exposed to 5 concentrations of [O_3] in an open-top chamber experiment, we found the increase in δ18O paralleled an increase in δ13C measured earlier in the same samples, meaning that the dominant effect of ozone was on gas diffusion and not on CO_2 fixation. Our results suggest that the dual isotope approach is capable of revealing the qualitative contribution of stomatal conductance (gs) and photosynthetic capacity (Amax), and deriving carbon water relations in different species and clones.
Key words: Dual Isotope Model, Tropospheric Ozone, Photosynthetic Capacity, Stomatal Conductance

Paleoecology of Penguin for the past 3000 Years and Its Association with Climate and Sea Ice Change

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Abstract: Adélie penguin species prefer pack ice habitat, it is a good bioindicator for Antarctic climate and sea ice change. There are rare high-resolution records for penguin ecological change and its association with marine environmental variation, due to the lack of suitable archives. Here we obtain a 3000 year sediment profile of penguin feathers (DM3) from Vestfold Hills, East Antarctica. We performed stable carbon and nitrogen isotope analysis on these feather remains, discussed its implication for penguin's habitat and dietary change with regional marine climate and sea ice change. Stable carbon isotope in penguin feathers reflects its foraging habitat, while nitrogen isotope the dietary items. Carbon isotopes in DM3 range from -25.41‰ to -21.61‰ with a mean of -23.31±0.71 ‰ (n=73). The δ15N values have a greater range from 7.95‰ to 13.42‰ with a mean of 10.84±1.15‰ (n=73). Stable carbon and nitrogen isotopes in DM3 show a positive correlation ship ($r=0.62$, $p<0.01$), suggests some common factors affect penguin foraging habitat and dietary compositions. During the past 3000 years, stable carbon and nitrogen isotope ratios in penguin show an overall depleted trend with fluctuations, opposite to the increased diatom-recorded sea ice extent in this region. This indicates that more low level krill are consumed by penguin during the neoglacial age (since ~2500BP) when the sea ice advanced. Meantime, the depleted carbon isotope signature in the sea ice diatom could transport to high trophic levels through the food chain. In DM3, carbon and nitrogen isotope profiles also show synchronous pattern in 2900–1700 BP, ~1500 BP and ~1200 BP and asynchronous pattern in 900–1100BP and 450–550BP, suggests that in addition to the sea ice change

which could affects penguin foraging habitat and dietary compositions, climate related carbon isotope variation in regional food chain baseline may also accounts for the carbon isotope change in DM3.

Key words: Antarctica, Stable Isotope, Food Chain, Climate Change

The Status of Mangrove Forest at Alas Joyo Segara Anakan, Central Java

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Abstract: Mangrove of Alas Joyo is a part of mangrove ecosystem of Segara Anakan Cilacap, Central Java. In the 1996-1997 large areas of mangrove forest in the SA were changed to the shrimp ponds, which were unproductive and eventually abandoned, and as well as large area was left as gap area. These gap area and the abandoned shrimp ponds quickly were colonized by the mangrove shrubs, Achantus ilicifoius, and liana. Derrys heterophylla. Beside In addition to the abandoned shrimp ponds, and gap area without mangrove trees, the SA mangrove has also experienced the siltation, 4.5 million ton per year since the 1980. The siltation created a lot of newly form-lands, and pro-grading lands. This newly-formed and pro-grading lands were supposed to be the habitat of the various mangrove tree species. However due to many of mangrove trees were cut down at large scale and which left the gap area, thus the gap area were colonized by shrub and liana mangroves, A. ilicifolius and D. heterophylla. We conducted research on the status of mangrove forest at Alas Joyo, a newly-formed land, and to determine: 1. the status of mangrove growth forms, species and their densities; 2. the soil qualities, NO_3, NH_4, PO_4, K^+, C organic, soil textures, pH, light intensity, the air humidity, soil and air temperatures. Vegetation data were collected using quadrate plots of 200mx200m; 20mx20m; and 0, 5mx0, 5m.We divided the studied area in 4 zones, Upper-low river bank, Upper Low, Upper Midle, and Upper Upper. The results revealed that at the Alas Joyo forest, A. ilicifolius and D. heterophyla covered respectively almost 100% and 75% of the area, and their number of individuals of A. ilicifolius varied between 304.700 and 1.306.900 per ha. There were 12 mangrove tree species, but the individual number of tree species were very rare, 1-6 individual per ha. These species were Rhizophora apiculata, R. mucronata, Bruguiera gymnorhiza, B. cylindrica, Avicennia alba, Sonneratia alba, S. caseolaris, Ceriops tagal, Aegiceras corniculatum, Xylocarpus moluccencis, X. granatum, and Nypa fruticans. We only found 2 species of seedling trees, A. corniculatum and B. Cylindrica, 42 and 3 individual per ha. The number individual of mangrove propagule trees were very rare.

These propagules were not distributed because they were trapped in the mangrove shrub and liana, which have both r and K strategies. If the tree propagules grew, they also were loss competition to the mangrove shrub and liana. The soil qualities showed that the area should be a good habitat for mangrove tree species to grow. The mangrove tree species in the Segara Anakan were threatened. Therefore, we proposed that the mangrove at Segara Anakan should be rehabilitated, to store the important ecosystem services at mangrove ecosystem itself and also in the sea scape.

Key words: Disturbed Mangrove, Mangrove Shrub-Liana, River Bank, Mangrove Zones

Research on Spectrum of Grassland Community in Lhasa River Basin

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Abstract: Using a portable spectrometer ASD Field Spec measured the spectral reflectance curve of main constructive species in the Lhasa River Basin, degradation indicator species and grassland communities with different degradation degree. The results showed that: the spectral characteristics of the poisonous plants (Stellera chamaejasme, Astragalus strictus and Ligularia lapathifolia) responsed of fencing basically the same, and the reflectivity outside fence was higher than that of inside fence, while the spectral reflectance of Ceratostigma minus outside fence at red band was higher than inside fence. The reflectivity at the near infrared band of the poisonous plants outside fence was significantly higher than that of the same plant in inside fence. The plant of outside fence was affected by grazing and drought， its spectral reflectance was closed to the spectral reflectance of bare soil at the visible range, while the plant community of inside fence has the basic characteristics of the vegetation spectrum. The reflectivity at the near infrared band was closely related to the biomass of the grassland community, which reflects the degree of grassland degradation and the reflectivity was showed as not degraded > moderate degradation > severe degradation. In addition, the water absorption valley at 1400nm can reflect the degradation Degree, the depth and width of the moisture absorption valley were showed as not degraded > moderate degradation > severe degradation.

Key words: Vegetation Community Spectrum, Grassland Community, Spectral Characteristics, Inside and Outside Fence

The Use of Carbon Isotopes and Cs^{-137} to Study Dam Watershed Carbon Erosion Processes

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Abstract: The coupling research of carbon migration and hydrological processes, carbon source and soil erosion or sedimentation play an important role in the study of ecosystem carbon erosion. In this study, by monitoring the carbon transport and its rainfall-runoff process during rainy season in Loess Plateau's dam Watershed and collecting different slope, altitude soil samples, we analyzed the different carbon transport under rainfall driving and further evaluated the C loss flux for dam watershed. Using the carbon isotope, Cs^{-137} tracer and SOC to analyze the carbon source and the soil erosion processes.So as to provide scientific basis for in-depth evaluation of carbon erosion and its hydrological process driving mechanism in the Loess Plateau.
Key words: Soil Erosion, Carbon Isotopes, Cs^{-137}, Loess Plateau

稳定同位素红外光谱技术在生态系统水循环过程研究中的应用

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Abstract: 稳定同位素红外光谱技术的进步为研究植物水分来源、蒸散组分区分等生态系统水分运移过程提供了新的契机。以稳定同位素红外光谱技术为基础，开展大气水汽 δ18O 和 δD 同位素比值和通量的原位连续观测，同时对土壤水、茎秆水、叶片水、降水、露水以及灌溉水 δ18O 和 δD 进行了连续的采样和分析，综合探讨植物水分来源和蒸散组分区分的方法论及其控制机制。研究结果表明：（1）结合 IsoSource 和 MixSIR 模型表明，千烟洲马尾松、湿地松和杉木具有相似的水分来源，存在明显的水分竞争关系；三个树种具有双根系特征，干旱时期(7-10 月)主要利用深层(50-100cm)土壤水，非干旱时期(11-6 月)主要利用浅层(0-20cm)土壤水，树木的水分来源存在明显的季节性转换。（2）张掖春玉米以表层 0-10 cm 土壤水为主要水分来源，利用比例为 86.7 ± 14.7%。春玉米并不直接利用灌溉水。四次灌溉事件期间的深层下渗水 (> 80 cm) 占灌溉水和降水总量的 39% (265 mm)。（3）基于同位素物质守恒原理，验证了稳态假设 13:00-15:00 近似成立。基于同位素稳态假设，千烟洲蒸腾与蒸散比例为 87.3±8.6% (51.5~99.4%)，而张掖为 0.87±0.052(71.3~96.0%)。该结果与传统的涡度相关-蒸渗仪方法在试验期间差异不显著。
Key words:稳定同位素光谱技术，稳定同位素质谱技术，涡度相关技术，生态水文

Effects of Simulated Warming on Soil Basal Respiration Rate of Forest Surface Layer at Different Altitudes in Sejila Mountain, southeast of Tibet

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Abstract: 【Objective】 In order to clarify the dynamic change of soil respiration rates at different altitudes forest surface layers, and also to provide scientific basis for the prediction of soil carbon dynamics at different altitudes in future climate changes, 【Method】 the forest soils at different altitudes in southeastern Sejila Mountain were studied to research responses of soil basal respiration in different altitude to temperature changes by laboratory simulated heating experiment. 【Result】Results reveal that: 1) The water content of soil increased with the increase of altitude, showed that: 4100 m>3990 m>3834 m, at the level of layer showed that: 0～5 cm>5～10 cm>10～20 cm; 2)Soil basal respiration rate and soil accumulated carbon flux increased with the increase of temperature, and elevation at high altitudes is greater than low altitude; soil basal respiration rate and soil accumulated carbon flux all shows: 0～5 cm>5～10 cm>10～20 cm, soil basal respiration rate and soil accumulated carbon flux all decreased with the increase of altitude in the same temperature; 3) The soil respiration rate of all levels and altitudes increased at first and then decreased with the extension of simulated culture time. Regression analysis showed that, there is a significant negative correlation between soil basal respiration rate and culture time with an exponential relationship between them; The soil respiration rate of all levels and altitudes increased with the extension of simulated culture time, and the increase of soil accumulated carbon flux was obvious in the first 14 days, then gradually became stable. There was a significant positive correlation between accumulated soil carbon flux and incubation time with a logarithmic function relationship between them; 4) Soil basal respiration temperature sensitivity coefficients of altitude (Q10) of 4 100 m, 3 990 m and 3 800 m were 1.56, 1.51 and 1.46, that was to say soil respiration of high altitude is more sensitive to temperature than low altitude, high altitude soils may release more CO_2 in the context of future climate warming. 【Conclusion】 Elevated temperature will accelerate the soil respiration carbon emission of forest ecosystem, and high altitude areas has a higher sensitivity.

Key words: Sejila Mountain, Forest Soil, Warming, Basal Respiration

ESC-07：可持续农业的理论与实践

Cropland Soil Quality Evaluation at a Regional Scale on the Loess Plateau

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Abstract: It's of great importance to study the characteristics of cropland soil quality and its influencing factors on the Loess Plateau at a regional scale. We divided the Loess Plateau in five agricultural regions, named Guanzhong Plain, Weibei Upland, Hilly and Gully Region, Yinchuan Plain and Shallow Mountain and Hilly Region, respectively, based on the ecology, agriculture, soil , cropping system and climate types. And Wugong, Ningxian, Zhuanglang, Pingluo and Ledu were selected as typical counties in each agricultural regions, respectively. We have conducted an in-depth study on regional evaluation of soil quality based on upscaling model. Based on typical counties and "land use-topography-soil series" combinations, scaling-up model of soil quality was setup and explored cropland soil quality and its spatial characteristics on the Loess Plateau at a regional scale with this model.1) Seen from the regional scale, cropland on the Loess Plateau lacked soil organic matter and total nitrogen. However, total phosphorus, total potassium, available potassium and surface available phosphorus were relative abundance. The content of subsurface available phosphorus in Hilly and Gully region was utterly lacked. Cropland in Guanzhong Plain faced the serious problems of soil compaction in which more than 43% area in this region had surface bulk density value between 1.4~1.5g/cm3 and 97% area with a subsurface bulk density value between 1.5~1.6g/cm3. In addition, there were more than 84% and 45% area with subsurface soil bulk density between 1.4~1.5g/cm3 in Yinchuan Plain and Weibei Upland region, respectively.

2) Establishing a soil quality reference within Loess Plateau, surface soil quality was primarily five and six grade levels with the area 79% and 20%, respectively and was distributed mainly over Guanzhong Plain, Fenhe Vally, mountain field in west Shanxi and north Henan, Weibei Upland region, middle and southwest of Hilly and Gully region and the west Yinchuan Plain. Subsurface soil quality was primarily six and seven grade levels with the area 57% and 31%, respectively. Soil quality at six grade level was distributed among Weibei Upland and west Yinchuan Plain. Hilly and Gully region had 55% and 45% area with six and seven grade levels, respectively. Much more attention should be paid to Guanzhong Plain and east Yinchuan Plain where subsurface

soil quality was primarily eight and nine grade levels.

Key words: Cropland Soil Quality, Loess Plateau, Regional Scale, Scaling-up Model

Rice Allelopathy on Weed Control and Underlying Molecular Mechanism

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Abstract: Rice allelopathy on weed had been reported for more than 20 years, and studies were well conducted in the last 10 years, however, the underlying mechanism has not been clearly elucidated. Regulation of gene expression is an initial response in plant interaction, and the miRNAs expression pattern on allelopathic rice PI312777 and its accompanied barndyardgrass (BYG) was investigated respectively by using high throughput sequencing technology. The results show that miRNAs relevant to plant hormone signal transduction, nucleotide excision repair, tropane, piperidine and pyridine alkaloid biosynthesis were enrich expressed on BYG, while only tropane, piperidine and pyridine alkaloid biosynthesis relative miRNAs were found enrichment on PI312777. Most of the enrich miRNAs from BYG that accompanied with PI312777 was enhanced up-regulated folds under elongation on co-cultured days, and it was peak at the 7th day. The reverse was true in the condition of BYG co-cultured with non-allelopathic rice Lemont, based on the qPCR detection of miRNAs dynamic expression under different co-cultured days. Increasing of BYG numbers accompanied with PI312777 also resulted in enhanced gene expression folds of enrich miRNAs on these BYG. Overexpression of PAL gene on PI312777 contributes to increase the miRNAs expression on the accompanied BYG, and silence of PAL gene on PI312777 leads to a reverse result. The target genes were presented a revere expression pattern in contrast to their relevant miRNAs. Moreover, increasing of BYG numbers with PI312777 resulted in decreased the IAA content but increased the apurinic/apyrimidinic sites (AP sites) in the root of BYG, and the BYG accompanied with PAL-OE transgenic lines had lowest IAA content and largest AP sites, but the reverse was true in the BYG accompanied with PAL-RNAi transgenic lines, however, no significant difference was found in the BYG co-cultured with non-allelopathic rice Lemont. In addition, BYG under phenolic acid allelochemicals treatment showed greatly enhancement on the gene expression level of the enrich miRNAs, which in turn to reduce the target gene expression. However, no significant change was found on the BYG treated by terpenoids. Further determination on microbe population numbers in the hydroponic solution showed that a special microbe named Myxococcus species were closely correlated with rice allelopathy potential. The number of Myxococcus was significantly

increased following the enhancing BYG density accompanied with PI312777, and hydroponic system of PAL-OE co-cultured with BYG contained highest Myxococcus numbers while the mono-cultured of PAL-RNAi lines had lowest Myxococcus contains, however, hydroponic solution from Lemont had lower Myxococcus numbers than PI312777 that under same treatment, and no significant difference was found among different ratios of Lemont/BYG co-cultured system. Phenolic acids contributed to increased Myxococcus numbers in the hydroponic solution, and the number was higher than that of terpenoids used. BYG co-cultured in sterile hydroponic solution contained Myxococcus showed increased gene expression level on the enrich miRNAs, and the miRNAs expression level was further enhanced in the condition of Myxococcus with its metabolisms, which indicated the important role of Myxococcus on rice allelopathy. According to the research, it was clear that rice allelopathy specially suppress the IAA synthesis and DNA damage repair on the surrounding BYG, by promoting of the enhanced expression on the relevant miRNAs, which in turn to inhibit BYG growth and development, and Myxococcus species play a vital part in the process of rice allelopathy on BYG.

Key words: Allelopathy, Allelochemicals, Mirna, Myxococcus

The Influence of Cultured Turtle Introduction on Rice Yield and Greenhouse Gases Emission

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Abstract: In this study, statistic chamber/GS system was used to monitor the GHGs emissions and changing rules of the GHGs flux (including CO_2, CH_4 and N_20) were analyzed as well under two different culture systems which are rice mono-culture(R-M) and rice-turtle co-culture(R-T).The relationship between GHGs emissions and rice yield were compared between two culture systems. In Chongming Island, Shanghai. The results showed that rice fields were sources of CH4 and N20 emission through the whole culture period. Except seeding and ripening stage. Rice fields were the sink of N_2O. Compared with R-M, the flux of CH_4 emission of R-T was lower in seeding, tillering, heading and mature stage which in seedling and tillering stages were significantly different（$P<0.05$）; Compared with R-M, the flux of CO_2 emission of R-T was lower in whole culture stages which in mature stage was significantly different（$P<0.05$）; Compared with R-M, the flux of N_2O emission of R-T was higher in seeding, tillering and jointing stages and lower in heading and mature stages.The yield of rice of R-T was 5292.12±191.25 kg/ha and R-M was 4435.17±196.92 kg/ha, The yield of rice increased by 19.32% after the introduction of turtle.

Key words: Chongming, Greenhouse Gases, Flux, Rice Yield

植物叶片光合作用的气孔与非气孔限制研究综述

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Abstract: 外界胁迫条件对植物生长和代谢的影响是多方面的，其中对光合作用的影响尤为突出。然而，光合速率主要受气孔还是非气孔因子的限制，目前尚无定论。本文从气孔与非气孔限制值的计算方法、不同条件下植物叶片光合作用的气孔与非气孔限制以及对光合速率的影响三个方面展开了讨论：（1）对（相对）气孔与非气孔限制值的各种计算方法进行了总结，并分析了各种计算方法的局限性，为判断一定条件下光合作用的主要限制因子提供依据。目前最常用的计算气孔限制值的方法由 Berry 和 Downtow（1982）提出，在实际应用中，学者们常常使用忽略 CO_2 补偿点的简化式。但是随着胁迫强度增加，CO_2 补偿点逐渐上升，因而基于该简化式计算的气孔限制值比真实值偏低。相对气孔与非气孔限制值能进一步解释两种因子的相对重要性，在今后的研究工作中应重点关注。（2）对以往光合作用的气孔与非气孔限制研究中涉及的外界胁迫条件进行了分类，从水分胁迫、盐碱胁迫、多因子复合胁迫、自然条件及其它胁迫条件等几个方面，对前人的研究成果进行了总结。结果表明：在绝大多数单一外界胁迫条件下，随着胁迫程度增加，影响光合作用的因子由气孔限制因子逐步转变为非气孔限制因子。在复合胁迫条件下，学者们尚未形成统一定论，难点在于确定引起植物光合作用变化的主导环节以及多因子复合后植物光合作用变化的原因。目前，有关植物叶片光合作用的气孔与非气孔限制研究多是在控制条件下进行，今后应加强自然条件下，尤其是环境恶劣地区植物叶片光合作用的气孔与非气孔限制研究。（3）分析了气孔与非气孔限制因子对光合速率的影响途径。对于气孔限制因子对光合速率的影响，由于气孔导度表征了气孔的开放程度，因此学者们主要分析了光合速率与气孔导度的关系，研究发现二者一般呈对数响应关系；对于非气孔限制因子对光合速率的影响，本文从叶绿体结构破坏、光合色素含量下降、光合酶活性降低、活性氧代谢功能破坏等几个方面进行了分析。其中，由于没有参数可以表征叶绿体结构的破坏程度，因而很难实现叶绿体结构破坏对光合作用影响的定量研究。

Key words: 光合作用, 气孔限制, 非气孔限制, 水分胁迫

Insights in the Mechanism of Proliferation on the Special Microbes Mediated by Phenolic Acids in the Radix Pseudostellariae Rhizosphere under Continuous Monoculture Regimes

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Abstract: As potent allelochemicals, phenolic acids are believed to be associated with replanting disease and cause microflora shift and structural disorder in the rhizosphere soil of continuously monocultured Radix pseudostellariae. The transcriptome sequencing was used to reveal the mechanisms underlying the differential response of pathogenic bacterium Kosakonia sacchari and beneficial bacterium Bacillus pumilus on their interactions with phenolic acids, the main allelochemicals in root exudates of R. pseudostellariae in the monoculture system. The microbes were inoculated in the pots containing soil and the medicinal plant in this study. The results showed that the addition of beneficial B. pumilus to the two-year planted soil significantly decreased the activity of soil urease, catalase, sucrase, and cellulase and increased the activity of chitinase compared with those in the second-year monocropping rhizosphere soil without any treatment. However, opposite results were obtained when K. sacchari was added. Transcriptome analysis showed that vanillin enhanced glycolysis/ gluconeogenesis, fatty acid biosynthesis, pentose phosphate, bacterial chemotaxis, flagellar assembly, and phosphotransferase system pathway in K. sacchari. However, protocatechuic acid, a metabolite produced by K. sacchari from vanillin, had negative effects on the citrate cycle and biosynthesis of novobiocin, phenylalanine, tyrosine, and tryptophan in B. pumilus. Concurrently, the protocatechuic acid decreased the biofilm formation of B. pumilus. These results unveiled the mechanisms how phenolic acids differentially mediate the shifts of microbial flora in rhizosphere soil, leading to the proliferation of pathogenic bacteria (i.e., K. sacchari) and the attenuation of beneficial bacteria (i.e., B. pumilus) under the monocropping system of R. pseudostellariae.

Key words: Rhizosphere, Phenolic Acid, Monocropping, Microbe

Contributions of Trap Crops to Optimize Agroecosystem for Sustainable Modern Agriculture

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Abstract: Trap cropping fits the concept of habitat manipulation of an agroecosystem to realize high yields and high quality by protecting the main crop through preventing target crops from pest attack. Besides the distinct effectiveness, trap cropping possesses

great potential in optimizing agroecosystem. Integrated pest management as an ecological method has benefited a lot from trap cropping in eliminating the pests of main crops since the concept of trap cropping was raised, Trap crops as guard plants have a significant effect on enemy attraction and pest control, consequently they enrich biodiversity of the field while they were utilized for integrated pest management. Potential effects of trap cropping on fields biodiversity play an important role in optimizing agroecosystem for ecological sustainable agriculture development.

Key words: Trap Cropping, Integrated Pest Management, Habitat Manipulation, Agroecosystem

Study on the Renewal Strategies and Methods of Urban Agriculture in Existing Residential Areas

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Abstract: The overloading of urban ecosystems causes severe problems in ecology and resource, and threatens national food and energy security. Whether the carrying capacity of the future city can support the survival and developmental needs of its residents becomes the key to the sustainable development of the city. This project aims at improving the carrying capacity of urban ecology, relying on the methods such as ecological footprint and GIS spatial analysis, research on the renewal strategies and methods of green productivity in existing residential areas. Based on a large amount of previous data accumulation, and based on the theoretical study of productive cities and the case database of productivity, the basic theory of existing production renewal is constructed. And then the reconstruction strategy of the resource production space and the existing residential environment, the reconstruction strategy of social relations and lifestyle, and the reconstruction strategy of productive infrastructure are discussed respectively, the renewal strategy system of residential productivity is formed; On the basis of theoretical and strategic research, the application of productive renewal are conducted in the sample residential area, and the processes and methods are discussed. Through tapping the productive potential of the residential area, the "space mutual exclusion" hypothesis in the ecological footprint theory is refuted, the residential area are guided to a productive one from a resource-consumptive one, and the trinity developmental mode of "production - life - ecological" in the residential area is achieved, thus providing new ideas for the ecological transformation and the renewal of existing residential in urban areas.

Key words: Urban Agriculture, Existing Residential Areas, ecologically productive area, Biocapacity

连作太子参土壤真菌 DGGE 分析及其拮抗菌的筛选鉴定

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Abstract: 太子参作为福建省大宗型道地药材，在生产过程中存在着严重的连作障碍现象。因此，本研究以福建道地药材品种“柘参 2 号”的根际土壤作为研究对象，通过 DGGE、平板分离以及 qPCR 定量分析等方法研究太子参连作障碍形成的机制。真菌 DGGE 结果表明，连作下太子参根际土壤中真菌群落结构与功能多样性发生明显变化，其多样性指数和均匀度指数随连作年限增加而下降。进一步结合测序结果，发现重茬 1 年和重茬 2 年太子参根际土壤的有益菌（如木霉属）含量较正茬土壤都显著降低，但是镰刀菌含量随着连作年限增加而呈现出增加的趋势。进一步进行土壤原位 qPCR 绝对定量验证分析发现，木霉菌的含量随着连作年限增加而显著减少。本研究进一通过平板分离到一株有益菌-哈茨木霉 ZC5。同时，基于本课题组前期对太子参根际土壤各酚酸含量的分析结果，本研究进一步通过配制混合酚酸来分析关键化感物质—酚酸类物质对根际特异关键微生物生长的影响。结果表明，该模拟土壤各酚酸配比的混合酚酸对木霉菌存在“低促高抑”的现象，说明连作下土壤微生态结构恶化与太子参根系分泌物介导相关。本研究结果为解决或缓解太子参连作障碍提供一种新思路。

Key words: 太子参, DGGE, 木霉, 酚酸

The Overall Effect Assessment of Different Celery Planting Process

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Abstract: China faces severe agricultural non-point source contamination and food safety challenges. These challenges are closely related with the planting process. Therefore, it is important to screen suitable planting technologies, which will not only promote farmers' income, but also control agricultural non-point source Pollution, and ensure food safety. During the growth of celery, growers emphasize the economical benefits of celery, while the government officials emphasize environmental benefits, and consumers emphasize the quality of celery. In order to screen an economical and environment-friendly planting technology, we establish an overall effect assessment system. As growers determine to apply which planting technologies practically, the weight of second level index is determined by the growers through questionnaires, while the weight of third level index is determined by related groups, including food safety specialists, environmental specialists and growers. Finally, results show that 87% of growers preferred a more economical planting technology, 10% preferred a planting technology with better quality celery, and 3% preferred a more

environment-friendly planting technology.
Key words: Planting Process, Celery, Overall Effect Assessment

Microbe Assisted Phytoremediation Could Be a Tool for Reviving the Soil

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Abstract: Sturdy plant like Prosopis juliflora is characterized by distinct and profuse growth even in nutritionally deprived soil and environmentally stressed conditions and is believed to harbor some novel heavy metal resistant bacteria in the rhizosphere and endosphere. A study was conducted to isolate and characterize Cr resistant bacteria from the rhizosphere and endosphere of P.juliflora growing on the tannery effluent contaminated soil. A total of 5 and 21 bacterial strains were isolated from the rhizosphere and endosphere, respectively, and were shown to tolerate Cr up to 3000 mgl−1. Tolerance to other toxic heavy metals was also shown by these isolates such as, Cu, Cd, Zn, and Pb, and high concentration (174gl−1) of NaCl. Moreover, Plant growth activities were also determined. The phylogenetic analysis done by 16SrRNA gene sequencing showed that the predominant species included Bacillus, Staphylococcus and Aerococcus. The inoculation of three isolates to rye grass(Lolium multiflorum L.) improved plant growth and heavy metal removal from the tannery effluent contaminated soil suggesting that these bacteria could enhance the establishment of the plant in contaminated soil and also improve the efficiency of phytoremediation of heavy metal-degraded soils. Although this process is slow but eventually the soil can be remediated from the heavy metals for the growing of other eatable crops without the danger of toxins in them.
Key words: Heavy Metals, Phytoremediation, Plant Growth-Promoting Bacteria, Rhizobacteria, Endophyticbacteria

Plant-Microbe Assisted Reclamation of the Soil to Obtain Sustainable and Toxic Free Agricultural Products

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Abstract: To feed the increasing world population with limited resources is becoming more and more challenging with the passage of time. To confront this challenge with limited fertile land, chemical fertilizers and pesticides are being used excessively

without foreseeing the devastating results. Due to over fertilization not only the lands are becoming less fertile but the environment is also getting polluted. To avoid the usage of inorganic fertilizers and to utilize barren and contaminated soils, the land should be treated with plant or crops which can use nitrogen efficiently with the application of the microbial inoculation which can convert non available nitrogen or which can work in low nitrogen and fix it for the plants and replenish the soil. To reclaim the soil from pollutants and contamination, the use of plant- microbe interaction also known as phytoremediation should be applied. This might be good approach to free the soil from toxic compounds and to revive the soil microbial diversity and minerals, crops can be grown in healthy soil but also as toxic free sustainable agrocecological production.

Key words: Plant-microbe Interaction, Phytoremediation, Nitrogen Cycling, Agroecology

北疆地区棉花作物需水量时空演变及影响因子

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Abstract: 摘要：基于北疆 25 个气象站 1961-2013 年的气象资料和棉花生育期资料，利用 FAO 推荐的 Penman-Monteith 公式及作物系数法，对棉花各生育阶段的作物需水量和灌溉需水量进行估算。结果表明，过去 53 a，北疆地区棉花需水量在各个生育期总体都呈下降趋势，其中，花铃期作物需水量下降趋势最为显著，变幅为-0.15mm/a；各生育期内存在多尺度的周期变化，其中在 30a 左右的大周期尺度上，各生育期作物需水量大致呈现了“偏高-偏低-偏高”的变化过程，在 15-17a 的中尺度周期变化，经历了“偏低-偏高-偏低”的变化过程，而在较小年际尺度上，作物需水量无明显的周期特征；空间分布上，作物需水量、灌溉需水量和水分盈亏指数多年均值在总体上大致呈现自西向东递减的分布特征；突变结果显示作物需水量在各生育期均呈显著减少趋势，且在北疆西北和西南地区最为明显；棉花需水量与气象因子相关性表明各个生育期内，平均风速、日照时数和平均气温都呈显著的正相关性，相对湿度均呈显著性负相关。研究结果可为北疆棉花适时定量灌溉和提高水分利用效率提供基础数据支撑。

Key words: 作物需水量, 水分盈亏指数, 时空分布, 棉花

Analysis of Spatial and Temporal Characteristics Drought-Flood Based on Standard Precipitation Index in Northern Xinjiang Province in Recent 53 Years

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Abstract: Since the beginning of the 21 st century，frequent extreme weather events have occurred under a background of global climate change. This pattern reflects the characteristics of climate change and drought and floods are one of the most serious disaster impacts for human beings. Exploring the relationship between climate change and drought/flood disasters using climate change performance characteristics has become a prime research problem. Drought/flood events frequently taken place in Northern Xinjiang Province，however，few studies have examined drought and flood assessment in this area. Here, The characteristics of drought and flood in Northern Xinjiang Province was analyzed based on monthly precipitation data of 23 meteorological stations from 1961 to 2012 by means of different scales of standard precipitation index, combined with trend analysis, GIS spatial analysis techniques, EOF and REOF method. combined with trend analysis, GIS spatial analysis techniques, EOF and REOF method. The results showed that: there was a significantly humid trend of northern Xinjiang during past 52 years. The frequency of drought decreased continuously during the period and specially presented more than the frequency of flood from 1961 to 1980. Whereas, the frequency of flood increased continuously during the period and specially presented more than the frequency of flood from 1981 to 2012. There were three types of spatial distribution of drought and flood in the area, and were divided in three region accordingly, i. e., Northern (precipitation comfort zone), Eastern (Extreme arid area), Western (arid area) and Mid-region (waterlogging area). Similarly, Shehezi, Tuoli and Kelamayi region located at the center of Xinjiang tend to be waterlogging all the year, Qinghe, Beitashan and Qitai region located in the east were easy to dry.

Key words: Standard precipitation index (SPI), Northern Xinjiang Province, Drought-wet, Variation

Yield and Water Use Efficiency of Dryland Potato in Response to Plastic Film Mulching on the Loess Plateau

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Abstract: Water shortage is a key factor limiting potato yield in dryland farming regions, and the practice of soil mulching with plastic film has proven to be effective for increasing crop yield and improving soil and water conservation. This study investigated the effects of plastic mulching on potato yield and water use efficiency (WUE) on the Loess Plateau of China. Our results indicated that relative to no mulching, plastic mulching significantly increased the yield and WUE. The effects on yield under different mulching methods were ranked as follows: ridge-furrow mulching (RFM) > flat mulching (FM), and the effects on yield with different mulching extents were ranked full-area mulching (FAM) > partial-area mulching (PAM). The effects of plastic mulching on the yield using different colors of film were ranked as white plastic mulching (WPM) > black plastic mulching (BPM) and under different rainfall levels as (precipitation < 400 mm) > (precipitation > 400 mm). The rankings of the effects of plastic mulching on WUE were the same as for potato yield. The yield–evapotranspiration (ET) relationship could be described using a quadratic polynomial, and the yield response curve to ET under plastic mulching fell above the no-mulching curve, indicating that plastic mulching can result in higher yields than no mulching when ET is equal. The yield–ET relationship indicated that potatoes required an ET of 334 mm and 360 mm to achieve the highest yield under plastic mulching and no mulching, respectively, and potato WUE increased linearly with yield under both plastic mulching and no mulching. This study indicated that RFM, FAM and WPM are the most appropriate potato management measures and that there is potential to improve the yield and WUE on the Loess Plateau.
Key words: Plastic Film Mulching, Yield, Water Use Efficiency, Potato

不同消减处理对连作三七根际土壤酚酸含量及真菌群落影响

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Abstract: 三七是五加科人参属植物，为我国道地名贵中药材，生长期长，生长缓慢。三七种植过程中会产生严重的连作障碍，即三七连作会出现产量低、品质劣、病虫害猖獗等，从而影响三七产业的可持续发展及中草药的经济效益，因此探索改善三七连作障碍的消减措施具有重大意义。本研究采用变性梯度凝胶电泳（DGGE）、实时荧光定量 PCR(RT-qPCR)技术分离不同连作年限或不同菌肥处理下三七根际土壤真菌群落及关键真菌的丰度分析，运用高效液相色谱(HPLC)分析不同连作年限或不同菌肥处理下三七根际土壤中的酚酸含量进行分析。研究表明：连作三七的出苗率、保苗率及产量均特低，并且三七连作导致理化养分吸收力下降（如速效氮磷钾重茬含量均最低），及连作土壤出现一定程度上酸化。土壤酚酸含量经 HPLC 分析发现，连作三七的酚酸并没有随连作年限的增加而增加反而下降。对照重茬未处理土壤，经过不同菌肥处理后，不同程度地缓解了土壤

养分流失，TRI 处理比 EM 处理能更好的平衡土壤养分元素，但是 EM 处理在降低酚酸含量方面比 FRI 更显著。DGGE 及 RT-qPCR 结合分析，三七不同根际土壤中真菌群落结构复杂，物种丰富，差异性显著，三七连作后大多数有益微生物减少，病原微生物增加明显，在生物多样性与真菌群落结构方面，EM 比 TRI 更接近 NP，不同菌肥处理均可以不同程度地抑制病原菌的滋生，维持土壤微环境的稳定。可见，三七连作障碍根本原因可能是连作下有益菌骤降而病原菌爆发即土壤微环境失衡，导致三七抵抗力下降，从而出现一系列的连作发应。菌肥运用的确在某种程度上改善了土壤微环境中微生物物种失衡的状况。本研究结果为深入研究三七连作障碍的机理，探索缓解连作障碍的消减技术提供一些理论支撑。

Key words: 三七, 连作障碍, DGGE, 消减策略

Temporal Dynamics of Growth and Nutrient Uptake by Neighboring Plant Species: Evidence from Intercropping

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Abstract: The productivity of species-diverse plant assemblages strongly depends on the temporal dynamics of growth and nutrient uptake by competing neighboring plants. Our understanding, however, of how rates of growth, Nitrogen (N), Phosphorous (P) and Potassium (K) uptake might change through time between neighboring plant species under field conditions is still very limited. Here we specifically measure temporal trajectories of growth, N, P and K uptake by staple food plants such as wheat (Triticum aestivum L.), barley (Hordeum vulgare L.) and maize (Zea mays L.) when growing either in monocultures or in more diverse intercropping systems. We ask how (1) plant species combinations, (2) N fertilization, and (3) film mulching might affect key indexes of growth, N, P and K uptake over time. Sequential harvest of subplots was performed between 7 and 10 times, and the data were fit to a logistic model to characterize growth and nutrient uptake trajectories.

Intercropping significantly increased the maximum biomass, maximum growth rates and maximum N, P and K uptake of wheat and barley. Growth and nutrient uptake by intercropped maize (either with wheat or barley) was reduced at early growth stages but it increased rapidly after wheat and barley were harvested. In the presence of film mulch and/or fertilization, maximum biomass, N and P uptake of intercropped maize was close to or significantly higher than that of maize alone. Intercropping induced significant temporal niche differentiation in the rate of maximum growth and nutrient uptake between intercropped species. Wheat and barley had higher initial and maximum instantaneous rates of growth, N and P uptake than maize, however,

maximum growth and nutrient uptake rates of maize significantly increased under N fertilization and film mulching. Our study is one of the first to provide evidence of important temporal niche differentiation ('temporal complementarity') in growth and nutrient uptake rates between neighboring plant species. We suggest that a better understanding of temporal trajectories of interspecific growth and nutrient uptake rates is crucial if we want to maximize nutrient-use efficiency and sustain over-yielding (i.e. food production) in plant species-diverse systems such as intercropping.

Key words: Intercropping, Biodiversity, Growth Dynamics, Nutrient Uptake

The Roles of Rhizosphere Microbiomes Mediated by Root Secretions in Consecutive Monoculture Problems of Pseudostellaria Heterophylla

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Abstract: Many crops suffer from the replant problem in the modern cropping system, and the root-associated microbiome is important for the health of plants, especially in the consecutive monocropping system. In our study, Illumina Sequencing and DGGE (Denaturing Gradient Gel Electrophoresis) were employed to monitor the microbial population changes under a consecutive monoculture system of Pseudostellaria heterophlla. Subsequently, quantitative real-time PCR (qPCR) was used to detect the amount of typical pathogen (Fusarium oxysporum) and beneficial bacteria (Bacillus amyloliquefaciens and Bacillus subtilis) in situ rhizosphere soil of P. heterophlla. Moreover, HPLC was used to identify phenolic acids in root exudates and explored the effects of the phenolic acid allelochemicals on the growth of typical pathogen (Fusarium oxysporum) and beneficial bacteria. The results illustrated that the successive cropping of P. heterophylla shifts the diversity and structure of microbial community in rhizosphere soil of P. heterophylla showing that the diversity of microbial community in rhizosphere soil of P. heterophylla was decreased with the increase of planting years while the structure of microbial community became more deteriorative. Moreover, the sizes of typical pathogen increased and the amount of beneficial bacteria decreased with the increasing years of monoculture. These changes finally resulted in the microecology imbalance in P. heterophylla rhizosphere and caused more and more serious consecutive monoculture problems in the long run. Further study revealed that phenolic acids in the root secretion of P. heterophylla increased with time increasing, which was closely related to changes in rhizospheric microorganisms. In conclusion, our research reveals that the consecutive monoculture problem of P. heterophylla closely associates with the changes of rhizosphere

microbiomes of P. heterophylla. Under consecutive monoculture system of P. heterophylla, allelopathic substance such as phenolic acids secreted by roots accumulate increasingly and they can mediate the changes of microbial community structure, which result in the changes of rhizosphere microbiomes of P. heterophylla with the phenomena of fewer beneficial microorganisms and more pathogenic microorganisms. Finally, a large number of pathogenic microorganisms cause severe disease. Adding the beneficial microbiomes in rhizosphere of P. heterophylla can alter the rhizosphere microbiome inducing the beneficial microbiome to become the dominant population which alleviates the replant disease. The result provides a new avenue for modulating the root microbiome to enhance crop production and sustainability, especially in the monoculture system.

Key words: Pseudostellaria Heterophylla, Consecutive Monoculture Problems, Replant Disease, Rhizosphere Micro-ecology

不同连作年限太子参块根定量蛋白质组学研究

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Abstract: 太子参（Pseudostellaria heterophylla）为石竹科多年生草本植物，具有极高的药用价值。在其人工栽培过程当中面临着严重的连作障碍问题，导致太子参地上部长势变劣，块根无法正常膨大，并最终致使其产量和药用品质的下降。然而，连作导致其药用品质下降机理尚不清楚。因而，本研究通过运用定量蛋白质组学技术（ITRAQ）对头茬、重茬一年和重茬两年的膨大中期的太子参块根样品进行分析。结果共鉴定到 3598 个蛋白，进一步对重茬一年和重茬两年相对于头茬差异蛋白进行分析，发现均有 47 个蛋白上调表达，其中 6 个共同上调表达的蛋白，重茬一年相对于头茬有 105 个蛋白下调表达，重茬两年相对于头茬有 103 个蛋白下调表达，其中 59 个共同下调表达的蛋白；进一步对共同差异蛋白分析发现与多糖合成相关的果糖-二磷酸醛缩酶、甘油醛-3-磷酸脱氢酶和二磷酸核酮糖羧化酶，与太子参环肽合成相关的蛋白半胱氨酸蛋白酶和丝氨酸蛋白酶、多肽合成 60S 酸性核糖体蛋白酶 P2A 均下调表达，相对荧光定量结果同样表明相关基因表达水平与蛋白表达水平一致。本研究从蛋白质水平初步揭示了连作太子参药效成分太子参多糖、环肽以及氨基酸等含量下降机理。

Key words: 太子参, 连作障碍, 定量蛋白质组学, 药效成分

The spatial structure analysis of virtual water for agriculture and crops in Jilin Province

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Abstract: As the economy and social development, water-starved is becoming serious and may impede future sustainable development. How to utilize water resource reasonably has become an important research hot spot. Agriculture is the main user of fresh water with 85% of global surface and ground water consumption, therefor, reducing the consumptive water use in this important sector of economy is part of all major strategies to conserve water resources. The theory of Virtual Water provide good strategies to save water in agriculture development. The calculation of virtual water in the time and special distribution can help make clear the water consumption and readjust industrial structure. Agriculture and livestock husbandry are two of main water consumers in China accounting for more than 60%, so knowing the quantity of virtual water is very important for their development. In this work, we use the theory of Virtual Water and take Jilin province as study area for a comprehensive evaluation of spatial structure of virtual water for agriculture and several main crops. The results show that the virtual water content of select agriculture in 2014 is nearly 25 billion m3, the agricultural proportions more than 50% of total virtual water. In addition, the highest virtual water content of agriculture as well as livestock husbandry mainly distributed in central areas of Jilin. We also find that the distribution of TVW calculated by us and the actual distribution of water resource have remarkable difference, which leads to the increase of water consumption and cost of agricultural production. This work is helpful for the structural adjustment and sustainable development of agricultural and livestock, realizing efficient utilization of water resource, and above all giving important guidelines for water-shortage area in not only Jilin province but also other regions in world.

Key words: Virtual water, agricultural sustainable development, Agriculture and crops, Regional variation

Impact of Tillage and Nutrient Management Practices on the Spring Weed Seed Bank in a Winter Wheat-summer Maize Rotation Farmland

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Abstract: During the development of the modern theory of sustainable agriculture

system, Nutrient management and Tillage impact on farmland ecological environment got the attention of the researchers. Weed seed bank, which is regarded as potential sources of farmland weeds is a vital part of studying farmland weed community ecology. Researches showed that tillage and nutrient management will have different influence on weed seed bank, but their interaction have not been proved. This research using the four types of tillage(no-till、deep loosening、rotary tillage and deep tillage), three types of nutrient management(farmers normal、optimal management and high production and efficiency) studied the characteristic of the size of spring winter wheat-summer corn crop rotation of farmland soil seed bank, the compose of species and the vertical distribution(0-7.5cm, 7.5-15cm). The results show that the winter wheat-summer corn crop rotation of farmland soil weed seed bank in the spring have 10 kinds of weeds, all of these weeds are common farmland weeds. The dominant species of these are Setaria viridis. The average species density of weeds is 6180 grain/m2, the top seed density is a bit higher than the lower density of the seed, account for 55.9%. Nutrient management has the significant influence on the density of the seed($p=0.031$)and species($p=0.027$), also for the vertical distribution of seed density($p=0.045$) ， tillage methods ($p=0.054$) and the interaction between nutrient management and tillage practices($p=0.040$). The significant differences are that dealing with farmers normal and deep loosening, seed density is significantly higher than the other three tillage low fertilizer treatment; dealing with farmers normal and no-till, the species richness is the highest; dealing with deep tillage and high production and efficiency, the number of the species is the lowest. And there is no significant differences about dealing with the characteristic of top and lower soil seed banks. In conclusion, under different cultivation way of using less nitrogen is helpful to control weed seed bank reserves; under non-tillage management , using less nitrogen is beneficial to keep the biodiversity of the surface of weed seed bank.Agricultural practice should be aimed at different tillage and nutrient management farmland to establish differential weed management strategies.

Key words: Tillage Practice, Nutrient Management, Farmland Weed Seed Bank

The Nutrient Losses from Vegetation Coils and Its Effects on Plant Growth

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Abstract: The vegetation coil was investigated for slope restoration and the effects of different fertilizer and water allocation as variable factors were studied. Moreover, the field rainfall monitoring experiment was carried out to explore the trend of morphological indexes for Amorpha fruticosa and water-holding capacity of leaf under

different water and nutrient gradients, and the nutrient loss from this coil. The results showed that nutrient losses in runoff from this coil were significantly affected by fertilizer use, and when given the more amount of fertilizer, the nutrient loss in runoff will trend higher. However, the experiment result for the concentration of nitrogen in runoff was insignificant, the concentration of phosphorus was increased, and the runoff concentration of potassium also became lower after some water retaining agents were increased. The concentration of nutrients in runoff after rainfall was generally described a trend: a slight fluctuation and then rises and finally a decrease. When the amount of fertilizer was F2, the nitrogen losses from vegetation coil were the lowest, with a appearance of little leaves. Furthermore, the phosphate fertilizer has a significant influence on crown size. When the water-retaining agent content is more, the water in vegetation coil also increased, so that this plant absorbs more water, this relative water content of leaves also increased. Ultimately, W3F4 was the most favorable for plant growth, which may be related to the loss of this runoff.

Key words: vegetation coil, nutrient loss, morphological indexes, rocky slope

Autotoxicity Problem in Ratooning Continuous Monoculture Tea (Camellia Sinensis L.) Gardens

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Abstract: Tea (Camellia sinensis L. O.Kuntze) is an important economic crop, which is extensively cultivated in southeast part of China. Auto toxicity has been reported to be one of the major issue impeding the replant problems in continuous monoculture tea gardens. However, potential autotoxins produced by degradation the leaf leachates are less known. (+)-Catechin (C), (−)-Epicatechin (EC), (−)-Epigallocatechin (EGC), (−)-Epicatechin Gallate (ECG), (−)-Epigallocatechin Gallate (EGCG) which are the characteristic flavonoids present at significant concentrations in the tea leaves, may enter the soil through decomposition of fallen leaves, resulting in auto toxicity problem in tea soil with increasing planting age. However, potential autotoxins from the degradation of fallen tea leaves in soil and their effect on the rhizosphere beneficial bacterial population and plants seedling are unknown. In this study, the autotoxicity of 30year tea rhizhospher soil was investigated. ±C, EC, EGC, ECG and EGCG were isolated from the fallen tea leaves and EC, Taxifolin (TF) and Protocatechuic acid (PCA) from 30year tea rhizosphere soil were analyzed and quantified by HPLC and LC-MS/MS. Further these compounds were selected for testing their autotoxic effects on beneficial Bacillus species growth, isolated from the rhizhosphere of tea soil and identified by 16s rRNA sequencing. PCA and TF significantly suppressed the growth of

Bacillus species in a concentration-dependent manner when applied as carbon source while EC showed moderate effect. When other ±catechin were applied, there was no significant effect on Bacillus but the most interesting results were, their metabolites i.e PCA and TF identified and analyzed by HPLC and LC-MS/MS. From these results it is concluded that leaves have catechins which were used by specific microbial population as carbon source and convert these compounds in more toxic form i.e PCA and TF in the soil. When the concentration of these toxic metabolites increased with age, the specific rhizhosphere bacterial population declined. It presumes that a close link exists between the autotoxic effects on beneficial microbes and the degrading compounds of fallen leaves with increasing planting age of tea plant.

Key words: Monoculture, Microbiome, Pyrosequence, LC-MS

Farmers' Adaptation to Aridification in the Agro - pastoral Ecotone in North China

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Abstract: The ecotone of agro-pastoral ecotone in North China is a fragile zone of ecology. The water resources are scarce and the drought problem is serious in recent 10 years. In this paper, household-based questionnaire survey was used to investigate the perceptions of farmers in the central area of North China's agro-pastoral ecotone -the north and south foothills of Yinshan Mountain, Inner Mongolia, to study their adaptive behavior and to analyze the factors affecting adaptive behavior. The results show that almost all of the households have been aware of the drought and its impacts. Including the impact on agricultural production (reduction of crop yields, area planted and reduction of agricultural inputs) and the impact on rural labor (the transfer of young labor force and low willingness to engage in agricultural production). In the persistence of the trend of aridity, the farmers mainly adopt adaptive measures such as crop management measures, water conservation and irrigation measures, and livelihood measures. Delaying planting time, purchasing drought-resistant seeds, covering plastic film and irrigation measures are more effective for farmers to cope with drought. The way to achieve good economic returns. However, irrigation measures have potential impacts on the ecological environment, and further study is needed. Further analysis of the differences found in different groups of people to adapt to adapt to the young labor initiative to adapt to more than the old labor force, and has a strong ability to adapt; young labor transfer, planting large contracting land behavior will farmer adaptive capacity influences. Finally, it is suggested that the government should strengthen the climate prediction, strengthen the research on drought-tolerant varieties and

water-saving technologies, guide the flow of young labor force in rural areas and encourage large-scale contracted land to improve the ability of farmers to cope with drought.

Key words: Aridification, Agro - Pastoral Ecotone, Factors, Adaptive Behavior

Ecological Services Value and Space-time Evolution Analysis of the Qingjiang Basin, China

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Abstract: As an important ecological barrier in Southwest China, Qingjiang basin plays an important guiding role in the development of typical mountainous towns. In this thesis, in order to quantify and evaluate the quality of ecological protection in the study area, remote sensing interpretation and visualization of RS were used to obtain the data of land use / cover change in the 4 period; Then based on the spatial distribution of ecological sensitivity and vulnerability, the ecosystem service value of Qingjiang River Basin was measured and predicted. Results showed: 1)The land use / cover type in 2000-2015 was dominated by forest land, accounting for 61.05% of the total area, followed by arable land accounts for about a total area of 21.86%, grassland, wetlands, water and other land contribution rate is the smallest, accounting for only about 17.09%; 2)The distribution of ecological environment and economic development in Qingjiang basin is inharmonious, the economic development level and vegetation coverage rate of Enshi, Changyang country and Yidu were the highest while Badong County, Hefeng county and five peaks county were the lowest; 3) ESV forecast in 2035 was $7,224.65million, an increase of 1.93% compared with 2000, and ESV rate of Enshi, Lichuan and Hefeng country was grew faster, respectively, 0.67, 0.57 and 0.56.But the growth of ESV of Badong County, five peaks and Yidu showed a downward trend, respectively -2.96, -8.39 and 0.90. The results provide scientific and reasonable basis for the government decision makers to implement the 13th Five-Year Plan and the sustainable development strategy in the future.

Key words: Ecosystem Service Value, RS and Arcgis, GM (1, 1), Qingjiang River Basin

ESC-08：京津冀城市群地区生态安全格局构建与技术保障

Introduction of Watershed Ecosystem in Fangshan Distict

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Abstract: The rapid urbanization has brought about a great risk to the ecological health of the watershed.Complex geographical environment,discontinuous hydrology processes and difficult to estimate climate change have posed serious challenges to traditional water-related ecosystem services assessment.Taking the area of about 2000 square kilometer in Fangshan District of Beijing as an example,there are three kinds of obvious problems in the river system:(1) River system trends to water channel.The slope of the main reaches of the four major rivers in Fangshan District are all man-made stone reinforced,including the mainstream of the plain area to the mountain water sources,the regional river has basically been degraded to the outlet channel.(2) River system trends to discontinuity.Uneven seasonal precipitation in Fangshan District,including approximately 70 percent of water gross aggregates in summer,and highly artificial control limit the original runoff of river.Therefore,majority of river reach is blocked due to lack of water resource in non-flood season and severe infiltration along the way.(3) River system trends to sewage. The risk of river water pollution is intensified by irrational composition of regional water resource and water structure.The water-related ecosystem safety and stability,receiving high concentration of nutrient(nitrogen and phosphorus) from groundwater and recycling water plants and heavy metal(arsenic and mercury) from regional environmental background,have to be posed by direct or indirect influence.Results are displayed and needed to be selected by appropriate evaluation index.Qualitative and quantitative analysis of ecological damage are carried out to restore,support and protect the watershed ecosystem services in Fangshan District as a decision support way.

Key words: Watershed, Water-Related Ecosystem, Fangshan

京津冀城市群区域生态安全格局协调与优化

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Abstract: 识别京津冀城市群生态空间范围，利用最小累计阻力模型计算生态空间保护压力格局；利用 CA 模型进行多情景城市生产-生活空间模拟，分析其对生态空间保护的潜在压力；计算城市生产-生活空间扩张适宜性与生态空间保护

压力格局，进行城市生产-生活空间扩张生态适宜性评价；根据城市生产-生活空间布局的生态适宜性和生态空间保护要求等目标，利用蚁群智能模型进行空间优化布局，获得京津冀城市群区域生态安全格局协调优化方案。
Key words: Ecological Security Pattern, Coordinate

Analysis of Wetland Landscape Degradation and Its Driving Factors of Beijing - Tianjin - Hebei Region from 1980 to 2015

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Abstract: Wetland is a unique ecological system formed by the interaction of water and land, which is one of the most important ecological environment of animals and plants and the ecological landscape of nature. It is closely related to human survival and development. However, under the impact of global climate change and human activities in recent years, wetland area is in a substantial reduction. Wetland landscape change has an important impact on wetland ecosystem, especially wetlands converted to farmland or other wetland landscape changes caused by drying. Analysis of the long-term characteristics of wetland landscape is critical to wetland planning and development.This paper aims to analyze the wetland landscape change and its driving factors in Beijing - Tianjin - Hebei region from 1980 to 2015 based on multi-temporal TM images. Landscape pattern analysis method is widely used in related research, including landscape pattern index and landscape dynamic change model through selected indices including patch area, patch average area, fractal dimension index, diversity, dominance and contagion indices. Furthermore, we quantified the annual rate of land-use change in the study area using classified Landsat images. The classified images were used to construct maps of wetlands degradation, and landscape metrics were calculated and analyzed spatiotemporally across class and landscape level from 1980 to 2015. Simultaneously, the paper explored the evolution mode and driving factors of wetland landscape pattern from nature and human activities. Due to the abundant wetland resources and rapid urbanization in Beijing - Tianjin - Hebei region, we chose Beijing - Tianjin - Hebei region as the research area. The results illustrate the validity of the method, which has potential to be used in wetland development.
Key words: Wetland, Landscape Degradation, Driving Factors, Beijing - Tianjin - Hebei Region

The Transformation of Nitrogen and Phosphorus in an Urban Scenic Rivcer with Rubber Dams and the Eutrophication Characteristics

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Abstract: River system is one of the most important and fragile parts in urban ecosystem, which has also been drasticly changed by human activities during the process of urbanization. As the freshwater eutrophication and environmental health get more and more public attention, more concerns are specifically needed to control the eutrophication problems of urban rivers. We took Qingshuihe in Zhangjiakou city as an example, a typical urban river within the Haihe watershed, in order to study the nutrients transformation along the channelized river with series of rubber dams, and to understand the eutrophication process in the regulated water way. The results showed that: the upper watershed flow inputs was the main nutrients source of the urban river, especially during snowmelt period; 58.5% total nitrogen (nitrate was the majority speciation) and 44.8% total phosphorus (particle phosphorus was the majority speciation) were sequestered within the urban river because of the series of rubber dams, and the nitrogen was mainy retained in the middle part of the urban river while phosphorus and suspened solid were mainy retained in the front part; for the high concentration of nutrients, the inflow water of the urban river was eutrophic, and after retention by rubber dams, successive booming of phytoplankton-Potamogeton crispus-phytoplankton and odorous green water were the main eutrophication problems in the impoundment water of the urban river, which were caused mainly by excessive nutrients inputs and intensive hydrology control. In conclusion, the managers have to take actions immediately to cut down the massive nutrients inputs from upper streams, to control the sediments sources of nutrients as well, which was mainly caused by suspended solid subsidence, and to diversify the landscape structure and hydrological characteristics within the dammed river channel, which had exacerbated the eutrophication risks in the urban river. And then we can improve the water quality of the eutrophic urban river and restore the environment of river systerms. Dammed scenic rivers and their eutrophic issues are prevailing in variety cities of China, our work would offer scientific evidences to improve water quality in urban areas.

Key words: Urban River, Rubber Dams, Nitrogen and Phophorus Retention, Eutrophic

Study on Land Surface Temperature of Beijing-Tianjin-Hebei Region Based on Remote Sensing Images

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Abstract: Land surface temperature (LST) is an important index of studying the energy balance of the land surface. It plays a significant role in the process of the material interchange and energy flow between the land surface and the atmosphere. Therefore, it is of great significant in studying the energy balance of the land surface, especially with closely relationship with geology, ecology, hydrology, weather and other fields. This paper takes the entire Beijing-Tianjin-Hebei region as the research area and utilizes split-window algorithm to conduct inversion to the thermal infrared temperature in Beijing-Tianjin-Hebei region. Afterwards, it combines the practical temperature data of the weather monitoring station to have precision validation.

In the temperature reversion process, the key part lies in the estimation to various parameters. First of all, split-window algorithm is confirmed to be selected according to the data characteristics of MODIS, so as to decide to choose the dual-factor model with a higher precision through comparing the precision of the existing temperature inversion models. Secondly, the brightness temperature of the corresponding wavebands can be calculated according to the 31 and 32 wavebands of the MODIS data. Afterwards, the vegetation index is calculated according to the 1 and 2 wavebands, thus calculating the vegetation coverage and then estimating the emissivity correction of the land surface. Finally, the emissivity of the land surface of 31 and 32 wavebands will be obtained. In the end, the land surface temperature can be obtained through the inversion of the dual-factor model and then the precision verification can be conducted combining the measured data.

Key words: Beijing-Tianjin-Hebei Region, Land Surface Temperature, Lanscape Pattern, MODIS

Socioeconomic Transition and Associated Impacts on Energy and Water Consumption in Jing-Jin-Ji Region

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Abstract: As one of the most important economic region in China, the Jing-Jin-Ji region is under rapid socioeconomic transition in the last decades. Such socioeconomic transitions, mainly promoted by industrialization and urbanization, were accompanied with great demand for energy and water, and further exacerbated the air pollution and

water scarcity issue in the region. Hence, understanding the impact of dramatic socioeconomic transition on energy and water resource consumption is essential for developing targeted and effective sustainable development strategy for Jing-Jin-Ji region. By developing a comprehensive analysis framework based on input-output model to describe the industrialization process and urbanization process, we will investigate the trends in energy and water consumption during the 1997–2012 period, identify the main sources for energy and water consumption, and evaluate how the industrialization and urbanization process impact the energy and water consumption in the region.

Key words: Jing-Jin-Ji, Socioeconomic Transition, Energy, Water

京津冀湿地鸟类食物链和栖息地生境修复技术研究

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Abstract: 综合文献调研和实地考察，综述了国内外鸟类生物链修复技术研究和鸟类栖息地生境修复技术研究，并总结了京津冀湿地水鸟生物链和栖息地生境存在的问题。将区域尺度湿地存在问题，在点尺度（琉璃河湿地）上进行技术示范，以体现示范工程的区域共性、普适性和代表性。研究尝试基于鸟类的种类和生物链，对鸟类栖息地进行分类。湿地关键物种栖息地修复技术研发包括微地形改造、土壤基质改良、水文联系重建、岸带护坡加固等；鸟类生物链全过程修复技术研发包括土壤生物恢复、水中动物繁殖、关键植物物种栽培与恢复、候鸟迁徙吸引、留鸟驻地营造等；候鸟及留鸟等关键物种栖息地生态修复全过程监测与效果评价研究。以湿地水鸟为研究对象，针对京津冀湿地水鸟的食物链和栖息地生境存在问题，有针对性的提出相应修复技术，为湿地研究工作者提供技术示范理论依据和案例基础。

Key words:水鸟，湿地鸟类生物链，栖息地生境，修复技术

Understanding the Mechanism of Urban Material Metabolism with MFA and ENA-An Experimental Study for 13 Cities in the Beijing-Tianjin-Hebei Urban Agglomeration

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Abstract: Nowadays, cities are considered as major consumers of natural resources, arising global resource shortages and environmental challenges. Therefore,

understanding the mechanism of material metabolism is crucial for modern cities' sustainable development. Here we plan to take the 13 cities in the Jing-Jin-Ji urban agglomeration as an example to explore their material flow processes. We quantify the energy and material flows through the 13 cities with the material flow accounting firstly. The results will help identify existing levels of resource consumption in the urban agglomeration and support for improving resource use efficiency. Next, network models comprising with 8 compartments (including environment, agriculture, mining, manufacturing, recycling, household consumption, construction and transportation) will be built, using the ecological network analysis. Combining both MFA and ENA, the direct and integrated flow processes and components' weight distributions from 2000 to 2015 are projected to be analyzed. Based on the projected results we can identify the key nodes and pathways within the metabolic system, and understand the drivers of the material flows. Finally, relationships among compartments will be identified, hence to examine the synergism level of the urban metabolic systems. This study can provide a reliable evidence for policy makers to identify the 13 cities' structure and characteristics in this region, further to alleviate disorders and resource waste in cities.

Key words: Urban Metabolism, Material Flow Analysis, Ecological Network Analysis, Jing-Jin-Ji

Study on the Change of Shannon Diversity Index in Beijing - Tianjin - Hebei Region Based on Moving Window

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Abstract: The Shannon diversity index (SDI) as an important statistical index to describe the diversity of a region is used to calculate a complete area using landscape pattern analysis software. On the basis of previous research and ARCGIS10.3 platform, a computational plug-in was developed, it calculated SDI by using a square-shaped moving window of arbitrary size, and the window SDI was assigned to the center of the window. The results showed that: in the Beijing-Tianjin-Hebei region, the largest SDI is 1.9751, 2.0507, and 2.1291; the average SDI is 0.5582, 0.5496, and 0.5699; the standard deviation of SDI is 0.3817, 0.3835, and 0.3793; the diversity of the whole area is increased, and the plain is more obvious than the mountain area.

Key words: Shannon Diversity Index, Landscape Pattern, Moving Window, Beijing-Tianjin-Hebei Region

Ecological Restoration Technical Plan and Key Demonstration Project of Liuli River Wetland Park

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Abstract: Beijing Liuli river wetland park is a key construction project to solve the problem of poor water quality, water shortage and biodiversity loss in the region. Liuli river wetland park restoration plan and demonstration project used 7 types of restoration technique, including wetlands ecological water requirement and ecological hydrology control technology, biological habitat construction technology, ecological slope protection technology and other techniques.Wetland ecological water requirement and ecological hydrology regulation technology and demonstration project compared the advantages and disadvantages of different ecological water requirement calculation methods and applicability, combined the specific conditions of the Liuli river wetland park, provided an ecological water requirement calculation method applicable to typical northern climate, with dam control river wetland. The ecological water requirement of each month was calculated, considered the surrounding water resources situation, ecological and hydrological regulation measures are put forward. The connectivity within the wetland hydrological connectivity, biological evaluation were evaluated, in order to provide advice and guidance for the project. Habitats construction technology and demonstration project investigated the existing kinds of fish and birds in Liuli river wetland park. Ecological space integrity and the integrity of the food chain were as the basis to improve the level of wetland biodiversity, to create a good habitat for fish and birds. Used the water level control, artificial land construction and habitat diversity habitat construction methods to restore habitat.Ecological slope protection project based on the concept of the human and the nature harmonious coexistence, according to current situation of slope protection, the range of demonstration area of ecological slope protection was determined, several ecological slope protection methods including ecological stone cage, ecological concrete slope protection technology were introduced. According to the cost and sites conditions,the ecological concrete slope protection technology was chosen in this project. Littoral ecological buffer has multiple functions including water purification and regulate micro-climate. Littoral ecological buffer construction project sorted out the buffer type, structure, plant configuration and other features of littoral ecological buffer, based on the situation of Liuli river wetland park, determined the construction technology in different zones in this project. Based on the analysis of the current status of artificial lake, artificial lake ecological system construction optimized the artificial lake ecosystem construction. Constructing the proper aquatic vegetation to improve biodiversity and ecological integrity of artificial lake, avoiding eutrophication

phenomenon.The water quality purification project of artificial wetland concerned with the scope of the Liuli river wetland project, proposed corresponding wetland layout in different zones of demonstration area. Study the substrate choosing, wetland plant configuration, artificial wetland operation maintenance and management system, achieving artificial wetland water quality improvement, it could provide technical parameters for the wetland operation and also make a demonstration role for later projects.

Key words: Liuli River Wetland Park, Habitat Improvement, Ecological Restoration

A Comprehensive View of Municipal CO_2 Emissions and Efficiency in China: Spatial Pattern and Socioeconomic Factors

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Abstract: Global warming caused by excess greenhouse gas emissions has become one of the most significant challenges. Cities are the key places to reduce CO_2 emissions with the increasing urbanization. Considering the disparity of economic development and urbanization level between cities in China, this study provides a comprehensive view of municipal CO_2 emissions and efficiency based on a high spatial resolution (0.1 °×0.1 °) grid data of carbon emissions in 2007. The spatial patterns of five emission indicators are totally different, while the national averages are all far less than the maximum. Thus, cities can be classified by the value of total emissions and emission efficiency to evaluate their emission behaviors. It is suggested that the most worthy attended cites (High-Low， Low-Low) are concentrated in North, Northeast and Northwest China. Furthermore, multiple statistical analyses reveal that urban scale, industrial structure and GDP have various effects on different emission indicators. The most noteworthy relationship is total emissions and GDP, industrial structure (the second industry proportion), population with a positive impact ($R2>0.2$, $p<0.01$), especially for GDP ($R2=0.63$). Finally, the emissions feature between town and country in Chinese cities are compared. We found that total emissions, per capita emissions and residential emissions in town are slightly higher than those in the rural on average. Results from this study can enhance on understanding the characteristics of CO_2 emissions in Chinese cities. It also can provide important insights for managers and decision-makers to design and implement differentiated policies that target on the specific environmental issues.

Key words: Spatial Pattern, Municipal CO_2 Emissions, Emission Efficiency, Socio Economic Factors

Study on Ecological Security Cooperative Consultation of Beijing - Tianjin - Hebei Urban Agglomeration

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Abstract: Based on the scheme of urban main function area (focus, optimization, restriction and prohibition of development zone), the urban agglomeration coordination coordination system of urban agglomeration was constructed with Pressure-State-Response cooperative concept.Constructing a Multi - objective Ideal Value Consultation Model for Ecological Space, and determining the positive and negative ideal value of ecological security of each functional area of urban agglomeration, the optimal area and the worst area of ecological security in each type of area were divided.Endly, Based on ESROVC MODEL, the ecological security index and pattern of various functional areas were diagnosed.

Key words: Urban Agglomeration, Ecological Security, Cooperative Consultation, Beijing - Tianjin - Hebei Cooperation

The Impact of Precipitation and Urbanization on Changes in Water Storage in Beijing-Tianjin-Hebei Urban Agglomeration

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Abstract: Total terrestrial water storage is influenced jointly by climate change and anthropogenic activities. In the last three decades, China has experienced a rapidly urban expansion and many urban agglomeration appeared. In the progress of urbanization, land cover change has impacted on the hydrological cycle. Beijing-Tianjin-Hebei urban agglomeration (Jing-Jin-Ji region) is the most typical one and is the economic center of China. However, it is lack of water in Jing-Jin-Ji region. Does urban expansion impact on changes in water storage? It is crucial to water resource management. In this paper, we aimed to analyze changes in water storage in Jing-Jin-Ji region and discuss the relationship to climate change and anthropogenic. Outputs of global land data assimilation system and EartH2Obsevation and were used to detect the variation pattern of water storage in recent 30 years. Both of terrestrial water storage and groundwater storage showed decrease trends. Terrestrial water storage declined significantly in the middle of Jing-Jin-Ji region. But, terrestrial water storage showed an increase trend in south Hebei. Groundwater storage decreased extremely almost in the whole region. But, groundwater storage decrease

insignificantly in north of Hebei as the vegetation coverage is high. In addition, precipitation decreased in north and increased in south. Variations in terrestrial water storage was impacted by precipitation significantly ($r=0.56$, $p<0.01$) while the correlation between groundwater storage and precipitation is insignificant. We selected night light index as anthropogenic activity. From 1980 to 2015, urban area increased 3992 km^2, and the agricultural water consumption decreased as the reduction of farm land. While the residents living water was increasing with the number of population increasing in the past 30 years. The cumulative groundwater consumption and night light index were increasing with population (the correlation coefficient were 0.99 and 0.97, $p>0.01$, respectively), although water supplied by groundwater decreased. We found that there was a significantly negative correlation between night light index and groundwater storage ($r=-0.87$, $p>0.01$) and an insignificant positive correlation between night light index and terrestrial water storage anomaly. We suggested that urban expansion is the relatively important factor to reduction of groundwater storage and precipitation is the relative important factor to variation in terrestrial water storage. Besides precipitation, changes in terrestrial water storage were also influenced by other factors, such as land cover change. In the future, we will go further to study the relationship between land cover change and variations in water storage.

Key words: Terrestrial Water Storage, Groundwater, Urbanization, Climate Change

ESC-09：草地功能及适应性管理

Differentiation of "Black Soil Type" Degraded Alpine Meadows in the Headwaters of the Qinghai-Tibetan Plateau, China

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Abstract: The alpine grassland ecosystem of the Qinghai-Tibetan plateau has been degraded since the late 1960s. Plant communities and soil properties were studied at five sites including four types of “black soil land” meadows and another site in an undegraded meadow; we studied the relationships between above- and below-ground vegetation characteristics and soil properties, and looked to see if differentiation existed among the different“black soil type” of degraded meadows. Results show the “black soil type” degraded meadows have higher plant biomass but lower vegetation cover, species richness and diversity than undegraded meadow. Soil water and soil organic matter content were the most important elements which influenced vegetation patterns. Also, different forb-dominated meadows exhibited inconsistent similarity not only with undegraded meadow but also between degraded meadows. This suggests grassland degradation results in variations in vegetation patterns; it also suggests the differentiation of degraded meadows is highly influenced by the soil properties and external disturbances.

Key words: Alpine Meadow, Differentiation, Qinghai-Tibetan Plateau, Degradation

Effects of Different Management Regimes on the Soil Seed Bank in Saline-Alkaline Grassland

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Abstract: Management regimes for vegetation restoration of degraded grasslands can significantly affect the process of ecological succession. However, few studies have focused on variation in the soil seed bank during vegetation restoration under different management regimes, especially in saline-alkaline grassland habitats. Our aim was to provide insights in the ecological effects of grassland management regimes on soil seed bank composition and vegetation establishment in mown, fenced, transplanted and natural grasslands sites, all dominated by the perennial rhizomatous grass Leymus chinensis. We studied species composition and diversity in both the soil seed bank and

aboveground vegetation in mown, fenced, transplanted and natural grassland sites in Northeast China. An NMDS (nonmetric multidimensional scaling) was used to evaluate the relationship between species composition, soil seed banks, aboveground vegetation and soil properties. Results showed that Fenced and mown grassland sites had high density and species richness in both the soil seed bank and aboveground vegetation. The Transplanted treatment exhibited the highest vegetation growth and seed production of the target species L. chinensis. Seeds of L. chinensis in the soil occurred only in transplanted and natural grassland. Based on the NMDS analysis, the number of species in both the soil seed bank and aboveground vegetation were significantly related to soil Na+, Cl-, RSC (residual sodium carbonate), alkalinity, ESP (exchangeable sodium percentage) and AP (available phosphorus). Soil seed bank composition and diversity in the saline-alkaline grassland were significantly affected by the management regimes implemented, and were also significantly related to the aboveground vegetation and several soil properties. Based on vegetative growth, reproductive output and maintenance of soil seed bank, the transplanting was identified as the most effective method for relatively rapid restoration of the target species L. chinensis.

Key words: Soil Seed Bank, Degradation, Grassland,Salinity

Eco-Evolutionary Dynamics of Plant Community Structure and Function in Tibetan Alpine Meadows

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Abstract: 1. The functional composition of plant communities responds to environmental change and disturbance through a combination of ecological and evolutionary adaptions involving the balance between intraspecific trait variability (ITV, resulting from both phenotypic plasticity of individuals and the adaptive evolution of populations) and changes in community composition (CCC, resulting from both species turnover and shifts in species abundance). Working in this conceptual framework, we analyze the eco-evolutionary dynamics of community structure and function in Tibetan alpine meadows distributed along soil resource gradients and in response to grazing.

2. For every species within each plot in alpine meadows both at differing elevations and aspects on each of three Tibetan mountains and at grazed and ungrazed plots in five sites across the Qinghai–Tibetan Plateau, we measured two chemical traits (Leaf nitrogen and Leaf phosphorus concentrations) and two morphological traits (SLA: specific leaf area, LDMC: leaf dry matter content) that characterize fundamental

tradeoffs in resource uptake strategies associated with growth rate. We distinguished the relative importance of ITV and CCC in affecting shifts in the community-weighted means (CWM) of these foliar traits in response to soil resource availability and to grazing.

3. In resource limited environments, alpine plant communities on Tibetan mountains increasingly tend to be dominated by species with a conservative resource strategy, while subordinate and infrequent species have an exploitive resource strategy and fast growth rates that increase their relative abundance and buffer decline in trait diversity at the community level. In contrast, less resource limited environments favor dominance by fast-growing species with exploitive resource use, while subordinate and infrequent species have a conservative resource use strategy. In short, the eco-evolutionary interplay between CCC and ITV effects acts to stabilize community function along soil resource gradients, promoting variation in species composition among plots at alpine meadow sites on Tibetan mountains. This interplay between CCC and ITV could provide an important buffering mechanism maintaining the structure and function of alpine communities under global change.

4. In response to continuous grazing, plants in Tibetan alpine meadows increase specific leaf area and foliar nutrients but tend to have lower leaf dry matter content, a response consistent with faster growth and regrowth under grazing. This ITV mediated response drives a shift in community function from conservative, slow-growing resource use in ungrazed meadows to exploitative resource use under grazing. This community-wide functional response enhances forage quality, in turn favoring the secondary productivity of small herbivorous mammal communities, but also contributes to accelerated depletion of soil available phosphorus.

Key words: Functional Trait, Community Assembly, Intraspecific Trait Variability, Eco-Evolutionary Dynamics

Effects of Native Community Density on the Invasion of Different Genotypic Diversity of Solidago Canadensis

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Abstract: Genotypic diversity may affect the invasiveness of alien plants and community density may affect the invasibility of native plant communities, respectively. To investigate the interactive effect of invasion by Solidago canadensis of different genotypic diversity and community density on biomass native plant communities and the competitive effect, we performed a greenhouse experiment. We established plant communities at two density levels (low and high density) and subject them in three

invasion partterns (i.e., without invasion, invaded by S. canadensis of one genotype or invaded by S. canadensis of four genotypes). Native communities consisted of eight native, terrestrial species of three functional groups, i.e. four grasses, two legumes, and two Asteraceaes. High genotypic diversity of S. canadensis can significantly enhanced the biomass of itself, but reduced that of the native community. High community density affected the total and stem mass of S. Canadensis, and increased the biomass of the native community. However, on the functional group level, both of genotypic diversity and community density affected the growth of legumes, and Asteraceaes, instead of grasses. High genotypic diversity also increased the competitive effect, and the relative dominance index of S. Canadensis. To be specific, the genotypic diversity can markedly affect the competitive ability, especially in the high density treatment. The results provide a basis for management strategies to control the invasion and spread of S. Canadensis.

Key words: Genotypic Diversity, Additive Effects, Non-Additive Effects, Community Density

Effects of Herbivore Assemblages on Nitrogen Cycling in Grassland

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Abstract: Herbivore grazing has major effects on soil nutrient dynamics in a variety of grassland ecosystems. Previous studies have examined how large herbivores as a group affect nutrient cycling, but little information is available on how assemblages of different herbivore species may influence nutrient cycling, and whether herbivore assemblage effects are influenced by plant community characteristics (e.g., composition, diversity) of the grazed grassland. We conducted a five-year, replicated grazing experiment to test the effects of different large herbivore assemblages (cattle grazing, sheep grazing, combined cattle and sheep grazing, no grazing) under moderate grazing intensity on soil nitrogen (N) mineralization rate in two types of grassland communities (high forb/high diversity and low forb/low diversity) in meadow steppe habitat of northeast China. Moreover, we examined two distinctly different pathways that herbivores could influence soil N availability: directly through urine and dung deposition and indirectly by shifting grassland species composition (i.e., the grass: forb ratio) and the quality of plant litter available to soil decomposers. We found that grazer effects on soil N availability (indexed with anion and cation adsorption strips) depended on herbivore assemblage, and the herbivore assemblage effects varied in the two types of grasslands. In one type of grassland characterized by low diversity, grazing by each of the herbivore assemblages enhanced soil N availability compared to the ungrazed plots, and mixed species (cattle and sheep) grazing had a greater effect than

single species grazing. In high diversity grassland, single species herbivore grazing significantly increased soil N availability, but mixed grazing had no effect. Effects on soil N availability were not completely consistent with herbivory-induced changes in the forb to grass ratio, but strongly and positively associated with the amount of dung deposited. We concluded that herbivore grazing generally increased soil N availability regardless of herbivore assemblage and plant diversity level of the grassland. Moreover, ungulate urine and dung played a primary role and changes in plant composition a secondary role in governing the facilitating effects of herbivores on soil N dynamics. This study indicates that grazer-induced changes in plant litter quality are not the critical mechanism through which herbivore grazing can affect nutrient cycling.

Key words: Herbivore Grazing, Excreta Deposition, Litter Input Quality, Soil N Availability

Response of Ecosystem CO_2 Fluxes to Grazing Intensity during the Growing Seasons in the Inner Mongolian Meadow Steppe of China

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Abstract: The flux of carbon dioxide (CO_2) plays a critical role in the carbon cycle of terrestrial ecosystems and is an important index of soil bioactivity, fertility and ventilation. Among terrestrial ecosystems, grasslands are one of the most important biome types, and they play an important role in regulating the global carbon cycle, as they comprise approximately 40% of the global land area. The Hulunber grasslands in Inner Mongolia cover an area of approximately 9.97×106 km^2 and are located in the eastern part of the Eurasian grassland region, these grassland ecosystems are important, typical native grasslands dominated by the grass Leymus chinensis that are essential for livestock farming in northern China. Grazing is the primary land use in the Hulunber meadow steppe. However, the effect of quantitative grazing on ecosystem carbon dioxide (CO_2) fluxes in this zone remains unclear. A controlled experiment was conducted from 2010 to 2014 to study the effects of six stocking rates (0.00, 0.23, 0.34, 0.46, 0.69, and 0.92 Animal Units ha^{-1}) on ecosystem CO_2 flux. Our resulted showed that substantial temporal fluctuations in the CO_2 flux occured among the different grazing intensities, with peak CO_2 fluxes usually occurring after effective rainfall. And our study found that the grassland greenhouse gas exchange intensity, but not the

direction, changed under grazing, the Hulunber steppe ecosystem CO_2 flux functioned as a carbon source during the growing and grazing season. The results of a repeated-measures ANOVA showed that there were significant differences in the CO_2 fluxes for the effects of year, treatment, and month under different grazing intensities. In addition, grazing had a long-term effect on ecosystems CO_2 flux emissions from the grassland, after 4-5 years of grazing, the CO_2 fluxes under high levels of grazing intensity (0.69 and 0.92 AU ha^{-1}) significantly decreased by 27.5-30.4% in 2012, 34.7-37.4% in 2013, and 30.5-32% in 2014 relative to the ungrazed treatment. And we observed a significant negative linear relationship between the ecosystems CO_2 fluxes and grazing intensity for the five-year mean. The ecosystem CO_2 emissions rate was significantly positively correlated with rainfall, soil moisture (SM), the soil C/N ratio, soil available phosphorus (SAP), soil NH^{4+}-N, soil NO^{3-}-N, aboveground biomass (AGB), plant ground cover, plant height, and litter and was negatively correlated with air temperature, total soil nitrogen (TN) and microbial biomass nitrogen (MBN). Using a correspondence analysis technique, we showed that the main factors influencing changes in ecosystem CO_2 emissions under grazing were AGB, height, coverage, SM, and NH^{4+} and NO^{3-} concentrations in the soil. Increased rainfall and reduced grazing resulted in greater CO_2 emissions. Our study provides important reference information for better understanding the effects of reasonable livestock grazing on grassland greenhouse gas fluxes in Inner Mongolia, which not only help to clarify grassland carbon cycling and its role in the global carbon cycle but also help to predict the response of grassland grazing systems to climate change.

Key words: Ecosystem CO_2 Fluxes, Meadow Steppe, Grazing Intensity, Environment Factors

Patterns of Grazing-Induced Changes in the Abundance of Arbuscular Mycorrhizal Fungi in a Semi-arid Grassland

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Abstract: Summary

1. Herbivores grazing have drastic effects on plant community, soil nutrient and environment factors (e.g. soil moisture, pH). Changes in plant host and soil abiotic factors are thought to influence the abundance of arbuscular mycorrhizal fungi (AMF), which is the foundation of mycorrhizal functioning. However, still less is known about how herbivore grazing modulates the abundance of AMF.

2. Here, we measured the responses of plant community, hyphal length density of AMF, soil nutrients and soil environment factors in a field experiment with 10-year grazing

intensity treatments in different topographic systems. This study was conducted to reveal pathways involved in determining the abundance of AMF.

3. We found that the abundance of AMF was linearly negatively related to grazing intensity in the slope system, while peaked at a moderate grazing intensity of 4.5 sheep/ha in the flat system. A structural equation model with hyphal length density as response variables indicated that grazing intensity decreased the abundance of AMF by changing soil nutrient in the slope system, but non-linearly influenced it through the dynamics of plant community and soil environment in the flat system.

4. Our findings highlight the importance of grazing intensity in regulating the abundance of AMF, which is modulated by topography location. Soil nutrient and environment and vegetation factors are crucial predictors for the abundance of AMF in respond to grazing. Herbivores may play a crucial role in modulating below-ground microorganisms and hence influencing the ecosystem functioning of grassland.

Key words: Grazing Intensity, Arbuscular Mycorrhizal Fungi, Hyphae Density, Topography

Differential Responses of Canopy Nutrients to Experimental Drought along a Natural Aridity Gradient

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Abstract: Droughts are projected to increase in both magnitude and frequency due to climate change. It is, however, poorly understood how canopy nutrient (N and P) concentrations (community weighted by species abundance) will respond to drought and how these responses may vary along a gradient of precipitation and shifting plant community composition. Nutrients in grassland plant canopies can be used to assess and predict the likely responses of fundamental ecosystem processes to environmental changes. At three sites along a natural aridity gradient in the grasslands of northern China, short-term drought manipulation caused irregular effects on canopy nutrient concentrations, and these were driven by combined effects of species turnover and intraspecific variation at each site. In contrast, along the aridity gradient, canopy nutrient concentration was inversely related to precipitation (the arid site had the highest canopy nutrient concentration) and this pattern was driven mostly by species turnover (i.e., an increase in abundance of species with higher nutrient concentrations). Short-and long-term reductions in precipitation directly affected plant nutrient status rather than indirectly via alterations in soil nutrient availability. We conclude that

canopy nutrient concentrations were more resistant to drought at drier sites, because of the opposing effects of species turnover and intraspecific variability and the higher drought tolerance of nutrient-rich species. Differing responses of canopy nutrient concentration to drought conditions along natural gradients vs. manipulative experiments in the same grassland biome highlights the complexity in predicting how these grasslands will respond to climate change.

Key words: Gradient Experiment, Intraspecific Variability, Manipulation Experiment, Nutritional Response

Study on Phosphorus of Degraded Meadow Ecosystem in Wugong Mountain

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Abstract: In the meadow zone of Wugong mountain at an altitude of 1600 m~1900 m, setting altitude of 50m as a gradient, choosing the similar simple conditions which including meadow degradation degree, meadow type, soil and terrain as the object on each gradient, each choose 3 pieces of 10m×10m elevation gradient experiment samples, a total of 21 pieces of samples. And in each increment random 3 pieces of normal meadow area as control. Using analysis of variance, correlation analysis, phosphorus chamber model method, this study expounds the different altitude and different soil depth distribution characteristics of soil phosphorus; Analyze the degraded meadow ecosystem Wugong mountain soil phosphorus availability of physical, chemical and biological factors; Discussed each indoor p reserves and flow process; For ecological restoration in Wugong mountain meadow degradation area provides a scientific basis. The main conclusions were presented as follows:1) The soil total phosphorus content in the study area was 0.57~1.39g ŀkg^{-1}; While f soil available phosphorus content in 7.0~11mg ŀkg^{-1}, the percentage of the total phosphorus was about 1%; Can extract the total inorganic phosphorus range of 0.56~0.134g ŀkg^{-1}, the percentage of the soil total phosphorus was about 48.6%; Soil organic phosphorus content in 0.21~0.70g ŀkg^{-1}, the percentage of total phosphorus was about 50.4%; The content of soil microbial biomass phosphorus in 12~52 mg ŀkg^{-1}, the percentage of total phosphorus in soil was about 4.41%. 2) The soil available phosphorus and calcium-phosphate was significantly negative correlation, which shows that soil available phosphorus content will reduce with the increase of the content of calcium-phosphorus content, it attributed to calcium phosphate was insoluble compounds, plants can not directly use of calcium-phosphorus, and thus affecting the effectiveness of soil phosphorus. With soil available phosphorus in soil total

phosphorus, aluminum-phosphate, microbial biomass phosphorus was significantly positively related, which indicate that soil total phosphorus, aluminum phosphorus, soil microbial biomass phosphorus may be a potential source of available phosphorus in soil. Soil microbial biomass phosphorus was soil organic phosphorus in plant an important way to absorb phosphorus, microbial biomass phosphorus has a fast turnover rate, can increase the effectiveness of soil phosphorus. Soil total phosphorus and available phosphorus level of soil effective phosphorus content and soil total phosphorus content was not directly. 3) The soil bulk density, water content quality can change soil phosphorus migration conditions, the oxygen content of the soil and soil redox potential, thus affecting soil p migration ability, the metal elements in soil and phosphorus chemical forms, influences the effectiveness of phosphorus removal. Soil acidity and soil organic matter on soil influence on phosphorus removal, and each form hydrolysis of total acidity of the soil increase can enhance the effectiveness of phosphorus, and the influence of soil pH of soil phosphorus availability was relatively complex, the change of the soil pH can change the configuration of soil phosphorus, which affects the effectiveness of phosphorus.

Key words: Meadow Ecosystem, Degradation, Phosphorus, Wugong Mountain

Arbuscular Mycorrhizal Fungi and Plant Functional Group Removal Interactively Alter Plant Productivity in the Typical Steppe

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Abstract: Biodiversity loss affects ecosystem functioning and services has gained wide interest among ecologists. It is well known that plant functional group (PFG) loss affects vegetation composition, soil properties and belowground community composition. However, whether biodiversity loss affects the response of arbuscular mycorrhizal fungi (AMF) and feedback to host plants in natural grassland is still unclear. We conducted a field experiment to address two questions: (1) how do AMF and PFG removal affect plant productivity? (2) how do AMF affect remaining PFGs growth after PFGs loss? This experiment was conducted at the Duolun Restoration Ecology Station of the Institute of Botany, Chinese Academy of Sciences, in Inner Mongolia, China (42°02'N, 116°17'E). The vegetation type is classified as temperate steppe, and the dominant plant species are Artemisia frigida and Stipa krylovii. In May 2015, we carried out a two-factor random block design, including factorial combinations of fungicide application (AMF; control and fungicide), PFG removal [Removal; no removal (CK), C3 grasses was present but both C4 grasses and forbs absent (+C3−C4−F), both C4 grasses and forbs were present but C3 grasses absent

(−C3+C4+F)]. The AMF suppression plots received fungicide (Topsin-M), as a soil drench. The control plots received the same amount water. For removal treatments, the target PFGs were completely removed by clipping the aboveground parts to 5 cm soil depth. Plant biomass were sampled and oven-dried, before being weighed in 2015 and 2016. Based on plant mycorrhizal dependency, the plant species were categorized three PFGs: C4 grasses, C3 grasses and forbs. Two-way ANOVA (generalized linear model; GLM) was used to test the treatments and their interaction effects on plant shoot biomass. Our results showed that Topsin-M addition and PFGs removal interactively impacted plant community biomass (all $P > 0.05$). Topsin-M addition increased community biomass in both C4 grasses and forbs removal plots, but the positive effects weakened with control or C3 grasses removal treatments (Fig 1a and b). A significant interactive effects on C3 grasses biomass was found (all $P > 0.05$). Topsin-M addition promoted C3 grasses biomass under both C4 grasses and forbs removal, but the positive effects weakened with control treatments in 2016 (Fig. 2b). No significant interaction on C4 grasses and forbs biomass were detected (Figs. 2c, d, e and f; all $P > 0.05$). Our results demonstrated that the effects of PFGs loss on plant productivity depend on AMF. Understanding the ecological functioning of AMF can increase our ability to predict vegetation dynamics in response to future plant diversity loss.

Key words: Arbuscular Mycorrhizal Fungi, Removal Experiment, Plant Functional Group, Grassland Ecosystem

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