Rivers as Linked Systems

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ABACUS Tierpark Hotel
Franz-Mett-Straße 3-9
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Public Transport: Underground U5, "Tierpark"

Conference Dinner
Altes Zollhaus
Carl-Herz-Ufer 30
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Public Transport: Underground U1, "Prinzenstrasse"

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Wednesday, 10.08.2011

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Elbe	Spree
8:00 h – approx. 18:00	9:00 h – approx. 15:00

(departure and arrival at Abacus Hotel Parking)

Please check the info board
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Thursday, 11.08.2011

Route description to Conference Dinner Venue (Thursday, 19:30 h)

Take underground U1

Step off at station
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Walk southward, cross bridge
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Turn right into “Carl-Herz-Ufer”

Walk 200 m

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see the restaurant
“Altes Zollhaus”

All in all approx. 500 m from
underground station.

Address: Altes Zollhaus, Carl-Herz-Ufer 30, 10961 Berlin

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10:00-10:20	Eco Evidence: using the literature to inform evidence-based decision making in river management. Angus Webb et al.	Fish in icy streams: and yet they move. Christine Weber et al.	Flood driven soil-groundwater coupling and impact of C and N cycling in a restored riparian aquifer. Simone Peter et al.
10:20-10:40	Stressors across multiple scales influence headwater stream biological quality in Great Britain. Michael Dunbar et al.	Influence of river water temperature on seasonal habitat variations of freshwater fishes. Kei Nukazawa et al.	Breaking the drought: Floods, carbon and prolonged hypoxia in a major river system. Kerry Whitworth et al.
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15:00-15:20	Food web connectivity and consumer-resource coupling in tropical floodplain rivers. Stuart Bunn et al.	Microscale Biogeographical Patterns of Microbial Communities in an Atlantic Rainforest Stream. Celio Jonck et al.	Using engineered large-woody debris jams to restore fish habitat and protect streamside properties, improvements and infrastructure in the Mashel River, WA, USA. Florian Leischner et al.
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16:40-17:00	Trophic patterns and carbon pathways in a temperate lowland river – a comparison of food webs in the main channel and tributary confluences. Michael Pingram et al.	Persistence of floodplain soil eukaryotes during hyper-drought conditions. Gavin Rees et al.	
17:00-17:20	Hot Spots and Seasonal Pattern of Heterotrophic Metabolism in a Large River (Elbe, Germany). Martin Pusch et al.	Identification of the limiting factors to freshwater pearl mussel (Margaritifera margaritifera) recruitment in the North Tyne catchment, North-East England. Marie-Pierre Gosselin et al.	
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10:00-10:20	Ecological assessment of running waters: do macrophytes, macroinvertebrates, diatoms and fish show similar responses to human pressures? Anahita Marzin et al.	Does habitat utilization represent habitat quality? What sturgeon telemetry tells us. Jörn Geßner et al.
10:20-10:40	Different response of fish and benthic invertebrate communities to constrained channel conditions in a mountain river. Bartłomiej Wyzga et al.	First feedback from the French river restoration case studies: elements for improving the next project design. Bertrand Morandi et al.
10:40-11:20	Coffee break	
11:20-11:40	Developing macroinvertebrate metrics to detect human pressure responses on large rivers in New Zealand. Kevin Collier et al.	Small streams and tributaries - their importance and restoration potential. Armin Peter et al.
11:40-12:00	Genetic diversity as an indicator for monitoring aquatic ecosystem condition. Ryan Woods et al.	The return of Atlantic salmon and increased benthic diversity in urban rivers in Oslo, Norway, as a result of improvements in water quality. Svein Jakob Saltveit et al.
12:00-12:20	Benthic macroinvertebrate taxa as indicators of ecological status: results from Lithuanian rivers. Giedre Višinskiene et al.	Are fish assemblages establishing at restored stream reaches predictable from the assemblages in the vicinity? Stefan Stoll et al.
12:20-12:40	Ecological feedback in rice paddy fields as wetlands in Japan. Keiko Muraoka et al.	Fish assemblage - local habitat relationship: the case of the lowland Wel River, Poland. Jacek Szlakowski et al.
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15:00-15:20	Exploration of factors at catchment and floodplain scales targeted to modelling structure of river macroinvertebrate communities in the Morava River basin. Karel Brabec et al.	Phytoperiphyton community structure and distribution in rivers flowing into White Sea. Sergey Komulaynen
15:20-15:40	Assessing physical habitat in streams; do geomorphologists and invertebrates see eye to eye? Tory Milner et al.	Relationship between blackflies (Diptera: Simuliidae) and some hydrochemical and hydrophysical parameters in the Nemunas River and its major tributaries. Rasa Bernotiene
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16:20-16:40	Assessment of floodplain biodiversity for large rivers – case study Germany. Mathias Scholz et al.	Large-scale longitudinal survey on the zooplankton of a large lowland river (Po River, Italy) by means of a Lagrangian sampling approach. Isabella Bertani et al.
16:40-17:00	European freshwater biodiversity: patterns, drivers and conservation priorities at the catchment scale. Nike Sommerwerk et al.	Species richness and habitat specialization of Chironomidae (Diptera) in the Tagliamento River, Italy using a DNA-based biodiversity assessment. Kozo Watanabe et al.
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10:20-10:40	Floodplain inundation character: the importance of spatial scale. Rajendra Shilpakar et al.	Effects of hydrologic connection with the river physicochemical properties and phytoplankton dynamics of backwaters in the lower Mississippi River floodplain. Clifford Ochs et al.
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11:20-11:40	Fundamental concepts for river management futures. Melissa Parsons et al.	Resilience of the ecology of a semi-arid floodplain in the face of hyper-drought. Darren Baldwin
11:40-12:00	Identifying Globally "Great" Rivers for Integrated River Basin Management David Galat	Hydrological disconnectivity: a comparison of natural, constant and hydropeaking regimes. Maria Cristina Bruno et al.
12:00-12:20	Longitudinal Connectivity of Stream Networks at a Catchment Scale - Ecological Implications and Quantification of Anthropogenic Alterations. Nevenka Bulovic et al.	A method to analyse characteristics of rapid fluctuations of flow and stage in rivers in consequence of hydropeaking. Julian Sauterleute et al.
12:20-12:40	Biocoenotic zonation of fish assemblages in European rivers in regard to climate change impacts. Florian Pletterbauer et al.	Resilience of tropical floodplain waterholes and the importance of connectivity. Neil Pettit et al.
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	Session 13 **“Biotic links”** Chair: J. Thorp	**Session 14** **“Hydraulic links”** Chair: T. Hein
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15:00-15:20	Flow drives nutrient and plankton dynamics in a large temperate river system (Waikato River, New Zealand). Konrad Górski et al.	Testing accuracy of a 1D hydraulic model for the simulation of potential stranding areas at the river scale. Roser Casas-Mulet et al.
15:20-15:40	Effects of hydrological connectivity change on a dryland river: the recent ecological history of floodplain lakes (billabongs), Macintyre River, Australia. Stephen Chilcott et al.	No age-effects on the functional redundancy of riparian ground beetles after an extreme flood event. Michael Gerisch et al.
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16:20-16:40	Modeling Large River Fish Population Responses to Global Climate Change: Missouri River Sturgeon Example. Mark L. Wildhaber et al.	Effects of two subsequent peak floods on vegetation pattern and channel morphology in a by-passed section of a braided gravel bed river. Michael Reich et al.
16:40-17:00	Geographical distribution of flow regime and its relationship to fish species richness in major rivers in Japan. Chihiro Yoshimura et al.	Pilot application of certification methodology for hydropower plants in Italy and Slovenia. Natasa Smolar-Zvanut et al.
17:00-17:40	Poster Session	
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Friday, 12.08.2011 – 09:00-14:00

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	Session 15 **"Hydraulic links"** Chair: K. Tockner	**Session 16** **"Hydromorphology"** Chair: J. Kail
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10:00-10:20	Network type and complexity drive abundance and diversity in connected landscapes. Mark Padgham et al.	Morphodynamics and woody debris dispersion in braided rivers: a flume experiment. Matilde Welber et al.
10:20-10:40	The spatial organisation of boundaries in stream networks. Murray Scown et al.	Channel heterogeneity at the catchment scale as indexed by estimates of morphological River Type and Stream Power; River Dee Scotland. David Gilvear et al.
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11:20-11:40	Population Trends of Flathead Catfish *Pylodictis olivaris*, Channel Catfish *Ictalurus punctatus*, and Blue Catfish *I. furcatus* in Impounded and Unimpounded Reaches of the Upper Mississippi River (1993-2007). Robert Hrabik et al.	Contemporary sediment exchange in a dryland floodplain river. Mark Southwell et al.
11:40-12:00	Determination of suitable spring snowmelt recession rates below dams for native species protection. Sarah Yarnell et al.	Increased sedimentation and turbidity in waterholes impact upon refuge persistence and quality. Jonathan Marshall et al.
12:00-12:20	Biophysical Linkages: Defining Physical Habitat Use Guilds for a Species Rich Large River. Piotr Parasiewicz et al.	Floodplain river sediment exchanges: ecological implications dryland river ecosystems. Martin Thoms
12:20-12:40	Presentation Zhifeng Yang 3rd ISRS Conference	
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12:45-14:00	Lunch break	

Keynote Lectures

The End of the River Continuum: River-Ocean Links that Drive Geomorphology, Hydraulics, and Ecosystem Function

MARTIN W. DOYLE[1]

[1] Department of Geography, University of North Carolina

A central tenet of river science has been the predominant influence of hillslopes and terrestrial systems on rivers. Or as Hynes captured it, “The stream is the product of its valley.” This terrestrial-hydrologic link is the foundation for broadly-influential concepts such as the watershed ecosystem concept and the river continuum concept; and recent studies continue to highlight the importance of terrestrial processes upstream driving rivers ecosystems downstream. The corollary to the terrestrial-river view is the ocean-river view at the downstream end of the river continuum. Ocean tides propagate far upstream through the channel network, affecting the flow of water, sediment, solutes, and organisms. At this downstream end of the river continuum, the normal conceptualization of streams as dependent on upstream forces is reversed: instead of watershed runoff shaping river hydrology and morphology, downstream rivers are potentially dominated by the influence of tides. Tides extend far upstream from the saline estuary, creating a tidal freshwater zone many 100s of km long in large rivers and stretching over half the length of many smaller rivers. Yet tidal rivers are conspicuously omitted from the formative conceptualizations of rivers: nutrient spiraling, river continuum, hierarchical patch dynamics, and flood-pulse concepts in ecology, along with hydraulic geometry, natural flow regime, and dominant discharge in hydrogeomorphology do not include a tidal component. Moreover, tides in rivers are not explicitly discussed in any of the basic stream ecology texts. Why have tidal rivers been so ignored from synthesis efforts in river science? We suspect that the answer is in part because concepts in river science (both stream ecology and fluvial geomorphology) have followed precipitation and flowpaths, and thus been constrained to framing rivers as the endpoint along the hillslope-riparian-stream continuum rather than the ocean-estuary-stream continuum. Moreover, tidal freshwater rivers lie at the disciplinary interface – the link – just downstream of the interest of river science, yet just upstream of estuarine science where concepts, tools, instruments, and even journals do not readily reside. This nexus of land-ocean linkage has thus remained a sort of disciplinary orphan. We have developed an ongoing research program on tidal rivers of the Southeastern United States in an effort to further understand links between hydro-geomorphology and ecosystem function. Our results to date show that tidal forces can cause threshold changes in channel morphology and hydraulics, which cascade into threshold changes in denitrification as well as changes in phytoplankton communities and associated primary production. Understanding, or recognizing, linkages in river ecosystems may be most easily accomplished in systems that lie at interfaces. We find that tidal freshwater zones of rivers are opportune areas for re-thinking some foundational concepts in river system science, challenging our basic notions of how rivers work, and setting new challenges for how they might be effectively managed.

Influence of hydromorphology on linking the distribution and connectivity of habitat mosaics for Atlantic salmon

CHRIS SOULSBY[1]

[1]Northern Rivers Institute, School of Geosciences, University of Aberdeen, Aberdeen, Scotland.

This contribution will draw on over 45 years of empirical research in the Scottish Highlands to examine the influence of hydromorphological conditions on the spatial distribution and temporal utilization of riverine habitats by Atlantic salmon. The freshwater phases of the life cycle of Atlantic salmon utilize a diverse range of habitats when spawning, emerging as fry, growing as parr, migrating as smolts and returning as adults. The spatial distribution of different habitats in river networks closely related to the channel geomorphology and landscape evolution history. The temporal utilisation of different habitats is, however, also dependent on hydrological conditions which can strongly influence the connectivity of different habitat mosaics at critical life stages. The extent to which catchment hydromorphology and explain the spatial distribution of salmonid habitats and temporal variation in their utilisation will be discussed. The implications of incorporating these new insights in fisheries management strategies will be assessed.

Troubled waters: Agriculture land use effects on riverine ecosystem structure and function

MARGUERITE A. XENOPOULOS[1]

[1] Department of Biology, Trent University

In all inhabited regions of the world, rivers are experiencing many and often irreversible changes from intensive land use. These effects on water supply and quality will be further amplified by future changes in land use, the global climate, and various other environmental stressors. Here, I will examine how the effects of one predominant land use, agriculture, on ecosystem structure and ecological function of streams and rivers of Ontario, Canada. Particular focus will be given to how altered land-water linkages result in changes to dissolved organic matter quantity and quality. Specifically, we recently found that the hydrological context the landscape controls the biogeochemistry of dissolved organic carbon exported from watersheds into streams. Hydrological connectivity, largely dictated by climatic factors and soil moisture conditions, affects the magnitude and nature of organic material inputs into streams of variable agricultural land uses. Furthermore, the processing of this organic carbon appears to be greater in the highly productive, agricultural streams, which further changes to the quality of the organic matter (less aromaticity). We have also found agriculture land use to alter the structure of communities (e.g., macroinvertebrates, fish) and the services that they provide (e.g., microbial activity, fungal biomass, nutrient recycling, decomposition, respiration, denitrification). Many of these changes result from the high nutrient concentrations that accompany overfertilization of agriculture lands. For example, we have found that the N and P content in benthic algae increases with the percent agriculture land use. In turn, nutrient excretion rates from macroinvertebrates and fish are greater in agriculturally influenced streams. However, some ecosystem functions related to nutrient cycling (e.g., decomposition, denitrification) appear to be decoupled from the highly productive river systems or at times decrease with increasing row crop (monoculture) land use. Understanding landscape-freshwater connectivity is particularly important when predicting how human-derived materials (agricultural and residential waste, fertilizers and pesticides) will affect the integrity of aquatic ecosystems.

Corridors and boundaries: rivers, their flood plains and biota

JACK STANFORD[1]

[1] Flathead Lake Biological Station, University of Montana

Contemporary theory in river ecology is focused on connectivity – how materials and energy flux occurs as a continuum or three dimensional corridor from headwater sources to confluence with the ocean. Boundaries between physical units are apparent, for example all rivers have repeating rapids/riffle-pool-run-tail out sequences defined by the distribution of power at a given discharge and channel form. These repeating sequences are scalable and produce a characteristic spectrum that defines geomorphic domains of river systems. However, boundaries are dynamic, constantly changing as the ability of water to move materials from upstream to downstream (cut and fill alluviation) varies with availability of water from the catchment. Geomorphic attributes of rivers and their valleys, however dynamic, are discernable and scalable in data obtained from satellite and airborne sensors. The density of channel connections (nodes) is controlled by channel slope, valley width, flow and sediment supply and therefore node density is a strong indicator of the character of alluvial flood plains that typically occur at slope breaks along the river corridor, rather like beads on a string. Flood plains have an array (catena) of distinct units or habitats determined largely by the degree of disturbance by flooding. The development and maintenance of the habitat catena determines floodplain biodiversity within the regional framework of species distributions. In some cases nutrient fluxes in river systems may be subsidized or altered by animal interventions, such as in salmon rivers where substantial marine nutrient loading may strongly influences ecological trajectories. To be successful, river conservation must be cognizant of connectivity and dynamic boundaries because human activities tend to sever connectivity and change boundary dynamics and natural ecosystem services suffer in consequence.

Impact of climate change on river ecosystems

NIKOLAI FRIBERG[1]

[1] Nat. Environmental Research Institute, Aarhus University

Rivers and riparian areas will undergo significant changes in the future, at both the European and global scale, as a direct response to the predicted changes in climate. Already today, recent changes in climate have had impact on run-off patterns of rivers and increased the temperature of freshwater ecosystems. Based on our research, we can predict that these changes will have implications for loss of nutrients and toxic compounds, carbon flux to the atmosphere and sensitivity of river ecosystems to other types of human perturbations. Increased winter discharge in the Northern part of Europe will increase the loss of nutrients due surface run-off and erosion processes, and extreme precipitation events will increase the risk of loss of e.g. pesticides to the aquatic environment. Direct effects of both changes in hydrological regimes and temperature will regionally be a decline, and some cases loss, of species adapted to the current climate conditions. Moreover, temperature will change ecosystem functioning across levels of organisation, in some cases making them overall more sensitive to pressures such as nutrients. Freshwater ecosystems are furthermore likely to be a source of CO_2 and greenhouse gasses with increasing temperature. All these impacts, together with direct effects of desiccation and flood induced habitat degradation, will degrade European freshwater ecosystems substantially if we do not adopt sustainable adaptation strategies that can counteract these negative impacts.

Historical destructuring process with biodiversity loss in the river-lake ecosystem of the middle and lower Yangtze Region

JIANBO CHANG[1]

[1] Institute of Hydroecology, Chinese Academy of Science

Human pharmaceuticals have emerged as pollutants of the aquatic environment. The presence of a cocktail of drugs in surface waters worldwide may cause detrimental effects on non target organisms. In Europe an environmental risk assessment (ERA) is required for the license of new medicines. This risk assessment begins with a predicted environmental concentration (PEC). If this value exceeds 10ng/L then further risk assessment is triggered. There is much debate about the accuracy of the PEC and the assumptions used in its calculation. The aim of this study was to assess the validity of the PEC calculation laid out in EMEA//CHMP/SWP/4447/00 guidelines for ERA of human pharmaceuticals. PEC calculations were performed for nine regularly occurring and highly prescribed pharmaceuticals, carbamazepine, diclofenac, ibuprofen, gemfibrozil, propranolol, paracetamol, tamoxifen, fluoxetine and trimethoprim and compared to concentration data in the published literature. The default parameters for consumption, i.e. the market penetration factor (Fpen) and the dilution factor of 10 are evaluated. The refinements that can be made to the initial PEC calculation such as removal during sewage treatment and metabolism are discussed. The findings highlight the difficulties in predicting environmental concentrations and applying the precautionary principle in order to prevent substances with potentially chronic toxic effects being released into the environment without adequate risk assessment.

Session 1: Socio-ecology

Maximising environmental watering benefits for a range of biota: Optimal allocation of flow releases

SIMON LINKE[1], JOE MCMAHON[1], JON OLLEY[1], STEPHANIE JANUCHOWSKI-HARTLET[1], RACHEL BLAKEY[2], EREN TURAK[2], ANDREW HIGGINS[3], NICK MARSH[4], BEN DOCKER[5], ALANA WILKES[5]

[1] Australian Rivers Institute, Griffith University, Brisbane, Australia
[2] NSW DECC, Australia
[3] CSIRO
[4] YORB
[5] Commonwealth Environmental Water Holder, Canberra, Australia

To develop a systems strategy for environmental water allocations, we combine principles from systematic conservation planning with environmental flow science. In our study system – the Murrumbidgee catchment, NSW, Australia – we derived watering requirements for multiple environmental attributes. After spatially mapping floodplains and wetlands we successfully modelled distributions for 68 taxa (8 frog taxa, 50 bird species, 10 aquatic plants) using multiple adaptive regression splines. Watering requirements for the species were derived from species trait databases and the relevant literature. We found inundation and seasonal preferences for 56 out of the 68 taxa.
To achieve optimal allocations we are addressing two key questions:
1. Given a certain amount of environmental water, what is the most efficient allocation that fulfils the highest number (and potentially highest diversity) of assets?
2. What is an optimal schedule across multiple season to deliver water?
In the optimisation, we used a simulated annealing algorithm to optimally allocate releases from 2 dams and buybacks from multiple watering points while maximising ecological benefits. We demonstrate how a targeted, systematic release schedule benefits more environmental assets and thus leads to increased efficiency and defensibility. The optimal strategy comprised of watering some regulated wetlands as 'secure assets', together with enhancing flows in the wetter months for in-channel benefits.

Eco Evidence: using the literature to inform evidence-based decision making in river management

ANGUS WEBB[1], SUSAN NICHOLS[2], RICHARD NORRIS[2], MICHAEL STEWARDSON[3], RALPH OGDEN[4]

[1] Department of Resource Management and Geography & the eWater Cooperative Research Centre, University of Melbourne
[2] Institute for Applied Ecology & the eWater Cooperative Research Centre, University of Canberra
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Rivers, as linked social-ecological systems, face great ecological pressures because of human activities. Managers must somehow balance the needs of environmental and human uses of river systems, and do so in a transparent and defensible manner. Sound decision making in environmental management relies on understanding causal relationships between environmental stressors and ecological responses. However, causal relations are difficult to demonstrate in natural environments because of the difficulty of performing experiments, natural variability, lack of replication, and the presence of confounding influences. Similar issues were recognized by epidemiologists in the 1960s, and 'causal criteria' were developed to assess causal relations in epidemiological investigations. There have been several calls to use causal criteria analysis in environmental science, but few case studies exist. This may partly result from the lack of a standardised method and analysis tools (analogous to statistical software). We will provide an introduction to the history and logic of causal criteria analysis; outline a systematic method and supporting software we have developed for using the scientific literature to assess causality in environmental studies; and demonstrate its application, strengths and weaknesses using the example of ecological response to changes in flow in regulated river systems. Such approaches can help to achieve balanced management outcomes in heavily developed environments.

Stressors across multiple scales influence headwater stream biological quality in Great Britain

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Using data from the Countryside Survey of GB we investigated relationships between land management and stream biological quality/ biodiversity. The dataset, consisting of surveys undertaken in 1990, 1998 and 2007, included c.250 stream sites with associated environmental characteristics quantified at three spatial scales: in-stream, riparian and wider landscape. We used macroinvertebrates as an indicator: O/E ASPT and CCI. We used a statistical framework to derive effects of each explanatory variable while holding others constant, and to separate spatial and temporal effects. There were additive effects of extent of arable land, inorganic nutrient concentrations and channel and riparian management. Patterns were predominantly spatial except where specifically noted: 1. Extent of arable land in the wider landscape had a negative association with stream biological quality and biodiversity. Through time, increases in cover of intensive grassland were associated with a decline in status (and vice-versa) 2. Soluble Reactive Phosphorus concentrations were strongly related to stream biological water quality and biodiversity; 3. Historical physical degradation of the stream channel, measured by the extent of resectioning is also negatively associated with stream biological quality and biodiversity; 4. Increased riparian woody cover along the stream is associated with improved stream biological quality and its general increase through time appears beneficial to macroinvertebrates.

Catchment land use classes as cumulative stressor on riverine fish

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This study aims at quantifying human impacts on stream health by land-use data with fish as indicator for (multiple-) impacted riverscapes. We investigate 1) if effects of multiple land-use classes act cumulatively and whether this is true across river types; 2) which of multiple land-use classes has the strongest effect and whether metrics of functional fish guilds react differently. The land-use composition in the catchment of 634 fish sampling sites in Austria is computed as percentages of six land-use categories: agriculture, pasture, urban land, forest, shrubland, and barren land. We find 15 medium-level correlations ($r>0.50$) within 11 biotic variables (10 metrics, 1 Index) contrasted to five land-use classes. Intolerant species correlated best to agricultural land use ($r=-0.57$). In a full land-use model of 5 land-use categories in a regression trees to predict the European Fish Index, agriculture and urbanisation are the best predictors and indicate significant effects at levels of >40% and >2.5%, respectively ($R^2=0.30$). A cumulative effect is indicated because a combination of high percentages of both is related to moderate status, whereas a level <40% agriculture combined with even >2.5% urbanisation is related to good status. Headwater river types (dominated by *Salmo trutta*) show stronger reactions to land-use than river types of lower gradient (dominated by *Rutilus rutilus)*. Headwaters turned out to be more sensitive to urbanisation than to agriculture.

No flow…no go – the dependence of barramundi (*Lates calcarifer*) fisheries on freshwater flow in Queensland, Australia

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Worldwide estuarine fisheries are under pressure from overfishing, water impoundment and habitat modification. Barramundi (Lates calcarifer) catches in Queensland are subject to high variability which has been attributed to the natural variability of freshwater flows when low levels affect nutrient input and availability of habitats. Here we provide an overview of previous studies on barramundi catch and freshwater flow and demonstrate the importance of runoff for the barramundi life-cycle. Presented statistical analyses on barramundi catches from Queensland, Australia showed significant relationships with rainfall as a proxy for freshwater flow in seven selected regions. Other parameters such as temperature also played an important role in determining high catch rates often with a two to four year lag effect. Increased climate variability in combination with habitat modification is likely putting more pressure on the barramundi stocks in Queensland and suggests an adjustment of current management practices.

Application of sulphur isotope ratios to examine the influence of riverine sulphur on dietary sources in Roman Oxfordshire, U.K.

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This study investigates the application of sulphur isotope ratios (d34S) in combination with carbon (d13C) and nitrogen (d15N) isotope ratios to detect the influence of environmental sulphur on the isotope values of archaeological human and faunal remains from Roman era sites in Oxfordshire, UK. Bone collagen of humans, terrestrial animals, and freshwater fish were isotopically analysed from four locations in the Thames River Valley, and a broad range of d34S signatures were found. The d34S values from the terrestrial animals were highly variable, but the d34S values of the fish were clustered and highly 34S-depleted. The results of the faunal remains suggest that riverine sulphur influenced the terrestrial sulphur isotopic signature. Terrestrial animals were possibly raised on the floodplains of the River Thames, where highly 34S depleted sulphur influenced the soil. The results of the humans suggest that food was consumed coming from resources with variable d34S signatures, which are a result of the freshwater sulphur brought onto the land. Furthermore, d34S ratios of modern water from the River Thames show a shift in d34S signatures in modern times, possibly due to industrial pollution. This research represents the most detailed application of d34S analysis to examine dietary practices during the Romano-British Period, and the first to use d34S values to determine the environmental influence of riverine sulphur on the diets of an archaeological population.

Great Rivers That Work For People And Nature

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The mission of the Nature Conservancy's (TNC) Great River Partnership (GRP) is to bring together diverse partners and sound science to expand options for achieving sustainable management and development of the world's great river basins. The GRP focuses on shared solutions to common land- and water-use dilemmas, recognizing the inescapable linkages between our economy, human well-being, and ecosystem sustainability. TNC's deep history in the Mississippi River Basin serves as a foundation to promote exchange of knowledge and expertise globally.
This presentation will review the six Operating Principles that underlie the GRP mission and the Strategic Goals that will guide the GRP Strategy from 2011-2016. It will also review key outcomes of projects that were the focus of the GRP in the last five years, including: a) a technical exchange between government agencies in China and United States to support adaptive management on the Yangtze River; and b) efforts to improve systemic reduction of nutrients in the Mississippi River Basin through a combination of proof-of-concept projects linked to public policy and funding.*The Great Rivers Partnership Team includes Divina Baratta, Gretchen Benjamin, Doug Blodgett, Scott Davis, Dave DeGeus, Dr. David Galat, Dr. Steve Haase, Sean McMahon, Michael Reuter, Diane Rudin, Todd Strole, and Vince Shay. GRP Board member Dr. Jim Thorp also made substantial contributions to t he development of the GRP Strategy.*

Session 2: Biodiversity I

Thermal heterogeneity and fish assemblages in a dynamic river floodplain mosaic (Oder River, Germany)

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River floodplains are composed of a mosaic of aquatic and terrestrial habitats. While flow has frequently been considered as a master variable that controls aquatic biodiversity and species behavior, little is known about thermal heterogeneity and its effect on aquatic biota in complex landscapes. However, quantifying thermal patchiness at the river floodplain scale remains a challenging task. In this study, we applied airborne thermal infrared (IR) imagery to characterize thermal heterogeneity at two flow conditions in a lowland river floodplain. In addition, the kinetic temperature was measured for four months, across the entire range of floodplain water bodies. At the same time we also electro-fished all major water bodies to identify the composition of fish assemblages. In spring (high flow) and summer (mean flow) the floodplain revealed a complex thermal mosaic. Cumulative degree-days and average temperatures were the main variables that differentiated individual water bodies. The water body types delineated based on spatial and seasonal thermal signatures also contained distinct fish assemblages. This study demonstrated the great potential of airborne thermal IR imagery for detecting and quantifying spatial heterogeneity, ecologically relevant warm and cold patches, and temperature gradients in complex landscapes. This information is expected to be crucial for quantifying and interpreting the effects of thermal heterogeneity on key ecosystem processes and biodiversity.

Fish in icy streams: and yet they move

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Winter is generally regarded as a critical period in the life-history of aquatic organisms. However, winter conditions in riverine systems have been little studied and have remained largely unconsidered in river ecology and management. This lack of data hampers forecasts about climate change effects which are expected to be most pronounced in the winter time in high altitude and latitude systems. For example, shifts between freezing and melting will become more frequent, leading to excessive formation of ice. We present new insights into the winter dynamics of fish assemblages and the processes that shape their habitats (ice formation, thermal regime, hydraulics). Winter-round tracking of 400 individually marked fish (European sculpin *Cottus gobio* and brown trout *Salmo trutta*) in a boreal stream demonstrated substantial movement in both species, even in the presence of large volumes of ice. Habitat availability and use varied considerably over time (different phases of winter) and space (different stream reaches). Results from the field study are compared with findings from a literature review on winter refugia for riverine fish. These habitats play a crucial role in population resistance and resilience, but have been widely neglected in river rehabilitation. We encourage more research activities during the cold season and draw conclusions for the planning and evaluation of rehabilitation projects to meet the challenges of increasing winter dynamics (“proactive restoration”).

Influence of river water temperature on seasonal habitat variations of freshwater fishes

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In order to assess the relationship between river water temperature variation and habitat of aquatic organism for future planning and implementation of environmental assessment and mitigation, habitats of freshwater fishes *Oncorhynchus masou masou, Plecoglossus altivelis altivel* and *Cyprinus carpio* in Natori River basin located at the middle of Miyagi prefecture in Japan were evaluated dynamically using the water temperature as one of the environmental indices. HSI (Habitat Suitability Index) and WUA (Weighted Useable Area) of aquatic creatures were quantitatively calculated from hydrological simulation with a heat budget model. As results, the part of HSIs of *Oncorhynchus masou masou* and *Plecoglossus altivelis altivel* tended to show high values in the points where they have actually observed. By incorporating the dynamical factor water temperature into the model, monthly evaluation especially for annual migratory organism including *Plecoglossus altivelis altivel* was enabled. Annual behavior of *Plecoglossus altivelis altivel* and part of behavior of *Oncorhynchus masou masou* can be represented by WUA fluctuations by considering river water temperature.

Macrophyte diversity in riverine backwaters; do floods really matter?

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In ecology disturbances are commonly accepted to be major drivers of species diversity and community composition. Disturbances remove biomass and create gaps that promote establishment of new species. At extreme disturbance intensity only the most tolerant species can persist. Low disturbance leads to competitive exclusion by a few dominant species. According to the Intermediate Disturbance Hypothesis (IDH) intermediate disturbance intensity plays a major role in regulating competition by removing sufficient biomass for a maximum of species to coexist.
Nevertheless in river ecology it appears that the role of hydrological disturbances in maintaining community diversity is often presumed rather than proven. In river floodplains floods are the main hydrological disturbances. The IDH is regularly invoked to explain interactions between floods and vegetation but we argue that flood disturbance is a more complex mechanism promoting species coexistence. Alongside temporal changes in connectivity disturbed habitats experience events that may both augment or reduce diversity due to a combination of different ecological responses to flooding.
This talk will report the results of an in situ study of the effect of floods on the biomass of four aquatic plants in riverine backwaters. It appears that complementary responses of species to flood disturbance can effectively buffer changes in biomass at a community level making aquatic vegetation surprisingly resistant to this disturbance.

Factors affecting the regeneration potential of understorey vegetation in a drought-affected semi-arid floodplain

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Soil seed banks are key to the persistence of plant species through unfavourable conditions, including prolonged floods and extended drought, in semi-arid floodplain wetlands. The contribution of soil seed banks to plant communities appears to be governed by flood pulse attributes, eg flood timing and duration, so floodplain vegetation tends to reflect recent flood history. Differences in the composition of soil seed banks available to contribute to extant vegetation responses to flooding are less well understood. In this study, we used field surveys and mesocosm experiments to investigate influences on the composition of the germinable soil seed bank across the landscape and the scales at which these operate, ie at a landscape-scale via variation in flood frequency or at a local-scale via topographical influence on flood duration and depth. Extant vegetation surveyed in this study reflected local factors, especially soil moisture. In contrast, soil seed bank composition was influenced mostly by flood frequency, but local elevation almost doubled the variation explained in soil seed bank composition. We argue this indicates hierarchical control of spatial variation in soil seed banks whereby landscape-scale flood frequency constrains the pool of species in the seed bank within an area and finer scale variation in topography determines the abundance of species at any one location by influencing inundation duration and depth and thus the reproductive success of individuals.

The importance of seasonal flow patterns for riparian vegetation dynamics

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Many of world's lowland rivers are regulated to suit human needs. In particular, regulation to provide water for irrigation often alters the seasonal timing of downstream river flows. We investigated the impact of altered seasonal flow patterns on the riparian vegetation of a number of lowland rivers in south-eastern Australia. We demonstrate how altered seasonal flow patterns affect the patterns of water-borne dispersal (hydrochory), germination, growth and reproduction of riparian plant species. Responses of individual plant species depended on whether or not their life-history strategy was favoured by the timing of regulated or natural flows. In general, exotic (non-native) species were advantaged and native species disadvantaged, by altered seasonal flows. For example, we found natural winter/spring flow peaks to be important for seed dispersal and recruitment of many native plants, while high irrigation flows in summer encouraged the dispersal of weedy annual species. Seedbank and flooding experiments revealed that seasonal flow timing is also important for the patterns of growth and reproduction of riparian plants. For example, in regulated systems, exotic annual grasses were favoured by unnaturally low winter/spring flows that allowed these species to attain high biomass and set seed. We conclude that altering natural seasonal flow patterns adversely affects native riparian plants and favours the spread of invasive exotic species.

Vegetation types linked to hydromorphological reaches along the Upper Kapos River, Southwest-Hungary

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Based on hydromorphological parameters (expressing channel, floodplain and valley character under seminatural conditions) four reaches can be distinguished along the Upper Kapos River (an indirect tributary of the Middle Danube): 1) headwater among loess hills, no floodplain, high valley confinement; 2) confined valley with a floodplain of uniform width, reduced slope; 3) partially confined valley with a floodplain of highly variable width (explained by tectonic history) and 4) partially confined valley with a broad floodplain. Links between hydromorphological reaches and floodplain vegetation were analysed by correspondence analyis (CA, CCA). Reaches show significant differences in their vegetation - although some parts of the area are under intensive agricultural land use. Study plots are grouped around habitat assemblages, closely associated to reaches. The uppermost reach can be characterized by *Alnus* gallery forests, remnants of the former continuous forest cover of this region. The second reach harbours typical vegetation types of moderately used valley bottoms of this hill region of Hungary: reed and sedge beds, secondary wet grasslands, bushes and small stands or alleys of *Salix* and *Populus* trees. The third and fourth reaches are not distinguished by vegetation: in floodplain pockets different kinds of seminatural or degraded wet meadows are found, indicating deeper groundwater level and shorter inundation period than in reach 2.

Session 3: Biogeochemistry

Changes in floodplain soil organic matter in response to inundation

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Organic matter stored in floodplain soil contributes to that floodplain's productivity and the productivity of the rivers that rely on the input of carbon from the surrounding floodplain to the river channel. Much of our knowledge of floodplain soil carbon transformations following inundation comes from mesocosm studies or investigations of rice paddy soil. There have been very few studies investigating carbon transformations in floodplain soils during field scale inundation events due to the logistics of sampling and problems associated with collection of controls and samples prior to inundation. In this study we had the opportunity to investigate soil carbon transformations on the lower Murrumbidgee floodplain (NSW, Australia) prior to (15 min to 12 hrs), during (after 20, 30 and 45 days inundation) and after drying (15-20 days). After 20 days of inundation we found a reduction in total organic matter (T-OM), microbial biomass carbon (MB-C) and labile carbon fractions (water extractable carbon [H_2O-C], permanganate oxidisable carbon [$KMnO_4$-C] and potassium sulphate extractable carbon [K_2SO_4-C]). The amount of labile carbon, with the exception of $KMnO_4$-C, remained lower than the controls after floodplain soil drying. However the T-OM and MB-C were significantly higher than controls after flood water receded. We developed a conceptual model of carbon dynamics in floodplain soils during and after inundation.

Flood driven soil-groundwater coupling and impact of C and N cycling in a restored riparian aquifer

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We investigated the effect of environmental heterogeneity and hydrological connectivity on organic carbon (OC) and nitrogen transformations in an aquifer of a restored and a channelized section of the River Thur, Switzerland. Spatio-temporal dynamics of organic matter stable C isotopic ratios, dissolved organic carbon polydispersity and fluorescence, and the composition of amino acids were investigated during variable discharge. Microbial abundance, extracellular enzymatic activities and secondary carbon production were related to OC characteristics. Concurrently, denitrification was measured by the dual stable isotope ratios of nitrate and the abundance of denitrification genes. The results showed that at the restored site, flood disturbances increased leaching of bioavailable OC from overlaying soils to the aquifer and increased there the efficiency of microbial OC transformation processes. Substantial losses of nitrate and enrichment of the residual nitrate in ^{15}N and ^{18}O developed after floods indicating a hot spot and hot moments of denitrification. For this hot spot, the hydrological regime and vegetation, which triggers high below-ground OC dynamics, represent the main factors allowing intense soil-groundwater coupling. Overall, river restoration enhances the capacity of the alluvial aquifer to remove and process OC, and provides valuable ecosystem services that go along with OC decomposition.

Breaking the drought: Floods, carbon and prolonged hypoxia in a major river system

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Hypoxic blackwater events are characterised by high levels of dissolved organic carbon, the metabolism of which results in low dissolved oxygen in the water column, which can cause fish and crustacean mortality. Understanding the drivers of and controls on hypoxic blackwater events is important in order to reduce the potential for detrimental water quality impacts and associated mortalities of aquatic organisms from both managed and natural flows. A series of flood events in south-eastern Australia during the late spring and throughout summer in 2010 – 2011 inundated large areas of forested floodplain. Much of this area had not been flooded for more than a decade due to a combination of climatic drought and river regulation. Extremely high concentrations of dissolved organic carbon and very low dissolved oxygen levels were recorded from water on these floodplains. The returning flood water created a plume of hypoxic to anoxic water that stretched over 1000 km along the Murray River and its tributaries and persisted for several months. In this paper we explore the biogeochemistry and hydrology underpinning such an extreme event and discuss the potential ecological consequences into the future.

Effects of changed hydrological connectivity on nutrient cycling of floodplains

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Floodplains are essential components within river systems controlling nutrient cycling by promoting transformation processes and thus, act as biogeochemical hot spots. The capacity of these transformation processes is closely linked to the hydrological exchange conditions, the connectivity with the main channel. The deterioration of river systems and their landscapes due to regulation and land use change has prompted restoration measures aiming to improve the ecological conditions of river systems. One of the aims is to improve the connectivity between these landscape elements and by that also enhance the spatial overall heterogeneity and temporal variability within the riverine landscape. An important aspect in that context is to what extent these measures affect the nutrient and organic matter cycling in floodplain river stretches. In general, at the landscape scale the mode of carbon and nutrient delivery, increasing residence time and contact area as well as extreme hydrological events control the nutrient uptake and retention. The present paper analyses the link between hydromorphology and biogeochemistry in a large river, the Danube River. We demonstrate that principles of hydromorphological dynamics control key ecosystem functions and explore potential implications for the management of large rivers.

The effect of the succession from grasses to trees on the nutrient budget of the surface soil of the sand bar in the gravelly rivers

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Forestation in the riverine sandbar always follows the succession of herbaceous vegetation. Soil nutrient dynamics therein, therefore, differ depending on the nutrient budgets of prevalent vegetation types. Nutrient budgets in the process of grass and tree colonization was observed in sandbar of a gravelly river channel. Allometric relations of tree biomass, diameter at knee-height and tree age were obtained separately between leaves and woody components. Then, the aboveground grass biomass, which die-off in winter, was also obtained as a function of shading by neighboring trees, substrate condition and soil nutrients. Nitrogen and phosphorus concentrations of each plant organ and underlying soil, including fixed nitrogen, were analyzed. From these results, the annual increment of nutrient stock in the woody components and the nutrient allocation to leaves were derived. The growth of grasses depends on the nutrient concentration of the soil, however, substantially suppressed by the colonization of trees. Annual uptake of nutrients was larger in older trees than that of younger ones, while a substantial fraction was allocated to leaves. The comparison of short term exchangeable amounts of nutrients between grasses and trees indicated that both were equivalent to each other. The allochthonous nutrient inputs by floods, nitrogen fixation, etc., have important roles in the succession from grasses to trees to keep the nutrient stock in the soil. With these components, the variation of grass biomass distribution was modeled.

Breakdown rates of dead fish: dependence on terrestrial consumers

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Many fish die when stranded in isolated pools. Water quality can decrease and become unfavourable for many fish species, food can be limited, and surface water can disappear altogether. What happens to these dead fish when pools dry up? We investigated the role of different types of consumers in the breakdown of dead fish in dry river beds, using an experimental approach. Four treatments were used to separate the effects of different types of consumers: a) microbial, b) flying invertebrates, c) all invertebrates, and d) all consumers. Steel cages were used in treatments a), b) and c) to exclude large consumers such as mammals and birds. Fish breakdown rates were fastest in the treatment where fish were accessible to all possible consumers. Fish breakdown rates were slowest in the microbial treatment, where fish were contained within mesh bags inside steel cages, and breakdown was limited to the activity of microorganisms. Dead fish in temporary rivers and streams can be a food source for a range of terrestrial consumers - vertebrates, invertebrates and microorganisms. This utilisation of dead fish from dried pools represents an export of aquatic nutrients to terrestrial ecosystems, and is an example of a temporal aquatic-terrestrial linkage in temporary rivers and streams.

Implications Of Marine-derived Nutrients From Anadromous Fishes On Productivity In Atlantic Rivers

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Returns of anadromous fish have declined dramatically in the past century throughout Atlantic Canada, reducing the delivery of marine-derived nutrients (MDN) to rivers. The role of MDN transport in coastal rivers is a function of net nutrients transferred by all anadromous fish and collectively may result in MDN subsidies equivalent to those delivered by salmon on the Pacific coast. The current scarcity of these fishes may have profound effects on aquatic production, particularly in nutrient-poor systems. We examined *i*) the primary pathways of incorporation of MDN delivered by several anadromous fishes to freshwater food webs, and *ii*) how different timing and spawning strategies affect freshwater productivity. Stable isotopes of carbon and nitrogen were used to track the flow of MDN from primary producers to consumers in rivers containing different species of anadromous fish. In rivers with rainbow smelt (broadcast spawners), MDN incorporation was in the form of direct consumption of eggs by freshwater invertebrates, and indirectly through nutrient uptake by the biofilm and subsequent grazing by invertebrates. In contrast, MDN incorporation was only through an indirect pathway in rivers with alewives, which are pelagic spawners. The connectivity between freshwater and marine inputs may be larger in scope than previously understood. The reduction of MDN may act to constrain freshwater productivity, and therefore, the sustainability of anadromous and resident fish populations.

Session 4: Trophic Links

Land use and food chain length: a stable isotope study on a small temperate river basin.

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Ecological management of aquatic ecosystems implies understanding the impacts of human activities on their functioning. Trophic relationships, which constitute a major ecosystem function, could be particularly sensitive to human land use in watersheds. To test this hypothesis, we sampled 18 sites located in 10 tributaries of the Orge river catchment, (937 km², France) and mainly differing from their watershed land use (predominantly urban, forested or agricultural watersheds). For each site, food webs were determined using nitrogen and carbon stable isotopes analyses of organic matter sources (162 samples), macroinvertebrates (272 samples) and fishes (772 samples). Preliminary results show that food chain length was not significantly influenced by sites position in the longitudinal gradient, positively correlated to the amount of agricultural land use and negatively with the amount of forest. According to these results solar energy inputs and aquatic primary productivity may play a decisive role for determining food chain length in these systems.

Food web connectivity and consumer-resource coupling in tropical floodplain rivers

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The dynamic seasonal hydrology of many tropical floodplain rivers and resultant changes in wetted area make studying food webs especially challenging. A solution to this problem is to use techniques that integrate ecological information over space and time. Stable isotopes are particularly amenable in this regard, revealing information about consumer movement patterns and sources of organic carbon that support food webs. We used a combination of broad-scale surveys, alternating wet/dry season sampling of multiple fish tissues with different turnover rates, and repeated intensive analyses coupled with standardized catch and biomass measurements, to determine food web properties in tropical floodplain rivers across northern Australia. Local sources of benthic algae dominated the diet of invertebrate consumers in all systems and also supported higher trophic levels (fish) in the system with limited hydrological connectivity (short flood duration and intermittent dry season flow). However, where there were strong lateral connections to the floodplain and perennial dry season flow, fish imported algal carbon from floodplains and adjacent coastal areas into main river channels and tributaries. These findings reveal the strong coupling of river and floodplain food webs in these systems associated with the annual flood pulse, and highlight the potential implications of water resource development that could threaten natural patterns of hydrologic and food-web connectivity.

Seasonal connectivity and biotic fluxes along river corridors and across river boundaries in the wet-dry tropics

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Rivers across Australia's tropical north have largely unmodified flow regimes and are characterized by their strongly seasonal flows. Variability in hydrological connectivity can either promote or limit the opportunity for biota to move both longitudinally along, and laterally across, river corridors. When in the annual hydrograph these movements of biota occur is not well understood. We sampled a range of aquatic biota over 16 months, to investigate the peaks in the lateral and longitudinal movement of aquatic biota and how assemblages change with hydrological connectivity. We sampled benthic algal biomass and productivity, benthic macroinvertebrate biomass and assemblages, and food web structure using stable isotopes analysis. We sampled the lateral flux of emergent aquatic and terrestrial invertebrates across the riparian zone, and we conducted directional sampling of fish assemblages to identify how longitudinal movement of biota is influenced by seasonal disconnection. We found that the transition periods between the wet and the dry seasons are key times for the movement of vertebrate and invertebrate biota, both laterally across the riparian zone and longitudinally along the river corridor. These seasonal transition periods were also important for primary and secondary benthic production. These results suggest that the timing and degree of hydrological connectivity play important roles in regulating the ecological fluxes of biota in these unmodified tropical rivers.

Trophic position of lake sturgeon (*Acipenser fulvescens*) in the Saskatchewan River

DAVID BRAUN[1], IAIN PHILLIPS[2], *BJÖRN WISSEL*[1]

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Lake sturgeon are large, cartilaginous, long-living fish that are endemic to larger mesotrophic and oligotrophic systems of the Central U.S., Great Lakes and several river systems throughout Canada. Currently, this species is threatened or endangered in all Canadian provinces they reside and improved efforts are imperative to identify the causes of their decline. Even though lake sturgeon are known to be associated with benthic habitats, due to mandatory non-lethal sampling methods, little is known about their diets. In this study we used fin clips as a sustainable method for diet reconstruction based on stable isotope mixing models. $\delta^{13}C$ and $\delta^{15}N$ were utilized to determine the proportion of available food sources for an adult lake sturgeon population (>50 cm) in the Saskatchewan River. Based on our analysis lake sturgeon diet consisted predominantly of crayfish (scavengers), while minor proportions were contributed by scrapers (snails), sediment dwellers (chironomids), and filter feeders (clams). Furthermore, diet composition was consistent on both spatial (>100 km) and temporal scales (months, years). Identifying critical food sources for lake sturgeon will be necessary to define and protect their critical habitat and develop a suitable conservation plan to improve the status of this species. Future analyses will be required to evaluate if the here identified diet requirements are also applicable 1) across lager spatial scales (100's of km) and 2) to juvenile sturgeon.

Trophic patterns and carbon pathways in a temperate lowland river – a comparison of food webs in the main channel and tributary confluences

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Tributary junctions are an important lateral component of large river ecosystems, providing valuable off-channel habitats for a wide range of fish and invertebrate species, as well as contributing carbon and allowing species to move between connected lakes, wetlands and headwater streams. We compared main channel food webs with those from within tributary confluences, an important lateral habitat in the lowland portion of the Waikato River. Tributary confluences represented a range of source inputs, e.g. lake or wetland derived. We used natural abundances of stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes, supported with dietary analysis to determine trophic linkages between species. The Isosource mixing model was used to estimate the contribution of basal carbon resources to secondary consumers. $\delta^{13}C$ and $\delta^{15}N$ isotope ratios of food web components varied spatially between tributary junctions and adjacent main channel sites, while longitudinal and seasonal patterns may also occur. Preliminary results suggest that fine seston and biofilms are important basal carbon resources in both habitats. Terrestrial carbon may also be a significant source of carbon to tributary junction food webs, particularly those originating from wetlands. A detailed understanding of spatial and temporal patterns of energy flow and trophic interactions is necessary to predict the possible outcomes of catchment management and restoration initiatives on biological communities in the lower Waikato River.

Hot Spots and Seasonal Pattern of Heterotrophic Metabolism in a Large River (Elbe, Germany)

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[1] , Leibniz-Institute for Aquatic Ecology and Inland Fisheries
[2] German Federal Institute of Hydrology

Hydrological dynamics, especially flooding regime, structure riverine and are key drivers for floodplain communities. The alluvial biota displays a large range of adaptations strategies to survive floods and/or droughts. Here we relate the combined distribution of functional traits of contrasted taxonomical groups with different mobility and ecological requirements of the Elbe grasslands to hydrological parameters in order to investigate resistance and/or resilience mechanisms in floodplain communities. Plants and macroinvertebrates show different trends in trait response to floods. Morphological adaptations including aerenchymatous roots and hydromorphic leafs for plants or crushing resistant shells for molluscs promote their survival in flood prone habitats whereas life history features such as adult overwintering stage together with mobility through flight ability explain the high resilience of floodplain ground beetles.

Session 5: Biodiversity II

Combining plant and macroinvertebrate traits to assess resistance and resilience mechanisms in floodplains

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[1] Conservation Biology, Helmholtz Centre for Environmental Research
[2] Institute of Ecology, Technische Universität Berlin
[3] ÖKON, Ltd. Ass. for Landscape Ecology, Limnology and Environmental Planning

Hydrological dynamics, especially flooding regime, structure riverine and are key drivers for floodplain communities. The alluvial biota displays a large range of adaptations strategies to survive floods and/or droughts. Here we relate the combined distribution of functional traits of contrasted taxonomical groups with different mobility and ecological requirements of the Elbe grasslands to hydrological parameters in order to investigate resistance and/or resilience mechanisms in floodplain communities. Plants and macroinvertebrates show different trends in trait response to floods. Morphological adaptations including aerenchymatous roots and hydromorphic leafs for plants or crushing resistant shells for molluscs promote their survival in flood prone habitats whereas life history features such as adult overwintering stage together with mobility through flight ability explain the high resilience of floodplain ground beetles.

Microscale Biogeographical Patterns of Microbial Communities in an Atlantic Rainforest Stream

CELIO JONCK[1], CRISTINA NAKAYAMA[2], RUBENS DUARTE[2], VIVIAN PELLIZARI[2]

[1] Petrobras Research Center
[2] University of São Paulo

The stress-gradient hypothesis (SGH) suggests that environmental stress modulates species interactions, causing a shift from negative interactions to net positive interactions with increasing stress. This switch in the sign of species interactions in turn influences biodiversity-ecosystem function (B-EF) relationships along stress gradients. Although the SGH has been the object of intensive investigation by plant ecologists in recent years, very few experiments with animals have been designed within a SGH framework. To overcome this paucity of SGH studies with animals, we conducted a stream microcosm experiment with macro-invertebrate shredders in which we manipulated litter quality (biotic stress) and measured species interactions along this resource quality gradient. We found a switch from negative to neutral interactions with increasing biotic stress, in line with, but not perfectly corresponding to, the pattern described by the SGH. We then re-examined published results from a SGH perspective and find that a diversity of patterns seem to characterize aquatic detritivore interactions along stress gradients. Although the basic pattern proposed by the SGH may not apply to all stress gradients and shredder taxa, we show that shredder species interactions generally change along stress gradients, which underlines the importance of incorporating environmental stressors more explicitly in B-EF research with animals.

Applicability of the Stress Gradient Hypothesis to animal communities: Insights from detritivorous aquatic insects

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[2] Pontificia Universidad Católica del Ecuador, Facultad de Ciencias Exactas y Naturales, Laboratorio de Entomología, Quito, Ecuador & Institut de Recherche pour le Développement (IRD), UMR AMAP, Montpellier, France

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Variability Strategies of two Perennial Floodplain Plant Species: Tangled Lignum (*Muehlenbeckia florulenta*) & River Cooba (*Acacia stenophylla*).

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[1] Riverine Landscapes Research Laboratory, University of New England
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Organisms have strategies to deal with the variability of their surrounding habitats. Some environments exhibit an extremely high level of variability and organisms living within these environments have had to develop efficient strategies to persist under different levels of disturbance, temperature and resource availability. Dryland riverine ecosystems exhibit extreme spatial and temporal variability in their hydrology and geomorphology. Australian dryland river systems are the most hydrologically variable in the world. Because of their sessile nature, plants have developed efficient strategies in order to tolerate or avoid stresses caused by abiotic fluctuations. Perennial plants inhabiting dryland floodplains are subject to stresses associated with flooding and drought, as well as the unpredictability of these events. Lignum and river cooba are two commonly occurring species of Australian semi arid and arid floodplains. Plant attributes including size, leaf morphology, reproductive effort and crown density were measured in areas of differing flood frequency and duration. It was hypothesised that lignum would respond through fluctuations in the level of reproductive effort, green biomass and leaf morphology, while cooba remained constant. Fluctuations were most evident in differences in lignum leaf surface areas between the different flood zones. The implications of these different strategies in terms of hydrology are discussed.

Persistence of floodplain soil eukaryotes during hyper-drought conditions

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[1] Murray-Darling Freshwater Research Centre and CSIRO Land and Water
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[3] CSIRO Land & Water
[4] CSIRO Ecosystem Sciences

Soil and sediment eukaryotes play an important role in the cycling of carbon and nutrients in ecosystems and changes in community structure can disrupt biogeochemical cycling. We used an ecogenomic approach to explore what happens to eukaryote soil communities when decade-long climatic drought conditions are super-imposed on a floodplain that has been starved of water through water resource development (i.e. under hyper-drought conditions). We compared the community structures in wetland sediments that had been exposed to 5 different flooding regimes - flooded for 12 months, dry within the last fortnight following 12 months of inundation, and dry for 9 months, 2 years and 9 years. A total of 5839 operational taxonomic units were identified. Eukaryote community structure was dependant on flooding history, with statistically different community composition occurring in flooded, recently dry and 2 year post flood samples. Remarkably, one third of the taxa existed at locations that were either underwater or had been exposed to nearly decadal long drought. The persistence of these biota clearly contributes to the maintenance of a diverse soil community even in the face of decade-long drought conditions without an intervening flood.

Identification of the limiting factors to freshwater pearl mussel (*Margaritifera margaritifera*) recruitment in the North Tyne catchment, North-East England.

MARIE-PIERRE GOSSELIN[1], LOUISE MILES[1], ROGER SWEETING[1]

[1] The Freshwater Biological Association

The freshwater pearl mussel (*Margaritifera margaritifera*) is endangered and declining throughout its entire range. On the rivers North Tyne and Rede, North-East England, the pearl mussel population has been estimated at approximately 50,000 individuals (2006) but shows little or no recruitment. The present study is aimed at 1) identifying the factors responsible for the lack of recruitment in the North Tyne/Rede population from historical flow, habitat, water quality data and from new data collected from fish and mussel surveys;
2) designing an evidence-based restoration plan to be implemented in the catchment. So far, analysis of historical data suggests that several factors may contribute to their decline, in particular: 1. Spates resulting from hydropower releases on the River North Tyne from Kielder Reservoir which increase shear stress and flush sediments and juvenile mussels downstream. 2. Lack or decline of suitable benthic habitat for mussels at all life stages. 3. Availability of potential fish hosts: Atlantic Salmon (*Salmo salar*) and /or brown trout (*Salmo trutta*). 4. Influences of land use changes over the past decades. This work emphasises the challenges faced when studying the linkages between environmental factors and the ecology of a species with a complex life cycle. It also highlights the need for a sustained, long term, corporate philosophy when assessing complex ecological changes.

Session 6: Restoration I

Evaluating the restoration of riparian ecosystems along a navigation canal: creating possibilities for vegetation establishment in constructed shallow waterberms?

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The project Seine Scheldt has besides a navigational plan, which aims to connect the Seine basin with the Scheldt basin for international transport, also a river restoration plan along the canalized Lys. Several measurements will be executed within this framework as the construction of nature friendly riverbanks, reconnecting meanders and construction of wetlands. A monitoring network for the evaluation of these measurements is designed. In 2008 the river restoration project has started with the construction of shallow waterberms. Two types of waterberms are made: constructions with azobé and constructions with wooden piles. We have made vegetation plots along transects in these two types of waterberms and evaluated the establishment of vegetation using several response variables: a distance measure (utilizing the abundance of typical riparian species and Ellenberg N-values), the number of species and the number of typical riparian species. Other variables as exposition, inclination and erosion -which might be relevant for the species composition- are analyzed as well.

Using engineered large-woody debris jams to restore fish habitat and protect streamside properties, improvements and infrastructure in the Mashel River, WA, USA.

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Traditionally, river stabilization projects in the western USA were designed to laterally shift the stream energy away from eroding banks. Those shifts sometimes had negative implications on fish in Pacific Northwest rivers, especially salmonid (*Oncorhynchus ssp.)* habitat in medium to high energy system. Only in recent decades, has mitigating of lost salmonid habitat been a consideration when designing erosion protection projects and those efforts have mostly been limited to the inclusion of minor log features. Engineered log jam (ELJ) technology is intended to emulate natural functions of in-stream woody debris aggregates that are large enough to direct stream movement and energy, influence localized sedimentation rates and provide complex fish habitat. The Nisqually Indian Tribe and its partners installed 17 ELJ's and several smaller log jams in 2000 meters of the Mashel River since 2006 and used this technology to increase salmon habitat throughout and provide bank protection in selected locations. The stream responded by redirecting energy vertically downward rather than laterally and therefore scouring deep pools that are critical to many life history stages of local salmonids. Post-project monitoring has shown achievement of our goals, no additional bank loss and improved habitat. Average summer usage of the stream reaches by juvenile coho salmon (*O. kisutch*) has increased three-fold in comparison to pre-project and control-reach data.

Using a Dynamic Vegetation Model as Follow-Up for River Restoration

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[3] 2School of Engineering Technical University of Lisbon

Riparian ecosystems behaviour is coupled to the hydrological frame acting upon the river systems and the latter shapes biophysical patches and plant populations. It is therefore partially replicable by models. As riparian ecosystems are amongst the most human perturbed, there is much effort to preserve them through river restoration actions. Simulation models have been contributing for supported decisions of river managers by predicting the outcomes of river restoration strategies. However, there are still few studies testing model predictions at the reach level and as follow-up of restoration actions. We present a case study of river reach restoration in 2002 in the upper part of the river Drau (Austria), with the aim of re-establishing a dynamic bank zone with varying degrees of hydraulic disturbance so that natural succession phases are present. We analyze simulation outputs and field results considering the initial restoration goals and diagnose further adaptive management measures required.

Session 7: Assessment I

How do human pressures influence the European Fish Fauna? A large scale view.

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[1] BOKU - University of Natural Ressources and Life Sciences, Vienna, Institute of Hydrobiology and Aquatic Ecosystem Management

Most European rivers are affected by different types of human pressures. We analysed pressure variables of 4 different pressure groups, i.e. hydrology, morphology, water quality and connectivity to detect spatial patterns, relationships and interactions between pressures, fish metrics and natural environment at the European scale. Based on literature and expert knowledge important pressures as well as fish sampling data and environmental data were identified and collected within the EU-project EFI+ in 14 countries at about 10 000 sites in Europe. In 90% of the catchments analysed fish migration was interrupted. Pressure analysis showed alterations in 55% for water quality pressures, 40% for hydrology, 37% for morphology and 34% for connectivity. In terms of combined pressure, 24% of sites are affected by single pressures, 22% by double pressures, 19% by triple pressures and 12% by four pressure groups. Only 23% of sites are not/slightly affected. In the reaction of the fish fauna, rheophilic, intolerant and potamodromous fish metrics showed strongest results, as they were able to discriminate between different pressure types and combinations. As the reaction of fish metrics often differed by natural environment, a more detailed view on eco region or catchment level was necessary to detect more specific reactions. Finally, our results clearly show that European rivers are multi-impacted and that the fish fauna shows strong reaction upon those impacts.

Ecological assessment of running waters: do macrophytes, macroinvertebrates, diatoms and fish show similar responses to human pressures?

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[1] Hydrosystems and Bioprocesses Research unit (HBAN), CEMAGREF

Commitments of the Water Framework Directive (2000/60/EC) traduce the current need for a global vision of river ecosystem responses to human pressures for decision makers. Yet, few studies have compared responses of aquatic organisms to human pressures (e.g. Hering et al. 2006) and properly distinguished natural environmental changes from human induced changes. Our study aimed at comparing the intensity and the precocity of the responses of four bio-indicators: macrophytes, fish, diatoms and macro-invertebrates, to specific human pressures excluding the natural variation of stream ecosystem functioning. As part of the WISER project, biological, water quality and hydro-morphological data were compiled for 290 French sites. National and European indexes (e.g. EFI) and metrics based on assemblage structure (e.g. richness) and ecological and biological traits were first standardized to acquire metrics independent of natural environmental variability. This first step was completed using data from 100 undisturbed sites (i.e. absence of significant human disturbance). Their responses to single human pressures linked to water quality, channelization, impoundment and local habitat alteration were then compared using an independent data set (127 impacted and 63 undisturbed sites). Results of such analysis are expected to help to evaluate the efficiency of river system assessment.

Different response of fish and benthic invertebrate communities to constrained channel conditions in a mountain river

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[1] Institute of Nature Conservation, Polish Academy of Sciences
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To promote restoration of the Biała River, Polish Carpathians, erodible corridor was established with alternating longer unmanaged channel sections and short channelized sections. To determine the effect of the alternation on river biocoenoses, the taxonomic richness of benthic invertebrates as well as the abundance and diversity of fish fauna were established for 11 pairs of channelized and unmanaged cross-sections. The cross-sectional variation of physical habitat parameters was also determined for both types of river cross-sections. Unmanaged cross-sections with two low-flow channels on average exhibited significantly greater variation in mean and near-bed flow velocity and bed-material size than single-thread, channelized cross-sections. Summer, autumn and winter surveys of invertebrates indicated that unmanaged cross-sections supported three times more taxa on average than channelized cross-sections. Electrofishings conducted in summer and autumn indicated no statistically significant differences in the number of fish species between both types of cross-sections, although the number of juveniles was significantly greater in the unmanaged cross-sections. This study indicates that short channelized river sections do not disrupt continuity of fish populations although they provide worse habitat conditions for juveniles. It also illustrates the need to investigate various groups of biota while determining the response of river biocoenosis to environmental stressors.

Developing macroinvertebrate metrics to detect human pressure responses on large rivers in New Zealand

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[4] Massey University
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Eleven 6th-7th-order rivers throughout New Zealand were sampled across a land use intensity gradient, characterised by upstream native vegetation cover and predicted nitrogen concentration, to evaluate the utility of macroinvertebrate communities colonising wood, stony riffles, littoral habitats (<1 m deep) and deepwater benthic habitats (>1.5 m deep) as indicators of human pressure in large rivers. Non-metric multidimensional scaling analysis of macroinvertebrate percent abundance data revealed an influence of channel gradient reflected in the absence of riffle habitat and fine bed substrates. For moderate gradient rivers with riffles, invertebrate communities colonising wood, littoral areas or deepwater habitats provided better discrimination of human pressure than those colonising riffles. Analysis of replicate deepwater and littoral samples at the upper and lower ends of the land use stressor gradient sampled suggested that non-EPT compositional measures (i.e., based on other insects, Crustacea, Mollusca, Oligochaeta) may provide robust assessments of impact response independently of habitat type in these large rivers. Our results suggest that sampling of multiple habitats was required to accurately document the biodiversity of large river macroinvertebrate communities, and that metrics derived from groups more common in large rivers may provide a useful addition to other metrics for documenting large river health.

Genetic diversity as an indicator for monitoring aquatic ecosystem condition

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Legislative and policy instruments are often in place to ensure the management and protection of aquatic ecosystems. In most cases it has been challenging to monitor how well these outcomes are being achieved because; 1) multiple stressors influence populations whereas management tends to focus on specific stressors; and 2) because it is often not possible to monitor populations at the large spatial and temporal scales at which populations function and management actions are implemented. As a result, ecological risk assessments are used to predict population responses to particular threats but it has not been cost-effective or even possible in many cases to directly measure the health of the populations in question. We present an innovative molecular approach to monitoring population health that overcomes some of these issues.
A preliminary risk assessment process identified flow regime changes and barriers to dispersal as significant threats to the long term viability of some aquatic fauna. We assessed effective population size (Ne) as an index of population viability because it gives an indication of the risk to the population from inbreeding, disease or environmental change. Our results show that catchments subject to flow regime change exhibit significant reductions in both effective population sizes and connectivity for fish populations. This confirms the threat to population viability from water resource development and in so doing, validates our risk assessment process.

Benthic macroinvertebrate taxa as indicators of ecological status: results from Lithuanian rivers

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The composition of benthic macroinvertebrates depends upon environmental conditions. Therefore, macroinvertebrates are widely used in the assessment of river ecological status. A number of biotic indices have been suggested for quality assessment of European rivers, based on quantitative and qualitative indices of benthic macroinvertebrates. The study of 33 different Lithuanian rivers (67 study sites) was undertaken. Collected data were utilized to test the validity of conventional biotic indices for the assessment of river ecological status. Further, the sensitivity of different macroinvertebrate taxa, primarily of caddisflies which are among the most sensitive groups of animals in reaction to change of hydrochemical and morphological alteration of rivers, was investigated. Results of this analysis were used to refine biotic indices in order to improve the validity of estimates of river ecological status under environmental conditions of Lithuania.

Ecological feedback in rice paddy fields as wetlands in Japan

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The total area occupied by rice paddy fields in Japan is 25,920 km^2, which is approximately 32 times that occupied by natural lakes and wetlands in the country. The irrigation regimes employed in modern rice paddy fields are restricted to the period between spring to late summer or autumn. Most rice paddies and channels are dry during the non-irrigation season. The aim of this study was to clarify the ecological feedback mechanisms affecting fish populations in these seasonally variable managed wetlands. Numerous amphibian, insect and fish species inhabit these artificial wetlands during the irrigation season. These temporary wetlands have abundant food in the form of plankton and provide safety from large predatory fish species. The species composition of these systems varies depending on the extent to which the rice paddies are connected to rivers downstream. A large number of the fry that hatch in these paddies disperse downstream, irrespective of whether the rice paddies are inundated or dry during the non-irrigation season, whether there are barriers to fish migration, or whether there bodies of water between the paddies and the rivers further downstream. And these fry dispersed from paddies also serve as a constant food supply for piscivorous fish below the paddies. Rice paddies are thus very important recruitment sites for fish species that spend either a part or all of their life cycles in rivers.

Session 8: Restoration II

Identification of limiting factors and thresholds for macroinvertebrate assemblages in European rivers

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It has been widely stated that pressures acting at large spatial scales influence and even limit macroinvertebrate assemblages and might constrain the effects of local restoration measures. Limiting factors typically result in wedge-shaped scatterplots which are believed to be common in river datasets. It is considered common knowledge that river biota primarily depends on water quality and is strongly affected by urbanization in general. However, there are few empirical studies which actually identified limiting factors and derived thresholds using appropriate statistical methods for wedge-shaped relationships, especially with the biological metrics developed for the EU-WFD as response variables. Three datasets were screened for wedge-shape relationships, the limiting effect was described using quantile regression, and threshold values were derived applying two statistical approaches: The first using aggregated response variables (metrics), the second deriving a threshold based on the negative taxon-specific responses (TITAN). There was empirical evidence for the limiting effect of water pollution and catchment land use and an indication of a mitigating effect of morphological restoration measures. The thresholds were in good agreement with values reported in literature but differed markedly depending on the statistical method used. A possible reason is the different focuses on (i) sensitive taxa, and hence, species conservation, and (ii) biological metrics, which also include the positive response of tolerant taxa and hence, rather reflect ecosystem functioning.

Does habitat utilization represent habitat quality? What sturgeon telemetry tells us.

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A major prerequisite for remediation of fish populations is providing the essential habitats and mitigating the underlying threats that led to decline or extirpation of a population. Two separate species of sturgeon are native to the tributaries to the North Sea and the Baltic, *Acipenser sturio* and *Acipenser oxyrinchus* respectively. Both species are considered extinct or missing since the 1970s in Germany. A remediation programme was initiated in 1996 based on ex-situ development of broodstock and subsequent release of F1 fish. Releases were carried out from March to November in various distances from the river mouth. Individual fish were marked at an age of 1+ with radio or ultrasonic telemetry transmitters and actively tracked to monitor the performance of individual fish following stocking. Habitat utilization of the juvenile sturgeon in the rivers Oder and Elbe was determined by proxies of migration speed or residence time. Habitat use was strongly restricted to mid channel habitats, while even groyne fields were not used on a regular basis. Differences in mobility were associated to season and morphology. Despite the fact that most habitat features directly influence abundance of prey items, structures used to rest were mainly deep pools. Major habitat deficits are related to the rivers' improvement for navigation resulting in uniform bed morphology with low prey densities. Functional habitat is required to increase the carrying capacity of the rivers for early life stages.

First feedback from the French river restoration case studies: elements for improving the next project design

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In France, many river restoration projects have been implemented since the beginning of the 1990's. Currently, European Water Framework Directive (2000), with "good ecological status" target, promoted this restoration policy but also highlighted needs of monitoring to confirm the success of such policy. However there is no national feedback about restoration practices and the ecological responses. Our work aims to bridge this gap, focusing on some case studies (e.g. Rhone, Rhine, Ain, Vienne) from interviews data with French scientists and operators, and from different kind of documents related to the projects (scientific report, technical and financial documents, etc.). The main aim is to understand the whole framework of restoration projects in an integrated way, from pressure characterisation to effectiveness evaluation of restoration measures. We give special attention to evaluation procedures and methods: what are temporal and spatial monitoring conditions? What are metrics and indicators used? What are the results of the evaluation? What is the pertinence of these results? And what is the coherence of evaluation with all the other elements of project implementation (e.g. objectives, measures)? These different questions conduct implicitly to analyse passage from theory to practices and to highlight effective constraints and needs of decision-makers in order to support restoration actions.

Small streams and tributaries - their importance and restoration potential

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The network dynamics hypothesis describes tributary confluences as locations where local heterogeneity may be increased. Tributary junctions represent morphological and biological hotspots. First, we assess the importance of tributary junctions for morphological changes in the Sense River system (Switzerland). A hydro-morphological mapping was carried out at 148 junctions. For most junctions we did not observe any morphological consequences, although few confluence effects could be observed . Results and apparent contradictions with the network dynamics hypothesis are discussed. We compare other stream catchments where junctions were studied acting as biological hotspots. The importance of tributaries and junctions as hotspots and stepping stones will be discussed.Second, we evaluate the potential of small streams for successful restoration. We studied 10 small streams in Switzerland and Liechtenstein using 9 different abiotic and biotic indicators. About 3-10 years after restoration was completed, we compared the restored reach with a degraded reference reach (channelized section). For all studied streams an ecological success could be detected. Distinct changes were observed for fish species composition. The restored reaches had a higher fish species diversity than the channelized reference reaches. The role of small streams, tributaries and junctions will be highlighted for future restoration activities.

The return of Atlantic salmon and increased benthic diversity in urban rivers in Oslo, Norway, as a result of improvements in water quality

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There are several rivers and streams that rise in the forests surrounding the city of Oslo, Norway. Most of them run through industrial and urban areas before they reach the sea. They have a long history of poor water quality and during the 1970s and early 1980s water quality was still very poor in the middle and lower reaches of these rivers. This was reflected in the paucity of the benthos and the absence of fish. However, considerable efforts were made to limit industrial discharges, pollution episodes and urban runoff, resulting in a substantial improvement in water quality. This improvement in water quality was accompanied by major changes in the benthos and fish populations of the rivers, especially the river, Akerselva, that runs through the city centre. Here Atlantic salmon (*Salmo salar*) became extinct in the 1850's, and did not return until 1983. Atlantic salmon and sea trout (*Salmo trutta*) now spawn in the lower reaches and it now supports juvenile populations of these salmonids and is popular as a sports fishery. In line with the improvement in water quality benthic biodiversity has also increased. The long-term monitoring of the rivers in Oslo, based on benthos and fish, has not only documented these improvements, but has also enabled the authorities to trace the source of several pollution episodes that have led to fish kills. The present conditions in the rivers have been characterized using the EU Water Framework Directive.

Are fish assemblages establishing at restored stream reaches predictable from the assemblages in the vicinity?

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It is commonly assumed that the species pools in the surroundings of restored reaches are important for the outcome of river restoration projects; however, their impact has never been quantified. Using electric fishing data from 18 river restoration projects and their surroundings, we analyzed how species occurrence patterns in the surroundings affect the species assemblages that establish at restored river reaches. 98.3 % of the species that established at a restored site had their closest known population within a radius of 5 km around the restored site. The number of species establishing at the restored sites depended on the number of species in the close vicinity. Even though restorations shifted the fish assemblages marginally towards their natural reference state, the assemblages at the restored sites were still far from reference conditions, since also the species pools in the vicinity of the restored reaches were greatly impoverished. The assemblage structure of fishes in the 5 km species pool explained 45% of the deviance in a generalized linear model on the species establishment after a restoration. Species presence at unrestored conditions as well as the species occurrence rates and population densities in the species pool were the most important variables in the model. This study emphasizes that knowledge on the species pool can be used to estimate the prospect of planned river restoration projects to meet their goals.

Fish assemblage - local habitat relationship: the case of the lowland Wel River, Poland.

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The 110 km long Wel River along its course creates differentiated riverine habitats used by diverse local fish assemblages. Due to landscape geomorphology, this geographically lowland river, instead of expected typical longitudinal pattern, resembles a patchwork of lowland and submountain stretches. In the upper and middle course the river flows through 10 lakes. Lowland and between and in the vicinity of lakes river stretches, with rich macrophytes vegetation on the bottom, gather cyprinid fish assemblage, strongly dominated by roach *Rutilus rutilus* and perch *Perca fluviatilis*. River stretches of submountain character, with steeper slope, pebble or stony bottom and well aerated, cooled by forest shadow water, support brown trout *Salmo trutta* and reophilic cyprinids as spirlin *Alburnoides bipunctatus* and dace *Leuciscus leuciscus*. In the salmonid type tributaries, of length range from 3.7 to 22.5 km and homogenous environment, brown trout, brook lamprey *Lampetra planeri* and bullhead *Cottus gobio* but yet with ninespine stickleback *Pungitius pungitius* on the second place after brown trout, prevailed. Apart natural differentiation the river course has been divided by eight water power stations and weirs, and recreational fisheries and stocking influence fish communities.Fish species diversity and abundance relation with site environmental parameters were studied with nonmetric multidimensional scaling NMDS and canonical correspondence analysis CCA methods implemented in R software package vegan.

Session 9: Assessment II

Application of the concept of radiating effects in measures planning in the scope of the European Water Framework Directive (EU-WFD)

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The EU-WFD sets out a deadline for implementing programs of measures to meet the Directive's main objective (good ecological status). Due to high costs and other restrictions it is not possible to improve entire water bodies. Therefore the state of North Rhine-Westphalia claims the application of the concept of radiating effects for planning cost-effective programs of measures. The main objective of the herein presented study was to apply this concept in practice and to validate it through biological measurements. The concept states that natural or semi-natural sections of water bodies have positive impacts on neighbouring, hydromorphologically altered sections. Flora and fauna species migrate actively or passively from these radiation sources with stable biocenosis into the altered sections and thereby improve the overall ecological status of water bodies. Consequently, a catalogue of requirements for different functional units (radiation sources and radiation pathways), predefined by the State Authorities of North Rhine-Westphalia, was deployed for a river basin of 340 km² and a total length of water bodies of 150 km. The resulting sequences of radiation sources and pathways were validated at 25 sites by using invertebrate Multi-Habitat-Samplings. The results of the biological samplings are in general agreement with the assumptions of the concept of radiating effects. The outputs of the herein presented case-study are of great value to water managers facing similar problems.

Exploration of factors at catchment and floodplain scales targeted to modelling structure of river macroinvertebrate communities in the Morava River basin

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The study was focused on evaluation of ecological linkages among stream macroinvertebrate communities and environmental factors at scale of river network. Agriculture, channelization, urbanization and industrial pressures interact with natural conditions in the Morava River basin. Potential ecological effects of stressors were considered according to spatial extent defined by stream buffer zones and sub-catchments. Information on nutrient releases from point sources, CORINE land use and riparian vegetation pattern were supplemented by data on water chemistry recorded at sites where benthic fauna has been sampled. Macroinvertebrate response was expressed in community-based metrics. A stressor-specific indicators, general biotic indices and traits-based metrics were investigated in relation to pressure risk assessment. Application of the SPEAR index in relation to modelled pesticides risk provided insight into one aspect of complexity in agriculture-related pressures on fluvial ecosystems.

Assessing physical habitat in streams; do geomorphologists and invertebrates see eye to eye?

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This study tests how reach-scale differences in physical habitat influence macroinvertebrate community composition, using forty stream reaches in the Eastern Cairngorm mountains, Scotland. A process-based typology was used to select and characterise the study reaches. Surveys recorded physical habitat characteristics, and sampled for macroinvertebrates. Multivariate ordinations and Analysis of Similarity (ANOSIM) indicated there was no significant overall relationship between channel type and macroinvertebrate community based on PC1 axis scores. Examination of individual channel types, however, revealed a statistical difference between the invertebrate assemblages of bedrock and step-pool sites. Similar ANOSIM results were obtained using PC2 scores, but when channel types were analysed separately, a difference was found between bedrock and wandering-bed reaches and between bedrock and actively meandering reaches. Indicator Species Analysis revealed six macroinvertebrate families that differed significantly among the channel types in relative abundance. Haliplidae were most characteristic of bedrock reaches, Taeniopterygidae, Chironomidae, Leptophlebiidae and Perlodidae were associated most strongly with step-pool reaches, while Limoniidae were most typical of wandering channels. The study shows that within-catchment differences in reach-scale physical habitat across channel types generally do not exert a significant influence on family-level macroinvertebrate composition.

Assessment of floodplain biodiversity for large rivers – case study Germany

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Floodplains are among the most valuable, but also most endangered ecosystems in Europe. They are hotspots of biodiversity and central elements of an ecological network. There is almost no other ecosystem type that offers such a remarkable variety of goods and services to humans like rivers and their floodplains. Floodplains can provide these ecosystem services only, if their ecological integrity is sustained. However, the ambitious objective of the European governments to stop biodiversity loss until 2010 most probably was not achieved for freshwater ecosystems and floodplains. Based on a first nationwide consistent and updatable inventory of the loss and status of German floodplains funded by German Federal Agency for Nature Conservation (BfN), which provided an overview of former and active floodplains in Germany (BMU & BfN 2009, Brunotte et al. 2009), we have developed methods to quantify and to assess floodplain functions and services for large rivers. This talk will focus on methods and results for a floodplain biodiversity index on a national scale derived from available spatial information on land uses, habitats and conservation status which are serving as surrogates for floodplain biodiversity.

European freshwater biodiversity: patterns, drivers and conservation priorities at the catchment scale

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Understanding historic and contemporary patterns of freshwater biodiversity is an important pre-requisite to identify priority areas for developing efficient conservation and restoration management strategies. We quantified the historic and present distribution of the freshwater fish fauna for 251 European primary river catchments (covering 90% of the continent). A total of 585 fish species have been identified so far, 38% of these are listed as threatened. 8% of the catchments have a share of more than 40% of nonnative species. Over time, species numbers of European river catchments increased on average by 5 species (= net gain) and their species composition has become more similar (3.46%). This homogenization results from the combined effects of the loss of primarily long-distance migrating species and the introduction of cosmopolitan species. Catchments in the Mediterranean that contain a disproportionately high number of threatened as well as nonnative fish species face highest levels of homogenization. Besides freshwater fish, we quantified current species distribution of amphibia, odonata, crayfish, water birds and molluscs for all 251 catchments and ranked natural as well as anthropogenic drivers that act on their distribution patterns. Further, we tested for congruence of drivers among the faunal groups. Our results provide a comprehensive overview of the European freshwater biodiversity and its main drivers/ stressors and allow for geographically explicit priority setting.

FORECASTER: facilitating knowledge exchange on hydromorphological and ecological effects of river restoration

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Within Europe, an overview of river restoration experiences is presently lacking and urgently needed to support EU member states to improve the ecological status of rivers. For most restoration measures there is insufficient knowledge on their effectiveness or a poor accessibility to existing experience and knowledge, in particular for the hydromorphological modifications of rivers and floodplains. In 2008 European countries participating in the IWRM-NET (www.iwrm-net.org) took the initiative to finance an international project addressing the knowledge needed to relate the hydromorphological condition to the ecological state of rivers. FORECASTER (http://forecaster.deltares.nl) aimed at improving the link between science and practice on river restoration through consultation of experts and end-users, and the development of a multilevel and operational webtool comprising a database of restoration case studies. The tool applies Google maps for easy access to the case studies and WIKI pages for collaborative development of the information in the system. It contains filters to facilitate access to the information, live-links between case studies, pressures, measures, biological and hydromorphological quality elements, and links to in-depth background information. At present the webtool contains information on over 100 sorted case studies originating from several European countries, and it has been embraced by the European Centre for River Restoration (www.ecrr.org) that will further develop it within the Life+ project RESTORE.

Session 10: Biodiversity III

BioFresh: Integrating Freshwater Biodiversity Data

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Scientists and water managers have collected a vast amount of data on freshwater organisms, but these data are often not publically available. One of the aims of the BioFresh (EU-funded FP7) project is to set up an on-line data portal designed to integrate and provide open and free access to freshwater biodiversity data from all possible sources. This information portal, available at http://data.freshwaterbiodiversity.eu/ is constructed as a data discovery tool, and allows scientists and managers to complement, integrate, and analyze distribution data to elucidate patterns in freshwater biodiversity. The georeferenced data will enable revealing the status and trends of freshwater biodiversity, and the services that it provides. The portal further envisages providing access to tools to visualize the response of freshwater biodiversity to environmental variation including climatic and socioeconomic pressures. This approach will not only shed new light on how freshwater biodiversity responds to global, European, and local environmental change and its drivers, but will also help to better manage the services provided by aquatic ecosystems by incorporating biodiversity science into effective conservation strategy, environmental agreements or related policy instruments. The data that were integrated during the first year of the project, already allow us to shed some light on the biodiversity patterns and data gaps that emerge and to demonstrate the potential of this integration approach.

Phytoperiphyton community structure and distribution in rivers flowing into White Sea

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The structural organisation of phytoperiphyton in 46 rivers of White Sea cost is described relying on the results of multiannual surveys. The taxonomic diversity of phytoperiphyton in the rivers studied, like that of any natural phytochoria, is due to the zonal position and history of the region, as well the landscape characteristics responsible for the morphometry of waterbodies. Most of the dominating algal species identified are typical of cold, oligotrophic waterbodies of Northern Europe.
The biomass of the attached communities is strongly dominated by green algae. Their distribution in the watershed was patchy, with a total cover varying from less than 1 to 60% of the streambed. The most common was Zygnema, occurring in about 50% of the localities surveyed.
The spatial distribution of the periphyton largely agrees with the concept of the river continuum. But there was a range in stream size, current velocity, shading, conductance and watercolour. This range in variables presumably has resulted in a diverse algaeflora of attached communities. Isolation is increased by the alternation of riffles and pools and is responsible for the pulse-like pattern of the changes observed in the taxonomic composition of the periphyton.

Relationship between blackflies (Diptera: Simuliidae) and some hydrochemical and hydrophysical parameters in the Nemunas River and its major tributaries

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Blackflies have a life cycle with an aquatic larval stage which can occur in enormous numbers in running water. Blackfly larvae are filter feeders, they are known as indicator of physical and chemical changes in water bodies. Investigations were carried out in 2001 – 2005 in the Nemunas river (the largest river in Lithuania) and in its four major tributaries (9 study sites). Material was collected from April till October, once per month. The species composition and the density of each species were determined. Hydrochemical (pH, amount of oxygen dissolved in the water, BOD_7, amount of nitrates and phosphates) and hydrophysical (current velocity, discharge, water temperature) parameters of investigated segments of rivers were provided by the Environmental Protection Agency and were used for a multivariate analysis. 18 species of blackflies were revealed. The study showed that species composition and density of each species of blackfly are related with particular hydrochemical and hydrophysical parameters of the investigated river segment. These relationships will be discussed in the presentation.

Large-scale longitudinal survey on the zooplankton of a large lowland river (Po River, Italy) by means of a Lagrangian sampling approach

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The ecology of zooplankton in large rivers has received growing attention in the last decades, and field surveys in rivers around the world contributed to expand knowledge on the mechanisms involved in regulating their abundance, diversity and spatio-temporal patterns. Most of these studies rely on a traditional sampling design, involving collection of samples at one or more stations at fixed time intervals, without accounting for water travel time from one station to the next. Nevertheless, in order to investigate changes in water quality and biotic communities during downstream transport, a Lagrangian sampling strategy is more appropriate, even though relatively few works applied this method to the study of river plankton. We present the results of a Lagrangian survey carried out for the first time in the Po River, the main river in Italy, during spring conditions. While previous studies in this river were confined to a single station or a very limited segment, we selected 12 stations along a 350-km stretch of its lowland section. Sampling of water and zooplankton was supported by an operational system collecting real time hydrometeorological data and forecasted meteorological conditions from a non-hydrostatic model, applying a hydrological and hydrodynamic chain and providing forecasting scenarios, including water travel time. Influence of the four major tributaries on community abundance and diversity, a formerly unexplored issue in this river, was also assessed.

Species richness and habitat specialization of Chironomidae (Diptera) in the Tagliamento River, Italy using a DNA-based biodiversity assessment

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The Tagliamento River in northeastern Italy retains the natural hydrologic and geomorphic dynamics of many Alpine rivers prior to human alteration. As such it provides a model for examining how biodiversity and environmental heterogeneity are related, and for guiding restoration efforts. The Chironomidae (Diptera) are thought to be the most structurally and functionally diverse community of aquatic insects in these rivers, but are usually neglected in ecological research because of the expertise and time required to identify species. Here we circumvent this using recently developed DNA sequence-based techniques that employ coalescent-based models to identify species groups. We use this approach to quantify species richness and micro- and macro-habitat specificity in order to examine the role of habitat heterogeneity in sustaining high species diversity of natural floodplains. To date, our results suggest a very high diversity of Chironomidae and a higher than expected degree of micro-habitat specialization.

Session 11: Patterns & Processes

Human-Mediated Changes in Hydrology Lead to Shifts in Riverine Trophic Structure

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It is abundantly clear that hydrological processes are the critical driver of the ecological character of riverine ecosystems. Unfortunately, it is also because of these hydrological processes that rivers are modified for flood control, hydroelectric production, navigation, and irrigation. The question then becomes "to what extent do changes in the hydrological condition alter river ecosystem function" and "what changes in hydrological character lead to shifts in trophic structure". We used museum specimens of fish to develop a timeline (60+ yr) of trophic metrics based carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios for several rivers in the Mississippi Basin USA. Trophic metrics were compared to a series of hydrological indices, calculated from historical discharge data, to determine the degree to which hydrological character has changed relative to a pre-regulation reference and what aspect of hydrological change most profoundly influenced trophic structure. The overall hydrological index suggested degradation of the hydrological character of all rivers examined. Seasonal amplitude, the range between maximum and minimum discharge, was the most severely degraded hydrological attribute for all rivers. An example of a link between hydrological and trophic changes was shifts in $\delta^{13}C$ of fish, indicating a change in basal resources supporting higher trophic levels. Further evidence of the effect of hydrological change and trophic structure will be presented.

Real-time ecosystem ecology

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Having worked for more than a decade along one of the most dynamic rivers globally, the Tagliamento River in NE Italy, I have had the opportunity to witness ecosystem processes „in action“. This has happened mostly by chance, having been at the place as these processes occurred. Some of these events have been eye-opening; such as the rapid expansion and contraction dynamics or the mass dispersal of terrestrial organisms during individual flood events. It is well known that short-term events may be critical for the maintenance of populations or for the total annual fluxes of material in catchments. Therefore, it is evident that synoptic studies or regular monitoring are insufficient in explaining some of fundamental patterns and processes along river corridors. For example, it would be a critical step forward if we could study the behavior of organisms during single flood events – and to link the organism´s behavior to the concurrent hydrogeomorphic processes. In this presentation, I will discuss the opportunities and limits in studying ecology and ecosystem processes in real time. Furthermore, there is a need, and an opportunity, to increase the capacity to carry out ecological studies immediately following major natural and human-induced disturbances.

Floodplain inundation character: the importance of spatial scale

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Floodplain ecosystems are heterogeneous environments shaped by processes operating over multiple temporal and spatial scales. Variations in the spatial pattern of wetting and drying overtime, influences the productivity and biodiversity of these complex ecosystems. Understanding the inundation character of floodplain landscapes and its influence on ecosystem structure and function is an important tool for managing these ecosystems. This study investigates the spatial organisation of inundated landscapes caused by two natural floodings and an environmental water (EW) event in the Yanga floodplain in SE Australia. A series of 21 Landsat TM images were used to determine the inundated wet mosaics created by flooding in 1990, 1991 and EW delivered to the floodplain in 2005. The spatial character of the wet mosaic was investigated at a range of scales using a series of metrics describing the size, shape and spatial arrangement of wet patches within each inundated landscape. A simple anti-clock wise hysteresis relationship was observed between number of wet patches and total inundated floodplain area at landscape scale. Similar pattern were noted for the wet mosaics within flood dependent vegetation communities for the 1990 flood compared to more complex pattern for the 1991 flood and 2005 EW events. The change in the spatial organisation of the wet mosaic overtime and its importance to floodplain ecosystem processes are discussed.

Fundamental concepts for river management futures

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The world's rivers are increasingly under pressure. There is a general recognition of the degraded state of rivers, which has led to river management strategies that aim to conserve the environmental amenity of rivers while maintaining the services that rivers provide to society. But what are the guiding principles to consider in managing rivers? How can river managers frame their policies and practices in a way that captures the key drivers of river environments? We suggest that there are several guiding principles that can be incorporated into river management policy and practice to improve conservation and use outcomes. These principles include: 1) river environments are heterogeneous in space and variable through time; 2) river environments operate at multiple spatial and temporal scales; 3) river environments are inter-disciplinary systems driven by aspects of hydrology, geomorphology, ecology, economy and society; 4) societal values drive decision making about the desired future state of rivers; 5) knowledge of river environments is incomplete, so river management should be adaptive; 6) river environments provide valuable ecosystem goods and services to society; 7) models, maps and monitoring are tools to answer questions about managing river environments; and 8) the social and ecological resilience of river environments should be maintained by river management. Each principle has a well-established theoretical and/or empirical basis. The principles also interlink to respond to calls for a holistic, systems approach to river management policy and practice.

Identifying Globally "Great" Rivers for Integrated River Basin Management

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The mission of The Nature Conservancy's Great Rivers Partnership is to bring together diverse partners and sound science to expand options for achieving sustainable management and development of the world's great river basins. The world's major rivers are distinguished by their sheer size and societal importance, but what constitutes a "great" river has no universal definition. Great rivers are also working rivers, vital to a region's cultural heritage and economic prosperity. Society's long reliance on great rivers has made them one of the most globally imperiled ecosystems. Quantitative criteria defining globally great rivers have been elusive. We used four physical properties to distinguish the largest of large rivers which rank highest in: basin size, channel length, water discharge, and sediment transport. No single physical property is sufficient to classify all great rivers; major rivers in arid regions may have a very large watershed, but low annual discharge (e.g., Colorado). Also, some major rivers with large drainage areas have relatively low sediment transport (e.g., Congo). Great rivers were identified using published geo-physical data to rank the world's 50 largest rivers for each property. A list of rivers that met one or more of these criteria was derived. We also compiled and report available geographic, socio-political, land-use, and relevant ecological statistics for rivers that met geo-physical criteria for being defined as great rivers.

Longitudinal Connectivity of Stream Networks at a Catchment Scale - Ecological Implications and Quantification of Anthropogenic Alterations

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Longitudinal connectivity within a stream network is important to biological communities, most noticeably to migratory fish. The landscape of many stream networks has been extensively modified with the construction of artificial barriers, such as road crossings, weirs, dams and floodgates. This has altered the natural connectivity of stream networks, with the various barriers inducing different degrees of fragmentation. With the use of GIS tools, a desktop approach is presented that will improve our understanding of the state of ecological connectivity within stream networks at a catchment scale. It provides an objective management tool for informed decision-making for the restoration of stream network connectivity. Artificial modifications to longitudinal network connectivity are made evident by the quantification of both natural and artificial states of connectivity, in terms of stream lengths and the classification of various River Types within a stream network with the use of various geomorphological parameters. Ecological values of each river type are assessed with the use of fish distribution data, and ranked according to preference. The applicability of the approach taken is demonstrated in the Hunter River Basin, New South Wales, Australia.

Biocoenotic zonation of fish assemblages in European rivers in regard to climate change impacts

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In the EU-Project Biofresh (http://www.freshwaterbiodiversity.eu/), biodiversity of freshwater ecosystems is a key component. As part of Biofresh, this study comprises two main issues: (1) description of a fish assemblage typology for unimpacted fish sampling sites and (2) analyses of climate change impacts on the elaborated typology. The fish fauna is characterised by a predictable sequence of distinct communities along the longitudinal gradient of the river course. A spatially based, river type-specific approach was used, to derive a distinct zonation of the fish fauna for existing sampling data (>700 sites in 14 countries) representing 50 common fish species in European rivers. Out of these fish zonation units, ranges of environmental variables were found. Related to climate change aspects, we used future projections of air temperature and bioclimatological variables as surrogates of changes in water temperature and hydrology, and analysed their impact on fish biocoenosis in different periods of the 21st century. Coenotic changes will be indicated by altered fish communities as range shifts will likely occur on species level, not at community level. Changing air temperature and precipitation were contrasted against the fish typology and the defined ranges of environmental variables. Hence, we observed changes of the future distribution of fish communities. Along the longitudinal gradient, reactions of fish to climatic induced habitat changes show diverse patterns.

Session 12: Connectivity

Environmental flows proposal to rehabilitate the physical habitat in a Lerma's river segment, located in Central Mexico

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This paper presents a proposal for environmental or ecological flow regime that contributes to the habitat rehabilitation in a section of the Lerma's River, located between La Piedad de Cabadas, Michoacán, and Santa Ana Pacueco, Guanajuato, Mexico. The Lerma river basin is located at the Central-West zone in the Mexican United States and represents the 3% (i.e. 53 591 km^2) from the national territory area. The Lerma river borns at Almoloya lagoon, from the West of Mexico City, and discharge at Chapala lake (The biggest lake in the country), after flowing in five states from the Mexican Republic, and its 708km legth. On this Republic zone approximately the 15% of the national population is settled down (i.e. approximately 15 million inhabitants), and one of the highest in importance as for industrial and agriculture production, it is deficient on water resources availability and, at the study section location, the superficial water available is used as agriculture irrigation. The segment of study forms a meander, it has a length of 12 000 meters, an average width of 50 meters and remains practically isolated the most part of the year, from the dynamic of the Lerma river, even having flows near the cero. Obtaining an environmental flow regime is based on the physical fluvial habitat simulation, which was done using topographical and habitat information from the river study section, a bi-dimensional model of the fluvial hydrodynamic and habitat suitability curves from the *Ictalurus punctatus* species.

Disconnectivity along the Adige River

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The Adige River is the second longest Italian river, with a total length of 410 km from the source in South Tyrol (1550 m a.s.l.) to the estuary in the Adriatic Sea. The main stem of the river is physically interrupted by impoundments in 7 reaches to abstract water mainly for hydropower production. As a consequence, downstream of these barriers the flow and thermal regimes are modified and the hydrological connectivity on the longitudinal dimension is interrupted. We analyzed such changes with particular attention to the reduction in variability of discharge and in the seasonality and predictability of the overall pattern timing of the thermal and flow regime, and to the resulting alteration of the temporal connectivity. Result once more suggest that compensation and restoration measures for hydropower production impacts are site specific but should be planned at the water basin level, with a multidisciplinary approach. Examples of such measures are provided and discussed.

Effects of hydrologic connection with the river physicochemical properties and phytoplankton dynamics of backwaters in the lower Mississippi River floodplain

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Flooding of the Lower Mississippi River (LMR) is constrained by an extensive levee system, but within the levees are numerous secondary channels and backwater lakes. With seasonal variation in river depth, there is a predictable temporal pattern in the degree of hydrologic connection between the main channel and these backwater sites. We examined the relationship of hydrologic connection between the LMR main channel and backwaters for temporal patterns in physicochemical properties and phytoplankton population dynamics. Between Nov 2007 and Sept 2009, samples were collected from the LMR channel and three backwater sites that vary in degree, timing, and duration of connection to the channel. With strong connection in spring, the backwaters experienced elevated turbidity and nutrient (N and P) concentrations, and low chlorophyll. With decreased connection in summer, there was a reduction in water velocity in backwaters, resulting in a decline in suspended sediments, photic zone deepening, an increase in chlorophyll by more than an order of magnitude on average, high dissolved oxygen, and a decrease in nutrient concentrations to near zero. This pattern of seasonal changes was similar in all sites with the timing and duration related to hydrologic connection strength. As seasonally dynamic hot spots of primary production, these backwater sites warrant detailed study of their roles in foodweb interactions, energy fluxes, and biogeochemical processes in the LMR floodplain.

Resilience of the ecology of a semi-arid floodplain in the face of hyper-drought

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Changes to river flow through regulation coupled with climatic drought (hyperdrought) have led to a substantial decrease in flood frequency on many floodplains worldwide. In this presentation we report on the results of a large (25 collaborators) multi-disciplinary project that sought to determine whether or not extended periods without floods would produce irreversible changes to the ecological character of a semi-arid flood-plain in south-eastern Australia; parts of which had not been flooded for up to 10 years. Using a space-for-time approach we examined the effects of extended periods without flooding on tree health, tree genetic make-up, soil micro- and meio- flora and fauna community structure and soil biogeochemical processes. We show that the floodplain ecosystem is highly resilient in the face of long inter-flood periods and explore some of the factors that impart resilience. For example, bioavailable soil carbon is an important resource in fuelling soil biogeochemical processes. We show that much of the bioavailable carbon in the floodplain soil is derived from aquatic macrophyte growth during flooding. Bioavailable carbon reserves decline during the inter-flood period, with little increase as a result of rain induced macrophyte growth. The presence of a drought-tolerant aquatic macrophyte seed bank confers resilience to the ecosystem's potential for soil organic carbon formation even over extended periods without flooding.

Hydrological disconnectivity: a comparison of natural, constant and hydropeaking regimes

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In Alpine streams the alterations of flow regimes are due to an excess (hydropeaking) or lack (Minimum Vital Flow) of variations, with different impacts on diversity and abundance of zoobenthos. We assessed the effects of the alterations of the hydrological regime on zoobenthic communities in a pristine Alpine steam (natural flow), in a set of artificial flumes directly fed by the same stream (constant flow) and in an hydropower-impacted reach of the same stream, 200 meters downstream of the flumes. The flumes had been naturally colonized and were kept at constant discharge, simulating the Minimum Vital Flow. At each station in the streams and in each flume we set replicates of Hester-Dandy artificial substrates, and from February 2010 we started collecting macroinvertebrates every two weeks from one substrates for each replicate/flume. In addition, one quantitative benthic sample per station or flume was collected with a Hess bottom sampler. Sampling ended in August, due to damage caused by an exceptional flood. Community composition differed among the three hydrological regimes: the hydropeaking impacted community was less abundant and less diverse. The community with constant regime reached high abundance from March, possibly due to organic matter accumulated by the lack of floods, with more detritivore and generalist taxa. The station with natural regime showed a stronger seasonality, and more specialized taxa than the previous two.

A method to analyse characteristics of rapid fluctuations of flow and stage in rivers in consequence of hydropeaking

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Power production by hydro-electric facilities according to rapidly varying demand on the electricity market (hydropeaking) may lead to unnatural fluctuations in flow and stage in rivers downstream of power plant outlets. We developed a method for automated analysis of time series in order to quantify these rapid fluctuations with the purpose of assessing impacts on the river ecosystem. Parameters of three categories were chosen: 1. Maximum and minimum of an increase/decrease, flow ratio (magnitude) 2. Average and maximal rate of increase/decrease, point of time, duration (scale of time) 3. Count of increase/decrease (frequency). The data processing comprises data reading, correction and preparation of the time series (outliers/error elimination, time shift and leap year, interpolation, smoothing), parameter calculation, statistical description and graphic illustration. The rapid fluctuations are identified by establishing river and data specific thresholds for the rate of change in flow and stage. Increases and decreases are analysed separately because they are related to different impacts. For instance, rapid decreases can cause stranding of juvenile fish, while rapid increases may lead to catastrophic drift of invertebrates. Descriptive statistics, yearly box plots, histograms, cumulative distribution functions and time series plots allow detecting trends over time and seasonal analysis considering biologically significant periods of the year (e.g. fish spawning or swim-up time).

Resilience of tropical floodplain waterholes and the importance of connectivity.

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Permanent and semi-permanent floodplain waterholes are scattered across vast areas of the wet-dry tropics of northern Australia. These wetlands across the floodplain provide dry season refugia for plants and animals, are a hotspot of productivity and form a critical part of the subsistence economy in remote Aboriginal communities. However this resource is under threat from the combined effects of invasive animals, weeds, and climate change. This study focuses on waterholes that persist throughout the dry season and as such are likely to have vastly different physicochemical features and level of resistance to disturbance from feral animals. At these waterholes there is a seasonal cycle of change in water quality through the dry season as quality deteriorates as conditions become increasingly drier. This is exacerbated by increasing cattle usage of waterholes through the dry season which increases turbidity and nutrient loads. Aquatic macrophyte biomass is at its highest in early-dry season but is dramatically reduced as plants are flushed out with the first wet season flows. However plants quickly re-establishes during the wet season. Greater depth provides waterholes with some resilience to the effects of cattle disturbance, as does the seasonal flushing of the waterholes with wet season rains. Therefore, continued connectivity with the river and its floodplain is vital for the persistence of these waterholes as is the maintenance of their crucial role in the river floodplain ecosystem.

Session 13: Biotic Links

Sampling benthic macroinvertebrates in low-gradient streams: does method make a difference?

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Abstract: The Wadeable Streams Assessment (WSA) was the first survey of stream biological condition throughout the United States. Between 2000 and 2004, EPA, states, and tribes collected chemical, physical, and biological data at 1,392 wadeable, perennial stream locations throughout the U.S. using the same standardized methods. The purpose of this nationwide sampling effort was to determine the biological condition of these waters and the primary stressors affecting their quality. The WSA used benthic macroinvertebrates to determine the biological condition of streams. However, in the study's 2006 report, it was recommended that future surveys evaluate the use of different, yet comparable, methods for different stream types (e.g., low-gradient vs. high-gradient) to support a more accurate assessment of condition. Accordingly, in preparation for the 2008–2009 National Rivers and Streams Assessment (NRSA), an expert panel was convened and developed a novel low-gradient sampling method to include as a research element of the survey. This experimental sampling protocol was piloted at all NRSA wadeable sites categorized as "low-gradient" in a side-by-side test with the method used in the WSA. Preliminary analysis results are presented.

Flow drives nutrient and plankton dynamics in a large temperate river system (Waikato River, New Zealand)

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Large river-floodplain systems are characterized by seasonal flow variability. High flows provide connection between the main channel, riverine lakes and wetlands as well as inundation of floodplain areas. We investigated the effect of flow regime on nutrient concentrations, phyto- and zoo-plankton abundance in the Waikato River system. We found that during high flows the concentrations of both particulate and dissolved inorganic species of phosphorus and nitrogen increased in stream tributaries due to sediment resuspension and runoff from catchments, while in tributaries originating from lakes inorganic nutrient concentrations remained low and phytoplankton densities were high. Nutrient concentrations in inundated floodplains decreased rapidly after the flood peak due to sedimentation and increased production of phytoplankton. Flooded habitats were dominated by large-bodied zooplankton. In some areas, however, there was hypoxia and indications of nutrient transformations from sediment anoxic processes. During low flows suspended sediment levels in tributaries and the main channel decreased markedly, phytoplankton abundance increased in all tributaries, especially the ones originating from lakes and wetlands, whereas rotifers were the dominant zooplankton group. Our study demonstrates strong coupling between flow regime and river nutrient and plankton dynamics, and highlights the importance of quantifying interactions between these factors for managing river water quality.

Effects of hydrological connectivity change on a dryland river: the recent ecological history of floodplain lakes (billabongs), Macintyre River, Australia

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Australia's river ecosystems have undergone dramatic changes since European occupation. Water resource development is one of the main contributors to impacts on riverine ecosystems by reducing flood frequency and hydrological connectivity of aquatic habitats, such as billabongs, on the floodplain. This study investigates the recent environmental history of billabongs on the Macintyre River, focusing on the effects of recent hydrological change, through examination of stratigraphic changes in pollen, diatoms, sediment texture and geochemistry in the sediments of four billabongs of varying flood frequency, hydrological connectivity and depth. Radiocarbon dating along with the stratigraphy of exotic pollen types indicates that the records range in length from 210 to 660 years and hence incorporate significant pre-European phases. Pollen records suggest a regional decline in *Casuarina* and increases in *Eucalyptus* associated with European settlement, but few other consistent or substantial changes in vegetation communities over time. Sediment geochemistry varied between frequently connected and less frequently connected billabongs, but there was no apparent influence from European settlement. In contrast, diatom assemblages varied substantially both spatially and temporally. This variation in response did not correlate with hydrological connectivity, suggesting that there is another critical factor influencing diatom assemblages and hence the structure of billabong ecosystems.

Modeling Large River Fish Population Responses to Global Climate Change: Missouri River Sturgeon Example

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To understand effects of climate change on fish populations of riverine ecosystems, climate predicted by course-resolution Global Climate Models must be downscaled to Regional Climate Models to watersheds to river hydrology to population response. Changes in discharge, channel morphology, water quality, and biota have been implicated as causative agents in the dramatic decline in Missouri River sturgeon. Recovery of the Missouri River ecosystem will require understanding the potential impact that climate change may have on sustainable fish populations as a result of changes in river dynamics. To accomplish this, river temperature and velocity distributions will be used within a sturgeon bioenergetics model. An additional challenge is quantifying sources of uncertainty given the highly nonlinear nature of interactions between climate variables and community level processes. We will present our modeling approach for understanding and accomodating uncertainty by applying multi-scale climate models and hierarchical Bayesian modeling frameworks to Missouri River sturgeon population dynamics and by linking models for system components together by formal rules of probability. The goal is to evaluate potential distributional changes in an ecological system, given distributional changes implied by a series of linked climate and system models under various emissions/use scenarios. This understanding will aid evaluation of management options for coping with global change.

Geographical distribution of flow regime and its relationship to fish species richness in major rivers in Japan

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In rivers, flow regime can be a selective force for species adapted to local habitats, which is recognized as an environmental filter of a regional species pool. The present study described the geographical distribution of flow regime in major rivers in Japan and the statistical relationships of flow regime to species richness of fish in lowland reaches. First, the flow regime of 57 major rivers from 1998 to 2002 was characterized by 21 flow regime indices describing its magnitude, frequency, duration, timing, and predictability. The relationship between flow regime indices and fish species richness was then investigated by multivariate analyses separately for major fish groups. Regional comparison of flow regime detected relatively high discharge and stability in rivers in northern Japan and low discharge and high variability in southern Japan, reflecting the latitudinal shift of catchment size and regional climate. Multivariate analyses found that high variability and low predictability of flow, in addition to latitude and water temperature, are significant factors for species richness of Gobiidae and diadoromous migratory fish. It implied their adaptation of such groups to harsh conditions in the south. Overall, the present study indicates that not only latitude and water temperature but also flow regime is a key to understanding the geographical distribution of freshwater fish species in Japan.

Session 14: Hydraulic Links I

Constraints of ecological restoration in a regulated river: small versus large scale actions

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During the second half of 20th century the River Lima (NW Portugal), was submitted to a large dam construction and to channel incision caused by gravel extraction, despite the entire main river valley being a Nature 2000 reserve. As a consequence the river channel has undergone continuous morphological modification, especially along downstream sections. The sediment deficit and the lowering of the river bed have caused a shift in the deposition of gravel and sand bars and an intense change in channel geometry, resulting in dramatic collapse of the riverbanks in the estuarine area. We show some integrative techniques that attempt to decrease fluvial erosion and improve physical heterogeneity. We show the limitations of these remedial, low scale actions (based on soil engineering complemented with groyne construction) and the need for such actions to be complemented by a more global strategy, which will be more effective in the self-restoration processes. This requires the determination of possible sediment sources and the remobilization of sediment deposits from specific areas in order to divert flow away from the more unstable banks.

Testing accuracy of a 1D hydraulic model for the simulation of potential stranding areas at the river scale

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Frequent changes in discharge downstream power plant in rivers can have large impacts on the aquatic environment. Research on environmental impacts of hydropower production has traditionally focused on long-term effects, but frequent hydropeaking impacts have only been studied in a limited number of cases. A well-documented impact of these sudden changes in discharge is the stranding of fish. However, a great degree of uncertainty in quantifying actual numbers still remains. Forseth *et al* 2009 used a 1D hydraulic model to estimate dewatered area and dewatering speed after a turbine shutdown event. Hydraulic data was then combined with draw down speed limits and observed fish densities to estimate the number of stranded fish. The method concluded on a highly dependence on precise simulations of the draw down zone. We aimed at improving stranded fish estimates by improving stranding areas calculation. Works were carried out in Lundesokna, a 10km river experiencing periods with rapid flow changes downstream the lower powerplant. We compared the detail needed in a 1D hydraulic model to simulate draw down areas with a 3D. The number of cross sections in three potential stranding areas was increased until they could replicate the accuracy of the detailed 3D method. Using this knowledge, planning of measurement campaigns and model setup for large scale stranding studies can be improved, and the extrapolation of measurements can be done with a larger degree of certainty.

No age-effects on the functional redundancy of riparian ground beetles after an extreme flood event

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Functional redundancy (FR) is based on the observation that some species perform similar roles in ecosystems and may be substitutable with little impact on ecosystem processes. There is, however, contrasting perception, as in most cases low FR was observed and almost nothing is known about the role of FR after severe disturbances. Here we analyze FR of ground beetles after an extreme flood and discuss if FR can enhance resilience. We sampled ground beetles directly after an extreme flood from 2002 until 2005 at the Elbe River in Germany. We measured FR as the difference between the total species number and the average number of species that increased functional diversity. We used mixed effects models to test whether highly redundant communities are more resilient than non-redundant communities. FR was mainly governed by season and hydrology, but not by time after the flood. We found that increasing FR caused decreasing resilience. Results suggest that long-term conditions rather than stochastic events drive the necessity of species of being redundant. We assume that FR is linked with the amount of resources provided, because FR was quasi non-existent when prey density was low. The results further imply that the existence of certain strategies, rather than trait diversity, is important for co-occurring species in frequently disturbed habitats. Although this finding supports recent trait filtering theories, it depends strongly on the definition of resilience.

Effects of two subsequent peak floods on vegetation pattern and channel morphology in a by-passed section of a braided gravel bed river

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The upper Isar (Germany) is one of the few remaining braided gravel bed rivers in the Alps. Discharge is reduced by diversion at the Krün weir since 1924. During major floods the weir is opened at peak flow to flush gravel downstream. With the reduction of discharge significant changes in vegetation pattern took place, characterized by a loss of pioneer communities. The establishment of a residual flow in 1990 did not solve this problem but supported the succession of willow thickets even more. After a long period without major floods, two hundred-year floods occurred in 1999 and 2005. We studied the effects on vegetation pattern and channel morphology in comparison to historic floods by time series of aerial photographs and historic maps (1858-2006), and cross-profiles (1965-2005). The 1999 flood changed vegetation only on 20% of the floodplain area, and the 2005 flood only on 12%. Both floods could not reduce the willow thickets significantly. The combination of vegetation maps with cross profiles demonstrates that there was no incision of channels since 1965, but an aggradation of fine sediments on the gravel bars which accelerated succession. Until now, minimum flow, flash floods and gravel extraction at the weir were discussed as the most relevant factors to improve ecosystem processes. Our results show that an additional focus on fine sediments is necessary to protect the endangered pioneer communities.

Pilot application of certification methodology for hydropower plants in Italy and Slovenia

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Approaches to evaluating hydrological changes below dams and to setting environmental flows along regulated rivers need to address the scale and dimensions of natural inter-annual variations. By reference to rivers across South West UK, this paper uses both regime classification and the indicators of hydrological alteration approach to demonstrate degrees of natural flow variability over different timescales and the spatial conformity of these variations, including decadal trends. The information of flow variability is then used to address implications for salmonid populations and to assess implications for flow regulation.

Session 15: Hydraulic Links II

Patterns of Flow Variability: considerations for river regulation

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Approaches to evaluating hydrological changes below dams and to setting environmental flows along regulated rivers need to address the scale and dimensions of natural inter-annual variations. By reference to rivers across South West UK, this paper uses both regime classification and the indicators of hydrological alteration approach to demonstrate degrees of natural flow variability over different timescales and the spatial conformity of these variations, including decadal trends. The information of flow variability is then used to address implications for salmonid populations and to assess implications for flow regulation.

Network type and complexity drive abundance and diversity in connected landscapes

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Landscape structure is an important determinant of spatial variation in biotic diversity. However, empirical relationships between the two are difficult to discern both practically, because such discernment requires multiple experiments at large scales, and theoretically, because there are currently very few predictions to guide experimental design. We developed a theoretical method based on stochastic population dynamics to relate both population abundance and diversity to landscape structure, and used it to compare terrestrial to riverine landscapes. The most diverse terrestrial landscapes were those that approximated dendritic structures typical of riverine landscapes. The most diverse dendritic structures were those with the highest numbers of refugia in the form of isolated, terminal branches. Importantly, while landscape structures with increased abundance also exhibited decreased stability of that abundance, dendritic networks typical of highly branched riverine systems had both the highest and the most stable patterns of diversity. These results have profound implications for evolutionary processes in connected landscapes. They suggest that highly branched riverine systems are uniquely able to foster diverse ecosystems in comparison both to less branched equivalents and to terrestrial landscapes. They also provide firm predictions that may be used to guide empirical comparisons of the biotas of different riverine and terrestrial landscapes.

The spatial organisation of boundaries in stream networks

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Ecological boundaries occur throughout riverine landscapes. They manifest in a range of patterns and processes; some inhibiting the movement of organisms or materials, others facilitating exchanges. Some boundaries behave as ecotones where biodiversity is increased across a gradient. Boundaries occur in three spatial dimensions within riverine landscapes. This study considers longitudinal boundaries within a stream network. Previous research has tended to focus on boundaries associated with tributary confluences or anthropogenic structures. However, natural changes between geomorphic process zones occur within stream networks and understanding the distribution and behaviour of these boundaries is important. This paper investigates the spatial organisation of longitudinal boundaries between geomorphic process zones throughout the stream network of ten basins in the Kimberley Region, Western Australia. Few anthropogenic structures occur throughout the Kimberley stream network, thereby providing an opportunity to investigate natural boundaries throughout a substantial stream network. 35,746 kilometres of stream network were characterised into 11 self-emergent 'River Types'. The organisation of boundaries between these River Types was investigated spatially and statistically using a range of diversity metrics common in community ecology. The distributions of boundaries were plotted on the stream network and differences between basins were investigated.

Population Trends of Flathead Catfish *Pylodictis olivaris*, Channel Catfish *Ictalurus punctatus*, and Blue Catfish *I. furcatus* in Impounded and Unimpounded Reaches of the Upper Mississippi River (1993-2007)

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Using 15 years of Long Term Resource Monitoring Program (LTRMP) data collected from impounded (Pool 26) and unimpounded (Open River) reaches of the Upper Mississippi River, we investigated the population dynamics of Flathead Catfish (*Pylodictis olivaris*), Channel Catfish (*Ictalurus punctatus*), and Blue Catfish (*I. furcatus*) from random sites located in side channel border (SCB) and main channel border (MCB) habitats. The objectives of this study were to (1) compare long-term trends (1993-2007) of three catfish species collected in the Pool 26 and Open River reaches of the Upper Mississippi River; and (2) to provide needed information to managers on population dynamics through time (catch-per-unit-effort and length-class distributions) using a binary gear approach of active (i.e., day electrofishing) and passive gears (hoopnetting). Overall, active gears resulted in a higher catch-per-unit-effort (CPUE) of all fish species in each habitat-reach combination as compared to the passive gears. CPUE using active gear resulted in a greater number of Channel Catfish captured in Pool 26 as compared to the Open River, with the Open River SCB habitat having the lowest CPUE in most years. For Blue Catfish, the Open River had a higher CPUE using active gear as compared to Pool 26, with the Open River MCB having the greatest CPUE every year. For Flathead Catfish, the MCB habitat had a higher CPUE as compared to SCB habitat, with the Open River MCB having the highest CPUE in most years.

Determination of suitable spring snowmelt recession rates below dams for native species protection

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Within Mediterranean-montane ecosystems, the spring snowmelt recession is a distinct feature of the annual hydrograph, bridging the physical disturbance of winter high flows with the biologically stressful conditions of summer low flows. The spring recession is predictable in shape and timing, providing a consistent ecosystem function that determines abiotic and biotic stream conditions. In regulated systems, the snowmelt recession is often absent as the predictable flows are captured behind dams. While restoration of the spring recession is an identified ecological goal, methods for determining suitable ramping rates to transition from high to low flows are lacking. Here we provide a quantitative analysis of the spring recession for selected locations in the Sierra Nevada, California, USA, using a negative exponential decay function to describe the rate of change in discharge. We statistically evaluate this model with existing hydrologic data and then apply a modeled recession to an assessment of suitable instream habitat for a native river-breeding amphibian of concern. Our results indicate unimpaired recession rates in the Sierra Nevada are consistent across watersheds and can be quantitatively modeled to provide ramping rate conditions suitable for native species. These results provide resource managers with increased knowledge of river ecosystem dynamics and help guide the prescription of flow regimes in managed systems to better mimic natural flow regimes.

Biophysical Linkages: Defining Physical Habitat Use Guilds for a Species Rich Large River

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The guild approach has been used widely to identify subsets of species that have similar responses to their shared environment. This approach is universal in its application (i.e., not river specific) by reducing the number of taxonomic groups required to provide information on the overall fish community, yet retains many of the dominant characteristics held by each member of the group. Guild development has typically focused on aspects of fish life-history that may not be appropriate for habitat driven management of large rivers. Therefore, establishing guilds based on linkages between physical and biological patterns are necessary. We demonstrate an approach to establish habitat use guilds based on meso-scale biological and habitat observations from the Niobrara River and Platte River, USA. We use 3 290 records of fish presence-absence and habitat data collected with help of a Prepositioned Area Electrofisher (PAE) to establish the linkage between fish assemblage and habitat patterns. Cluster analysis identified 5 guilds and multivariate habitat suitability analysis identified guild specific physical threshold variables. These guilds provide a basis for simulation modeling of habitat management scenarios for conservation of large, species rich rivers. Key Words: Guilds, Physical Habitat, Large Rivers, Multivariate Statistics, Fish Communities

Session 16: Hydromorphology

Fluvial geomorphology of South-Central Africa determined from remote sensing & GIS

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Africa has a unique bi-modal topography of which approximately two thirds is of low elevation (< 600 a.m.s.l) with the remainder having a mean elevation greater than 1000 a.m.s.l. The Congo-Zambezi watershed occurs in an area where a rapid change from low to high elevation is observed. This watershed divides the world's 2nd (Congo) and 21st (Zambezi) largest rivers in terms of volume. Understanding the evolution of these large rivers and their tributaries is of fundamental importance when investigating links between landscape and aquatic faunal evolution in south-central Africa. Yet, the origin of these drainage systems rarely receives deserved attention in contemporary geology and biology. With the use of remote sensing (RS) and a geographic information system (GIS), the longitudinal profiles of a total of 18 rivers on Congo-Zambezi watershed were mapped. Of the mapped rivers, 12 rivers originate in the southern extent of the Congo basin and 6 have their origin in the northern extent of the Okavango-Zambezi basins. The entire river dataset is contained within a GIS and the relevant attribute data is fully searchable, highlighting knickpoints occurrences. Recorded fish distributions across the study area are mapped. The combination of the fish data and the current morphology of these rivers may provide insights into the recent evolution of the local landscape and, by extension, of bi-modal Africa.

Morphodynamics and woody debris dispersion in braided rivers: a flume experiment

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Braided floodplains are the product of strong mutual interactions between flow, sediment transport and vegetation. Driftwood is a key feature of these dynamic riverine environments, playing a significant role in the morphodynamics and ecology of braided corridors. Our study provides a quantitative analysis of wood transport and deposition in this spatially complex, multi-channel context.
Physical modelling was performed in a large laboratory facility at the University of Trento, Italy. The 3 m wide, 25 m long flume was set up to reproduce typical discharges and slopes of natural gravel-bed braided rivers and wooden dowels were used as surrogate logs. A laser profiler and a reflex camera provided high resolution plano-altimetric characterization of the network.
Both steady and unsteady flow simulations of wood transport were performed and the impact of different discharges on travel time and distance was analyzed. Dowels of various sizes and shapes were used to assess the influence of log properties on their mobility. Deposition patterns were analyzed and linked to the structure of the braided network and the aggradation/degradation of the riverbed. The physical model was able to reproduce the peculiar, ecologically relevant wood dispersal phenomena observed in real-scale streams, such as the accumulation of debris jams on bars, the characteristic scour and deposition patterns around logs and the remobilization of wood during floods.

Channel heterogeneity at the catchment scale as indexed by estimates of River Type, channwel width and Stream Power; River Dee Scotland

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This paper explores the concept of river heterogeneity and demonstrates channel heterogeneity at the catchment scale on the River Dee in Scotland. Catchment scale digital data encompassing channel slope, discharge, channel and floodplain width, and geology for the whole of the River Dee stream network was used to construct estimates of Stream Power and geomorphic River Type. River typing was based on a modified version of the Montgomery and Buffington typology (1997) as used by the Scottish Environmental Protection Agency. The work follows an earlier field based study of morphological river typing on the river (Milner, 2010). Stream power and morphological heterogeneity was examined using traditional ecological indices of diversity such as evenness, richness and abundance. Heterogeneity was also examined spatially with reference to stream order, and reaches with and without tributary junctions. Predictions of changed heterogeneity under climatically induced flood regimes for 2050 and 2080 scenarios were also explored.

Contemporary sediment exchange in a dryland floodplain river.

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Floodplains are temporary alluvial stores that experience erosion and deposition processes over a range of spatial and temporal scales. Knowledge of the bi directional movement of sediment to and from floodplain surfaces during moderate to low flow events is poorly understood, as is the influence of this movement on the floodplain sediment textural mosaic over time. This study aims to firstly characterise the nature of sediment exchange on inset-floodplain surfaces over a series of four flow events, and then determine how the distribution of inset-floodplain sediment texture varies over time as a result of flooding. The response of inset floodplains to flooding appears to be quiet complex, with both deposition and erosion of material occurring over individual flood events. Large-scale geomorphic constraints appear to be having little influence over the direction and amount of sediment exchanged between inset-floodplains and the river channel. The main drivers appear to revolve around the timing of flow events, and the temporally and spatially variable supply of sediment to these inset-floodplain surfaces. The mosaic of distinct sediment textural groups on inset-floodplains is dynamic over time with 36% of surfaces changing their textural character to fall into a distinctly different textural group as defined by Entropy analysis. These results may have implications for the storage of sediment related nutrients on the various floodplain surfaces of this large dryland river system.

Increased sedimentation and turbidity in waterholes impact upon refuge persistence and quality

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The Moonie River in southern Queensland, Australia is typical of many dryland rivers where flow is intermittent and in-channel waterholes are critical drought refuges for fish and other biota. Because the Moonie catchment is largely cleared and gully erosion is prevalent, we were concerned: firstly, that waterholes were filling with sediment thus reducing their persistence time; and secondly, that increased turbidity was limiting primary productivity within waterholes, thus impacting their quality as refuges. We used Digital Elevation Models (DEMs) of 15 waterholes and measured water loss to model drying and found depth to be an accurate predictor of persistence. Sediment cores from waterholes revealed 2.3 m of fine sediment deposited within the past 50 years. Implications for refuge function are serious as this translates to over 12 months less water availability during drought. In long droughts this would dry some otherwise permanent waterholes. Profiles of light intensity through the water column across a gradient of turbidity revealed a tight relationship between attenuation and turbidity. Using this and the DEMs, we modelled waterhole euphotic bed area and water-column volume across a range of turbidity values. Most response to turbidity increase occurred at low values, which are rare in the catchment (mean 873 NTU). No pre-clearing turbidity records exist, so we cannot confirm clearing has impacted refuge quality, but this work has demonstrated both the potential and mechanism for such impact.

Floodplain river sediment exchanges: ecological implications dryland river ecosystems.

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Inset floodplains are a common feature of dryland river systems. These depositional landforms are attached to the bank between the riverbed and the main floodplain surface. Along the Barwon-Darling River in New South Wales, Australia, seven inset surfaces are identified. We use optical dating techniques and the presence of numerous European artefacts to show that these in-channel features range in age from ~10 to 2,000 years. Sediments are fine grained in nature and the presence of numerous organic layers is a feature of these in-channel deposits. Three main stratigraphic sequences were recorded: a general fining upward sequence; a series of fine laminated sediments; and, a distinct cut and fill sequence. Given the age and stratigraphy of these features it is suggested that large quantities of sediment are exchanged between these temporary storage areas and the main channel over a period of 10- 2,000 years. In addition, allochthonous carbon is an essential component of these deposits and given the amount of this material stored within these inset floodplains it is predicted that it is as significant a source of carbon for riverine biota as is contemporary material. This highlights an important link between the physical structure of the river and ecological functioning in large dryland river ecosystems.

Posters

Above- and belowground biomass of black locust (*Robinia pseudoacacia* L.) in riparian zones and the relationships with channel evolution

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In the last two decades, fixation of river courses in Japan and degradation of the riverbed have led to the development of raised floodplains covered by forests containing trees such as black locust (*Robinia pseudoacacia* L.), which is a non-native species. The black locust forests are one factor interfering with conservation of riparian habitat and flood control. It is therefore necessary to quantify the biomass of these forests to support river management. In this study, we quantified the relationship between above- and belowground biomass of black locust trees and evolution of the channel under different flood regimes in riparian areas of the Chikuma River. We developed allometric equations to relate above- and belowground biomass to the diameter at breast height of black locust. We described channel evolution by means of cross-sectional survey data obtained from 1960 to 2010. The above- and belowground biomass of black locust increased with increasing distance from the river and with slower rates of channel evolution, both of which suggest that riparian black locust grows best in more stable environments such as riparian areas at a greater elevation above the river with fewer flood disturbances.

The effect of fixed nitrogen as a nitrogen source of the soil of the sediment bar in the gravelly channel and its effect on the herbaceous plant growth

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Since the sediment bar in gravelly channels are very low in nitrogen content, accumulation of nitrogen is one of the most important issues in the forestation process, particularly for the invasion of herbaceous plants therein. Thus, nitrogen-fixing *symbiosis* between *legume* plants and their rhizobial *symbionts* has a great impact in the processes. Nitrogen concentration and stable isotope ratio of river water, soil and plants were measured at sediment bars of different altitudes, which were covered with layers of fine sediment and *Pueraria lobata*, a legume herbaceous liana. These sediment bars were originally gravelly. The concentration of TN in soil was higher at the rarely inundated sites, and had a negative correlation with the frequency of flood inundation. There was a clear decreasing trend in the fraction of d15N with increasing TN of the soil. The comparison of d15N in water and atmosphere indicated that higher fraction of nitrogen content at the rarely inundated sites was originated from fixed nitrogen, while that of the frequently inundated sites attributed to the river water. The herbaceous plant biomass had a positive correlation with soil nitrogen concentration, and d15N ratios in the plant tissues followed the similar trend as in the inhabiting soil. These relations indicating that large herbaceous plant biomass in higher nitrogen sites is dependent on the nitrogen fixed by *P. lobata*.

Effects of an artificial impoundment on the zooplankton assemblage of a lowland river (Po River, Northern Italy)

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The impact of a main-channel dam on the zooplankton assemblage of a large lowland river (Po River, Italy) was investigated as part of a project aimed at assessing ecological alterations induced by the presence of an artificial impoundment along the river. The Isola Serafini dam was built in the 1960s in the middle reach of the Po River to generate hydroelectric energy. A sampling campaign was carried out from June to September 2009. Water samples were collected fortnightly upstream, inside and downstream of the impoundment for analyses of hydrochemistry, phytoplankton and zooplankton. We hereby focus on the observed changes in abundance and composition of the zooplankton assemblage. Contrary to our hypotheses, we did not notice any increase of microcrustaceans in the reservoir as a result of reduced water current and turbidity. Nevertheless, we detected a more than three fold increase in rotifer density compared to the upstream site. Our results point towards a significant impact of the dam on the zooplankton assemblage only during extremely low-water phases, when the hydraulic retention time is sufficiently high. Considering the frequent and prolonged summer drought events recorded in the Po River in the last years, we postulate that changes in zooplankton abundance and composition induced by the presence of the dam can be even greater than hereby reported and could therefore significantly affect ecosystem processes.

Reviewing the evidence for ecological impact of misconnections

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Sewer misconnections are where a wastewater discharges into a surface water sewer, thus releasing untreated waste directly to a local watercourse. Estimations of the number of household misconnections in England and Wales range from 300,000 to 3 million including washing machines, toilets, and showers amongst other sources. Misconnections have been a recognised problem since separate sewer systems were introduced to the UK in the 1950s. Only in the last decade has focussed action been taken to reduce and prevent the misconnection problem, through campaigns such as “connect right”, and efforts to identify and rectify misconnections. Very little work has been carried out to date, investigating the impacts of misconnections on the ecology of rivers. They are likely to cause similar problems to untreated sewer outfalls, such as decreasing the DO, through increased BOD and COD, and increasing concentrations of organic contaminants and nutrients, all of which may cause major impacts on the ecology of the receiving water. This poster will review evidence from a range of studies, demonstrating the impact which misconnections can have on the ecology of receiving waters, and aims to identify potential methods with which to investigate these impacts, considering biological indicators, water quality measurements, and more modern investigative techniques to determine the impacts and quantify their effects.

Diversity of native and invasive fish species in a hydrographic basin of the semiarid Northeastern Brazil

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The conservation of fish diversity is a major global environmental challenge. Native freshwater fish fauna of Brazil are represented by the orders Characiformes, Perciformes, Siluriformes and Synbranchiformes. The population increase and demand for quality fish generate the need for aquaculture. Consequently, anthropic factors ranging from deforestation, construction of reservoirs on rivers and introduction of invasive species generate negative impacts on native fish. Proliferation of invasive fish species has been deemed as a threat to the integrity of native fish. However, the extent to which these factors can interfere and modify semiarid freshwater ecosystems remains an open question. Construction of reservoirs has altered the natural hydrological regime of water bodies located downstream, and adversely impact the migratory fish. Introductions of exotic and carnivorous fish from other basins have significantly mediated to the decline of native fish. Deforestation causes pluvial shifts and in tropics rainfall is the main environmental driver that modulates fish spawning. Changes in environmental constraints present new challenges to survival and reproductive success of native fish. Declining fish populations have far reaching socioeconomic impacts which are compelling reasons for proper management. Strict regulations on introductions of fish and restrictions on non sustainable aquaculture practices would reverse ecosystem degradation and conserve fish diversity.

Hang around the shoreline: fish larvae distribution in a large temperate floodplain

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We examined the use of flooded terrestrial habitats by fish larvae in a semi-natural large floodplain (Volga, Russian Federation) by comparing densities at the shoreline of permanent water bodies with flooded terrestrial habitats. Fish larvae were collected using hoop-nets in four permanent floodplain water bodies and adjacent flooded terrestrial habitats during the flooding seasons of 2007 and 2008. We found that overall larval densities at the shoreline of permanent water bodies were 6- to 10-fold higher compared to flooded terrestrial habitats. Shorelines appear to offer significantly better habitat for newly-hatched larvae, most likely because here there is an influx of food and warmer water from flooded terrestrial habitats, combined with refuge from cold, open water of permanent water bodies. At the same time the risk of hypoxia of shallow flooded terrestrial habitats, and the risk of predation by fish from the permanent water bodies is reduced. Therefore, the main importance of terrestrial flooded areas for the floodplain fish community appears to be the production of food organisms that comes available for larvae and juveniles with retreating water after flooding. However, given the large extent of flooded terrestrial areas, even at low densities they may accommodate large numbers of fish larvae.

Strategies to conserve the endangered freshwater pearl mussel *Margaritifera margaritifera*

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The freshwater pearl mussel *Margaritifera margaritifera* is listed as Endangered by IUCN and is declining throughout the whole of its holarctic range. It has a complex life history including an obligatory parasitic stage on the gills of a salmonid fish. Major anthropogenic influences like such as habitat degradation and modification, the creation of barriers to salmonid migration, nutrient enrichment and siltation all of which are currently contributing to decline of *M. margaritifera.* Our lack of knowledge about the range and severity of pressures in pearl mussel rivers is disturbing and measures are urgently needed to protect this keystone species. The Tyne Pearl Mussel Project in NE England, delivered by the Freshwater Biological Association (FBA) and the Environment Agency, will go some way towards understanding the pressures on pearl mussels within this catchment. The major project output will be the development of an evidence-based restoration plan for the catchment, driven by the needs of the pearl mussel. This project has developed from the Freshwater Pearl Mussel Ark Project, a collaborative project between the FBA, the Environment Agency and Natural England. The main objective of this project is to rear juvenile mussels from nine English populations for eventual release back into their native catchments. It is anticipated that wild mussel populations will continue to decline if the in-river and catchment issues are not addressed.

Shallow bathymetric mapping of Buffalo Island Chute: examining change over time

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Buffalo Island Chute (side channel) is located along Middle Mississippi River (MMR), mile 24.5-26.3R. The river's morphology has been changed in large part because of channelization and maintenance of the 9 ft. navigation channel. The goal of this project is to physically alter structures in the chute to improve water quality, diversify habitat, and improve fish community structure and resiliency. Fish, water quality, and elevation data are being collected to quantify the changes before and after construction.This chute is one of several island complexes that become isolated from the main channel during low river stages. The primary purpose of the Buffalo Chute Restoration Project is to increase connectivity of the side channel to the main river channel. Water depths were recorded using boat mounted GPS depth sounders. Exposed sandbars were mapped with GPS units and laser levels. All measurements were tied to the current river stage. We collected 5,322 data points in November, 2007, and 3,055 data points in December, 2008, across the 116 acres of side channel. The elevation waypoints were interpolated into a surface or digital elevation model (DEM) with ArcMap's Spatial Analyst extension. This work allowed us to compare the morphology of the side channel at two different time periods. Using Spatial Analyst again, we subtracted the 2007 DEM from the 2008 DEM to see where sediment had been deposited and eroded. The end result was another raster indicating areas of change, which confirmed our field observations.

Buffalo Chute Monitoring: Synopsis of pre-construction data on a habitat rehabilitation project

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Natural resource agencies identified Buffalo Island Chute as an ecologically important side channel in the Middle Mississippi River in 2000, deeming it worthy of habitat rehabilitation. The primary purpose of the Buffalo Chute Restoration Project is to increase connectivity of the side channel to the main river channel. The proposed rehabilitation work calls for notching closing structures to bed elevation, dredging, and constructing two short dikes perpendicular to the right descending bank of the side channel below the internal closing structure. The Open Rivers and Wetlands Field Station (ORWFS) initiated a pre-construction fish assemblage (summer and winter) and water quality monitoring program to assess the impacts of the proposed modifications to the chute complex and two years of sampling were conducted. For both years, the fish samples produced mostly Cyprinids in both seasons. Species richness on average was 26 species with the highest richness (n=40) in summer of year two and the lowest richness (n=26) in winter year two. Species diversity estimates were higher in year one compared to year two, H' = 3.6 to H' = 3.2, respectively. Similarly, Camargo's Index of Evenness was greatest in year one compared to year two, E' = 0.22 to E' = 0.16, respectively. Water quality measurements were collected using a Hydrolab DS 5X datasonde and Van Dorn vertical sampler. Measurements were summarized for the two year study.

Spatial and temporal patterns of surface water temperature observations in main and side channels from the Middle Mississippi River, USA, 1993-2007.

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Water quality has been continuously monitored by the Long Term Resource Monitoring Program (LTRMP) in the Middle Mississippi River (also known as the "open" portion of the Upper Mississippi River) since 1991. The original fixed-point sampling design was augmented by a stratified-random design in 1993 and includes both "water physical" and "water chemical" parameters. Data collection is rigidly standardized and sampling effort is equally divided between main and side channel strata. To characterize and display these large datasets so managers can use the information to make informed decisions about habitat mitigation and future restoration, we summarized 14 years of long-term data into descriptive and time-series outputs. Visual display of time-series data for surface water temperature was completed by examining *t*-statistic deviations of both the main and side channel observational means standardized to main channel means. Using a GIS, we plotted deviations of *t*-values in both the main and side channels, emphasizing side channel variation using the main channel as the standard for comparison. Plots of these data highlight reaches in both the main and side channels where patterns have emerged through time and causes of such patterns can be described by the occurrence of physical structures in the river and river regulation management.

Fish Habitat Monitoring in the Main Stream of the Mekong River using Fish finder and Acoustic Doppler Current Profiler

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Watershed management in developing regions has an endless dilemma between rapid development for economic growth and ecological conservation. The Mekong River watershed is facing with conflicts between drastic change of industrial structure and conservation of ecological service. Since the 1990s, a series of dams called “the Mekong Cascade” have been under construction. Dam construction has multiple economic values as electric power supply, irrigation water, flood control, etc. On the other hand, the artificial discharge controls of dam have a potential to change suitable fish habitat. We focused on impact of anthropogenic watershed change on the dynamics of flooded area and freshwater fish habitat. Our study site is located on 100 km down stream from the Golden Triangle region of Myanmar, Laos, and Thailand. We selected a 10-km in this main channel for fish habitat monitoring. We modeled the river hydrology in the years 1991 and 2002, before and after the Manwan dam construction (1986–1993). In the habitat monitoring of Mekong River fish, we used fish finder and ADCP (Acoustic Doppler Current Profiler) that is attached to survey boat simultaneously. Then, we analyzed the relationship between numbers of fish signs in fish finder and hydrological factor including river structures. Next we applied the estimated regression equation to each grid of hydrological model. Through this procedure, habitat suitability index map of freshwater fish was created in the main channel.

Short term effects of floodplain recreation on the amphibian community.

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At present time one third of all described amphibian species of the world is being threatened. Among a large number of threats the destruction of natural habitats (i.e. wetlands in the temperate zones) is one of the main drivers of the global amphibian decline. Natural habitats are largely reduced and isolated surrounded by heavily disturbed areas whereas they are used as breeding sites and essential for amphibians to complete their life cycles. To compensate amphibian decline at national and regional scale conservation plans often rely on restoration of wetlands. Scientific knowledge regarding the colonisation process of restored wetlands however remains scarce.
Following an old dyke opening and establishment of a new dyke eight wetlands were created in 2006 as compensation measure in the floodplain of Rosslau (Saxony Anhalt, Germany) located within the UNESCO biosphere reserve, ”Middle Elbe”. In the following year we monitored 27 wetlands of the floodplain, including sites newly created, during the breeding season to assess short term amphibian colonisation of recently created wetlands.
This poster presents important predictors of habitat suitability supporting high species richness. Our results indicate that restored wetlands are valuable habitats for at least a subset of the amphibian fauna of this region and could locally counter balance amphibian populations decline.

The role of backwaters in the maintenance of macrophyte diversity in large rivers.

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Research in river ecology conducted in floodplains mainly focuses on river corridors. However a strong hydrological dynamic promotes the formation of lateral aquatic habitats with varying degrees of connectivity to the main channel. Under base flow backwaters maintain a downstream connection to the main channel and experience standing water conditions that favour macrophyte growth. During flood flows they briefly but fully connect to the main channel and then experience potentially-disturbing high water velocities.
Backwaters are recognised as a major reservoir of floodplain biodiversity, acting as a refuge for numerous organisms, including aquatic plants. Nevertheless, biological assessments both of main channels and backwaters are rarely conjugated and in conventional monitoring, despite their perceived value, backwater habitats are often ignored. This hinders appreciation of the importance of lateral connectivity and the relative importance of backwater habitats and main channel in maintaining diversity on large rivers.
This poster presents the results of macrophyte surveys along two large rivers in Scotland where we focus on the design of a sampling strategy that can efficiently and accurately assess plant communities at the level of the river and its floodplain and can adequately reflect the contribution of backwaters to the overall maintenance of diversity.

Freshwater mollusks biodiversity affected by invasive mollusks *Tarebia granifera* Lamarck, 1822 and *Corbicula fluminea* Müller, 1774 in the Tuxpam and Tecolutla rivers, Mexico

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The Tuxpam and Tecolutla rivers in the Gulf of Mexico, are located in the Mesoamerican biodiversity hotspot and support different environmental disturbances: crude oil extraction, agriculture and livestock. Aquatic mollusks, physicochemical water and sediment characteristics were examined along the main watercourse of these rivers during three periods of one year: the wet, dry and the northern winds season, when hurricanes are frequent. In both rivers water and sediment characteristics and mollusk fauna showed environmental gradients and differentiate two zones: freshwater and estuarine. Differences were also found between the dry season, with higher inorganic salts content, and the wet and northern winds and hurricane seasons, when inorganic and organic nutrient inputs occurred. Nine and eleven taxa of mollusks were detected in the Tecolutla and Tuxpam rivers, respectively. In both rivers, the introduced gastropod *Tarebia granifera* is the dominant species in the freshwater zone, followed by the introduced bivalve *Corbicula fluminea*. Native mollusk species are confined to point-locations and attained very low densities. The gastropod *Neritina virginea* and the bivalve *Brachidontes exustus* were dominant in the estuarine zone of both rivers. Climatic events affected the densities and distribution patterns of mollusk. *T. granifera* and *C. fluminea* exhibit characteristic of invasive species and pose a risk to native mollusk biodiversity in these rivers.

Effects of water-level fluctuations on river bank fauna on the Dunajec River, SE Poland

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Water-level fluctuations, causing floods or droughts, are the main factor disturbing channel-bank burrowing biota and controlling their diversity and abundance. Changes in the river bank ecosystem of the Dunajec, caused by summer and winter floods, have been examined during the last two years. The most frequently observed burrowers in the alluvium include European mole (*Talpa europaea*), common earthworm (*Lumbricus terrestris*), a few species of ground beetles (*Carabidae*) and solitary bees (*Ammophila*). Generally, the highest biodiversity of this fauna, especially beetles, occurs under moderate level of disturbances. With low level of disturbances, large, long-living species dominate, whereas with high-level disturbances small, short-living forms prevail. A large majority of the small organisms inhabiting the alluvial deposits are not adapted to survive floods. On the contrary, European mole and bank swallow (*Riparia riparia*) build their burrows beyond the range of flood waters. Burrows of the latter are long enough to enable nesting during the progressive erosion of the banks. A major flood can completely modify river banks, making them unsuitable for quick re-colonisation. A long flooding in the spring 2010 killed the majority of the burrowing organisms on the channel banks and their populations, especially those of the ground beetles, did not restore that year. On the contrary, the solitary bees quickly restored their burrows in place of the destroyed ones.

Network for a Better Thames

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The Water Framework Directive[i] (WFD) is the most important piece of legislation for management and protection of natural water resources in the EU. At its core, the WFD has a set of demanding targets that aim to prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters. Integrated river basin planning, requiring detailed understanding of environmental issues and external pressures to water bodies is integral to implementing the WFD. The Environment Agency (E.A.), responsible for implementing River Basin Management Plans (RBMP) in England and Wales, identified gaps in scientific knowledge which, if resolved, would improve the prospects of reaching and exceeding proposed WFD targets. In the Thames River Basin District, a densely populated area of 16,133 km^2, the academic community was identified as being a major, untapped, resource of scientific knowledge with the potential to contribute expertise to the RBMP.The aim of the Better Thames Network is to promote discussion and collaboration between academic institutions and WFD stakeholders. The mechanisms used to achieve such an integration of expertise will be discussed, these include an open access database, focussed case-study led workshops and promoting multidisciplinary solutions.
[i] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

Scaling *Glossosoma* (Trichoptera) density by abiotic variables in mountain streams

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The stream-dwelling larvae of the caddisfly *Glossosoma* spp. are dominant grazers in lotic food webs and are capable of suppressing stream periphyton. We explored a method for developing a scaling relationship between macroinvertebrate density and local hydraulic variables. As an example of this method, we quantified habitat for larval stone-cased caddisflies, *Glossosoma califica* and *Glossosoma penitum*, in three coastal mountain streams in northern California over two years. Variogram analysis of *Glossosoma* spatial density and relative roughness revealed overlap in the separation distance above which point measurements were statistically independent. The analysis resulted in an average variogram range of 0.39 m for *Glossosoma* density and 0.26 m for roughness height. We applied dimensional analysis to develop a functional relationship from a power law based on dimensionless local hydraulic and larval density variables that was applicable to areas where *Glossosoma* are present. *Glossosoma* densities were negatively correlated with streambed relative roughness and positively correlated with the ratio of inertial to gravitational forces in the stream. The proposed functional relationship described 41% of the variance in the spatial distribution of glossosomatid larvae. This expression could predict how density and effects of these grazers would change under variable hydraulic conditions.

Extraction of pool-riffle structures form LiDAR water surface data

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Pool-riffle structures in rivers are important geomorphology for river environment, because it is said that river bed structures mainly determine habitat and biomass of aquatic lives. However, field surveys of pool-riffle structures in river usually spend much cost and time. We challenged these problems by using LiDAR water surface elevation data. Generally, it is difficult to measure water surface with LiDAR. Recent studies, however, have indicated that data of water surface can be obtained if the incident angle of laser is sufficient. By using LiDAR data, we can measure the profile of water surface in riffle where wavelets occur. In this study, we used LiDAR data at Toyo River in Aichi Prefecture, Japan. In addition LiDAR, aerial photographs were simultaneously taken. We extract the elevations of water surface and determined the water surface slope in 0.5m grid along a river. Then, we determined the location of pools and riffles whether slope angle is more than a threshold value or less. As a result, the pool-riffle profiles obtained from the different measurements were well-agreed each other. By using LiDAR data, moreover, it is possible to detect subtle wave that cannot be detected by aerial photos. As a result of this study, it is suggested that temporal distribution of structures within river can be evaluated by using this method.

Diversity patterns of vegetation in floodplain of river Drava (Southern Hungary) at three levels

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Biodiversity of floodplains is created by different routes, and harboured in stages of terrestrializational succession, more or less changed by human activities. This diversity can be described at various levels, each of which represents different aspects of diversity of the complex floodplain landscape. In our study we compared the diversity of 21 oxbows of river Drava at three levels: physiognomic habitats, plant communities and plant species. Oxbows were categorized into five types depending on successional stage, flooded/protected part position and degradation. Comparisons were based on total and average habitat/community/species numbers (alpha diversity), contribution to gamma diversity of the floodplain and two beta diversity indices (Whitaker's and Wilson-Shmida). Most alpha diversity was bound to middle stages of succession, according to usual successional schemes. These stages also represented most of gamma diversity. Beta diversity indices revealed a different picture: they gave remarkably higher values for flooded-side middle stage, and even for the end stage, compared to protected-side middle stages. Differences were most pronounced by species data. Alpha diversities of habitats proved to be poor indicators, but beta diversities calculated from habitat data gave results comparable to those of other levels. Our results highlight the importance of precise definition of diversity and its indicators in planning and monitoring biodiversity conservation projects.

Lipid peroxidation and antioxidant enzymes in the freshwater snail *Physa mexicana* exposed to water of two rivers from the Mexican Atlantic Slope

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The health of aquatic biota can be severely compromised by a variety of pollutants released by human activities such as: pesticides, heavy metals, hydrocarbons, as well as the complex mixture of them. Routinely, chemicals are applied for pest control and to fertilize the fields. Likewise, wastewaters are directly discharged without treatment in streams, rivers, and lakes, mainly, as is the case of the rivers Tuxpan (Tx) and Tecolutla (Tc), Mexico. Tc river is considered as a healthy ecosystem by Environmental Mexican authorities. We assess the toxic effects of the water of Tc and Tx rivers on the oxidative stress in the aquatic snail *Physa mexicana*, an indigenous gastropod, using a set of biomarkers: superoxide dismutase (SOD), catalase (CAT) and Glutation peroxidase (GPx), and the level of lipid peroxidation (LPX). Static bioassays of 96 h exposure to water collected in December 2008 and April 2009 from three sites of each river were carried out with *P. mexicana*. LPX levels showed a decreasing gradient from the upper reaches to the down reaches in Tc in December, while in Tx, the gradient was inverted in the same time. In April LPX was higher in Tx. SOD was highest in the upper reaches of Tc in December. GPx and CAT increased its activities to face the oxidative stress. The antioxidant system, in both rivers, is responding to adverse effects of oxidative stress measured as lipid peroxidation level exerted by the xenobiotic mixture discharged into the rivers.

Macroinvertebrates in two neotropical rivers in the Atlantic slope of México: biodiversity, richness patterns and community structure

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The pollution of aquatic ecosystems has become a matter of global concern. Particularly, tropical areas where freshwater resources are mainly endangered by anthropogenic activities such as wastewaters discharge, agrochemicals, deforestation and stony material extraction, among others. The diversity of freshwater organisms is affected by water quality changes. Benthic macroinvertebrates (BM) are the most commonly suggested group of freshwater biota to be used as bioindicators. From December 2009 to November 2010, we study two tropical rivers: Tuxpam (Tx) and Tecolutla (Tc) in the dry and wet seasons to analyze the biodiversity and changes in abundance and to assess the community structure of MB. The rivers are in the Neotropical Atlantic Mexican Slope. Five study sites were selected in each river where MB were collected. Biodiversity index, abundance and importance value index (IVI) were assessed. In Tc MB 51 families with total abundance of 472 org/m2 were found, and 44 families in Tx (635 org/m2), being the families Leptophlebiidae and Baetidae those with the highest IVI in both rivers (31 and 26, respectively). The IVI scores of Corixidae, Ceratopogonidae and Heptageniidae were the lowest (0.6). The families with the widest range were Leptophlebiidae, Thiaridae, Baetidae, Philopotamidae Hidropsychidae, Naucoridae and Elmidae. The dry season was the most diverse and with highest abundance. Tc displayed the higher taxa; while, Tx showed higher abundance.

The Rhine-Main-Observatory – a new research platform for interdisciplinary river floodplain research

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With this poster, we would like to introduce the newly established "Rhine-Main-Observatory" (RMO) to the scientific public. The RMO is a well-equipped 100km² research platform in the floodplain of the river Kinzig/Hesse. It is part of the LTER-network. We would like to invite scientists working in various fields, including stream ecology, coupling of terrestrial and aquatic habitats, land use and climate change ecology, to make use of this research platform.

Sustainability and performance of rock-ramp fishways to mitigate habitat bottlenecks in lowland rivers

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Few river restoration projects are monitored, which leaves questions about their long-term ability to meet management and environmental policy goals and wastes opportunities to improve future practice. In regulated lowland rivers, dams and their resulting impoundments result in river fragmentation, increased sedimentation and the loss of habitats with coarse substrates. The purpose of this study is to evaluate the effecttiveness of replacing small dams with rock-ramp fishways (fish ramps), to promote fish migration and overcome the typical habitat bottleneck in lowland rivers, the lack of gravel spawning sites. Eco-hydrological monitoring will address how time and fine sediment impact the habitat suitability of 5 similarly-constructed fish ramps of different ages for lithophilic macroinvertebrate and fish species in the Dosse River, northern Germany. It is predicted that the earlier-constructed fish ramps accumulated a higher percentage of fine sediment, successively lowering their suitability for lithophilic species.The ability of fish ramps to overcome habitat bottlenecks while enabling fish migration has been largely overlooked, and few studies address the aging of restoration structures. If a natural flow dynamic is lacking, succession contradicts the suitability of the coarse gravel substrate for lithophilic species. Adaptive management (i.e. post-installation maintenance) may be necessary to realize the desired ecological improvements by fish ramps in the long term.

Ecological prioritization: a basis for planning river restorations in Switzerland

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After two centuries of river degradation, the 21st century is the century of river restoration. In Switzerland the modified water law (2011) is demanding river restoration activities and an ambitious program has been started to improve the ecological status of rivers and lakeshores on a broad scale. About 50 % of the streams and rivers in the Swiss plateau are severely degraded in morphology and many artificial barriers impede fish migrations. In order to improve the ecological conditions of streams 60 Mio. CHF (approx. 80 Mio. €) will be invested every year. However the funds will not be large enough to support all restoration activities needed. Therefore prioritization is essential to decide which and where measures should be realized to achieve the highest ecological recovery. Different prioritization approaches and strategies have been developed in conservation and restoration ecology. From literature studies we have derived different concepts of prioritization, e.g. approaches that focus on cost-efficiency, target species, rarity, connectivity, hotspots, stepping stones, etc. These concepts will be discussed in relation to the specific problems in Swiss streams and suitable prioritization measures are proposed.

Hydromorphological complexity, water quality and benthic invertebrate communities in a mountain river, the Czarny Dunajec, Polish Carpathians

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Diversity of benthic invertebrate communities in a mountain river subjected to human impacts was compared with the degree of heterogeneity of physical habitat conditions and physico-chemical water quality. Growing complexity of flow pattern in the river was associated with increasing cross-sectional variability in physical habitat parameters. Single-thread cross-sections hosted only a few, mostly eurytopic invertebrate taxa (2-3 functional feeding groups). In multi-thread cross-sections, those communities were more diverse, with all functional feeding groups and taxa with various habitat preferences. Physico-chemical parameters consistently pointed to high water quality, unlike the scores of invertebrate-based, BMWP-PL index indicating the water to vary between high and poor quality. The relationship of the scores with the flow pattern complexity and a lack of their dependence on physico-chemical water parameters suggest the index should be an indicator of the ecological integrity of rivers, dependent both on their hydromorphological and physico-chemical characteristics, rather than of water quality. Taxonomic richness of the invertebrate communities positively correlated with a degree of variation in physical habitat parameters and was best predicted by the number of flow threads in a river cross-section. This indicates that restoration of the morphological complexity of the river will be necessary for future recovery of these communities in impacted river sections.

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