XXV Congresso AIOL

On-line – 30 giugno-2 luglio 2021

Contributi innovativi dell'oceanologia e della limnologia alla conoscenza, al recupero e alla salvaguardia delle risorse acquatiche minacciate dai cambiamenti globali

Strumenti e approcci innovativi nelle scienze acquatiche in un mondo che cambia

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Monica Tolotti, Fondazione E. Mach, Istituto Agrario di S. Michele all'Adige, S. Michele all'Adige (TN)

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Silvia Bianchelli, Università Politecnica delle Marche, Ancona
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Diego Copetti, CNR-IRSA, Brugherio (Monza-Brianza)

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PROGRAMMA DETTAGLIATO

MERCOLEDÌ 30 GIUGNO

9:00	**INTRODUZIONE E SALUTI DI BENVENUTO**
9:15	**ANTONIO PUSCEDDU. Disentangling the ecological role of natural and anthropogenic disturbance in marine ecosystems: from detection to solutions**
	SESSIONE SPECIALE 6 – Inquinamento da microplastiche negli ambienti marini e d'acqua dolce: stato delle conoscenze, approcci ed esperienze di governance. MODERATORI: SILVIA GALAFASSI, ALESSANDRO CAU. *Presentazioni orali*
10:00	Maria Sighicelli*, Lucia Coscia, Stefania Di Vito, Francesca Lecce, Annalisa Leone, Patrizia Menegoni, Simone Nuglio, Miriam Pierotti, Loris Pietrelli, Giorgio Zampetti. *The microplastic monitoring of Italian lakes: from the Goletta dei Laghi campaigns to life blue lakes project*
10:15	Andrea Binelli*, Lara Nigro, Camilla Della Torre, Stefano Magni. *A realistic approach for the assessment of plastic contamination and its ecotoxicological consequences: a case study in the metropolitan city of Milan (N. Italy)*
10:30	Arianna Bellasi*, Roberta Bettinetti. A reliable method to investigate microplastics in a lacustrine ecosystem
10:45	Maria B. Sathicq*, Andrea Di Cesare, Diego Brambilla, Florian Breider, Sylvain Coudret, Gianluca Corno. *AENEAS project: Assessing the role of coastal anthropogenic use in determining the impact of microplastic particles on the microbial communities of the Northern Tyrrhenian Sea*
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11:15	Anna Winkler*, Andrea Masseroni, Diego Antonioli, Michele Laus, Paolo Tremolada. *Following the fate of microplastic along the Ticino river, Italy*
11:30	Raffaella Sabatino. *Microplastic particles as carriers of antibiotic resistance in aquatic systems*
11:45	Vincenzo Donnarumma*, Fabio D'Agostino, Roberta Piredda, Augusto Passarelli, Cecilia Balestra, Erik R. Zettler, Linda Amaral-Zettler, Raffaella Casotti. *Variability of microplastic abundances and their attached microbial communities in an urbanized coastal area*
12:00	Stefano Magni*, Lara Nigro, Camilla Della Torre, Andrea Binelli. *Ecotoxicological characterization of plastics along the Lambro River (Italy)*
12:15	Veronica Nava*, Miguel Matias, Beata Messyasz, Andreu Castillo-Escrivà, Zeynep Ersoy, Pedro M. Raposeiro, Ezequiel Marzinelli, Mariana Mayer-Pinto, Hector González Sanchidrián, Mariana Pinedo-Troncoso, Barbara Leoni. *Microalgal colonization of microplastics in experimental mesocosms across the iberian peninsula*
12:30	**PATRICIJA MOZETIČ. Long-term changes in the phytoplankton community under climate change and other anthropogenic drivers (northern Adriatic Sea)**
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14:00	Raul Primicerio. *Arctic aquatic ecosystems and environmental change impact*

14:30	Martina Gastaldi*, Geneviève Lacroix, Valérie Dulière, Luca Schiavon, Mario La Mesa, Chiara Papetti. *Let's see where they MIGHT go: a connectivity study of Antarctic fish populations by Lagrangian simulation in the Weddell Sea and Antarctic Peninsula*
14:45	Stefano Brighenti*, Maria Cristina Bruno, Walter Bertoldi, Valeria Lencioni, Geraldene Wharton, Francesco Comiti, Monica Tolotti. *Cold refugia in warming mountains: a glimpse of hope for alpine stream invertebrates?*
15:00	Maria Chiara Vulcano*, Stefano Brighenti, Maria Cristina Bruno, Leonardo Cerasino, Werner Tirler, Monica Tolotti. *Diatoms assemblages in headwaters influenced by glaciers and permafrost under alpine deglaciation*
15:15	Monica Tolotti*, Luca Carturan, Ulrike Nickus, Hansjörg Thies, Handong Yang, Federica Camin. *Coherent response of Alpine lakes to combined global warming and airborne contamination as revealed by sediment records*
15:30	Rocco Tiberti*, Michela Rogora. *15 years of limnological research in Western Italian Alps, between science and conservation*
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17:45	Cindy Paquette*, Irene Gregory-Eaves, Beatrix E. Beisner. *Environmental filtering on zooplankton communities across high latitude Canadian lakes*
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18:00	Lisa Giordani*, Federica Camin, Leonardo Cerasino, Andrea Lami, Anna Occhipinti-Ambrogi, Handong Yang, Monica Tolotti. *Long-term ecological evolution of a high-altitude lake in the Central-Eastern Italian Alps as showed by palaeolimnological proxies*
18:05	Melissa Maini*, Laura Iacobelli, Rocco Tiberti. *Both mountain lake biota and game fish are better off without introduced minnows*
18:10	Laura Iacobelli*, Melissa Maini, Rocco Tiberti. *Rapid assessment of fish presence and relative density in mountain lakes by visual inspection*
18:15	Simona Musazzi*, Angela Boggero, Riccardo Fornaroli, Andrea Lami, Aldo Marchetto, Arianna Orrù, Daniele Paganelli, Rocco Tiberti, Silvia Zaupa, Michela Rogora. *Alpine lake monitoring as a contribution to the National Emission Ceilings (NEC) Directive*
18:20	Andrea Lami*, Simona Musazzi, Antonella Miola, Claudia Poggi, Renata Trevisan. *A paleolimnological multiproxy investigation in a small alpine lake: L. Colbricon Inferiore (Trentino, Italia)*
18:25	Michela Rogora*, Gabriele Tartari, Luca Paro. *The RESERVAQUA project: first insights on water quality in permafrost-affected water bodies*
18:30	Monica Tolotti*, Leonardo Cerasino, Claudio Donati, Massimo Pindo, Michela Rogora, Roberto Seppi, Davide Albanese. *Alpine headwaters emerging from glaciers and rock glaciers host different bacterial communities: ecological implications for the future*

GIOVEDÌ 1 LUGLIO

9:00	**FABIO LEPORI. The surprising ecology of a perialpine lake: insights from long-term monitoring**
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10:00	Silvia Pulina*, Jorin Hamer, Giannina S. I. Hattich, Julia Romberg, Cecilia T. Satta, Birte Matthiessen. *The role of intraspecific morpho-functional trait variability in marine phytoplankton responses to changing nutrient scenarios*
10:15	Elisabetta Manea*, Caterina Bergami, Lucia Bongiorni, Lucilla Capotondi, Elisabeth De Maio, Alessandro Oggioni, Alessandra Pugnetti. *Towards the harmonization of the fragmented approach to environmental monitoring and conservation: first insights from the marine ecological observatory of the Adriatic Sea*
10:30	Santina Soru*, Patrizia Stipcich, Giulia Ceccherelli, Antonio Pusceddu. *Impact of a simulated Marine Heat Wave on quantity, composition and degradation rates of sedimentary organic matter*
10:45	Valentina Esposito*, Rocco Auriemma, Cinzia De Vittor, Nuria Teixido, Maria Cristina Gambi. *Shallow hydrothermal vents: natural laboratories for global environmental change research*
	SESSIONE SPECIALE 4 – La ricerca sui grandi laghi subalpini tra analisi di serie storiche di dati e nuovi approcci di studio. MODERATORE: BARBARA LEONI. *Presentazioni orali*
9:45	Rosario Mosello*, Michela Rogora. *Aspects of the historical development of studies on the deep Italian subalpine lakes*
10:15	Diego Copetti*, Andrea Fenocchi, Claudia Dresti, Michela Rogora, Fabio Buzzi. *Two decades of limnological investigations on Lake Como: field data analysis and ecosystem modeling*
10:30	Marco Cifoni*, Angela Boggero, Diana Maria Paola Galassi, Michela Rogora, Marzia Ciampittiello, Barbara Fiasca, Tiziana Di Lorenzo. *Assessing the effects of water level variations on the copepod assemblages of the littoral zone of Lake Maggiore*
10:45	Luigi Hinegk*, Luca Adami, Sebastiano Piccolroaz, Marina Amadori, Guido Zolezzi, Marco Toffolon, Marco Tubino. *Multi-decadal management of Lake Garda water resource*
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11:30	Viviana Pasquini*, Marco Secci, Davide Moccia, Angelica Giglioli, Antonio Pusceddu, Piero Addis. *The potential role of the sea cucumber Holothuria tubulosa on sedimentary protein loads and degradation rates*
11:45	Claudia Ennas*, Claudia Morys, Clare Bradshaw, Antonio Pusceddu. *Quantity, biochemical composition, and degradation rates of organic matter in coastal marine sediments areas affected by different levels of bottom trawling impact*
12:00	Luca Russo*, Vincenza Casella, Anna Marabotti, Roberta Congestri, Ferenc Jordán, Domenico D'Alelio. *Are metabarcoding data useful to reconstruct food webs in pelagic systems?*
12:15	Gabriele Del Gaizo*, Luca Russo, Daniela Cianelli, Fabio Conversano, Simona Saviano, Isabella Percopo, Domenico D'Alelio. *Biogeographic differentiation of mixoplankton along the Campania coasts*

12:30	Silvia Bianchelli*, Fabio Rindi, Marco Lo Martire, Davide Ippoliti, Ettore Nepote, Francesco Martini, Simonetta Fraschetti, Roberto Danovaro. *Restoration actions under Covid-19 pandemia: possible positive effects on the success*
12:45	Viviana Fonti*, Andrea Di Cesare, Paola Del Negro, Mauro Celussi. *Microbial pollution and antimicrobial resistance associated with urban wastewaters treatment plants in the Adriatic Sea*
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13:00	Amira Saidi*, Elisa Banchi, Viviana Fonti, Vincenzo Manna, Cinzia De Vittor, Michele Giani, Francesca Malfatti, Mauro Celussi. *Microbial Dynamics in Shallow-Water Hydrothermal Vents in the Mediterranean Sea (Panarea Island, Italy)*
13:05	Denise Lenzo*, Laura Pezzolesi, Marina Antonia Colangelo, Andrea Pasteris. *Effects of microalgal allelochemicals on meiobenthic community: a microcosm study*
13:10	Nicolè Caputo*, Franca Guerrini, Laura Pezzolesi, Rossella Pistocchi. *The water's colours of algal blooms in the brackish Lago delle Nazioni*
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11:30	Claudia Dresti*, Michela Rogora, Andrea Fenocchi. *Hypolimnetic oxygen depletion in a deep oligomictic lake under climate change*
11:45	Gary Free*, Mariano Bresciani, Monica Pinardi, Nicola Ghirardi, Giulio Tellina, Giulia Luciani, Rossana Caroni, Claudia Giardino. *Detecting climate driven changes in chlorophyll-a in deep subalpine lakes using long term satellite data*
12:00	Michela Rogora*, Claudia Dresti, Rossana Caroni, Aldo Marchetto, Lyudmila Kamburska, Martina Austoni, Paola Giacomotti, Arianna Orrù, Gabriele Tartari, Rosario Mosello. *Nutrient trends in a deep oligomictic lake: the role of external loads versus internal processes*
12:15	Nico Salmaso*, Adriano Boscaini, Giulia Riccioni, Giorgio Franzini, Giampaolo Fusato, Federica Giacomazzi, Chiara Zampieri, Silvia Costaraoss, Giovanna Pellegrini, Sabrina Pozzi, Renate Alber, Hannes Rauch, Alberta Stenico, Samuel Vorhauser, Elisa Zanut, Fabio Buzzi, Serena Bernabei, Claudia Greco, Paolo Tomassetti, Leonardo Cerasino. *Patterns of geographical distribution of toxigenic cyanobacterial species and oligotypes in the perialpine lake district*
12:30	Leonardo Cerasino*, Adriano Boscaini, Nico Salmaso. *First report of cyanotoxins in benthic mats from Lake Garda*
12:45	Roberta Piscia*, Michela Mazzoni, Roberta Bettinetti, Rossana Caroni, Davide Cicala, Marina Manca. *Stable Isotope Analysis and Persistent Organic Pollutants in Crustacean Zooplankton: The Role of Size and Seasonality*
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13:00	Angela Boggero, Lyudmila Kamburska, Silvia Zaupa, Daniele Paganelli, Michela Rogora, Marzia Ciampittiello, Marco Cifoni, Tiziana Di Lorenzo. *Synoptic research on the potential impacts of water management strategy on Lake Maggiore ecosystem (NW, Italy): the Interreg project PVT*
13:05	Lyudmila Kamburska*, Silvia Zaupa, Daniele Paganelli, Angela Boggero. *Size structure and body mass of Chironomid larvae under different water level management in the temperate deep subalpine Lake Maggiore (NW Italy)*
13:10	Mariano Bresciani*, Gary Free, Claudia Giardino, Monica Pinardi, Giulio Tellina, Stefan Simis, Jean-Francois Cretaux, Chris Merchant, Herve Yesou, Claude Duguay, Bruno Coulon. *Analysis of global satellite products for the Essential Climate Variable 'Lakes' in the LTER framework*

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14:45	Florian Kokoszka*, Fabio Conversano, Daniele Iudicone, Bruno Ferron, Pascale Bouruet-Aubertot, Justine Mc Millan. *Microstructure observations of the summer-to-winter destratification at a coastal site in the Gulf of Naples*
15:00	Mattia Pivato*, Daniele Pietro Viero, Sonia Silvestri, Luca Carniello. *Modeling water temperature dynamics, a step forward in understanding the eco-morphodynamics of shallow water environments*
15:15	Elisa Lovecchio*, Stephanie Henson, Nathan Briggs, Filipa Carvalho, Nicolas Gruber, Matthias Münnich, Giulia Bonino, Simona Masina, Dorotea Iovino. *Biophysical interactions at the ocean's mesoscale: eddy and filament impacts on the marine organic carbon and oxygen cycles*
15:30	Simone Zazzini*, Agnese Pini, Giovanni Leuzzi, Paolo Monti. *How to parameterize mixing processes in the marine water column*
15:45	Elisabetta Persi*, Gabriella Petaccia, Stefano Sibilla. *Numerical investigation on water levels and velocity distribution affected by deposited large wood*
16:00	Erica Matta*, Marina Amadori, Mariano Bresciani, Claudia Giardino, Karin Schenk, Thomas Heege. *Role of spatial variability, data availability and operative application in the production of lake evaporation maps. A combined remote sensing and numerical modeling study*
16:15	Marina Amadori*, Francesca De Santi, Virginia Zamparelli, Giacomo De Carolis, Gianfranco Fornaro, Marco Toffolon, Nicola Ghirardi, Gary Free, Claudia Giardino, Mariano Bresciani. *Understanding lake surface transport patterns from space: opportunities and challenges from Earth Observation and numerical modelling*
16:30	Camille Minaudo, Camilla Capelli*, Massimiliano Cannata, Fabio Lepori. *What drives primary production phenology in large mesotrophic lakes?*
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17:00	Sebastiano Piccolroaz*, Bieito Fernández Castro, Hannah Elisa Chmiel, Pascal Perolo, Alfred Wüest. *CO_2 fluxes in a large perialpine lake modulated by near-surface stratification, internal motions and biological processes*
17:15	Francesco M. Falcieri*, Mathieu Dever, Mara Freilich. *Subducting filaments at fronts in the Alboran Sea: Physical, turbulent and biological evidences*
17:30	Domenico D'Alelio*, Salvatore Rampone, Luigi Maria Cusano, Valerio Morfino, Luca Russo, Nadia Sanseverino, James E. Cloern, Michael W. Lomas. *Machine learning identifies a strong association between warming and reduced primary productivity in an oligotrophic ocean gyre*
17:45	Andrea Fenocchi*, Michela Rogora, Claudia Dresti. *Deep intrusions of tributaries are suppressed for increasing winter residual stratification in deep oligomictic perialpine lakes south of the Alps*
18:00	Marco Toffolon*, Luca Cortese, Damien Bouffard. *A minimal model to study the contrasting role of cooling and wind on the freeze-up time in lakes*
18:15	Gianni Tartari*, Diego Copetti, Andrea Franzetti, Marcella Balordi, Franco Salerno, Sudeep Thakuria, Barbara Leoni, Gianluca Chiarello, Pierangela Cristiani. *Role of manganese in the meromictic subalpine Lake Idro*
	SESSIONE SPECIALE 3 – Mescolamento, trasporto e dinamiche termiche in fiumi, laghi e mare:

	dialogo tra fisica e biologia. MODERATORE: ULRIKE OBERTEGGER, MARCO TOFFOLON. *Poster flash-talk*
18:30	Ulrike Obertegger*, Daniele Andrei, Sebastiano Piccolroaz, Giovanna Flaim. *Dissolved oxygen in a wind-shielded mountain lake is determined by the interplay of ice cover and extreme events*
18:35	George E.A. Swann, Virginia N. Panizzo, Sebastiano Piccolroaz*, Vanessa Pashley, Matthew S.A. Horstwood, Sarah Roberts, Elena Vologina, Natalia Piotrowska, Michael Sturm, Andre Zhdanov, Nikolay Granin, Charlotte Norman, Suzanne McGowan, Anson W. Mackay. *Changing nutrient cycling in Lake Baikal determined by enhanced deep ventilation during the last century*

VENERDÌ 2 LUGLIO

	SESSIONE SPECIALE 3 – Mescolamento, trasporto e dinamiche termiche in fiumi, laghi e mare: dialogo tra fisica e biologia. MODERATORE: SEBASTIANO PICCOLROAZ. *Presentazioni orali*
9:00	Bieito Fernández Castro*, Marian Peña, Enrique Nogueira, Miguel Gilcoto, Esperanza Broullón, Antonio Comesaña, Damien Bouffard, Alberto C. Naveira Garabato, Beatriz Mouriño-Carballido. *Intense ocean mixing by fish spawning aggregations*
9:15	Ulrike Obertegger*, Giovanna Flaim, Sabrina Pozzi. *Lake Caldonazzo, effects of re-oligotrophication and climate change on lake thermal structure, the past and the future*
9:30	**FRANCESCO POMATI. Do phytoplankton dream of environmental change, or monster copepods?**
	SESSIONE SPECIALE 2 – Ecosistemi fluviali italiani: caratteristiche, biodiversità, gestione e minacce nell'era del cambiamento globale. MODERATORE: MARIA CRISTINA BRUNO. *Presentazioni orali*
10:15	Alberto Doretto*, Francesca Bona, Elena Piano, Anna Marino, Silvia Quadroni, Stefano Fenoglio. *Siltation and stream macroinvertebrates: from the community response to the development of a stressor-specific biomonitoring index*
10:30	Silvia Quadroni*, Giuseppe Crosa, Paolo Espa, Francesca Salmaso. *An extraordinary research opportunity from an extraordinary sedimentation event*
10:45	Maria Cristina Bruno*, Silvia Folegot, Stefano Larsen. *Desilt or not desilt? The effects of a sediment flushing on Alpine macroinvertebrate communities*
11:00	**COFFEE BREAK**
	SESSIONE SPECIALE 2 – Ecosistemi fluviali italiani: caratteristiche, biodiversità, gestione e minacce nell'era del cambiamento globale. MODERATORE: MATTIAS GAGLIO. *Presentazioni orali* *Presentazioni orali*
11:15	Stefano Larsen*, Bruno Majone, Patrick Zulian, Elisa Stella, Alberto Bellin, Maria Cristina Bruno, Guido Zolezzi. *Combining hydrologic simulations and stream-network models to reveal flow-ecology relationships in a large Alpine catchment*
11:30	Erica Vassoney*, Andrea Mammoliti Mochet, Paolo Vezza, Claudio Comoglio. *Multi-Criteria Analysis for the assessment of environmental flow scenarios released from hydropower dams in the Alpine area*
11:45	Alex Laini*, Simone Guareschi, Gemma Burgazzi, Richard Chadd, Iakovos Tziortzis, Massimo Ventrucci, Paolo Vezza, Paul J. Wood, Pierluigi Viaroli. *Using macroinvertebrates functional information to assess flow alteration in rivers*
12:00	Francesca Vallefuoco*, Stefano Larsen, Maria Cristina Bruno, Walter Bertoldi, Guido Zolezzi. *Tools to assess the impacts of multiple stressors on function and diversity of a river network*
12:15	Alexandra Nicoleta Muresan*, Mattias Gaglio, Giuseppe Castaldelli, Elisa Anna Fano. *Po river basin land-use/land-cover (LULC) change effects on water quality*

12:30	Cinzia Podda*, Alessio Musu, Francesco Palmas, Melissa Serra, Antonio Pusceddu, Andrea Sabatini. *Impact of larger dams on freshwater distribution of Anguilla anguilla (L., 1758)*
12:45	Vanessa De Santis*, Silvia Quadroni, Robert J. Britton, Antonella Carosi, Isabella Vanetti, Catherine Gutmann Roberts, Massimo Lorenzoni, Giuseppe Crosa, Serena Zaccara. *Diversity of the Italian fluviolacurstrine barbels threatened by the invasion of the European barbel*
13:00	Luca Bonacina*, Sergio Canobbio, Riccardo Fornaroli. *Influence of the predator Salmo trutta trutta on the habitat preference, community structure and growth rate of a Cottus gobio population*
13:15	**LUNCH BREAK**
	SESSIONE SPECIALE 2 – Ecosistemi fluviali italiani: caratteristiche, biodiversità, gestione e minacce nell'era del cambiamento globale. MODERATORE: MATTIAS GAGLIO. *Presentazioni orali*
14:00	Stefano Fenoglio. *Alpine streams: problems and management perspectives between global changes and local pressures*
14:30	Vanessa Modesto*, Luca Tosato, Ashkan Pilbala, Nina Benistati, Luigi Fraccarollo, Donatella Termini, Dario Manca, Tommaso Moramarco, Nicoletta Riccardi. *Mussel behavior as a tool to measure hydrological stressors*
	SESSIONE SPECIALE 2 – Ecosistemi fluviali italiani: caratteristiche, biodiversità, gestione e minacce nell'era del cambiamento globale. MODERATORE: MATTIAS GAGLIO. *Poster flash-talk*
14:45	Maria Cristina Bruno*, Laura Gruppuso, Alberto Doretto, Elena Piano, Elisa Falasco, Francesca Bona, Stefano Fenoglio. *Can artificial flumes effectively simulate a field experiment? Evidences from a study on the effects of flow intermittence on ecosystem processes*
14:50	Francesca Vallefuoco*, Stefano Larsen, Pietro Franceschi, Walter Bertoldi, Guido Zolezzi, Maria Cristina Bruno. *Application of a Random Forest a-posteriori classification to predict multiple stressors impacts on benthic function and diversity of a river network*
14:55	Cinzia Podda*, Jacopo Culurgioni, Giovanna Chessa, Riccardo Diciotti, Marco Maxia, Alessio Musu, Francesco Palmas, Gabriele Sanna, Melissa Serra, Andrea Sabatini. *Glass eels (Anguilla anguilla, L. 1758) recruitment evaluation through a new sampling method*
	SESSIONE SPECIALE 6 – Inquinamento da microplastiche negli ambienti marini e d'acqua dolce: stato delle conoscenze, approcci ed esperienze di governance. MODERATORI: SILVIA GALAFASSI, ALESSANDRO CAU. *Poster flash-talks*
15:00	Claudia Dessì*, Cinzia Podda, Lucia Pittura, Alessandro Cau. *Preliminary data on European eel skin mucus as trapper of microplastics in riverine ecosystems*
15:05	Pankaja A. Gorule*, Lucia Pittura, Maria Cristina Follesa, Alessandro Cau. *Microplastic contamination in two benthic decapod crustaceans from Sardinian seas*
15:10	Giulia Dalla Fontana*, Anastasia Anceschi, Tiziano Battistini, Enrico Gasparin, Raffaella Mossotti. *Preparation of a standard method for detection, monitoring and measurements of microplastics with fibre shape*
15:15	Federica Rotta*, Camilla Capelli, Fabio Lepori. *Microplastics as emerging contaminants in Lake Lugano: present knowledge and future perspective*
15:20	Raffaella Mossotti* Giulia Dalla Fontana, Anastasia Anceschi, Tiziano Battistini. *Standard analytical method for the quantification of microplastic with fibre shape*
15:25	Silvia Galafassi*, Maria Sighicelli, Antonio Pusceddu, Roberta Bettinetti, Alessandro Cau, Maria Eleonora Temperini, Raymond Gillibert, Michele Ortolani, Loris Pietrelli, Silvia Zaupa, Pietro Volta. *Microplastic pollution in Perca fluviatilis from four Italian south-alpine lakes*
	SESSIONE SPECIALE 4 – La ricerca sui grandi laghi subalpini tra analisi di serie storiche di dati e nuovi approcci di studio. MODERATORE: MICHELA ROGORA, BARBARA LEONI. *Poster flash-talk*
15:30	Francesca Ciutti, Cristina Cappelletti. *Distribution of Corbicula clams (Veneroidea, Cyrenidae) in Lake Garda (Italy)*

15:35	Rossana Caroni*, Rocco Tiberti, Dario Manca, Simona Musazzi, Andrea Lami, Massimiliano Cannata, Daniele Strigaro, Michela Rogora. *Development of high-frequency monitoring in the insubric lakes: LM1 buoy as a pilot experience within the cross-border project SIMILE*
15:40	Martina Austoni*, Lyudmila Kamburska, Aldo Marchetto, Michela Rogora. *Diatom composition and Functional Groups in Lake Maggiore through 20 years of monitoring data*
	SESSIONE PLENARIA – MODERATORI: NICO SALMASO, DOMENICO D'ALELIO. *Poster flash-talk*
15:45	Gianni Tartari*, Giovanni Bergna, Manuela Antonelli, Arianna Azzellino, Marco Bernardi, Marzia Bernasconi, Giorgio Bertanza, Andrea Binelli, Chiara Brioschi, Sara Castiglioni, Enrico Davoli, Laura Eleonora, Antonio Di Guardo, Claudia Doria Depero, Stefania Federici, Silvia Galafassi, Maria Cristina Gugliandolo, Viviane Iacone, Marco Lietti, Stefano Magni, Christian Malacrida, Francesca Malpei, Valeria Marchesi, Valeria Mezzanotte, Raffaella Mossotti, Bruno Pannuzzo, Marco Parini, Roberta Pedrazzani, Stefano Polesello, Alberto Sala, Stefano Tani, Pietro Volta. *Emerging micropollutants in Lombardy*
15:50	Adriano Boscaini*, Leonardo Cerasino, Nico Salmaso. *Biomonitoring survey of the hydrographical network in the MAB UNESCO Alpi Ledrensi and Judicaria Biosphere Reserve (Project AcquaViva)*
16:00	**PREMIAZIONI E NOMINA ORGANI COLLEGIALI DEL CONSIGLIO DI PRESIDENZA**

SESSIONI PLENARIE

Fabio Lepori

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Biosketch

I am a freshwater ecologist working at the interface between applied ecology and community ecology. After graduating in Natural Sciences in 1996, I pursued graduate education at Cardiff University, Wales, obtaining a Master and a PhD degree in Hydrobiology. I since worked as postdoctoral researcher (Umeå University, Sweden and Colorado State University, USA), Assistant Professor (Lyon University, France), Senior researcher, and Professor (University of Applied Sciences on Southern Switzerland). The consistent threads across this personal and professional path have been a keen interest in the natural history of aquatic organisms and a concern for the state of freshwater ecosystems. Currently I am particularly interested in the responses of lake pelagic communities to restoration and the pressures of global change.

Selected publications

Lepori, F. and Capelli, C., 2019. Seasonal variation in trophic structure and restoration effects in a deep perialpine lake (Lake Lugano, Switzerland and Italy). Journal of Great Lakes Research, in press.

Lepori, F. and Roberts, J.J., 2017. Effects of internal phosphorus loadings and food-web structure on the recovery of a deep lake from eutrophication. Journal of Great Lakes Research, 43, 255-264.

Lepori, F. and Malmqvist, B., 2009. Deterministic control on community assembly peaks at intermediate levels of disturbance. Oikos, 118, 471-479.

Lepori, F., & Hjerdt, N. (2006). Disturbance and aquatic biodiversity: reconciling contrasting views. BioScience, 56, 809-818.

Lepori, F., Palm, D., Brännäs, E. and Malmqvist, B., 2005. Does restoration of structural heterogeneity in streams enhance fish and macroinvertebrate diversity? Ecological Applications, 15,.2060-2071.

The surprising ecology of a perialpine lake: insights from long-term monitoring

Ecological restoration needs ecological theory, but scientists sometimes neglect to consider that restoration helps develop or revise theory. Lake Lugano, a peri-Alpine lake undergoing restoration from eutrophication, showed some surprising changes, prompting us to renew our insights about lake ecology. I will focus on two areas of community ecology—the driver-response relationship and the trophic structure-resource relationship. I will compare textbook models of these relationships with patterns observed in monitoring data for some key ecosystem features, including food-web structure, trophic structure, and primary productivity. The examples will show how some of the patterns appear surprising or even paradoxical when compared to conventional wisdom. These patterns, along with trends observed in other peri-Alpine lakes, are expanding our understanding of lake ecology. In turn, a better understanding will help us adapt restoration measures and increase the chances of restoration success. A more integrated interrelationship will benefit both ecological theory and ecological restoration.

Patricija Mozetič

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https://scholar.google.com/citations?user=0KzXa2gAAAAJ&hl=sl

Biosketch

Assoc. Prof. Dr. Patricija Mozetič was awarded a Ph.D. in biology in 1997 at the University of Ljubljana (Slovenia). Her research activities cover the study of the role of phytoplankton in coastal pelagic food web (diversity, biomass, and abundance of phytoplankton, photosynthetic properties and primary production), study of harmful algal blooms, long-term changes in phytoplankton community in relation to climate change and eutrophication and implementation of the EU directives (WFD and MSFD) in the national water policy. In 2018, she was appointed head of Marine Biology Station Piran. For more than a decade, she was being assigned the leader of two national monitoring programs. She attended several phytoplankton courses, joined the Spanish scientific expedition Malaspina 2010 and obtained grants as a visiting scientist in Italy and the USA. From 2002 onwards, she is the national representative of the Intergovernmental Panel on Harmful Algal Blooms of the UNESCO IOC-HAB program. Since 2013, she is also employed at the University of Primorska and holds lectures at undergraduate and master's study programs. She was the mentor of three Ph.D. students. Until now, she published 58 scientific and professional articles, 3 chapters in monographs, 70 presentations at scientific meetings.

Selected publications

Brush, M.J., Mozetič, P., Francé, J., Bernardi Aubry, F., Djakovac, T., Faganeli, J., Harris, L.A., Niesen, M. 2021. Phytoplankton dynamics in a changing environment. In: Malone, T.C., Malej, A., Faganeli, J. (eds.). Coastal ecosystems in transition: a comparative analysis of the northern Adriatic and Chesapeake Bay, (Geophysical monograph series). AGU: Wiley.

Mozetič, P., Cangini, M., Francé, J., Bastianini, M., Bernardi Aubry, F., Bužančić, M., Cabrini, M., Cerino, F., Kraus, R., Marić Pfannkuchen, D. et al. 2019. Phytoplankton diversity in Adriatic ports: Lessons from the port baseline survey for the management of harmful algal species. Marine Pollution Bulletin, 47, 117-132.

Mozetič, P., Francé, J., Kogovšek, T., Talaber, I., Malej, A. 2012. Plankton trends and community changes in a coastal sea (northern Adriatic): bottom-up vs. top-down control in relation to environmental drivers. Estuarine, Coastal and Shelf Science, 115, 138-148.

Mozetič, P., Solidoro, C., Cossarini, G., Socal, G., Precali, R., Francé, J., Bianchi, F., De Vittor, C., Smodlaka, N., Fonda Umani, S. 2010. Recent trends towards oligotrophication of the Northern Adriatic: evidence from chlorophyll a time series. Estuaries and Coasts, 33 (2), 362-375.

Turk Dermastia, T., Cerino, F., Stanković, D., Francé, J., Ramšak, A., Tušek-Žnidarič, M., Beran, A., Natali, V., Cabrini, M., Mozetič, P. 2020. Ecological time series and integrative taxonomy unveil seasonality and diversity of the toxic diatom Pseudo-nitzschia H. Peragallo in the northern Adriatic Sea. Harmful Algae, 93, 101773.

Zingone, A., Escalera, L., Aligizaki, K., Fernández-Tejedor, M., Ismael, A., Montresor, M., Mozetič, P., Taş, S., Totti, C., 2020. Toxic marine microalgae and noxious blooms in the Mediterranean Sea: A contribution to the Global HAB Status Report. Harmful Algae, 102, 101843.

Long-term changes in the phytoplankton community under climate change and other anthropogenic drivers (northern Adriatic Sea)

Important information about the functioning of marine pelagic ecosystems can be derived from the study of planktonic time series. Such studies, with a historical perspective in time and space, are primarily used to distinguish unsystematic natural variability from trends or shifts in coastal ecosystems that are often associated with anthropogenic disturbances, e.g. eutrophication superimposed on climate change impacts in the last decade. The northern Adriatic Sea (NA) is a semi-enclosed coastal ecosystem characterized by sharp gradients in nutrients, chlorophyll-a, and productivity with distance from major riverine inputs of freshwater and nutrients. Due to its extensive river basin, it has long been considered one of the most productive areas of the Mediterranean, experiencing frequent episodes of various aspects of anthropogenic eutrophication in the decades from the 1970s to about 1990s, and finally undergoing cultural oligotrophication in the mid-2000s. Besides the general lowering of trophic status, evidenced by a decrease in chlorophyll-a, the most striking feature from the time series spanning more than three decades (1985-2018) is the increase in seawater temperature, particularly in the last decade in the northernmost part of the NA, the Gulf of Trieste (0.14 °C $year^{-1}$ and 0.12 °C $year^{-1}$ at the surface and above the bottom, respectively). The effect of increased temperature is most evident in precipitation, leading to alternating droughts and floods on pluriannual to multidecadal scales. These features coupled with human activities lead to unbalanced nutritional conditions in the seawater. The complexity of anthropogenic drivers and their impacts on the phytoplankton that dominate primary production in this coastal ecosystem is assessed at the community level, as changes in the phenology of phytoplankton taxa and specifically of species responsible for Harmful Algal Blooms.

Francesco Pomati

Department of Aquatic Ecology, Eawag: Swiss Federal Institute of Water Science and Technology, and Institute of Integrative Biology, ETH-Zürich, Switzerland.
https://www.eawag.ch/en/department/eco/main-focus/phytoplankton-ecology/; https://aquascope.ch/

Biosketch

I am a senior research scientist at Eawag and a lecturer at ETH-Zurich. I graduated at the University of Milan (Italy) in Ecology and obtained a PhD in Microbiology at the University of New South Wales (UNSW, Sydney, Australia). After graduation, I have been a Postdoc at University of Insubria (Italy), a vice Chancellor's Research Fellow at UNSW, a Marie-Curie Fellow and a Postdoc at Eawag, before obtaining tenure as a group leader in the Eawag department of Aquatic Ecology. I have worked on the molecular and ecological basis for the production of cyanobacterial toxins, the environmental risk assessment of water-borne micropollutants, and the environmental controls and consequences of lake phytoplankton dynamics. I have broad interests in microbial community ecology and evolution. I aim at understanding the effects of (human-induced) environmental change on plankton biodiversity, and the consequences of biodiversity change for aquatic ecosystem processes. I approach community ecology from a trait-based perspective to link individual and population responses to community and ecosystem level interactions. To achieve the above goals, I apply or develop new tools for studying microbial communities in their natural environment.

Selected publications

Merz, E., Kozakiewicz, T., Reyes, M., Ebi, C., Isles, P., Baity-Jesi, M., Roberts, P., Jaffe, J.S., Dennis, S., Hardeman, T., Stevens, N., Lorimer, T. & Pomati, F., 2021. Underwater dual-magnification imaging for automated lake plankton monitoring. bioRxiv.

Isles, P.D.F. & Pomati, F. (2021). An operational framework for defining and forecasting phytoplankton blooms. *Front. Ecol. Environ.*, in press.

Thomas, M.K., Fontana, S., Reyes, M., Kehoe, M. & Pomati, F. (2018). The predictability of a lake phytoplankton community, over time-scales of hours to years. *Ecol. Lett.*, 21, 619–628.

Fontana, S., Thomas, M.K., Moldoveanu, M., Spaak, P. & Pomati, F. (2018). Individual-level trait diversity predicts phytoplankton community properties better than species richness or evenness. *ISME J.*, 12, 356–366.

Monchamp, M.E., Spaak, P., Domaizon, I., Dubois, N., Bouffard, D. & Pomati, F. (2018). Homogenization of lake cyanobacterial communities over a century of climate change and eutrophication. *Nat. Ecol. Evol.*, 2, 317–324.

Pomati, F., Jokela, J., Simona, M., Veronesi, M. & Ibelings, B.W. (2011). An automated platform for phytoplankton ecology and aquatic ecosystem monitoring. *Environ. Sci. Technol.*, 45, 9658–9665.

Do phytoplankton dream of environmental change, or monster copepods?

The relative importance of abiotic and biotic controls in driving community dynamics is of central interest in Ecology. This is particularly relevant for plankton communities, which regulate essential aquatic ecosystem processes and services. The ecology of plankton is characterised by fast growth rates and significant temporal fluctuations in biotic and abiotic conditions, at both short and long time scales, implying non-equilibrium and nonlinear dynamics, which challenge our ability to understand mechanisms and predict community change. I will briefly review the state of the art and present some work done in our group to understand and forecast biodiversity change in phytoplankton communities, including algal blooms. I will focus particularly on ongoing work that aims at the relative importance of abiotic and biotic controls on phytoplankton dynamics using data from Swiss lakes at different scales of space and time, and on new tools to test assumptions and theories in plankton community ecology using in situ automated data and machine learning.

Antonio Pusceddu

Dipartimento di Scienze della Vita e dell'Ambiente; Università degli Studi di Cagliari
https://unica.it/unica/it/ateneo_s07_ss01.page?contentId=SHD30902

Biosketch

I'm Full Professor of Ecology and Coordinator of the Biology School at the University of Cagliari and Vice-President of the Italian Society of Ecology. I've been President (2016-2019) and Vice-President (2012-2015) of the Italian Association of Limnology and Oceanography. Formerly Associate Professor (2008-2015) and Senior Researcher (1998-2008) at the Polytechnic University of Marche (2008-2015), PhD in Marine Environmental Sciences (University of Genoa, 1997) and Degree in Biology (University of Cagliari, 1991). I coordinate the project "Marine habitats restoration in a climate change-impaired Mediterranean Sea" (2020-2022) and participated in many local, national and international projects. I carried out my research in several marine ecosystems, from transitional ecosystems to the oceans' hadal depths. My research interests deal with the trophodynamics of marine benthic ecosystems and ascertaining how they vary in response to different typologies of natural or anthropogenic disturbance, including climate change. I authored >140 articles in international ranked journals, currently score a Hirsch factor of 43 and >5000 citations (SCOPUS, April 2021). Since July 2017 I'm included in the Top Italian Scientists list (Natural & Environmental Scientists) of VIA. I'm currently the Co-Editor in Chief of Advances in Oceanography and Limnology (AIOL Journal).

Selected publications

Pusceddu A., Mea M., Canals M., Heussner S., Durrieu de Madron X., Sanchez-Vidal A., Bianchelli S., Corinaldesi C., Dell'Anno A., Thomsen L., Danovaro R. (2013) Major consequences of an intense dense shelf water cascading event on deep-sea benthic trophic conditions and meiofaunal biodiversity. Biogeosciences, 10: 2659-2670

Pusceddu A., Bianchelli S., Martín J., Puig P., Palanques A., Masqué P., Danovaro R. (2014) Chronic and intensive bottom trawling impairs deep-sea biodiversity and ecosystem functioning. Proceedings of the National Academy of Science of the United States of America 111(24): 8861-8866

Pusceddu A., Fraschetti S., Scopa M., Rizzo L., Danovaro R. (2016) Meiofauna communities, nematode diversity and C degradation rates in seagrass (Posidonia oceanica L.) and unvegetated sediments invaded by the algae Caulerpa cylindracea (Sonder). Marine Environmental Research, 119: 88-99

Bianchelli S., Buschi E., Danovaro R., Pusceddu A. (2016) Biodiversity loss and turnover in alternative states in the Mediterranean Sea: a case study on meiofauna. Scientific Reports, 6: 34544. doi: 10.1038/srep34544; ISSN: 2045-2322

Paradis, S., Pusceddu, A., Masqué, P., Puig, P., Moccia, D., Russo, T., Iacono, C. Organic matter contents and degradation in a highly trawled area during fresh particle inputs (Gulf of Castellammare, southwestern Mediterranean). Biogeosciences 16(21) 4307-4320.

Cau A., Avio G.C., Dessì C., Follesa M.C., Regoli F., Pusceddu A. 2019. Microplastics in the crustaceans Nephrops norvegicus and Aristeus antennatus: Flagship species for deep-sea environments? Environmental Pollution, 255(1), article 113107

Disentangling the ecological role of natural and anthropogenic disturbance in marine ecosystems: from detection to solutions

Disturbance can be defined as a phenomenon composed of discrete, often unpredictable, events over time which undermine ecosystems' stability through direct and indirect effects influencing the performance of individual organisms, whose consequences pervade all hierarchical levels of ecological organization. Anthropogenic disturbance has pervaded the entire biosphere and, to date, >40% of the global ocean is exposed to multiple stressors (e.g., pollution, destructive fishing practices, overfishing, aquaculture, spread of invasive species, eutrophication, oil and gas operations, offshore renewable energy search and development, coastal engineering and development). In spite of the huge conservation efforts and the continuous implementation of environmental management measures aimed at preserving marine ecosystems' abilities to produce goods and services needed for human wellbeing, the global oceans are experiencing unprecedented rates of change. In addition to these disrupting factors, climate change (CC) is severely impairing marine habitats' integrity and ecosystems' functioning. Using examples from recent research outcomes, I will delineate the potential risks of synergistic effects of natural and anthropogenic disturbance on a selection of marine ecosystems and habitats and will provide a vision on possible solutions to counteract, wherever possible, or adapt to global change effects on marine ecosystems.

Alfred Wüest and Beat Müller

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Biosketch

Since 2012, I am a Full Professor at ENAC-EPFL for the Physics of Aquatic Systems Laboratory (Margaret Kamprad Chair). My original background is in medium-energy particle physics (U of Zürich) before I turned to aquatic physics with a PhD at Eawag/EHZ-Zürich. I spend most of my scientific career at Eawag and EPFL in Switzerland besides one-year stays at UW (Seattle), UBC (Vancouver), IOS (Sidney, Victoria), and UNZA (Lusaka, Zambia). Since 1989, I was head of the Aquatic Physics Group at Eawag, where I focused on (i) microstructure observations of small-scale turbulence of boundary layers and stratified mixing as well as double diffusion, (ii) turbulence modelling and internal wave analysis and (iii) the relation of physical processes on biogeochemical cycling in lakes. The third aspect was one of my key interests and I initiated several interdisciplinary projects related to primary production (Lake Brienz, Lake Geneva) and its anthropogenic disturbance by water resources management (Lake Ohrid, Lake Kivu, etc). Besides more than 170 peer-reviewed publications with more than 10k citations, I contributed to over 2500 pages of consulting and expert services - mainly to governmental agencies. I also served in numerous national and internal activities, including editor services to AS, L&O, and WRR and I was member of the Eawag Directorate for six years.

Selected publications

Wüest, A., D. Bouffard, J. Guillard, B.W. Ibelings, S. Lavanchy, M-E. Perga, N. Pasche (2021). LéXPLORE – a floating laboratory on Lake Geneva offering unique lake research opportunities. WIREs Water, accepted

Fernández Castro, B., H.E. Chmiel, C. Minaudo, S. Krishna, P. Perolo, S. Rasconi, and A. Wüest (2021). Primary and net ecosystem production in a large lake diagnosed from high-resolution oxygen measurements. Water Resources Research, 57(5): e2020WR029283.

Krishna S., H.N. Ulloa, O. Kerimoglu, C. Minaudo, O. Anneville, and A. Wüest (2021). Model-based data analysis of the effect of winter mixing on primary production in a lake under reoligotrophication. Ecolog. Modelling. 440: 109401

Müller, B., T. Steinsberger, A. Stöckli, and A. Wüest (2021). Increasing carbon-to-phosphorus ratio (C:P) from seston as a prime indicator for the initiation of lake reoligotrophication. Environmental Science & Technology, 55(9), 6459–6466.

Steinsberger, T., A. Wüest, and B. Müller (2021). Net ecosystem production of lakes estimated from hypolimnetic organic carbon sinks. Water Resources Research 57(5): e2020WR029473.

Steinsberger, T., R. Schwefel, A. Wüest, and B. Müller (2020). Hypolimnetic oxygen depletion rates in deep lakes: Effects of trophic state and organic matter accumulation. Limnology and Oceanography 65(12): 3128–3138.

Müller, B., T. Steinsberger, R. Schwefel, R. Gächter, M. Sturm, and A. Wüest (2019). Oxygen consumption in seasonally stratified lakes decreases only below a marginal phosphorus threshold. Scientific Reports, 9: 18054.

Schwefel, R., B. Müller, H. Boisgontier and A. Wüest (2019). Global warming affects nutrient upwelling in deep lakes. Aquatic Sciences 81(3): 50, Doi: 10.1007/s00027-019-0637-0.

Schwefel, R., T. Steinsberger, D. Bouffard, L.D. Bryant, B. Müller, and A. Wüest (2018) Using small-scale measurements to estimate hypolimnetic oxygen depletion in a deep lake. Limnology and Oceanography 63(S1): S54–S67, doi: 10.1002/lno.10723.

Does productivity decrease as phosphorus levels drop?

I am now at the end of my career as a lake research scientist to Eawag and EPFL – and this question was in the background behind the set design of my entire scientific activity. This question is motivation twofold: (i) With the phosphorus levels decreasing since the early 1980s, the water quality responsibles of Governmental agencies were constantly looking out for answers whether the management goal of «medium productivity» is achieved or whether additional measures are needed to reduce nutrient inflows to lakes? This question became more urgent in Switzerland as the professional fishermen started to complain that catches dropped disproportionally during the last decade. (ii) For various reasons, it is expected that the physical environment of the surface layer affects productivity. With lakes developing towards reoligotrophication, the recycling of nutrients by deep winter mixing and the seasonality of nutrient inflows become increasing relevant as the nutrient stock in lakes are dropping. My goal for this talk is to create a unified framework for what we have learned over the past two decades and give an outlook what the newly established LéXPLORE Platform on Lake Geneva can provide to this fascinating topic.

COMUNICAZIONI ORALI

Bacterial taxonomic and functional diversity in the Venice lagoon water-sediment interface

Elisa Banchi (1)*, Cecilia Balestra (1), Matteo Bazzaro (1), Annalisa Franzo (1), Federica Relitti (1), Alessandro Vezzi (2), Paola Del Negro (1), Mauro Celussi (1), Francesca Malfatti (1,3)

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(2) Dipartimento di Biologia, Università di Padova, via Bassi 58/B, 35131 Padova
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In the marine environment, the microorganisms that live at the water-sediment interface play an essential role in the deposition of organic matter and nutrient cycling, as well as in the biomass, diversity, and ecosystem functioning. In this study, we aimed at deepening the knowledge of the microbial communities living at the water-sediment interface in the Venice Lagoon, one of the largest coastal transitional ecosystems in the Mediterranean Sea, with a focus on biogeochemical cycles and anthropogenic-related pressure. During 2019 and 2020, we carried out seasonal sampling in five stations characterized by different levels and sources of pollution and covering the four sub-basins of the Venice Lagoon. DNA metabarcoding and metagenomics were used to finely characterize the microbial communities. At the taxonomic level, the communities clustered mainly based on the sampling area, and the biodiversity was mostly shaped by the numerous low abundant taxa. Significant differences in functions related to key oceanic markers, contaminants, pathogenicity, and antibiotic resistance were also detected. These data will provide new insights on the spatial and temporal distribution and the dynamics of the microbial communities in the Venice Lagoon in terms of biodiversity, functions, and metabolisms.

Restoration actions under Covid-19 pandemia: possible positive effects on the success

Silvia Bianchelli (1)*, Fabio Rindi (1), Marco Lo Martire (1), Davide Ippoliti (1), Ettore Nepote (1), Francesco Martini (1), Simonetta Fraschetti (2), Roberto Danovaro (1,3)

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Macroalgal forests composed by fucalean brown seaweeds of Cystoseira, Ericaria, and Gongolaria form one of the most complex, productive and vulnerable shallow-water habitats in the Mediterranean Sea. These forests are rapidly regressing with negative impact on the associated biodiversity and ecosystem functioning. In this study we carried out a pilot restoration action of *Gongolaria barbata* along the Monte Conero coast (Western-Central Adriatic Sea, Mediterranean Sea), under different conditions of human impact (i.e., presence of a harbour, urbanization, and tourism) and natural characteristics (i.e., different levels of exposure). To perform the experiment, we took advantage of the lockdown imposed during the Covid-19 pandemic, which possibly contributed to the healthy condition of the donor population of *G. barbata* growing in a large rock-pool near Ancona town and to the efficient recruitment with lower human pressures during the spring months. Numerous new recruits were found also on many small boulders, used for transplanting in the selected sites. The experiment is still ongoing and the first results confirm the feasibility of this approach (allowing to avoid any laboratory cultures). We observed different growth rates depending on the features of the experimental site, with the maximum observed in the site farthest from the city, with potential positive effects also on the associated benthic fauna and possible implications in assessing restoration thresholds along gradients of human pressures.

Biogeographic differentiation of mixoplankton along the Campania coasts

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Protistan plankton (i.e., unicellular eukaryotes) were traditionally classified as either phytoplankton or micro-zooplankton. Over the last decade, the phytoplankton-zooplankton dichotomy appeared as outdated, because most protistan plankton were described as mixotrophs, capable of both photosynthesis and phagocytosis – i.e., the so called "mixoplankton". In virtue of their innate biological properties, these organisms are now considered important players in planktonic food webs, as they can induce a substantial switch in the pathway of carbon fluxes. In this contribution, we assessed the status of the mixoplankton compartment along the coasts of Campania region during oceanographic cruises carried out in the Gulf of Gaeta, Napoli, and Salerno, during the same season (i.e., autumn). Water samples at two depths (0 and 10 m) were inspected in light microscopy, protistan plankton were counted, and biodiversity indexes were compared with physical conditions of the water column, inferred from both direct (CTD profiles) and indirect measurements (satellite data), plus geomorphology of the coast, such as proximity of rivers. Considering both vertical and horizontal differentiation between mixoplankton communities, also in terms of the relative dominance of mixotrophic vs. heterotrophic taxa, we discuss the potential functioning of the plankton food web deriving from the multifaceted biodiversity that we detected.

Quantity, biochemical composition, and degradation rates of organic matter in coastal marine sediments areas affected by different levels of bottom trawling impact

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Bottom trawling (BT), one the most concerning anthropogenic disturbances affecting oceans worldwide, can have severe effects on benthic biogeochemistry, the magnitude and direction of which, however, are not consistent across areas, regions and oceans. We tested the null hypothesis by which quantity, biochemical composition, and degradation rates of organic matter (OM) in coastal marine sediments (Baltic Sea) do not vary across a BT gradient, including levels of low, intermediate, and high BT impacts, identified after a MDS inspection of VMS data and a set of environmental variables (nutrients, oxygen and depth). Sediments were analysed in terms of protein, carbohydrate, lipid and phytopigment contents and C degradation rates. OM contents were highest in the top 2 cm of highly impacted grounds, but no significant differences were observed among levels of BT impact in deeper sediment layers. BT highly impacted sediments showed a rather different biochemical composition, due to higher protein and carbohydrate contents. C degradation rates were highest in highly trawled sediments, where, however, C turnover were slower. Our results confirm that BT can exert severe effects on sediment biogeochemistry, with potential consequences on the overall ecosystem functioning of coastal benthic ecosystems.

Shallow hydrothermal vents: natural laboratories for global environmental change research

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A major goal of global environmental change research is to determine the effects of the main drivers on species and communities, and whether organism's biological responses persist and are maintained at levels that are similar to, or different from today. To this purpose, several studies were conducted on marine hydrothermal vents, unique extreme environments considered as natural proxies to evaluate future ocean's scenarios. Shallow hydrothermal systems, characterized by temperature and pH alterations, allow to conduct short or long-term studies on organisms that are ecologically and evolutionarily adapted to these extreme conditions, providing insight into the community- and ecosystem-level responses, and identifying species with functional traits that allow them to tolerate the conditions of future marine ecosystems. Here we report trends of taxonomic and functional biodiversity of benthic invertebrates along gradients of ocean acidification in shallow hydrothermal systems of the Aeolian Islands (Italy), evidencing a general shift towards loss of biodiversity and consequently alteration of ecosystem functioning, such as a simplified trophic web. At the same time, we will also point attention to rare and new species that, able to cope with the extreme conditions of these volcanic-derived systems, seemed to opportunistically exploit empty niches reaching abundances never observed in other areas.

Microbial pollution and antimicrobial resistance associated with urban wastewaters treatment plants in the Adriatic Sea

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Poorly treated sewage still represents a large fraction of the wastewaters released into the Mediterranean, with potential multiple adverse impacts due to the introduction of microbial pollutants, pharmaceutical substances with antimicrobial properties, nutrients, and contaminants. The Interreg project AdSWiM aims at improving coastal marine water quality by improving sewage treatments and by a managed use of treated wastewaters. Wastewater treatment plants (WWTPs) discharging into the Adriatic Sea and with different purification efficiencies are here investigated as a source of microbial pollutants of emerging interest. Effluents of WWTPs and their receiving marine waters have been analysed for their bacterial community composition, for faecal indicator bacteria and for the concentration of antibiotic resistance genes (ARGs). Where sewage is subjected only to primary treatments (e.g. mechanical removal of solids) the respective marine receiving waters i) share high numbers of molecular OTU with the plant effluents, ii) faeces and sewage associated bacterial taxa are found in larger proportions, and iii) have higher concentrations of ARGs. While the type of sewage treatment can have a substantial effect in maintaining a good environmental state, WWTPs still may represent a major source of ARGs, which may result in the emergence and selection of resistant bacteria.

Towards the harmonization of the fragmented approach to environmental monitoring and conservation: first insights from the marine ecological observatory of the Adriatic Sea

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Marine Ecological Observatories (MEOs) are conceived as platforms able to support marine monitoring and conservation strategies, and their design and establishment is fostered at the European level. Indeed, the data and knowledge collected and made available through MEOs can inform policies dealing with monitoring, conservation, and management of the marine environment. This is possible when MEOs adopt a holistic view by integrating and harmonizing long-term oceanographic and ecological research and monitoring programmes according to the ecological connectivity concept. We present and discuss these issues in the context of the Adriatic Sea, where the ecological observatory "ECOAdS" is under development in the framework of the Interreg Italy-Croatia project ECOSS (Observing System in the Adriatic Sea: oceanographic observations for biodiversity). We here evaluate synergies and discrepancies among diverse EU environmental directives in force, notably the Habitats and Birds Directives, the Water Framework Directive, and the Marine Strategy Framework Directive, to inform the building of the observatory and to strengthen the cooperation between marine conservation and monitoring at the basin scale. We start assessing how ECOAdS may respond and contribute to the directive requirements, highlighting which are the main gaps that need to be addressed and delivering some hints for its further developments.

High contribution of dark inorganic carbon uptake to microbial carbon cycling in a shallow Mediterranean basin

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Microbe-mediated dark dissolved inorganic carbon (DDIC) assimilation is of substantial importance for organic matter cycling in the marine environment. By oxidizing reduced inorganic compounds, chemolithoautotrophic microbes fix dissolved inorganic carbon (DIC) to produce the organic compounds fuelling their growth. DIC uptake is also involved in heterotrophic processes, like anabolic pathways and anaplerotic reactions, the latter used to replenish metabolic pathways intermediates. Aiming to decipher the contribution of these metabolic pathways in the coastal northern Adriatic Sea, we measured surface and bottom DDIC uptake rates for 2.5 years at monthly intervals. Alongside, key biogeochemical parameters, including heterotrophic carbon production (HCP) and microbial community dynamics were assessed. DDIC uptake rates represented a variable, but occasionally substantial, (4-33%) fraction of the microbial carbon production (i.e., DDIC uptake + HCP rates). HCP and DDIC uptake rates were strongly correlated, suggesting that a considerable fraction of the observed DDIC fixation rates derived from anaplerosis. Multivariate analysis revealed that DDIC uptake rates and organic matter dynamics were weakly linked; a stronger association was found with ammonia concentration in bottom samples, suggesting an increased chemoautotrophy importance. Higher Archaea relative abundance coupled with higher DDIC contribution to microbial carbon production in these samples would support this hypothesis.

The potential role of the sea cucumber *Holothuria tubulosa* on sedimentary protein loads and degradation rates

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Holothuria tubulosa Gmelin 1788, is one of the most common sea cucumbers in the Mediterranean Sea, generally associated with organically enriched coastal sediments and seagrass beds. As a large deposit-feeder, it is responsible of strong bioturbation processes and play a putative key role in sedimentary carbon cycling and benthic trophodynamics. With the final aim of exploring the potential use of *H. tubulosa* as a tool for remediating eutrophicated sediments, we investigated the contents and degradation rates of sedimentary proteins extracted from the esophagus and the end gut of sea cucumbers collected in two sampling sites (Gulf of Teulada and Oristano) characterized by contrasting sediment grain size and sedimentary organic loads. In the sea cucumbers from both sites, protein contents and degradation rates in sediments extracted from the esophagus were significantly higher than those in the end gut. We estimated that *H. tubulosa* has the potential to assimilate from 10 to 75% of the ingested sedimentary proteins. These results confirm that sea cucumbers can behave as benthic "bioreactors" and thus, possibly, be used for restoring eutrophicated sediments, like those beneath mariculture plants.

The role of intraspecific morpho-functional trait variability in marine phytoplankton responses to changing nutrient scenarios

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Nutrient limitation is expected to increase in the future ocean driven by intensified water column stratification due to increasing temperature. High variability in phytoplankton morphology at inter- and intra-specific level is a powerful strategy to cope with changing nutrient conditions. Nine genotypes of the diatom *Chaetoceros affinis* were incubated in the short-term at seven nitrate regimes to study the intraspecific morphological trait dynamics. Preliminary results suggest a significant intraspecific cell size and S/V variability of the diatom which can be explained by both plasticity of genotypes and to a larger extend by differences in mean trait values among genotypes. This significant variability allowed to group the cells into four morphotypes diverging in diameter size. Comparable intraspecific morphological variability of the diatom was also observed over a previous long-term experiment with a community consisting of *C. affinis* and the coccolithophore *Emiliania huxleyi* with nine genotypes each, treated with three nitrate conditions. Here, plasticity played a more important role to explain morphological variability among the remaining *C. affinis* genotypes compared to the short-term. Results on the still ongoing analyses will be important to understand the potential importance of phytoplankton intraspecific phenotypic variability in changing environments which is still poorly studied.

Are metabarcoding data useful to reconstruct food webs in pelagic systems?

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Metabarcoding data are increasingly used to derive statistical co-occurrence networks, which can show how a community is divided into sub-communities of organisms frequently found together. In this study, we explore the usefulness of this type of data with the aim of understanding if and to what extent such co-occurrences can be informative for trophic interactions and food web structure. We analyzed two published co-occurrence networks describing winter and autumn pelagic communities from Monterey Bay (California). By revising the literature about the biological characteristics and diets of the taxa, we i) assigned to each co-occurrence between taxa a degree of plausibility, and ii) used the most plausible links to assemble trophic networks. Overall, we found a total of ~39% and ~28% of potentially trophic interactions within the winter and autumn networks, respectively. Furthermore, 90% and 100% of the obtained winter and autumn trophic networks were composed of plankton with a relevant presence of mixotrophic organisms participating in several interactions. We then analyzed the structural properties and the roles of the taxa of these networks and found that the structure of metabarcoding-derived food webs showed a trophic hierarchy that is generally found in planktonic food webs derived from different approaches.

Impact of a simulated Marine Heat Wave on quantity, composition and degradation rates of sedimentary organic matter

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Marine heatwaves (MHWs) occurrence is increasing due to global warming. Since marine coastal sediments are hotspots of C cycling, MHWs are expected to affect coastal biogeochemistry. We exposed coastal sediments to a simulated MHWs, generated by a warm water plume released by an electric power plant in NW Sardinia (Mediterranean). The effects of +2°C and +6°C anomalies were studied, using a BACI design, after 3 and 11 weeks from the plume release. We observed temporal changes in sedimentary organic matter (OM) features, which were clearly influenced by the MHW, but primarily in response to the largest T anomaly. Biopolymeric C and phytopigment contents increased after the MHW release, then recovered to pre-event conditions after 11 weeks. In the short term, protein and carbohydrate degradation rates decreased and increased, respectively, suggesting that MHWs have different effects on different components of OM. C degradation rates decreased and C turnover time increased after the MHW, but recovered to pre-event conditions after 11 weeks. We conclude that MHWs affects OM quantity, composition, and degradation rates in the short-term by increasing the amount of energy available for benthic consumers but slowing down C cycling, but also that these effects are counterbalanced in longer temporal scales.

Influence of the predator *Salmo trutta trutta* on the habitat preference, community structure and growth rate of a *Cottus gobio* population

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The bullhead *Cottus gobio* is a small-sized fish widespread over most of the European continent and listed in Annex II of EU Habitats Directive for its great conservation interest. In the last decades bullhead populations suffered a widespread decline, so the species is classified as potentially endangered. Among the factors linked with this decline there are chemical pollution, habitat deterioration, and the massive introduction of salmonids. This study aims to better understand in which way the presence of the predator *Salmo trutta trutta* affects *Cottus gobio* populations. The investigation was carried out in two sites of the Nossana stream, a groundwater-fed watercourse located in the Serio catchment (Orobian Alps, Italy). The downstream site hosts a fish community constituted by both bullhead and brown trout while in the upstream site there are only bullheads. An insurmountable barrier isolates the upstream population of *C. gobio* from salmonids, while the other and environmental characteristics of the two sites are fully comparable. We evaluated the community structure, the habitat preference and the body condition of bullhead populations. The results indicate that the presence of trout decreases the abundance of younger bullheads, reduces the average adult body size and induces a bullhead suboptimal habitat occupation.

Desilt or not desilt? The effects of a sediment flushing on Alpine macroinvertebrate communities

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Sediment flushing from dams is a prescribed practice to desilt reservoirs; it helps restoring longitudinal sediment transfer continuity in rivers, but it also leads to negative ecological impacts. The Val Pusteria dam is periodically flushed into the Rienz River, in South Tyrol (NE Italy). We monitored a flushing event conducted from 27th May to 14th June 2019 by collecting macroinvertebrates 10 days before, and then 40 and 74 days after the completion of the operations and recording turbidity was recorded continuously for the entire duration of the event. We selected seven biological traits related to organism size, life cycle duration, mobility (dispersal and locomotion), feeding type, substrate and current velocity preference to characterize and compare the invertebrate communities before and after the sediment pulse disturbance. Invertebrate assemblages taxonomic richness and Shannon diversity decreased 40 days after the event, but density and richness recovered over time. Shifts in species composition were observed in post flushing samples, with a reduction in density of sensitive species and shredders. Post-flushing samples were generally characterized by sediment-tolerant taxa, able to cope with the new habitat conditions. Altered taxonomic and functional community composition following the flushing prevented the full functional recovery to pre-disturbance conditions.

Diversity of the Italian fluviolacurstrine barbels threatened by the invasion of the European barbel

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Italian peninsula significantly contributes to the global freshwater fish diversity, comprising 55 native species, 35 of which are endemic. Nevertheless, freshwater ecosystems are among the most threatened by anthropogenic activities and particularly by the invasion of exotic species. Fishes of the *Barbus* genus are good models to represent this situation in Italian rivers. Six endemic species of this genus are recognized in Italian running waters, with two of these having been recently established. Conservation of these species is triggered by the invasion of the European barbel via genetic pollution due to introgressive hybridization. The biological and ecological impacts of genetic introgression have received relatively less consideration and here we present a multidisciplinary approach aimed to address these aspects. Through analysis of the nuclear and mitochondrial DNA, two populations were identified as purebred while other two revealed 43% to 84% *B. barbus* alleles. Then significant alteration of morphology, biological traits and trophic ecology (as per stable isotopes and gut content analyses) were found suggesting element of hybrid vigour and a functional role shift of those fish with a higher proportion of *B. barbus* genome. The results have important implication for the conservation of endemic barbels and their habitat.

Siltation and stream macroinvertebrates: from the community response to the development of a stressor-specific biomonitoring index

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Siltation (i.e. the excessive and unnatural accumulation of fine sediment) is recognized as one of the most diffuse impacts in rivers, due to the intensification of hydro-morphological (i.e. dams, water abstraction, climate change) and land-use (i.e. deforestation, agriculture, urbanization) alterations at local and watershed scale. Here, we present an overview of our studies dealing with the response of benthic invertebrate communities to fine sediment in Alpine streams (Northwestern Italy). Combining results from a manipulative experiment with controlled conditions and three field studies, we first evaluated the main effects of the accumulation of fine sediment on macroinvertebrate communities in terms of composition and structure. Then, the resulting most sensitive metrics were statistically aggregated into a multi-metric and stressor-specific index (SILTES – Siltation Index for LoTic EcoSystems), which encompassed a mix of taxonomical and functional metrics. Finally, two independent case studies on sediment flushing operations from reservoirs were used to validate this new-developed index and compare its performance with other routinely applied indexes. Findings of these works provide useful insights for biomonitoring the effects of man-induced siltation in streams and contribute to improve the diagnostic ability concerning stressor-specific alterations.

Alpine streams: problems and management perspectives between global changes and local pressures

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Italy is one of the richest European countries in terms of diversity and abundance of running waters. Alpine rivers are particularly interesting, for their environmental characteristics, high biodiversity, landscape, but also for their vulnerability. Alpine rivers are characterized by a unique biota, which is extremely adapted to severe environmental conditions, and are of primary importance to provide ecosystem services and good water resources. However, in recent years numerous threats are progressively altering the natural conditions of these systems. First, there are factors acting on a global scale, such as climate change. Water temperature increases directly threaten the alpine biota, typically stenothermal, and together with the alterations of precipitations which modify the flow regimes, they enhance the occurrence of hydrological extremes (droughts and floods). Furthermore, at the local level, even if Alpine lotic systems have been traditionally characterized by a low anthropic impact, in recent times these environments have been increasingly threatened by withdrawals in dams and reservoirs used for hydropower, irrigation, drinking water, recreation (artificial snow) that are altering the hydromorphology of these environments. Some suggestions to counteract these threats will be presented, such as habitat restoration projects, innovative monitoring systems, development of research centers, dissemination initiatives and innovative management approaches.

Using macroinvertebrates functional information to assess flow alteration in rivers

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Macroinvertebrates are frequently used for river biomonitoring through the development of specific biological indices. However, most historic approaches are limited in terms of their geographical application in other areas due to taxonomic constraints. Here a new trait-based index, Flow-T, based on the flow preferences of invertebrate taxa is presented. Flow preferences based on the ecological “current velocity” traits proposed by Tachet et al. (2010) and available for nearly 500 invertebrate taxa were obtained. The newly developed index was tested on a range of different river types from UK, Cyprus and Italy to evaluate its response in different biogeographic and hydro-climatic regions. Flow-t index displayed significant correlations with LIFE (Lotic-invertebrate Index for Flow Evaluation) in all countries examined. Furthermore, it was sensitive to the flow conditions within different aquatic mesohabitats (e.g., pools, riffles, glide). Flow-t can potentially be applied where information on hydraulic preferences of macroinvertebrate taxa are not available providing a highly flexible and geographically generalizable approach. Flow-T represents a promising flow sensitivity index that is applicable at the European scale and allows inter-regional comparisons that will help water resource managers to gauge the effects of changes in the pattern of flow at the local scale.

Combining hydrologic simulations and stream-network models to reveal flow-ecology relationships in a large Alpine catchment

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Flow regimes profoundly influence river organisms and ecosystem functions, but regulatory approaches often lack the scientific basis to support sustainable water allocation. In part, this reflects the challenge of understanding the ecological effects of flow variability over different temporal and spatial domains. Here, we use a process-based distributed hydrological model to simulate 23 years of natural flow regime in 100 bioassessment sites across the Adige River network (NE Italy), and to identify typical nivo-glacial, nivo-pluvial, and pluvial reaches. We then applied spatial stream-network models (SSN) to investigate the relationships between hydrologic and macroinvertebrate metrics while accounting for network spatial autocorrelation and local habitat conditions. Macroinvertebrate metrics correlated most strongly with summer, winter, and temporal variation in streamflow, but effects varied across flow regime types. For example (i) taxon richness appeared limited by high summer flows and high winter flows in nivo-glacial and pluvial streams, respectively; (ii) invertebrate grazers increased proportionally with the annual coefficient of flow variation in nivo-glacial streams but tended to decline with flow variation in pluvial streams. Although local land-use and water quality also affected benthic communities, most variation in macroinvertebrate metrics was associated with spatial autocorrelation. These findings highlight the importance of developing environmental flow management policies in ways that reflect specific hydro-ecological and land use contexts. Our analyses also illustrate the importance of spatiallyexplicit approaches that account for auto-correlation when quantifying flow-ecology relationships.

Mussel behavior as a tool to measure hydrological stressors

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Freshwater mussels are considered suitable bioindicators and used in real-time remote monitoring systems to detecting disturbances on ecosystems. One of the most successful methods is the valvometric technique that exploits the Hall sensor to measure the valve gaping behavior of mussels. The duration and frequency of valve opening amplitude and closure can therefore be recorded. These technologies have been used in the past to detect pollutants in the water, whereas studies that address the impact of hydromorphological pressures are still lacking. The main aim of the present study is to assess the influence of flow with sediment transport as well, both in steady and in unsteady (transient) conditions, in four endpoints of mussel's behavior: normal activity, resting, transition and avoidance. To this aim, experiments in laboratory flumes with mussels on a bed made of sands, for varying flow discharges, have been conducted. Results suggest that during transients and in the presence of sediment transport, mussels change their behavior, showing an increase of their valve opening-closure frequencies and amplitudes. These results are encouraging to support the use of mussels as biosensor also in their natural habitat (rivers or lakes) to monitor the occurrences of natural events involving hydro-morphological variations, as floods.

Po river basin land-use/land-cover (LULC) change effects on water quality

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Water consumption and water quality are influenced principally by anthropogenic pressures. Furthermore, hydrological cycle is modified by climate change which accentuate the anthropic impacts. Changes in terms of Land-Use/Land-Cover (LULC) pattern is considered one of the main drivers for water quality degradation. This study aims to analyse the relationship between LULC and Po basin water quality. To analyse LC changes and LU intensification maps of Po river basin from 1960 to 2018 were used. Po river is the main river in Italy and its basin covers 82.788 Km² of the national territory. The results showed agriculture intensification and urbanization as the main LULC changes. Moreover, the results emphasize pasture loss due to their abandonment, but also grassland and some agricultural field (i.e. rice field, orchard, etc.) decline. Agriculture intensification, mainly arable land and farm animal, and artificial pattern such as urban area expansion lead to an increase in terms of fertilization rates and urban waste. The results highlight that LC changes and LU intensification can influence water quality. Furthermore, the different LULC can have different impacts related to the pollutant origin. Lastly, the results might aid water management.

Impact of larger dams on freshwater distribution of *Anguilla anguilla* (L., 1758)

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The European eel *Anguilla anguilla*, (L. 1758) is a catadromous, migratory, Critically Endangered, and protected species (EU Regulation 1100/2007). Its complex life cycle exposes this species to anthropogenic threats determining, since 1970s, a progressive decline. Among those factors, habitat loss and fragmentation caused by dams are the most threatening. We analyzed the effects of larger dams (height > 15 m) on the historical (1940-1970) and current (2016-2020) distribution of *A. anguilla* within the Sardinian hydrographic district (Italy). The species occurred in 92% and 7% of the total catches in the past and recent inventories, respectively, suggesting a collapse by ca. 85%. Using Boosted Regression Trees (BRTs) we investigated how eels' occurrence is affected by several dams' characteristics in the Sardinian rivers' network in the two historical periods. Our results show that the eels' historical distribution was influenced by habitat fragmentation, water flow, distance from the dam, connectivity, and height of dams. The current distribution was influenced by dams age, distance from the sea and height of the dam. Our results suggest that, for an effective long-term restoration of eels, historical occurrences, wherever available, should be considered for a proper management of those factors (dams' age and height) that mostly affected their distribution.

An extraordinary research opportunity from an extraordinary sedimentation event

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On August 2017, a massive rock slope failure triggered an extreme sedimentation event in a regulated Alpine river (the Mera River). This event lasted one month with sediment concentration peaking up to several hundred g/L, and overall sediment yield of 0.4-0.8 Mm^3. A significant fraction of this sediment volume settled along the river, following a deposition pattern mostly related to the river morphology: maximum depths up to >1-2 m of deposited sediments were measured in the final section of the river, characterized by mild slope and wide cross-sections. These exceptional circumstances along with the availability of pre-disturbance monitoring data provided us with a unique opportunity to assess the impact of severe sediment loading on the riverine ecosystem. Here, we present the results of two field studies carried out during the year after the event. First, we assessed the early-stage impact of this event through a before/after comparison of benthic macroinvertebrate communities. Then we focused on the comparison between the zoobenthic community dynamics recorded in two mesohabitats (a riffle and a glide) characterized by different substrate and deposition pattern. A more coherent identification of the evolution of the channel morphology along with the recovery trajectories of the riverine communities will be expectantly supported by an ongoing INTERREG project (GE.RI.KO MERA).

Tools to assess the impacts of multiple stressors on function and diversity of a river network

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Anthropogenic impacts and hydromorphological alterations modify habitat integrity and connectivity, which support aquatic ecosystems and biodiversity. We assembled a dataset including macroinvertebrate field data collected between 2009 and 2019 from 160 sampling sites, distributed over 90 rivers/streams in Trentino. First, we classified each site by its environmental characteristics (e.g., season, elevation, stream typology) and assigned a pressure typology to each site based on the expert judgement of the Environment Agency operators and the values of the main quality indices according WFD. Thus, pressures were categorized based on the presence of hydrological, morphological, and chemical alterations, including the co-occurrence of two or more alteration types. Second, we investigated patterns in benthic community under the different pressure categories to assess relationships between the functional structure and the ecologically-relevant environmental features. The majority of stream sites were a-priori considered impacted by either one or a combination of anthropogenic alterations (~80%), with only 16% of sites in reference conditions. Hydromorphological impacts was the most common pressure significantly affecting the Adige watershed. Understanding the responses of benthic communities to hydromorphological disturbances regardless of their sensitivity to water pollution can be a useful tool in the assessment of the ecological status of Alpine running waters.

Multi-Criteria Analysis for the assessment of environmental flow scenarios released from hydropower dams in the Alpine area

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Alpine watercourses are subject to conflicting interests, related to the increasing demand for hydropower generation and the need for protecting aquatic ecosystems and natural sceneries, further exacerbated by the current and foreseen effect of climate change on the water resources availability. The use of suitable decision support systems, involving local stakeholders, can help decision-makers to achieve more sustainable solutions for such complex water management problems. In Aosta Valley (NW Italy), an experimental approach based on the use of multicriteria analysis (MCA) is being applied to identify the optimal environmental flow scenario to be released by hydropower plants. Four criteria are considered (Energy, Environment and Fishing, Landscape, Economy), quantified by a set of indicators directly related to the watercourse discharge, trying to balance the interests of different water users. Among the considered indicators, the Index of river Habitat integrity (IH), derived from the MesoHABSIM (Mesohabitat Simulation Model) methodology, is used to quantify the impacts of withdrawals on river ecosystems, with a focus on the fish population. Based on the case study of a small run-of-the-river hydropower plant, the main aspects of this procedure, which is currently applied to other thirty-two decision-making processes in the region, are presented and discussed.

SESSIONE SPECIALE 3 – Mescolamento, trasporto e dinamiche termiche in fiumi, laghi e mare: dialogo tra fisica e biologia – Sebastiano Piccolroaz, Ulrike Obertegger, Marco Toffolon, Francesco M. Falcieri

Understanding lake surface transport patterns from space: opportunities and challenges from Earth Observation and numerical modelling

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Remote sensing has been widely used to monitor lake water quality by providing maps of turbidity, chlorophyll, and water temperature. However, an accurate knowledge on the flow field is fundamental for understanding the transport dynamics underlying nutrients pathways and water quality in lakes. Such information has been so far obtained only through in situ measurements and numerical models. We combine Earth Observation (EO) and numerical modeling methods to infer lake surface transport. Our case study is Lake Garda (Italy), where a long-term dataset of satellite imagery and a validated 3D hydrodynamic model are available. We first extract qualitative information on the flow field from optical derived products. Thermal and turbidity maps are analyzed together with numerical results to understand horizontal and vertical exchanges of water. We then move to microwave sensors (SAR), whose use is well established in open waters but seldom exploited in enclosed basins. We present results from an explorative study on the use of SAR sensors over lakes to extract spatially resolved surface current velocity. In this regard, the model results are used to interpret the SAR retrieved signal and to understand the limits and potentialities of EO-based methods for the quantitative estimation of lake surface currents.

What drives primary production phenology in large mesotrophic lakes?

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Primary production (PP) is a key ecosystem function in lakes. Assessments of long-term changes in PP have been linked to both top-down and bottom-up factors. However, it remains unclear how local changes (e.g., re-oligotrophication) and climate change influence PP intensity and temporal dynamic (i.e., PP phenology). Here, we obtained temporally-enhanced PP time series from low-frequency measurements, combining production-irradiance (P-I) relationships with meteorological forcings using the Python tool Softlake (https://pypi.org/project/softlake/). We then used modelled PP time series to characterize PP phenology and identify the link with physical drivers, including the duration and intensity of winter mixing, stratification onset and break-up, and meteorological variables. We applied this approach to monitoring datasets from Lakes Geneva (France-Switzerland) and Lugano (Italy-Switzerland). Winter mixing and the timing of seasonal stratification, by affecting epilimnetic nutrient replenishment, were the dominant controls of PP phenology. In the long-term, winter mixing tended to become shorter and stratification break-up occurred later in the year, leading to an earlier onset of stratification (-7 days/decade) and sustaining a longer period of moderately high PP. The tight coupling between physical drivers and primary production in large lakes shown by this work supports rising concerns about the impacts of climate change on lake ecosystems.

Machine learning identifies a strong association between warming and reduced primary productivity in an oligotrophic ocean gyre

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Phytoplankton play key roles in the oceans by regulating global biogeochemical cycles and production in marine food webs. Global warming is thought to affect phytoplankton production both directly, by impacting their photosynthetic metabolism, and indirectly by modifying the physical environment in which they grow. In this respect, the Bermuda Atlantic Time-series Study (BATS) in the Sargasso Sea (North Atlantic gyre) provides a unique opportunity to explore effects of warming on phytoplankton production across the vast oligotrophic ocean regions because it is one of the few multidecadal records of measured net primary productivity (NPP). We analyzed the time series of phytoplankton primary productivity at BATS site using machine learning techniques (ML) to show that increased water temperature over a 27-year period (1990–2016), and the consequent weakening of vertical mixing in the upper ocean, induced a negative feedback on phytoplankton productivity by reducing the availability of essential resources, nitrogen and light. The unbalanced availability of these resources with warming, coupled with ecological changes at the community level, is expected to intensify the oligotrophic state of open-ocean regions that are far from land-based nutrient sources.

Subducting filaments at fronts in the Alboran Sea: Physical, turbulent and biological evidences

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Submesoscale instabilities along oceanic fronts can cause water intrusions from the surface mixed layer into the stratified pycnocline. These are important drivers of vertical exchange that potentially play a significant impact on the transfer of physical properties and biological tracers. The CALYPSO (Coherent Lagrangian Pathways from the Surface Ocean to Interior) ONR research initiative focuses on observing and understanding coherent vertical pathways by which vertical exchange occurs. Observations (CTD, uCTD, microstructure profiles) collected in early April 2019 on the R/V Pourquoi Pas? in the Alboran sea, show that fronts in this area subduct water masses, generating intrusions. The analysis of the temperature profiles highlighted the presence of several intrusions moving along isopycnal surfaces in the proximity of the frontal areas. The intrusion signal was also clearly visible in biophysical properties with elevated Chlorophyll-a concentrations and dissolved oxygen values, well below the deep chlorophyll maximum. From a microstructure point of view, the upper and lower limits of the subducted features exhibited high turbulent dissipation rates, with values of O(10^-7) W/ m2. These dissipation rates are higher than what is generally observed at such depths and point to enhanced mixing activity at the boundaries of the intrusions that move along isopycnal surfaces.

Deep intrusions of tributaries are suppressed for increasing winter residual stratification in deep oligomictic perialpine lakes south of the Alps

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In the deep oligomictic perialpine lakes south of the Alps, full turnover events are increasingly rarer and mixing depths at the end of ordinary winters are progressively shallower. This is due to air temperature warming, leading to the increase of the residual water column stability in winter. As a result, hypoxic conditions have occurred or are on the verge of establishing in the deep hypolimnion. It is believed that the only source of hypolimnetic oxygen replenishment would be then represented by deep intrusions in winter of colder oxygenated waters from the tributaries. However, here we show that deep insertions are suppressed for increasing winter residual stratification, applying a simple algorithm calculating daily intrusion depths and mass discharges of dissolved oxygen, including turbulent entrainment, for the four main tributaries of Lake Maggiore over 1993-2020. This occurs mainly as riverine intrusions are heated up by entrained warmer stratified surface water, reaching equilibrium density at shallower depths. The entrainment phenomenon also proved itself fundamental for oxygen replenishment, leading to mass discharges of oxygen intruded into the deep hypolimnion up to more than two orders of magnitude larger than the original ones from the tributaries.

Intense ocean mixing by fish spawning aggregations

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Small-scale turbulent mixing plays a pivotal role in shaping the circulation and properties of the ocean. Despite recent advances in understanding most aspects of this role, the nature and significance of biomixing — turbulent mixing effected by marine biota — remains controversial. The main point of contention pertains to the efficiency of biomixing, which the few in situ observations available suggest to be much lower than that of geophysical turbulence or than expected from bulk assessments of biomixing's large-scale influence. Here, we shed new light on this problem by analysing high-resolution measurements of small-scale turbulence in a coastal upwelling area. We show that turbulent dissipation is elevated 10—100-fold (up to 10^{-6}-10^{-5} W kg^{-1}) every night during the 14-day measurement record due to the swimming activity of anchovy spawning aggregations. Turbulent mixing is invigorated concurrently to dissipation, and occurs with an efficiency comparable to that of geophysical turbulence. Our results demonstrate that biologically-driven turbulence can be a highly effective mixing agent, and call for a re-examination of its impacts on productive upper-ocean regions.

Microstructure observations of the summer-to-winter destratification at a coastal site in the Gulf of Naples

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A dissection of the physics of the seasonal cycle of the oceanic upper layer stratification is necessary to improve climate predictions and to constrain the response of biogeochemical cycles to the climate change. Here we present a time series of vertical profiles of epsilon, the dissipation rate of turbulent kinetic energy, obtained from a microstructure profiler at a mid-latitude 75m-deep coastal site covering the destratification occurring during the summer-to-winter period. The main signature of the destratification is a progressive deepening of the mixed layer depth (MLD) from September to November, that extended to the water-column's bottom at the beginning of winter. By grouping the data into temporal and vertical bins we found that the statistics of epsilon depend upon the time of the year and the position with respect to the MLD. A seasonal increase in storminess is correlated with the increase in intermittency of the turbulence in the mixed layer. A co-location of patches of higher epsilon with the shear maxima of the two first baroclinic modes suggests internal waves activity plays a role in setting the mixing intensity despite the lack of tidal forcing. The low-passed microstructure shear distribution seems to support this hypothesis despite possible signal contaminations. The actual origin of these energetic motions remains to be investigated. Overall, this study confirms that the variability of the stratification is ruled by several physical processes whose importance varies with the seasons. Predicting a change in stratification thus requires tackling the challenge of understanding and parameterizing these processes.

Biophysical interactions at the ocean's mesoscale: eddy and filament impacts on the marine organic carbon and oxygen cycles

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Mesoscale structures such as eddies and filaments (with typical size of 20-200 km) are ubiquitous features of the ocean's circulation and have a key role in modulating the marine biogeochemical cycles. In this talk I will illustrate the role of mesoscale eddies and filaments in shaping the marine organic carbon and oxygen cycles at the boundary of two productive coastal regions of the Atlantic Ocean: the Canary Upwelling System and the Benguela Upwelling System. Using 3D coupled physical-biogeochemical simulations, I will show that mesoscale structures have a key role in the lateral relocation of the organic carbon produced along the coast of the Canary Upwelling System: narrow coastal filaments drive 80% of the organic carbon flux from the coast towards the open ocean, while eddies extend this flux towards the middle of the North Atlantic gyre, shaping the open ocean biological activity. Using high-resolution glider data collected in the Benguela Upwelling System, I will also illustrate the set of mechanisms through which mesoscale eddies can give rise to low oxygen events in the waters adjacent to the upwelling system, discussing the different role of eddy trapping, stirring and enhanced remineralization.

Role of spatial variability, data availability and operative application in the production of lake evaporation maps. A combined remote sensing and numerical modeling study

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We present an Earth Observation based methodology (EO-LSEv) for the retrieval of evaporation rates from water surfaces. The proposed model uses satellite derived surface water temperatures and meteorological data (i.e. wind speed, air temperature, relative humidity) for estimating the heat flux associated to evaporation at satellite overpasses, based on the bulk transfer theory (Dalton's law). A simplified energy balance equation is also computed exploiting satellite reflectances in the VIS-SWIR spectral range. Through the integration of the energy balance equation over 1hr time intervals, EO-LSEv can also compute daily evaporation rates from a lake. In this work we applied the EO-LSEv model to Lake Garda (Italy) and compared its outputs with the results of the hydro-thermodynamic model (Delft3D) forced by an atmospheric model (WRF).
In order to achieve the best benefit from remote sensing techniques (e.g. repeatability and independency from in-situ measurements), we investigated the sensitivity of EO-LSEv to different meteorological data sources (i.e. in situ weather stations and freely available climatic models).
The evaporation rates estimated from EO-LSEv are consistent with those modelled with Delft3D when the same weather forcing is used. The role of the spatial distribution of the weather forcing (especially wind) is investigated under an operational perspective.

Lake Caldonazzo, effects of re-oligotrophication and climate change on lake thermal structure, the past and the future

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During recent decades, climate change and re-oligotrophication have been affecting many lakes. Lake restoration frequently involves smaller lakes (<10 km^2) that are often overlooked in long-term limnological studies despite their importance for local stakeholders. In 2016, we published a study on the interplay between re-oligotrophication and climate change on the thermal structure of Lake Caldonazzo (Italy – southern Alps; area = 5.6 km^2; maximum depth = 49 m) for the years 1973–2014. This study verifies predictions made with new data concerning the period 2014 – 2020. Even though new data were not taken at the same months than for the published study, predictions made were supported by new data. For example, hypolimnetic oxygen increase did not continue and showed a stagnant period after the year 2000, identifiable only with the longer dataset. Hypolimnetic cooling remained stable, beyond the year 2015. Even though predictions made were accurate, the continuous monitoring of Lake Caldonazzo, an important tourist attraction of the area, is necessary to detect any changes in the lake trophic state because of eutrophication-like effects of on-going climate change.

Numerical investigation on water levels and velocity distribution affected by deposited large wood

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Large wood has a significant impact on the riverine ecosystem. It can be mobilized during floods or high flow conditions and can stop on the riverbanks, on river bars, at large boulders or at man-made structures. When their deposition occurs inside the active channel, an increase of the upstream water level and the formation of pools and steps is observed, contributing to the flow regime diversity and creating suitable areas for fishes. With a two-way coupled numerical model that can simulate large wood transport, a series of tests is performed in a real-scale domain within a reach of the Rienz river, where known geometry, flow conditions and wood positioning were available from previous studies. The tests are performed in fixed-bed conditions. After assessing the results and the model capabilities to replicate the test case, scenarios are modelled by varying the large wood position and orientation. Based on the different initial conditions, the variation of the depositional areas is recorded, also considering the interaction with existing large boulders. Then, for a selected scenario, a detailed analysis of the flow velocity distribution upstream of the deposited logs is carried out.

CO_2 fluxes in a large perialpine lake modulated by near-surface stratification, internal motions and biological processes

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Carbon dioxide (CO_2) fluxes between inland water bodies and the atmosphere largely contribute to the global carbon budget, hence influencing climate at global scale. Owing to this important role and further stimulated by the ongoing change in climate, large efforts have been devoted in the last decades to the direct measurement of such fluxes and the definition of empirical parameterizations for their quantification based on more widely available measurements of pCO_2 and atmospheric energy fluxes (i.e. wind speed). Despite the significant advancements on the topic, understanding the interplay between physical and biochemical processes governing CO_2 fluxes between lakes and the atmosphere still poses scientific challenges. This is particularly true in large systems, where complex three-dimensional processes interact at various temporal and spatial scales, questioning the assumptions underpinning gas exchange models. Here, we contribute to the understanding of such interactions with a high-resolution CO_2 flux and microstructure dataset acquired at nearly weekly frequency at the floating platform LéXPLORE (https://lexplore.info/) on Lake Geneva (Switzerland-France) during the last year. The dataset shows that both fine-scale near-surface stratification and long-lasting large-scale motions are relevant in affecting CO_2 fluxes at the lake-atmosphere interface, thus challenging the application of existing gas flux models, which typically do not consider these aspects.

Modeling water temperature dynamics, a step forward in understanding the eco-morphodynamics of shallow water environments

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Water temperature is a crucial parameter for many eco-biological processes in coastal ecosystems affecting, e.g., vegetation growth or the carbon sequestration potential. Water and sediment temperature data we collected in the Venice lagoon enabled us to investigate in detail the net heat flux both at the sediment-water and air-water interface. Based on these findings we developed a spatially explicit water-temperature module to be coupled to an already existing two-dimensional hydro-morphodynamics model specifically designed for shallow water environments. We calibrated and tested the model on the case study of the Venice lagoon using both in-situ point data, which provide local information about the time evolution of the water temperature at different locations within the lagoon, and remotely sensed water temperature information that ensure an instantaneous but spatially distributed description of the process. The model proved to describe properly the water temperature dynamics in time and space ranging from the sub-daily to the seasonal timescale. Finally, we performed preliminary investigations on the role of water temperature on the micro-algae proliferation and the related sediment bio-stabilization over a shallow tidal flat using a 0-D approach as a first step towards a spatially explicit investigation of the process based on the 2-D model.

Role of manganese in the meromictic subalpine Lake Idro

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In the Lake Idro (Northern Italy), a deep (124 m) meromictic-subalpine lake, the hydrochemical data highlight three main peculiarities characterizing the meromixis: a) absence of a clear chemocline, b) presence of a high manganese/iron ratio (up to 20 mol/mol), and c) existence of a stable manganese dominated turbid stratum (40-65 m) enveloping the redoxcline (~45-55 m) in the upper monimolimnion. The contribute examines the distribution of dissolved and particulate forms of transition metals (Mn and Fe), alkaline earth metals (Ca and Mg), and other macro-constituents or nutrients (S, P, NO_3-N, NH_4-N), and discusses their behavior over the redoxcline, where the main transition processes occur. Field measurements and theoretical considerations suggest that the turbid stratum is formed by a complex mixture of manganese and iron compounds with a prevalence of $Mn^{(II)}/Mn^{(III)}$ in different forms including dissolved, colloidal, and fine particles, that give to the turbid stratum a typical white-pink opalescent coloration. The bacteria populations show a clear distribution with specific populations dwelling the mixolimnion, turbid stratum and monimolimnion. The study suggests that the upper zone of the turbid stratum could be eroded during intense weather-hydrological conditions with oxidation and partial recycle of $Mn^{(II)}/Mn^{(III)}$ to $Mn^{(IV)}$ compounds.

A minimal model to study the contrasting role of cooling and wind on the freeze-up time in lakes

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The duration of the period between winter homothermal conditions (4°C) and ice formation (0°C at the surface) in dimictic lakes depends on two main processes: water cooling due to net heat loss and wind-driven mixing of the surface layer. They play an opposite role in the inverse stratification dynamics and contribute to the large inter-annual variability observed in ice phenology. More intense cooling accelerates the rate of decrease of lake surface water temperature (LSWT), while stronger wind deepens the surface layer, increasing the heat capacity, and thus reduces the rate of decrease of LSWT. We propose a minimal model based on a simplified description of these two processes (stratification and mixing) which relies on a single calibration coefficient, the efficiency of the wind energy transfer to the change of lake potential energy. The application to five different lakes in Switzerland is discussed, and Monte Carlo simulations are used to statistically characterize the response of the lakes to the atmospheric forcings.

How to parameterize mixing processes in the marine water column

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This work is focused on the turbulent phenomena that affect physical and biological process in the Ocean Surface Boundary Layer (OSBL) with the intention of parameterizing them. The various choices that already exist to compute the vertical eddy viscosity and diffusivity coefficients were discussed and compared. In literature, these coefficients can be assumed to be either constant, or a function of the local Richardson number, or computed from a turbulent closure model. A new parameterization of the diffusivity coefficient was developed. The idea behind this parameterization is that through similarity laws based on quantities (such as the mixed layer depth and the friction velocity) calculated by operational oceanography models, it is possible to obtain information on turbulent diffusivity and therefore on the mixing of physical, chemical and biological quantities on the water column. The main actors of this parameterization are the experimental profile of the vertical velocity variance (D'Asaro, 2001) and the theorical formulation of the mixing length (Craig & Banner, 1994). This information on turbulence can be used directly for modeling the dispersion of pollutants in the marine environment with Lagrangian Stochastic Model.

SESSIONE SPECIALE 4 – La ricerca sui grandi laghi subalpini tra analisi di serie storiche di dati e nuovi approcci di studio – Michela Rogora, Nico Salmaso, Barbara Leoni

First report of cyanotoxins in benthic mats from Lake Garda

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Cyanobacteria represent a health hazard in aquatic environments due to their ability to produce a range of toxic metabolites, which can cause either immediate illness or long-term effects in both humans and animals. In the large subalpine lakes planktonic species *Planktothrix rubescens* and *Tychonema bourrellyi* are the main responsible of toxin production (microcystins and anatoxins, respectively) in pelagic environments. Considering Lake Garda, the largest Italian water basin, toxin measurements conducted in the last decade with a monthly frequency indicate a constant presence of both microcystins and anatoxins, yet at concentrations well below the safety thresholds indicated by the World Health Organization. Moreover, in this time span, anatoxin-a has become dominant, reaching annual maximum concentrations even two orders of magnitude higher than microcystins. However, a recent investigation, conducted in the frame of the Eco-AlpsWater project (financed by the Interreg Alpine Space programme), has revealed the presence of cyanotoxins also in benthic samples; in particular, remarkable quantities of anatoxins have been found in biofilms collected from rocks in different sites of Lake Garda shores. Considering that benthic cyanobacteria can grow in high abundance in mats, anatoxins can reach dangerous concentrations in this material and constitute a potential threat for people and animals nearby

Assessing the effects of water level variations on the copepod assemblages of the littoral zone of Lake Maggiore

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In this study, we aimed at assessing the effects of water level variations (± 1.06 m) on the copepod assemblages of the littoral zone of Lake Maggiore using both a taxonomy-based and a trait-based approach. To this end, we carried out an intensive sampling survey in three water level periods (high, medium, and low), in three sites (Bolle di Magadino_CH, Fondo Toce_IT and Sesto Calende-Angera_IT) and in two habitat types (dry and wet) in the summer of 2019 and 2020. The results showed that the water level variations had a relevant effect on both the taxonomic composition and the functional traits of the copepod assemblages. In particular, we assessed that the copepod abundances, body size and biomass, as well as the abundances of ovigerous females, grazer and scraper species, were higher during the high-water level period than in the periods with medium and low levels. On the contrary, in the low-level period, there was a clear dominance of omnivorous and deposit-feeder species. This pattern was, although weakly, partly determined by N-NO3 concentrations that varied significantly during the high, medium, and low levels. The study was funded by the INTERREG ITALIA-SVIZZERA project "PARCHI VERBANO TICINO - ID481668".

Two decades of limnological investigations on Lake Como: field data analysis and ecosystem modeling

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Long-term limnological data time-series are relevant tools to study the lake ecosystem evolution, at the physical, chemical, and biological level. The value of long-term monitoring data is magnified when they are used to implement process-based model applications. In such cases, monitoring data collected for institutional purposes, can find a further important research-oriented use. In this contribution we present some key findings of a long-term monitoring program and the first preliminary results of a one-dimensional modelling exercise carried out on Lake Como. Lake Como is a large-deep south-Alpine lake characterized by a peculiar Y-like shape, consisting of three main arms (i.e., northern, south-western, and south-eastern). Since 2003, monitoring data have been collected in selected stations representative of the three basins. Field data analysis underlines changes at the physical, chemical, and biological level over the last two decades and a marked spatial productivity gradient among the three basins, with the south-western one characterized by the highest values of both nutrients and algal biomass. The usefulness of coupling intensive field campaigns with three-dimensional model applications in environments with such a complex shape, will be also discussed.

Hypolimnetic oxygen depletion in a deep oligomictic lake under climate change

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Dissolved oxygen (DO) concentration is a fundamental metric to describe climate-related changes in deep lakes. Increasing water temperatures enhance thermal stratification, thus reducing the intensity of mixing processes. Growing isolation of hypolimnetic water from atmospheric oxygen leads to hypoxia/anoxia at the lake bottom, which add up to limited nutrient circulation and algal blooms as side effects of climate warming in deep basins. In this study, first we analysed the long-term (1988-2020) observed trends of DO concentrations in the oligomictic and oligotrophic deep subalpine Lake Maggiore (Italy/Switzerland), with particular emphasis on the recent dynamics, which highlight an alarming decrease of deep-water DO. Then, we simulated through GLM-AED2 (General Lake Model – Aquatic EcoDynamics) the possible effects on DO concentrations over the water column of a full overturn taking place both (i) now and (ii) after decades of hypolimnion isolation, originating from the climate warming predicted by the Swiss Climate Change Scenarios CH2011. The latter event would lead to temporary hypoxic conditions along the whole water column, threatening species living in surface layers, notably fish.

Detecting climate driven changes in chlorophyll-a in deep subalpine lakes using long term satellite data

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Lakes in the subalpine region of Northern Italy have experienced an increase in water temperature and mixing regime alteration due to climate change. Time-series of satellite chlorophyll-a concentration from four optical sensors between 2003–2018 allowed us to assess climate driven changes in phytoplankton phenology. Non-parametric multiplicative regression (NPMR) was used to analyse the changes that occurred in lakes Garda, Como, Iseo and Maggiore. In all four deep lakes there has been a disruption from a traditional pattern of a spring chlorophyll-a peak followed by a clear water phase and summer/autumn peaks. This was replaced after 2010-2012, with lower spring peaks and a tendency for annual maxima to occur in summer. There was a tendency for this switch to be interspersed by a two-year period of low chlorophyll-a. Time, air temperature, total phosphorus, winter temperature and winter values for the North Atlantic Oscillation were found as significant factors. The change from spring to summer chlorophyll-a maxima, relatively sudden in an ecological context, could be interpreted as a regime shift. The cause is probably cascading effects from increased winter temperatures, reduced winter mixing and altered nutrient dynamics. Future trends will depend on climate change and inter-decadal climate drivers.

Multi-decadal management of Lake Garda water resource

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Growing human activities and ongoing changes in hydroclimatic conditions impact a wide range of physico-chemical and biological processes of a lake. Likewise, they can also affect water resources availability with possible consequences for their management and utilization. Here, we investigate how anthropogenic and hydroclimatic stressors modified the water balance of Lake Garda over more than a century. Specifically, statistical analyses of lake levels and outflow discharges over the period 1888-2020 outlined the role of hydraulic regulation and catchment management. A significantly decreasing trend of the outflows and a relevant seasonal shift of the lake level was observed after the construction of the Salionze Dam in 1951. In addition, the annual water balance of Lake Garda was explored to assess the hydroclimatic components that have mostly controlled the lake storage variation over the period 1928-2020. The water balance components (e.g. lake evaporation, evapotraspiration in the catchment) were estimated by implementing different equations available in the literature, and the uncertainty produced on the results was evaluated together with that of the available data. Eventually, we compared the long-term trends detected in Lake Garda with those of some selected European perialpine lakes to discuss how lake management interacts with climate change and an increasing water demand.

Aspects of the historical development of studies on the deep Italian subalpine lakes

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Limnological studies on lakes Maggiore, Lugano, Como, Iseo and Garda, introduced in Italy in the early 1900s by Pietro Pavesi (University of Pavia), had first considered only the biology, transparency and temperature of surface waters, with sporadic temperature profile of the entire water column. It was only in 1928 that the first synoptic picture of the deep subalpine lakes was presented by Rina Monti. The comparative approach continued with Edgardo Baldi and Livia Pirocchi, pupils of R. Monti, and with Vittorio Tonolli, first directors of the Italian Institute of Hydrobiology. In the 1980s, an important study was carried out as part of a national project funded by the CNR. In the same decade, research groups from Italian universities began to operate on the various lakes, and in 1990s the Regional Agencies for Environmental Protections (ARPA) also started the lake monitoring. Thus, the conditions for collaborations were created, sometimes in the form of simple agreements (Informal Group of Limnology). Since 2014, the deep subalpine lakes have been included in the LTER Italy and LTER Europe networks.

Stable Isotope Analysis and Persistent Organic Pollutants in Crustacean Zooplankton: The Role of Size and Seasonality

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Zooplankton, an important carrier in transferring matter, energy, and pollutants through aquatic food webs, includes primary and secondary consumers and their relative contribution to the standing stock biomass vary seasonally. In an effort to understand pollutant dynamics in the pelagic food web of Lake Maggiore, we analysed zooplankton plurennial changes in concentration of Persistent Organic Pollutants (POPs, PCBs and DDTs) and in taxa-specific $\delta^{15}N‰$ signatures in two size fractions (≥450 µm and ≥850 µm) representative of predation of zooplanktivorous fish. The goal of the study was to verify: (1) the existence of a relation between nitrogen isotopic signatures and pollutant concentrations; (2) the predominance of size versus seasonality for concentration of pollutants; (3) the contribution of secondary versus primary consumers to carbon and nitrogen isotopic signatures. We found: (1) the $\delta^{15}N‰$ of two size fractions significantly correlated to POPs concentration; (2) the prevalence of seasonality versus size in pollutant concentrations and isotopic signatures; (3) the bulk zooplankton nitrogen isotopic signature of the two size fractions resulted from a biomass-weighted taxa-specific isotopic signature, enabling us to distinguish between the contributions of secondary and primary consumers to measured nitrogen enrichment, from which the concentration of pollutants depends.

Freshwater fish biomonitoring in the Alpine area using eDNA metabarcoding

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Many freshwater fish are experiencing critical population declines with risk of local or global extinction because of intense anthropogenic pressure and this can have serious consequences on freshwater ecosystem functioning and diversity. Current fish monitoring techniques for large rivers and lakes, however, have known shortcomings. Within the Water Framework Directive (WFD, 2000/60/EC) environmental DNA (eDNA) based methods are proving to be a promising tool for freshwater fish biodiversity assessment. Within the EU project Eco-AlpsWater, advanced high throughput sequencing (HTS) techniques are used to improve the traditional WFD monitoring approaches by using environmental DNA (eDNA) collected in Alpine waterbodies. An eDNA metabarcoding approach has been evaluated by using mock samples within an intercalibration test, and has been used to study fish biodiversity of eight lakes and six rivers of the Alpine region including four EC countries (Austria, France, Italy, Slovenia) and Switzerland. This approach, based on HTS sequencing of a section of the mitochondrial 12S rRNA, allowed to assess freshwater fish biodiversity and their distribution in the different habitats. These data represent the first attempt to provide a comprehensive description of freshwater fish diversity confirming the applicability of eDNA metabarcoding analyses for fish biomonitoring in Alpine and perialpine lakes and rivers.

Nutrient trends in a deep oligomictic lake: the role of external loads versus internal processes

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Lake Maggiore is a deep oligomictic lake belonging to the “Southern Alpine Lake” LTER site which has been studied for physical, chemical and biological aspects since the 1980s. The lake recovered from eutrophication thanks to the reduction of catchment loads and reached a stable oligotrophic status by the end of the 1990s. However, both reactive and total phosphorus have started to slightly increase since 2010, leading to a shift of the lake trophic state towards oligo-mesotrophy. This increase in phosphorus was limited to the hypolimnetic layers, concentrations being fairly stable or decreasing in the epilimnion. Reactive silica and nitrate also progressively increased in the hypolimnion, while nitrate and total nitrogen steadily decreased in surface layers, especially in the summer period. These changes were assessed in relation to catchment loads, atmospheric deposition and climate-related change in lake hydrodynamics. Long-term change in phytoplankton biomass and chlorophyll levels were also considered. Results clearly demonstrated how in the recent period nutrient dynamics became more controlled by in-lake processes, in particular stratification and mixing regime, in turn affected by climate change. Decrease of nitrogen atmospheric loads and change in phytoplankton phenology and community composition also played a role in the dynamics of nitrogen compounds.

Patterns of geographical distribution of toxigenic cyanobacterial species and oligotypes in the perialpine lake district

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Eco-AlpsWater (EAW) is a major European project co-financed by the European Regional Development Fund (ERDF) through the Interreg Alpine Space program (www.alpine-space.eu/projects/eco-alpswater). The aim of the initiative is to integrate traditional water monitoring approaches implemented in the Alpine region and in Europe (Water Framework Directive-WFD) with high throughput sequencing technologies (HTS). In this work we will present the rationale and results obtained in the Italian hydrographic network, with a focus on large subalpine lakes and cyanobacterial communities determined on samples collected in pelagic areas and rocky-shore biofilms (Lake Garda). Overall, the pelagic and biofilm samples showed distinct communities, with only a few shared species and oligotypes (amplicon sequence variants) mostly belonging to the Chroococcales. One of the most widespread pelagic species in the Italian district and the whole Alpine region was *Planktothrix rubescens*. In contrast, *Tychonema bourrellyi* showed consistent populations only in the southern subalpine lake district. The normalized DNA sequence abundances of these two species were highly correlated with the microcystin and anatoxin-a concentrations, demonstrating a high consistency of the results obtained by HTS and metabolomic profiling, and a high ability of HTS to predict the toxigenic potential due to the production of hepatotoxins and neurotoxins in inland waters.

SESSIONE SPECIALE 5 – Ecosistemi acquatici freddi: fortezze di biodiversità sotto il fuoco del cambiamento globale – Monica Tolotti, Andrea Lami, Giampaolo Rossetti

Cold refugia in warming mountains: a glimpse of hope for alpine stream invertebrates?

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Climate change is causing a rapid warming of the alpine river networks, thus threatening the survival in the long-term of cold-adapted taxa, including specialised species from glacier-fed streams. Within this context, research is increasing on the potential role of streams fed by “rock glaciers” (rocky landforms with permafrost ice) as climate refugia in warming mountains. In fact, rock glaciers are less vulnerable to air warming when compared with valley glaciers, and still support cold water conditions in deglaciated landscapes. In a high-mountain area of the European Alps (Sulden valley), we studied the hydroecology of streams emerging from rock glaciers (rock glacial), vegetated slopes (krenal) and glaciers (kryal, glacio-rhithral). Rock glacial streams were very cold (<1.5°C), and composition, abundance and diversity of dwelling invertebrates were similar to those of krenal and glacio-rhithral stream sections. Although cold-adapted EPT species were abundant in rock glacial streams, and preliminary identification of Chironomidae specimens confirmed the presence of species typical of cold environments (*Diamesa* genus), not all species present in the kryal were found in the rock glacial streams. Thus, further research is needed on rock glacial communities, to predict the fate of cold-adapted biodiversity and inform climate adaptation strategies in warming mountains.

Let’s see where they MIGHT go: a connectivity study of Antarctic fish populations by Lagrangian simulation in the Weddell Sea and Antarctic Peninsula

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Under a climate change scenario, the Weddell Sea continental shelf (Antarctica) is likely to be a sink area of biodiversity and a refugium for highly cold-adapted benthic organisms. One of the plans that are currently underway in international waters is to establish a network of marine protected areas (MPAs) at a circum-Antarctic scale. In this perspective, including the Weddell Sea in the spatial planning of MPAs in the Southern Ocean will be essential. To this aim, and considering that patterns of connectivity are increasingly recognized as relevant information to support spatial planning of MPAs, we have generated connectivity data for a range of Antarctic fish species, mainly located in the Weddell Sea and Antarctic Peninsula. We have focused on species of the sub-order Notothenioidei with different ecological habits: three species of the genus *Chionodraco* (icefish, benthic) and *Aethotaxis mitopteryx* (nototheniid, pelagic). Considering the life-history traits of the target species and the distribution of genetic variability, we have generated some hypotheses of large-scale connectivity that we have tested by using the Lagrangian module of COHERENS to simulate particle dispersal.

Contemporary and historical lake health conditions assessed through the LakePulse network: A first Canada-wide assessment of lakes

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LakePulse is an NSERC-funded network dedicated to assessing the health of Canadian lakes. To reach this goal, LakePulse sampled 664 lakes across the country and we are now analyzing these data and translating knowledge to scientists, policy makers and other stakeholders. On behalf of the network, we will review the overall structure of the program and highlight preliminary findings from analyses of biotic (e.g., plankton and subfossil assemblages) and abiotic (e.g., mercury and lead) indicators. The LakePulse network is integrating results across contemporary and historical time scales by conducting parallel analyses of samples from the water column and from natural archives preserved in lake sediment records. For example, we have found that sedimentary diatom and cladoceran assemblages showed varying degrees of change between pre-industrial and contemporary times across different ecozones. Likewise, total mercury concentrations in Canadian lake sediments showed substantial intra- and inter-regional variability, but were generally found to be in higher concentrations in contemporary sediments relative to pre-industrial conditions. Overall, the LakePulse network will provide a much-needed perspective on the spatio-temporal heterogeneity of lake ecosystems in Canada, a country that is a key steward of a significant proportion of global inland waters.

Environmental filtering on zooplankton communities across high latitude Canadian lakes

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Zooplankton are excellent indicators of the ecological integrity of lakes, given their central food web position and their long-term preservation in lake sediments. However, there is a fragmented and limited understanding of their responses and contributions given that, historically, most studies have focused on the effect of individual stressors on zooplankton communities, mediated through changes in water quality (e.g. macronutrients, temperature, or chemicals). As home to more lakes than any other nation, Canada's lakes provide an ideal study landscape to improve on the understanding of multiple factors acting simultaneously to influence zooplankton communities over extended periods of time. In the context of the NSERC Canadian Lake Pulse Network, pelagic zooplankton was sampled in 624 lakes across Canada, spanning 12 ecozones. Of these, 58 lakes were sampled in three high latitude ecozones (Boreal Cordillera, Taiga Cordillera and Taiga Plains). We evaluated the effect of 100+ environmental variables on these northern zooplankton communities using both taxonomic and functional approaches. Our results point to the combined effects of local environmental variables and lake morphometry in shaping zooplankton taxonomic and functional biogeography across northern Canadian lakes, furthering our understanding of their health status and the consequences of human perturbations.

Arctic aquatic ecosystems and environmental change impact

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Arctic ecosystems are experiencing the highest rates of climate warming. The ecological impact of climate change is being documented across Arctic aquatic ecosystems. In marine ecosystems, impact entails poleward distributional shifts and reorganization of ecosystem structure and function. In lakes, limitations on dispersal constrain the scope for redistributions, and impact of warming is manifested as change in phenology and abundance. The observed population and community level impact is mediated by individual level responses in life history and behavior, ecological interactions and ecosystem engineering. I will review direct and indirect effects of climate change, and cumulative effects of environmental stressors, on Arctic ecosystems state, functioning and vulnerability. Focusing on hotspot areas of climate warming, such as the Barents Sea and North-East Fennoscandia, I will illustrate the impact of environmental change on Arctic aquatic ecosystems using long-term studies of lakes, coastal waters, and open sea. In light of the ongoing rapid and pervasive impact of climate change in the Arctic, I will conclude on research priorities and candidate measures of climate adaptation for a sustainable management of aquatic ecosystems.

15 years of limnological research in Western Italian Alps, between science and conservation

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Several anthropogenic threats affect European high mountains lakes (HMLs) at a variable spatial scale. Climate change, glacier retreat, and long-range transported air pollutants are global/regional threats, which superimpose to some common local threats, e.g., water exploitation, point-source pollutants, and alien fish. Such disturbances can interact and alter the community composition and biogeochemical cycles of HMLs, ultimately affecting the conservation state of habitats and species of EU community importance. This complex conservation issue has been addressed with a long-term limnological study (2006-present) based in the Gran Paradiso National Park and Mont Avic Natural Park (Western Italian Alps). This study has a focus on applied conservation issues and aims at providing feasible solutions, at least for local conservation problems. For example, alien fish eradication and re-oligotrophication techniques have been experimented. At the same time, the long-term collection of chemical and biological data is populating a large dataset of ecological variables which is already providing information on the effects of global change. Our presentation is an overview of the main conservation/scientific achievements of this limnological study. We propose prevention from local threats and habitat recovery actions to mitigate the effects of both global and local anthropogenic pressures.

Coherent response of Alpine lakes to combined global warming and airborne contamination as revealed by sediment records

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Alpine lakes are considered as sentinels of climate change and ideal research-objects to investigate the ecological effects of global warming combined with anthropogenic airborne contamination. Nonetheless, the evaluation of long- term environmental and ecological lake evolution is hampered by scarce monitoring data and must rely on the palaeolimnological approach. We present the results of a sediment study, conducted on a set of mountain lakes of the southern Central-Eastern Alps, aimed at investigating the effects of the current Alpine deglaciation on lake habitat and biodiversity, and at revealing signs of airborne contamination. Radiometrically dated short cores were analysed for lithological (water and organic content), biogeochemical (C and N stable isotopes and CN content of bulk organic matter) and biological (subfossil diatoms) proxies. Lake productivity and biodiversity show clear responses to the end of the Little Ice Age and to the warming acceleration since the 1980s. The isotopic signature of sediment organic matter outlines a coherent increase in nitrogen atmospheric deposition during the last 100-150 years, in agreement with results from many lakes in the northern hemisphere. The results suggest a possible synergy between global warming and nitrogen enrichment in driving the biological changes recently observed in all the study lakes.

Diatoms assemblages in headwaters influenced by glaciers and permafrost under alpine deglaciation

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In the present context of climate warming, the influence of permafrost (soil remaining at ≤0°C for at least two consecutive years) to the Alpine hydrology is increasing, while glaciers and snowpack shrink. As observed in previous studies, water emerging from rock-glaciers (rocky landforms resulting from mountain permafrost) exhibit distinctive features (e.g. constantly cold and clear water, stable channels, high solute and trace elements concentrations) that determine characteristic habitat conditions and biotic communities. We investigated the physical and chemical conditions, and benthic diatoms assemblages during the vegetative period of two consecutive years in a set of kryal (glacier-fed), krenal (groundwater-fed) and rock-glacial (rockglacier-fed) headwaters of the Eastern Italian Alps. The three stream typologies showed distinct physical habitat, while differences in water chemistry were related to lithology, water origin and seasonality. The diatom abundance appeared inhibited by the glacial ablation in summer, and affected by increasing solute concentrations in autumn. We observed a general shift of the maximum annual abundance from autumn to spring/early summer. The progressive glacier retreat, and the consequent reduction of environmental harshness and habitat heterogeneity in Alpine catchments, may enhance diatoms abundance and α-diversity, and cause a decrease in β-diversity.

SESSIONE SPECIALE 6 – Inquinamento da microplastiche negli ambienti marini e d'acqua dolce: stato delle conoscenze, approcci ed esperienze di governance – Silvia Galafassi, Alessandro Cau

A reliable method to investigate microplastics in a lacustrine ecosystem

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Plastic is one of the most commonly produced and used materials in the world due to its outstanding features. However, the worldwide use of plastics and poor waste management have led to negative impacts on ecosystems. One of the most affected is aquatic ecosystem, with over than 4,800 million of tons of plastic released in worldwide oceans every year. Microplastics (MPs), which are defined as plastic particles with a size range < 5 mm, are particularly troubling. Due to small size these are easily ingestible and different studies have been performed with the aim of evaluating impacts of MPs on organisms. However, in order to completely understand consequences of MPs in aquatic ecosystems freshwater environments in particular- there is an increasing necessity to quantify and characterize MPs litter. Despite the increasing awareness, a standard protocol to extract MPs from natural matrices is still lacking. The lack of a unified method hinders data harmonization and comparison in different environmental settings, making a global comprehension of the amount of plastic dispersed unrealizable. In this light, we propose an easily reliable method to quantify MPs in freshwater zooplankton that can be also applied to other matrices.

A realistic approach for the assessment of plastic contamination and its ecotoxicological consequences: a case study in the metropolitan city of Milan (N. Italy)

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Although laboratory experiments are indispensable for evaluating the different conditions of uptake, infiltration and accumulation of plastics in organisms, as well as for studying their mechanisms of action, there is still no direct correlation with the effects of plastics in the environment, as the first type of studies are conducted at higher concentrations and using plastic debris that do not reflect the complexity of the mixtures sampled in the environment. In this context, the purpose of this study was to perform a qualitative and quantitative assessment of the plastics sampled in 9 of the main watercourses surrounding the metropolitan city of Milan (N. Italy) and contemporarily to evaluate the ecotoxicological effects of the same mixtures of sampled plastics. We carried out the sampling with two twin plankton-nets of 100 µm mesh which allowed the collection of even the smallest fraction of plastics, whose polymeric composition was recognized by a Fourier-transform infrared micro-spectrometer (µATR FT-iR). Then, we have tested the possible ecotoxicological effects directly on the plastic mixtures sampled by exposing the freshwater bivalve *Dreissena polymorpha* for 7 days, using a biomarker suite for the evaluation of several cellular and molecular effects. In this presentation the main results obtained will be shown.

Variability of microplastic abundances and their attached microbial communities in an urbanized coastal area

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Microplastics (MP) are a global threat for ocean and human health also in consideration of their physical, chemical and biological transformations which bring to fragmenting into pieces millimeter and even micrometers in size. Little is known also about their role as a vector of potential harmful organisms, in particular about the spatio-temporal variations and/or specificity to substrate of their attached communities in nature, generally referred to as the microbial plastisphere. We present here a comparison of MP in terms of concentration and chemical identification, together with characterization of microbial plastisphere of collected floating MP (< 5 mm) at three stations in the Gulf of Naples in 2018, 2019 and 2020. Microbial communities were characterized by Scanning Electron Microscopy (SEM) and Illumina 16S rDNA amplicon sequencing. MP were mostly represented by Polyethylene (PE) and were more abundant in summer than in the winter (6.20 vs 1.42 mp m-3 on average). Diatoms and bacteria were the most abundant microbes on MP, with different densities and components than free-living counterparts. PE-attached microbes appeared to be different both among different seasons and comparing with communities attached to other polymers, with Flavobacteriaceae, Saprospiraceae and Rhodobacteraceae bacteria always dominating but in different percentages and with very little overlap in terms of single OTUs. Plastisphere characterization has been carried out in particular to test the hypothesis that this community is sensitive to substrate, but also that environmental conditions in the surrounding waters and its structure composition may provide insights on the biofilm formation.

Ecotoxicological characterization of plastics along the Lambro River (Italy)

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In this study we applied the pivotal approach of ecotoxicology, named Environmental Risk Assessment, to evaluate both the presence and effects of plastics in a water course which crosses a great industrialized area of the Po Valley: the Lambro River. We collected plastics in five different sampling stations using two plankton nets with a mesh of 300 µm. Plastics were quantified and characterized through a Fourier Transform Infrared Spectroscopy coupled with an optical microscope (µFT-IR). We evaluated the toxicity and uptake of collected plastic particles on the freshwater mussel *Dreissena polymorpha* for 21 days in semi-static conditions using biomarkers and gel free proteomics. Moving to the results, we observed a plastic contamination along the Lambro River from 0.5 ± 0.3 plastics/m^3, in the first sampling station (Merone), to 14.3 ± 11.0 plastics/m^3 in the last sampling point (Grafignana) and estimated a plastic release into the Po River of about 100,000,000 plastics/days. Regarding the impact of these contaminants, we observed an increase in mortality and cytotoxicity in mussels exposed to plastics from the two last sampling points, as well as a diffuse alteration of both oxidative status and energy stock. Obtained results suggest that the ecotoxicity of plastics is not strictly related to their concentrations, and other factors as shape, size and polymer composition modulate the impact of these contaminants on freshwater species.

Microalgal colonization of microplastics in experimental mesocosms across the iberian peninsula

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Microplastics (MPs) can be colonized by a wide range of species (“plastisphere”). Even though plastisphere research mostly focused on heterotrophic bacteria, the presence of epiplastic microalgae has been repeatedly documented. However, studies investigating the colonization of MPs by microalgae are still limited, and mainly performed in marine environments. In this study, we assessed periphyton growth and diversity on two different plastic polymers (i.e., high-density polyethylene - HDPE, polyethylene terephthalate - PET) in freshwater mesocosms distributed across five locations in the Iberian Peninsula. Our results showed that colonization occurred in a range of diverse freshwater ecosystems, since we observed biofouling of the MP surfaces in all conditions, regardless of the sites and the plastic polymer type. The amount of biomass developed on substrates differed based on the polymer type, with higher biomass developed on PET substrate compared to HDPE. We observed a rich community of microalgae on both substrates (242 species), but we did not observe species-specificity in colonization of the different plastic polymers. Indeed, local species pool rather than polymeric composition seems to be the determinant factor defining the community diversity.

Microplastic particles as carriers of antibiotic resistance in aquatic systems

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Microplastic Particles (MPs) are ubiquitous pollutants, widespread in a broad range of ecosystems. The contribution of MPs to the spread of antibiotic resistance genes (ARGs) and antibiotic resistant bacteria (ARB) into the environment is still largely unexplored. Thus, understanding the dynamics of ARGs on MPs in different environments has a primary importance. For this reason, we sampled MPs in a wastewater treatment plant (WWTP), as it represents a key crossroad for ARGs and MPs to enter the environment. In particular, we collected MPs before and after the final disinfection, since the disinfection can contribute to lower their load, besides influencing ARGs dynamics. We compared the bacterial community composition, by 16S rRNA amplicon sequencing, and the abundance of antibiotic and metal resistance genes, using qPCR, of the biofilm on MPs and of planktonic bacteria in pre- and post-disinfection wastewaters. We found that potentially pathogenic bacteria had higher abundances in treated wastewater than on MPs. Furthermore, the analyzed resistance genes showed contrasting dynamics, with only sul2 significantly more abundant on MPs than in the planktonic bacterial community. Our results suggest that in WWTP effluents MPs do not constitute a hotspot of antibiotic and/or metal resistance genes, nor of potentially pathogenic bacteria.

AENEAS project: Assessing the role of coastal anthropogenic use in determining the impact of microplastic particles on the microbial communities of the Northern Tyrrhenian Sea

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Microplastic particles (MPs) are a largely studied pollutant of emerging concern. The presence of MPs in waters exposed to anthropogenic impact interferes with several ecological interactions and provides additional niches for allochthonous bacteria, acting as a refuge for potential pathogenic bacteria and as a hotspot for the spread of resistances. We assessed diversity, composition and antibiotic resistome of microbial communities on MPs and in water in six sites along the coast of the Northern Tyrrhenian Sea characterized by different land use (i.e. industrial, leisure, agricultural, natural reserves) by shotgun sequencing and FTIR-spectrometry. The number of MPs and the dominating polymer found (polyethylene) confirmed the results from previous studies. The bacterial community varied between water and MPs, with an enhanced presence of the potential pathogen *Vibrio* on MPs. The antibiotic resistance genes were slightly more abundant on MPs, being tetracycline the most important gene in determining this difference. Conversely, these microbiological variables were rather reproducible for the same substrate along the transect, independently by the sampling site. Our results demonstrated a limited impact of land use on both, MPs abundance and microbial community composition and functions, highlighting the dominating effect of diffusion caused by surface water streams along the Tyrrhenian coast.

The microplastic monitoring of italian lakes: from the Goletta dei Laghi campaigns to life blue lakes project

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Plastic debris is a growing pollutant in worldwide environments. Microplastics (MPs) are constantly increasing in aquatic and terrestrial ecosystem and very little data are available for freshwater systems. Several studies highlighted that rivers and effluents are major pathways for plastics of terrestrial sources. There is a knowledge gap related to MPs abundance and dispersion in Italian lakes. Starting from 2016 and in the following 3 years during the campaigns of Goletta dei Laghi, Enea and Legambiente have monitored 13 lakes and 5 rivers in Italy. MPs abundance, shape and chemical composition were identified. MPs were found in all surfac e samples with the highest particles concentrations near water inflow of rivers. From 2019 to 2023 this MPs monitoring activity (collection, analysis, evaluation) in the lakes is one of the planned actions Blue Lakes project (LIFE18-GIE_IT_000813). Core of this action is to provide a Standardized Monitoring Protocol concerning the design and implementation of MPs monitoring programme to share with Regional Agencies for Environmental Protection (ARPA). All data collected will be shared at different levels (regional, national and international) in order to store the results in a Data Management System.

Following the fate of microplastic along the Ticino river, Italy

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The interest in studying microplastics (MPs) in freshwater is continuously increasing. Still, one of the unknowns is the spacious variation of MP transport. Here, we investigate the spatial distribution of MP in water surface, subtidal sediment, fish (*Silurus glanis*), and macroinvertebrates (Hydropsichidae) along the length of the Ticino river in North Italy. In this study we aim to provide additional insight in (1) microplastic transport along a river and potential correlation between the sampled matrices and (2) sampling and extraction techniques for freshwater ecosystems. MP was present in all samples. The mean concentration for surface water was 33.4 (± 20) MPs/m^3, for sediment 11.02 (± 7.77) MPs/kg, for fish 1.40 (± 1.31) MPs/individual, and for macroinvertebrates 0.21 (± 0.18) MPs/individual. A trend along the course of the river could not be detected; the MP load in samples did not increase significantly with increasing length of the river. The MP ingested by benthic invertebrates and fish did not reflect the environmental contamination, as no significant correlation could be detected. However, increasing flow rate showed higher MP concentrations as a consequence of elevated suspension. Moreover, the highest MP concentration in sediment samples were observed where MP load in water surface was lowest.

POSTER

The water's colours of algal blooms in the brackish Lago delle Nazioni

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Lago delle Nazioni (Ferrara) is a semi-artificial brackish lake, located along the North-Western Adriatic coast. During the winter 2019-2020 a reddish-brown discoloration of the water caused by an intense monospecific bloom of the dinoflagellate *Prorocentrum cordatum* (Ostenfeld) was observed, with densities up to $4.7x10^7$ cells L^{-1}, corresponding to a chlorophyll *a* peak of 251 µg L^{-1}. The event occurred with low concentrations of both inorganic nitrogen (N) and phosphorous (P) in the water, resulting in a N:P molar ratio far lower than the Redfield one. Afterwards, the seasonal succession of phytoplankton communities has been shaped by the dominance of picoplanktonic species (<3 µm) turning the water into a long-lasting green colour. The average chlorophyll *a* concentration was 36 µg L^{-1}, showing peaks in autumn 2020 and in spring 2021 (45 µg L^{-1}) when vertical mixing took place. This *lasting* bloom caused harmful effects on a recently established breeding of Manila clam, representing a net economic loss. Both bloom-forming species have been isolated to investigate the physiological traits and their links to environmental drivers. To meet the challenge of the Ecological Restoration, a pilot project of seaweed cultivation is in progress to promote biodiversity, productivity and *blue* ecosystem services.

Effects of microalgal allelochemicals on meiobenthic community: a microcosm study

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Allelopathic interactions are likely to play an important role in species' successions. Field and laboratory studies have shown that marine algae, particularly diatoms, produce allelopathic compounds with high structural variability, including the polyunsaturated aldehydes (PUAs). Negative effects on the reproduction of marine organisms exposed to PUAs have been observed (e.g. reduction in survival, egg production and hatching success), including predators such as copepods. In this study, laboratory experiments in microcosms were carried out to evaluate: i) the effect on the meiobenthic assemblages of *Skeletonema marinoi,* which is a diatom known to produce PUAs compared to *Phaeodactylum tricornutum*, a diatom that does not produce these compounds; ii) the effects of PUAs standards with a different length of the carbon chain on the meiofauna associated with the macroalga *Dictyopteris polypodioides*, in a short (96h) and a long (7 days) time test. The results showed: i) a potential effect of PUAs produced by *Skeletonema,* as well as of standard compounds, on the meiobenthic community in microcosm, specifically a higher mortality of nauplii and adult copepods with high concentrations of PUAs standards and ii) a greater toxicity of long-chain compounds (decadienal, C10:2) compared to short-chain ones (heptadienal, C7:2).

Microbial Dynamics in Shallow-Water Hydrothermal Vents in the Mediterranean Sea (Panarea Island, Italy)

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Shallow-water hydrothermal vents are forms of active volcanism. These extreme environments are usually characterized by high temperature, high concentration of CO_2 and H_2S and low pH. Microbes are the key players in biogeochemical cycling in the vent systems. We investigated the oligotrophic Mediterranean prokaryotic community structure and activity in the shallow-water hydrothermal vent of Panarea Island. We sampled 13 stations along a transect, characterized by 3 active vents. The water column was stratified with a strong thermocline at 25 m depth. A Deep Chlorophyll Maximum as detected between 50 and 100 m. Microbial abundance ranged from 0.2 to 1.3 x 10^9 cells L^{-1} and bacterial carbon production ranged from 2.4 to 75.4 ng C L^{-1} h^{-1}. Overall, low rates of organic matter hydrolysis were measured. While microbial abundance and production were shaped by the water column physical structure, some degradation activities were enhanced by hydrothermal fluids. From the 16S rDNA (V4-V5) amplicon sequencing, we identified a surface, a deep and a vent-influenced microbial community. Bottom communities were richer and more diverse. Pelagibacter and Prochlorococcus were the most abundant taxa in all the stations. The vent-associated stations showed a prevalence of Thiomicrospira, a sulphur oxidizing taxon.

Can artificial flumes effectively simulate a field experiment? Evidences from a study on the effects of flow intermittence on ecosystem processes

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Artificial flumes have been often used to simulate processes occurring in natural conditions, as they can be used to simplify the set of abiotic factors that influence a biotic response, as in the case of flow intermittence and consequent riverbed drying, which is becoming increasingly frequent in mid-elevation streams and rivers in the Alpine area. Due to the highly dynamic flow regimes of intermittent streams and interactions among multiple environmental factors, result from such flumes simulations require evaluation and, if necessary, calibration with data from field experiments. We therefore compared the results of a flume experiment simulating leaf litter processing with those obtained from natural field data. In both experiments, we sampled the macroinvertebrate community and measured leaf decomposition rates at comparable time intervals. We observed consistent patterns in both spatial and temporal total β-diversity and leaf mass loss in the two experiments. Where flowing water was present during the whole experiment, leaf litter decomposition was faster and macroinvertebrate communities were more stable and taxonomically richer. These results highlight drying events as a key influence on ecological communities, and suggest that flume experiments can provide an effective proxy for naturally-occurring processes in stream ecosystems.

Glass eels (*Anguilla anguilla*, L. 1758) recruitment evaluation through a new sampling method

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The status of European eel population depends on the extent of glass eel recruitment. There are few and fragmentary available data concerning this phenomenon. We report a one-year glass eels survey carried out between 2020 and 2021 in three estuaries (Pula, Pramaera and Coghinas rivers, Sardinia, Italy) using a novel experimental monitoring tool, the "Flottante" trap, a mobile floating shelter made up of ten superimposed sheets of geomat (size 50x50 cm). To understand the recruitment dynamics in these river mouths, monthly samplings were carried out during new moon week. The temporal trend showed a general correspondence with glass eel recruitment data obtained with the experimental protocol normally used (fyke nets). The observed differences in terms of abundance, biometrics are site-dependent and probably linked to local environmental conditions. This evidence suggest that the sea surface currents could play a leading role in the dispersion of glass eels arriving from the sea. Anyway, the "Flottante" trap can be considered a reliable and easily usable sampling method that we can implement in a new sampling protocol to support the recovery of this critically endangered species.

Application of a Random Forest *a-posteriori* classification to predict multiple stressors impacts on benthic function and diversity of a river network

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Expert knowledge is increasingly used in conservation science to classify dynamic and complex ecosystems, while overcoming typical data-limitations. Based on the expertise of field operators from the local Environment Agency, we classified 160 stream sites in Trentino according to the presence of known hydrological, morphological and chemical alterations, including also sites in reference conditions and sites without significant alterations. We then used machine learning approaches to examine the degree to which a-priori expert classification matched a Random Forest *a-posteriori* data-driven classification based on the taxonomic and functional composition of benthic macroinvertebrates. The match between the two classifications was only partial. While stream sites in reference conditions were correctly classified, discrimination between hydro-morphological and chemical alterations was often poor. This suggests that indicators based on macroinvertebrates taxonomic and functional classification used to assess the ecological status of streams in mountain areas, can assess the overall stress of a waterbody, but they show poor sensitivity to specific stressors, with relevant outcomes for the water management of Alpine running waters.

SESSIONE SPECIALE 3 – Mescolamento, trasporto e dinamiche termiche in fiumi, laghi e mare: dialogo tra fisica e biologia – Sebastiano Piccolroaz, Ulrike Obertegger, Marco Toffolon, Francesco M. Falcieri

Dissolved oxygen in a wind-shielded mountain lake is determined by the interplay of ice cover and extreme events

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Generally, hypolimnetic dissolved oxygen (DO) decreases with climate change. However, in oligotrophic Lake Tovel (Italy), a deep mountain lake, annual mean DO (% saturation) has increased from near anoxia to > 20 % in the bottom layer (35–39 m). Long-term patterns of DO (1937–2019) were analysed to link DO to drivers and indices of mixing. While spring mixing remained temporally limited, later ice-in (5.1 days decade per decade) and the positive relationship between ice-in and DO the following year evidenced autumn mixing as the main driver for hypolimnetic DO increase. Hypolimnetic DO was replenished also by extreme meteorological events with 14 deep mixing events (i.e., hypolimnetic DO > 40%) only partially indicated by density dependent indices (Schmidt stability, relative thermal resistance, Lake Number, and Wedderburn Number). Lake Tovel's shift from meromixis to dimixis was driven by climate warming (i.e., increasing air temperature 0.6°C per decade) that delayed ice-in and increased autumn mixing. This study underlines the vulnerability of mountain lakes and their different response to climate change with respect to more studied lowland lakes.

Changing nutrient cycling in Lake Baikal determined by enhanced deep ventilation during the last century

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Lying in a rift zone in southeastern Siberia, Lake Baikal is the world's oldest, deepest, and most voluminous lake. Cited by UNESCO as the "most outstanding example of a freshwater ecosystem" and designated a World Heritage Site in

1996 due to its exceptionally high level of endemicity, the lake and its ecosystem have become increasingly threatened by both climate change and anthropogenic disturbance. Here, we present a record of nutrient cycling in the lake, derived from the silicon isotope composition of diatoms, which dominate aquatic primary productivity. Using historical records from the region, we assess the extent to which natural and anthropogenic factors have altered biogeochemical cycling in the lake over the last 2,000 years. We show that rates of nutrient supply from deep waters to the photic zone have sharply risen to unprecedent levels since the mid-19th century in response to changing wind dynamics and reduced ice cover, which together enhanced deep ventilation in the lake. With stressors linked to untreated sewage and catchment development also now impacting the near-shore region of Lake Baikal, the resilience of the lake's highly endemic ecosystem to ongoing and future disturbance is increasingly uncertain.

Emerging micropollutants in Lombardy

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Lombardy Energy Cleantech Cluster (LE2C) in 2018 established the Emerging Micropollutants Working Group (GdL-MIE) involving experts from universities, research bodies and integrated water services of Lombardy outlining a multidisciplinary collaboration with the aim of contributing, through the collection of detailed information on emerging pollutants, to the definition of management strategies for environmental protection. Given the growing emergency for microplastics in aquatic environments, GdL-MIE has also turned its attention to this problem, creating a focus on the state of knowledge and research skills in the Lombardy region. Using a rigorous methodological approach and a simple but exhaustive representation of 350 emerging pollutants, for a total of almost one million of measures ($9.77\ 10^5$), provided by the six Data Owners (ARPA Lombardia, MM, CAP Group, BrianzAcque, CNR-IRSA and IRFMN), has been produced a synthesis of knowledge available. Considering the entire database, most of the measurements (92.5%) were below the analytical limit of detection (LOD) in all water compartments considered: groundwater, rivers, lakes, drinking water, waste water, sediments, biological matrices. In this contribute a summary of the results obtained are reported.

SESSIONE SPECIALE 4 – La ricerca sui grandi laghi subalpini tra analisi di serie storiche di dati e nuovi approcci di studio – Michela Rogora, Nico Salmaso, Barbara Leoni

Diatom composition and Functional Groups in Lake Maggiore through 20 years of monitoring data

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Lake Maggiore is a deep oligotrophic subalpine lake in Northern Italy which underwent a stage of eutrophication from the 1960s to the mid 1980s. During the recent period, climate-driven events became more prominent, overlapping with the long-term oligotrophication pattern. Recent studies showed that shifts in diatoms assemblages indicate changes in climate and trophic changes. So herein, we used phytoplankton monthly and fortnightly data for the period 1999- 2019 collected within the research program funded by the International Commission for the Protection of Swiss-Italian Waters (CIPAIS). The taxa recorded were grouped in Functional Groups (FG) according to Reynolds and species were selected as those that contributed at least 5% of the mean phytoplankton biomass. We report the results of FG application of variations in diatom community structure and diversity as a possible response to long-term change in nutrient and climate conditions in Lake Maggiore over the last 20 years. Our results suggest that, beside the trophic status, climate warming can alter the structure of the diatom community, thus increasing awareness towards the functional properties of the species involved.

Synoptic research on the potential impacts of water management strategy on Lake Maggiore ecosystem (NW, Italy): the Interreg project PVT

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Lake Maggiore and the River Ticino outlet are freshwater bodies of pivotal environmental interest, shared between Italy and Switzerland. They constitute an important water resource and an environmental corridor connecting the Alpine natural water source to the vast water-exploiting Po Plain. Since the 1960s, when the first attempt of a share management was performed, the cross-border nature and often-conflicting needs of the many stakeholders involved makes the management of the common resources of this enlarged ecosystem very complex. In this context, the focus of the INTERREG project Parchi Ticino-Verbano (PVT; ID 481668) management is to define feasible, sustainable and shared environmental management strategies.
The main aim of PVT is to understand the impacts of the management of summer lake water levels on the entire Lake Maggiore ecosystem (both the lake and its river outlet). An overview of the activities carried out during the project is shown, with a résumé on the effects of water level management on the lake biological assemblage composition and the functional traits of their components, the planned environmental restoration interventions along the lake shores and the river banks, the control of invasive alien plant species.

Biomonitoring survey of the hydrographical network in the MAB UNESCO Alpi Ledrensi and Judicaria Biosphere Reserve (Project AcquaViva)

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Conventional taxonomic identifications based on the discrimination of diacritical morphological traits and culture based techniques have often proved inadequate in the study of microbial biodiversity (bacteria and protists) and biogeography of aquatic ecosystems. Moreover, investigations are generally focused on lakes and rivers that are also of interest for economic exploitation, therefore disregarding the small and/or ephemeral water bodies. Yet, due to their patchy and temporal habitat complexity, these neglected hydrographical elements can host a vast microbial diversity. In this work, we will report the results of a large survey of biodiversity carried out on water and sediments collected in the MAB UNESCO Alpi Ledrensi and Judicaria Biosphere Reserve (Project Acqua Viva) using high throughput sequencing (HTS) of 16S and 18S rDNA markers. The survey was carried out in 2019 in 20 sites of different sizes and characteristics. The study has allowed to disclose a high number of amplicon sequence variants (ASVs) belonging to a wide range of bacterial/cyanobacterial and protists groups. The presence of potentially toxigenic cyanobacteria was detected only in a few water bodies, including Lake Ledro, which showed the presence of *Planktothrix rubescens* and, for the first time, *Tychonema bourrellyi* in the pelagic samples.

Analysis of global satellite products for the Essential Climate Variable 'Lakes' in the LTER framework

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The ESA CCI Lakes is a multi-disciplinary project (https://climate.esa.int/en/projects/lakes/) to exploit satellite data to create the largest and longest possible consistent, global record of lake climate variables: lake water level, extent, temperature, surface-leaving reflectance, and ice cover. The first version of the database includes 250 globally distributed lakes with temporal coverage ranging, depending on the variable, from 1992 up to 2019. The dataset is now growing to 2000 lakes and by next November the new version of satellite products will be accessible. In this study the potential of the dataset is being explored for different case studies (i.e. Mendota, Erken, Balaton, Iseo, Garda, Trasimeno, and Peipsi) as part of the Long-Term Ecosystem Research (LTER) network. Satellite products of chlorophyll-a, turbidity and lake surface temperature from 2002 to 2019 are compared and integrated with the corresponding in situ data in the LTER dataset. Time-series of satellite data are then explored to examine trends in the context of key meteo-climatic variables.

Development of high-frequency monitoring in the insubric lakes: LM1 buoy as a pilot experience within the cross-border project SIMILE

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A high frequency monitoring (HFM) system for the deep subalpine lakes Maggiore, Lugano and Como is under development within the EU INTERREG project SIMILE. The general aim of SIMILE is to improve and optimize lake monitoring integrating conventional monitoring, satellite data, in situ HFM data, and user-contributed georeferenced data. HFM in particular, may overcome the drawbacks of conventional discrete monitoring, giving the opportunity to measure an increasing number of limnological and ecological parameters at short temporal intervals. A HFM station (LM1) consisting of a monitoring buoy was placed in Lake Maggiore in 2020. LM1 represents a pilot experience, aimed at providing the practical know-how needed for the development of the whole HFM system. To increase replicability and transferability, LM1 was developed in-house, and conceived as a low-cost modular system. In the poster, the main features of LM1 (hardware and software) are described, as well as the adopted Quality Assurance/Quality Control (QA/QC) procedures. Examples of high-frequency data and the applied QA/QC from the first 1-year of functioning of LM1 are provided, with a focus on chlorophyll data, from sensor calibration to field validation.

Distribution of Corbicula clams (Veneroidea, Cyrenidae) in Lake Garda (Italy)

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Lake Garda, the largest Italian lake, is suffering from the introduction of several non-indigenous species during the last decades and can be considered one of the main European freshwater hotspots of xenodiversity, with a total of 42 recorded species of fish, invertebrates, macrophytes and macroalgae. Among Bivalvia (Veneroidea, Cyrenidae), *Corbicula fluminea* and *C. fluminalis* were first observed in 2002 and 2008 respectively. In the last years, observation of specimens that did not resemble either of these taxa, suggested that populations of invasive *Corbicula* of Lake Garda could include some other taxa not previously recorded. After a morphometric characterization of *Corbicula* shells and comparison with specimens collected in Spain (Ebro and Ter rivers), in 2017 we confirmed the presence in the lake of two other related species not previous recorded, namely *C. leana* and *C. largillierti*. The syntopic presence of four species of this genus in a single environment is a singular occurrence both in Italy and Europe. The current state of distribution shows that *C. fluminea* and *C. flumunalis* are widespread and very abundant along the lake shore corresponding to low water lake depth. *C. largilliertii* shows an increasing diffusion and *C. leana* has a limited distribution.

Size structure and body mass of Chironomid larvae under different water level management in the temperate deep subalpine Lake Maggiore (NW Italy)

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The amplified water level fluctuations (WLF) caused by natural and anthropogenic disturbances are recognized as one of the factors that strongly modified the structure and the functioning of the lake ecosystems. This is particularly true for chironomid assemblages, the largest family of aquatic insects dominating lakes. However, knowledge of how the distribution, diversity and size structure of chironomids are altered under different water level regimes is still fragmentary, especially about the temperate lakes. Here, we report our preliminary results on near-shore chironomid assemblages obtained in the frame of a three-year INTERREG Project "Parchi Verbano Ticino" (PVT; ID 481668) aimed to understand the impact of WLF on littoral macroinvertebrate community structure of the deep oligotrophic Lake Maggiore (Italy). The lake is regulated from mid-March to mid-September through the Miorina Dam placed at the lake's outflow (River Ticino). Only samples collected from July to September in 2020, at three sampling sites characterised by different water level regimes (high/low water level) and depths (deep/intermediate/shallow) were detailed. Length-mass regression models for the most common species and subfamilies are presented. Alterations in size, morphological traits, relative abundance and diversity in relation to different water level regimes are considered as possible indicators of water management impact.

SESSIONE SPECIALE 5 – Ecosistemi acquatici freddi: fortezze di biodiversità sotto il fuoco del cambiamento globale – Monica Tolotti, Andrea Lami, Gianpaolo Rossetti

Long-term ecological evolution of a high-altitude lake in the Central-Eastern Italian Alps as showed by palaeolimnological proxies

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High-altitude lakes are particularly susceptible to climate change and anthropic impacts that modify the ecosystem environmental features and trigger the response of the biota. Palaeolimnological studies based on the analysis of proxies preserved in lake sediments aim at reconstructing the ecological evolution of lakes and surrounding environment at secular to millennial scale. This allows to evaluate the lake response to various external influences and to formulate hypotheses about future ecological evolution. We analysed two parallel cores sampled from a high-altitude lake located in the Ortles-Cevedale Group in the Central-Eastern Italian Alps (Lago Marmotte). A small glacier occupied the upper part of the lake catchment until the 1970s, while currently only discontinuous permafrost is still present. The aim of the present study was to verify whether the recent deglaciation of this Alpine catchment led to lake ecological changes that are preserved by sediment proxies, in particular stable C and N isotopes of sediment organic matter, and subfossil algal pigments and diatoms. The results show that the lake underwent two major environmental and ecological changes, i.e. after the end of the Little Ice Age (~150 years ago) and during the last 40 years, after the acceleration of the global warming.

Rapid assessment of fish presence and relative density in mountain lakes by visual inspection

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Introduced fish are a widespread ecological threat in originally fishless mountain lakes, but basic distribution data are largely missing for most mountain regions. Using time-consuming standard methods (e.g., fishing nets) to assess fish populations can be unrealistic, because the large number of mountain lakes. To overcome this problem, alternative rapid monitoring methods would be helpful. A candidate method, which enables observing fish from the shoreline, is Visual Encounter Survey (VES), which takes minutes and is already used for amphibian monitoring in mountain lakes and ponds. We evaluated VES as a method for monitoring introduced salmonids and cyprinids (the most widespread fish families) in mountain lakes. We found that VES is very effective (almost 100% detection probability) for both families when fish live at high densities, and that it also provides good (>30%) detection probability for low-density populations. VES also provides reliable indications on the relative density of introduced fish populations. However, it is inappropriate for species identifications and in general for all the operations which need fish manipulation. We propose VES as a complementary method to monitor fish populations which underwent previous assessment, and as a realistic method to redact large fish distribution inventories, not needing high taxonomic detail, but necessary for the implementation of important conservation measures.

A paleolimnological multiproxy investigation in a small alpine lake: L. Colbricon Inferiore (Trentino, Italia)

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Lake sediments have long been used as an archive for paleoclimatic-paleoenvironmental reconstructions, with more and more refined techniques developed in the late 40 years. This work is an attempt to reconstruct with a multiproxy paleolimnological technique the ecosystem response in Colbricon Inferiore, a small high-mountain lake located in the Paneveggio-Pale di S. Martino Natural Park (Trento, Italy). The major climatic changes during the Holocene period have been defined by the pollen record and the main changes occurred in the phytoplankton community have been inferred and evaluated on the base of algal carotenoid and diatom remains. The major changes occurred in the lake proxies match the climatic shifts detected by the pollen records. Comparing the response of diatom versus algal carotenoids we can highlight that (i) diatom respond more clearly to the major climatic event than photosynthetic pigment; (ii) photosynthetic pigment response seems more linked to process in the catchment such an early human impact. (iii), both diatom and pigment proxies seem to respond with different intensity to climatic driver forcing, showing a strong response in the early phase of the lake development and a marked resilience in more recent time.

Both mountain lake biota and game fish are better off without introduced minnows

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Small fish species such as minnows are introduced into originally fishless mountain lakes by anglers that use them as a bait for salmonids. Minnows severely impact native biota but are nevertheless released believing to forage/favour game fish. However, our results indicate that minnows negatively interact with game fish, reducing their relative densities and biomasses. We believe that this information should be disseminated among anglers and become a strong argument in support of some urgent conservation measures, i.e., prohibiting the use and release of live baits. Indeed, the negative impact on game fish is a pragmatic argument for ensuring the compliance with such restrictions by anglers, including those less sensitive to conservation issues.

Alpine lake monitoring as a contribution to the National Emission Ceilings (NEC) Directive

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Within the activities for the implementation of the NEC Directive, aimed to the reduction of atmospheric pollutant emission, 8 high altitude alpine lakes in the N-W Italian Alps for which long-term data are available (since the 1980s), have been selected for monitoring. These sites lie on a gradient of sensitivity to acidification (as the main pressure) and are affected by medium-high nitrogen deposition. Besides sampling for chemical analysis, samples have been collected for macroinvertebrates and epilithic diatoms, both included among the biological indicators suggested by Annex V of the NEC Directive, and zooplankton, following a European wide standardized sampling protocol. Focus of the monitoring is the assessment of chemical and biological responses to reduced surface water acidification, by analysing temporal trends, describe the extent and degree of acid sensitivity and possibly identify suitable biological indices for Italian sites. Behind it, a dataset of chemical and biological data of high-altitude lakes, both previously and newly acquired, was developed. In this poster, the sampling campaigns, the adopted monitoring protocols and the dataset developed are described, as well as some preliminary results of the first year of activity.

The RESERVAQUA project: first insights on water quality in permafrost-affected water bodies

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The amount of water stored in the Alpine glaciers represents an invaluable asset for millions of people. The INTERREG project RESERVAQUA aims to improve the present knowledge about the availability and use of water resources in the Alpine hydrographic basins, included the amount of water stored in permafrost and rock glaciers, and to develop proper tools for the cross-border management of this water resource. In this context, beside quantity, also water quality assessment plays a fundamental role. Outflows from catchments characterized by cryospheric features may indeed cause serious changes in water chemistry downstream. As part of the RESERVAQUA project, research activities aimed to evaluate water quality in selected Alpine basins characterised by the presence of permafrost have been started. Some field campaigns were performed in the summer 2020 in the Ossola Valley (North-Western Alps, Piedmont region), to identify suitable sampling sites, place in-situ instruments for high-frequency monitoring and collect samples for chemical analysis. Both new and already monitored sites, with long-term chemical data, have been included in the project. In the poster the first results are presented, together with a description of the main project aims.

Alpine headwaters emerging from glaciers and rock glaciers host different bacterial communities: ecological implications for the future

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Alpine glaciers are predicted to vanish within the next few decades due to the global warming. As the thawing rate of mountain permafrost ice is much lower than for glacier ice, a shift from glacial to periglacial dynamics is predicted for Alpine headwaters during the 21st century. However, knowledge on chemistry and biology of water emerging from Alpine rock glaciers (i.e. permafrost landforms composed by mixed ice and debris) is still sparse. We present the results from an investigation of glacier-, rock glacier- and groundwater/precipitation-fed streams of the Italian Central Alps aimed at exploring bacterial community composition and diversity in epilithic and surface sediment biofilm. Rock glacier-fed waters showed high solute concentrations related to bedrock lithology, and their highly diverse bacterial assemblages significantly differed from those detected in glacier-fed streams. Bacterial taxonomic composition appeared as mainly related to water and substrate type, as well as to water chemistry, in particular to concentrations of nutrients and trace metals. This study supports the hypothesis that rock glacier-fed headwaters represent chemically and biologically peculiar ecosystems able to act as *ecological refugia* for cold stenotherm taxa, and suggests a potential driving role of thawing permafrost in modulating future ecological traits of Alpine headwaters.

SESSIONE SPECIALE 6 – Inquinamento da microplastiche negli ambienti marini e d'acqua dolce: stato delle conoscenze, approcci ed esperienze di governance – Silvia Galafassi, Alessandro Cau

Preparation of a standard method for detection, monitoring and measurements of microplastics with fibre shape

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In recent years, an increasing number of microplastics have been found in the environment (air, sediments, freshwaters, rivers and oceans) and a large proportion of them may come from washing effluents of synthetic clothes and show a microfilaments shape. There are no standard method to detection, monitoring and measurements of microplastics. The novelty of the work is the design of a protocol to produce standard suspensions with concentrations between 76 N° filaments/L and 853 N° filaments/L of synthetic microfilaments using four different polymer threads (PA 6, PA 6.6, PET, PP). These were cut at pre-determined lengths of 200 µm and dispersed in three water batches of 300, 500, 900 ml to obtain three different concentrations. The results highlighted the relationship between concentration and probability of the detection of the single microfilaments: increasing the number of microfilaments in the sample suspension the detection probability decreases. Using an appropriate concentration of microfilaments as an internal standard it might be possible to evaluate the recovery rate in microplastics analysis in real sample.

Preliminary data on European eel skin mucus as trapper of microplastics in riverine ecosystems

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Accidental ingestion of microplastics (MPs) in aquatic fauna is widely documented, as a consequence of the consistent presence of these particles in their associated environment. Nevertheless, among possible interactions of MPs with aquatic biota, little is known about the potential role of skin mucous surface (SMS) on accumulation and carriage of micro-sized plastics. This study examined for the first time how MPs adhere in the SMS of European eel (*Anguilla anguilla*, Linnaeus 1758) wild specimens, collected from three rivers of Sardinia island (Mediterranean basin). We found microplastics in each of the samples (n=4), with an average of 3.25 ± 2.63 SD MPs individual^{-1}. The majority of MPs recorded were in film shape. The chemical characterization through µFT-IR (micro Fourier Transform Infrared spectroscopy) showed an heterogenous composition of the MPs detected, which comprised not only the most frequent polymers in the aquatic environment like polyethylene and polypropylene, but also ethylene-vinyl acetate, polyoxymethylene and polyterpene. On average, plastic particles measured 282 ± 346 µm on length. More in-depth studies need to focus on European eels SMS potential to act as a MPs trap and vector, especially considering its catadromous life cycle that could potentially drive MPs dislocation among different aquatic environments.

Microplastic pollution in *Perca fluviatilis* from four Italian south-alpine lakes

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Microplastic particles (MPs) contamination of aquatic environments has raised a growing concern in recent decades, because of their numerous potential toxicological effects. Although fish are among the most studied aquatic organisms, reports on MPs ingestion in freshwater environments are still scarce. Here, MPs presence in the digestive system of one of the most widespread and commercially exploited freshwater fish, *Perca fluviatilis* (Linnaeus 1758), was investigated in four different Italian south-alpine lakes. Microplastic particles occurred in 86% of the analysed specimens, with average values ranging from 1.24 ± 1.04 MPs fish^{-1} in L. Como to 5.59 ± 2.61 MPs fish^{-1} in L. Garda. The isolated particles were mainly fragments, except in L. Como where films were more abundant. Most common polymers were polyethylene, polyethylene terephthalate, polyamide, and polycarbonate, although a high degree of degradation was found. Despite the high number of ingested MPs, fish health (evaluated by means of Fulton's body condition and hepatosomatic index) was not affected. Instead, fullness index showed an inverse linear relationship with the number of ingested particles, which suggests that also in perch MPs presence could interfere with feeding activity, as already described for other taxa.

Microplastic contamination in two benthic decapod crustaceans from Sardinian seas

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The rapid production and utilization of plastics in various ways has generated a drastic rise in its environmental release over the past few decades. Microplastics, which are plastic particles of dimension comprised between 1 and 5mm, have been widely detected in all oceanic matrixes, including *biota*. This study aims to assess and compare for eventual significant differences in microplastic contamination for two ecologically relevant decapod crustaceans dwelling in European Waters: the European spiny lobster *Palinurus elephas* (Fabricius, 1787) and the Norwegian lobster *Nephrops norvegicus* (Linnaeus, 1758). These species also have a remarkable economical relevance since both are internationally referred as gourmet food. Samples of the two specimens were collected at depths comprised between 50-100m for *P. elephas* and 400-660m for *N. norvegicus* from the island of Sardinia (Italy). As a preliminary investigation, a total of 4 and 9 digestive tract were analysed for *N. norvegicus* and *P. elephas*, respectively, with more than 500 MPs-like particles isolated and sorted for polymer identification, performed by means of μFT-IR. The contamination of the two species was significantly different in terms of number of particles and relative size, while the polymeric composition did not show any significant difference, with polyethylene (PE), followed by polypropylene (PP), polyamide (PA) and polyester (PES) fibres being the dominant fraction of the ingested microplastic particles.

Standard analytical method for the quantification of microplastic with fibre shape

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This research study made in collaboration between Aquafil Spa and CNR STIIMA (Biella Department) is aimed at the creation of a standard method applicable to the determination of microplastics (MPs) with fibre shape in different matrices present in the textile field such as waste water from clothes washings, water effluents or solids from industrial processes, air. Depending on the matrix of the water sample, it may be necessary to pre-treat the sample to concentrate the microplastics and eliminate inorganic and organic contaminants (e.g. biological) that could interfere with their identification. The method involves a preliminary observation of the sample under an optical microscope and subsequently identification of microplastics with molecular spectroscopy using two different option of molecular spectroscopy techniques, Micro-FTIR (Fourier Transform InfraRed Spectroscopy coupled with optical microscopy) and Micro-Raman (Raman Spectroscopy coupled with optical microscopy) to identify and count plastic particles up to a micronic or submicronic dimension. Moreover, it is designed to provide a data about size, numerical concentration, surface area, volume weight of MPs identified in the sample. This work is in progress and the *Draft PrENISO 4484-2 Textiles* is currently being evaluated by the ISO and CEN commissions, in particular in its CEN Enquiry stage.

Microplastics as emerging contaminants in Lake Lugano: present knowledge and future perspective

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Plastic pollution, including macro- and micro-plastics, is ubiquitous in aquatic environments across the globe. Compared to marine ecosystems, only few studies (fewer than 4% of scientific publications) have investigated microplastics in fresh-water environments. Therefore, data on the sources, distribution, fate and biological effects of microplastics in fresh-water environments are still scarce. For example, microplastic research in fresh waters has focused on the water's surface, which may underestimate microplastic contamination across the water column. This lack of investigation needs to be addressed, because recent research suggests that microplastic contamination in lakes can be as severe as in marine systems. Here we present preliminary results from ongpoing microplastic research in Lake Lugano (Switzerland and Italy). In this lake microplastics are one of the major emerging environmental concerns, because a pilot study indicated a high degree of pollution (mean concentration of 0.2 # m^{-2}, approximately twice the average of other Swiss lakes). The main objective of our research is to measure the abundance and distribution of microplastics in the main different components of lake ecosystems (surface waters, water column, sediment, and organism). The results will provide a comprehensive basis for understanding and managing the environmental impact of microplastics in Lake Lugano.

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