ABSTRACT BOOK

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SCIENCE & IMPACT

Keynote

IMPACTS OF RISING CO2 ON HARMFUL ALGAL BLOOMS

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Harmful cyanobacteria provide a serious threat for water quality and human health in many eutrophic lakes worldwide. Although recent studies indicate that cyanobacterial blooms will benefit from global warming, their response to rising CO_2 levels remains less clear. We combine new mathematical models, laboratory experiments and field research to study dynamic feedbacks between phytoplankton growth and the inorganic carbon chemistry of lakes. In line with field observations, the results show that dense cyanobacterial blooms can deplete the dissolved CO_2 concentration to limiting levels and raise the pH to 9 or 10. However, above some threshold, rising CO_2 alleviates cyanobacteria from carbon limitation, which will result in less intense CO_2 depletion and lake acidification. The model predicts that rising CO_2 levels will enhance cyanobacterial blooms in eutrophic lakes, and lab experiments indicate that cyanobacteria will produce a higher toxin content per cell. Furthermore, we found genetic variation in the carbon uptake systems of harmful cyanobacteria. Competition experiments revealed that low pCO_2 selects for strains with high-affinity carbon uptake systems, whereas high pCO_2 selects for strains with low-affinity but high-flux uptake systems. This is confirmed by field studies, which show similar changes in strain composition. In total, these findings warn that rising CO_2 levels are likely to result in a marked intensification of cyanobacterial blooms, with microevolutionary changes that alter the genetic composition and toxin production of these blooms.

Keynote

PATTERN, MECHANISM, PREDICTION: LINKING LIMNOLOGY AND SYSTEM-ECOTOXICOLOGY

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The provisioning of freshwater in sufficient quantity and quality is increasingly challenging. This challenge however, is not only related to hydrological and chemical issues but is also tightly linked with the ecological processes of aquatic ecosystems. Scopes to improve management in order to obtain freshwater systems with high quality therefor include:

(i) quantifying the self-purification capacity of aquatic ecosystems and wetlands and its links to the ecological quality,

(ii) quantifying the link between freshwater quality and community structure to identify sentinel species and community measures to indicate chemical pollution.

These applications require a quantitative mechanistic understanding of ecological processes within a community and their links to environmental parameter. However, it is well known that these interactions offer 'unlimited' complexity. A reduction of complexity – targeted towards a specific problem – is therefor inevitable, approached by observing patterns, deducing mechanisms and validating predictions.

Keynote

SHIFTS IN SEASONALITY AND QUANTITY OF WATER IN MOUNTAIN SOURCE AREAS IN A WARMING CLIMATE: RESULTS FROM THE EU/FP7 'ACQWA' PROJECT

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Future shifts in temperature and precipitation patterns, and changes in the behavior of snow and ice in many mountain regions will change the quantity, seasonality, and possibly also the quality of water originating in mountains and uplands. As a result, changing water availability will affect both upland and populated lowland areas. Economic sectors such as agriculture, tourism or hydropower may enter into rivalries if water is no longer available in sufficient quantities or at the right time of the year. The challenge is thus to estimate as accurately as possible future changes in order to prepare the way for appropriate adaptation strategies and improved water governance.

The ACQWA project aimed to assess the vulnerability of water resources in mountain regions such as the European Alps, the Central Chilean Andes, and the mountains of Central Asia (Kyrgyzstan) where declining snow and ice are likely to strongly affect hydrological regimes in a warmer climate. Based on RCM (Regional Climate Model) simulations, a suite of cryosphere, biosphere and economic models were then used to quantify the environmental, economic and social impacts of changing water resources in order to assess how robust current water governance strategies are and what adaptations may be needed to alleviate the most negative impacts of climate change on water resources and water use.

The results from the ACQWA project suggest that there is a need for a more integrated and comprehensive approach to water use and management. In particular, beyond the conventional water basin management perspective, there is a need to consider other socio-economic factors and the manner in which water policies interact with, or are affected by, other policies at the local, national, and supra-national levels.

Keynote

CONFRONTING HYDROLOGIC ALTERATION IN THE QUEST FOR RIVERINE CONSERVATION IN THE 21ST CENTURY

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Humans are transforming riverine ecosystems around the planet, causing rapid declines in aquatic biodiversity and ecosystem goods and services. Among the key drivers of this transformation are various forms of water infrastructure (dams, irrigation works) that fundamentally modify natural hydrologic regimes and many biophysical processes in aquatic and riparian systems. One major response to this degradation has been to restore some historical flow variability to dammed rivers through provisioning of environmental flows. A foundation of this approach is to manage toward a historical reference condition; however, baseline conditions are rapidly changing with persistent human land use modification, with assisted spread of exotic species and now with rapid climate change. The social and scientific expectation of a future that deviates markedly from the past is fueling paradigm shifts in water resources management and conservation ecology philosophy. What can (and should) riverine scientists do to help guide the evolution of a new management perspective that can promote ecosystem resilience and support biodiversity sustainability in the face of increasing human water demand and expanding water infrastructure? How can the science and application of environmental flows be expanded into a more effective framework for riverine biodiversity conservation at local to basin scales in a rapidly changing world?

Keynote

INTEGRATING ECOLOGY AND EVOLUTION IN STREAM ECOSYSTEMS

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Despite the development of ecology and evolution took separate paths from the very beginning, earlier ecologists already recognised their interaction. Today, there is no doubt that ecology and evolution are strongly intertwined and have been merged into the subdiscipline of evolutionary ecology. I will address the topic of evolutionary ecology from populations to ecosystems, focusing on the latest research in stream ecology. At the population level, microevolutionary ecology analyses how within-species trait variability is related to the environment. Despite streams offer a great opportunity to study how changes in environmental conditions trigger evolutionary adaptations, microevolutionary studies have been more neglected in these ecosystems than in others. At the community level, macroevolutionary ecology analyses how between-species trait variability is related to the environment. Studies on macroevolutionary ecology in streams are abundant and have provided a comprehensive understanding of how local stream communities are organised. Finally, the growing interest in linking micro and macroevolutionary processes to the ecosystem level also highlights the importance of evolution in ecosystem processes. Individual, species, and ecosystem traits and their trade-offs are key points to understand patterns and processes occurring at all levels, which can provide a more integrated vision of the relationship between ecology and evolution.

Keynote

AQUATIC BIODIVERSITY SUSTAINING KEY ECOSYSTEM SERVICES

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There is growing consensus that failure to value the world's ecosystem services has led to widespread errors in environmental management with associated resource degradation. Freshwater ecosystems are a prime example: when managed appropriately, they provide major services such as water supply, fish production, flood control, nutrient transport, health benefits and recreation. However, these services have been compromised extensively because they are seldom recognised fully in catchment management. Pressures on river ecosystem services will grow in future as land use intensifies, water demands increase and climate change exacerbates many existing pressures.

Sustainable management of river ecosystem services depends on understanding the organisms and ecological processes that underpin them. Through *in situ* experiments and long term analysis of big data at a range of scales, the large interdisciplinary DURESS project assessed quantitatively how river services such as fish production or water quality regulation depend on river organisms, and whether there are biodiversity thresholds under which services collapse or are compromised.

Keynote

TRAIT-BASED APPROACHES TO UNDERSTAND PLANKTON COMMUNITIES IN A CHANGING CLIMATE

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Planktonic communities are at the base of many aquatic food webs and greatly affect biogeochemical cycles and water quality. Changing climate and other anthropogenic stressors are altering planktonic community structure and dynamics in complex, non-linear ways. Trait-based approaches, with the explicit consideration of traits and trade-offs, provide a mechanistic basis for understanding responses of different functional groups to changing environmental conditions. I give examples of what traits may be the most important and how trade-offs determine contrasting ecological strategies. I then discuss the new frontiers in plankton trait-based research that include understanding intraspecific trait variation, both due to phenotypic plasticity and genetic differences, and trait evolution. Applied environmental problems such as ecological assessment and restoration can also benefit from a trait-based perspective.

Keynote

PLANKTON VIRUSES IN LARGE AND DEEP SUB-ALPINE LAKES

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Viruses are the most abundant and diversified biological entities in aquatic ecosystems. They are also recognized as one of the main forces intervening in the regulation of both bacterio- and phytoplankton communities. While bacteriophages have been extensively studied, the knowledge about the diversity, dynamic and structure of algal viruses (i.e. dsDNA viruses such as cyanophages and phycodnaviruses that infect cyanobacteria and eukaryotic phytoplankton, respectively) is still scarce, and this is particularly true for fresh waters. Thus, we conducted a one-year survey of surface waters of Lakes Annecy and Bourget (the 2 largest sub-alpine lakes in France) and studied viral community structure and diversity using a battery of viral marker genes. We obtained a large amount of data and results, highlighting that (i) both cyanophages and algal viruses are very diverse, (ii) some of these viruses are unique to alpine lakes, (iii) algal viruses display distinct community dynamic patterns between lakes and such dynamics is associated to significant shifts in phytoplankton biomass and/or structure, (iv) virus-induced bacterial mortality vary between 6% and 53% and cyanophages can be responsible for high mortality of picocyanobacteria at certain periods of the year, etc... All in all, our result revealed that plankton viruses are likely to be an important compartment to consider to understand and explain (microbial) functioning in sub-alpine lakes.

This conference deals with the presentation of the results of the Ph.D work awarded by EFFS, originally entitled *Freshwater dsDNA viral diversity: A special emphasis on viruses infecting phytoplankton (cyanophages and phycodnaviruses) and T4-like myophages in peri-alpine lakes*

RS02 - Oral

LINK BETWEEN HYDROLOGICAL AND HYDROCHEMICAL TRENDS IN THE ARVE RIVER DURING LAST DECADES

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Analysis of streamflow data of the Arve River at the Bout-de-Monde (CH) gauging station over the last four decades show a statistically significant decrease in flows at the annual scale and during the summer seasonal maximum flows. At the same time chemical elements that have a strong inverse relationship with flow, sulphates in particular, show at significant increase especially during summer months. Other chemical elements such as Barium show a more complex behaviour. We explore the relationship between the hydrological and hydrochemical trends in the framework of a hydrochemical mixing model accounting for 'geographic' sources. The end-members of this model are direct precipitation, soil-water and groundwater originating from carbonate and respectively crystalline geological formations. While we acknowledge the limitations of this approach in a large and heterogeneous catchment such as the Arve River, we believe that it offers useful insights into the spatiotemporal sources of flow and in the mechanisms that underlie the observed temporal trends.

RS02 - Poster

IMPACT OF CLIMATE CHANGE AT REGIONAL SCALE: THE CAS OF THE ARVE RIVER, SNOW ICE AND RAIN REGIME.

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Addressing climate change impact on local scale remains one of the biggest challenges of climate research [(1)]. Previous work [(2)] allowed the classification of rivers from the Genevian area (ou Geneva region ?) between different types according to their chemical composition. The seasonal evolution from pluvial to snow-ice regime was highlighted by the method developed. (the methods described ?). Consequently, we considered the time series occurrence of transition between rain to ice-snow regime together with the time length of snow melting influence. It appears that during the studied time frame (20 years), this transition tends to occurs earlier and earlier in the year (± 2 weeks) and lasts longer.

RS02 - Oral

MACROINVERTEBRATE DRIFT-BENTHOS PATTERNS IN GLACIAL STREAMS UNDERGOING RAPID ENVIRONMENTAL CHANGE

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This study examined seasonal drift-benthos patterns in the Val Roseg catchment (Switzerland) – a glacial-fed stream system undergoing environmental change during the past decade from rapid glacier retreat. Samples were collected monthly from October 2008 to August 2009 in a glacial lake outlet stream, a proglacial (glacier-fed) stream, and their post-confluence stream (main channel), and data compared with the same sites in 1997/1998. Temporal trends in physico-chemical parameters indicated the greatest glacial meltwater influence in the proglacial stream and its lower inflow in 2008/2009 compared to 1997/1998. Drift largely coincided with benthic structure at each site, although drift-benthos patterns were sporadically asynchronous, depending on site, season and flow conditions. Our results indicate that low to moderate flow conditions are most favorable for benthic macroinvertebrates in glacial streams. Drift density was significantly lower in 2008/2009 than in 1997/1998. In 2008/2009, we observed lower chironomid, but higher ephemeropteran and plecopteran drift densities. The observed drift-benthos changes likely reflect behavioral and life history responses of proglacial stream macroinvertebrates to seasonal shifts in environmental conditions in response to glacial retreat.

RS02 - Oral

IDENTIFYING EUROPEAN FRESHWATER SPECIES POTENTIALLY VULNERABLE TO THE IMPACTS OF CLIMATE CHANGE

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We present a multi-trait approach for identification and protection of potentially vulnerable freshwater species to the impact of climate change (CC) in Europe. The 'Climate Change Vulnerability Score' (CCVS) is an aggregation of six autecological traits: endemism, micro-endemism, temperature preference, altitudinal preference, stream zonation, and life-history traits (reproduction and life duration. A vulnerability score (0 – invulnerable to 6 – highly vulnerable to climate change) was assigned to 1,940 species of Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies, collectively referred to as EPT) and demonstrated the applicability of the CCVS on three spatial scales: 1) European states, 2) the German federal state of North Rhine-Westphalia (NRW) and 3) the Ruhr River basin. Overall, we identified 157 EPT species as being highly vulnerable to CC (CCVS≥4). These are mostly found in the mountainous areas of France, Italy and Spain. Only eight relatively vulnerable EPTs (CCVS 3) were found in NRW, mainly in the highland regions of the Sauerland and the Eifel, and at the upper reaches of the Ruhr catchment. To further stabilize this method and improve its applicability, it is necessary to complete the autecological information for all EPT species, as well as for other taxonomical groups.

RS02 - Oral

MOUNTAIN GLACIERS PROMOTE AQUATIC METACOMMUNITY DIVERSITY IN ALPINE STREAM NETWORKS

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One impact of climate change is the acceleration of glacial shrinkage, resulting in a modification in glacial meltwater contribution to alpine streams flow. As alpine glacierized catchments are unique freshwater ecosystems exhibiting singular environmental features associated to specific assemblages of species, any changes in glacier meltwater flow are likely to affect aquatic biodiversity. While this assumption may appear trivial at the stream level, we still have a poor understanding of potential effects of glacier runoff modifications at the watershed level, where complex stream network features come into play. In this study, we propose to use metacommunity theory as a conceptual framework to better understand how river network structure influences the spatial organization of aquatic species assemblages in glacierized catchments. We sampled benthic macroinvertebrate communities and characterized geographical, physico-chemical and food resource conditions in 51 stream sites in a glacierized catchment of the Ecuadorian Andes. Using partial redundancy analysis, we partitioned community variation to evaluate the relative strength of environmental conditions (e.g., glaciality, food resources) vs. spatial processes (e.g., overland, watercourse, and downstream directional dispersion) in organizing the aquatic metacommunity. Results revealed that both environmental filtering and dispersal-driven processes dictated macroinvertebrate metacommunity structure. Among all environmental variables, glaciality best explained community variation among stream sites. In addition, by providing harsh environmental conditions, glacial meltwater limited macroinvertebrate waterborne dispersion within the network of streams. Glacial meltwater generated high environmental heterogeneity and prevented non-adapted species with low overland (aerial) dispersal capacity to colonize throughout the entire catchment. Thus, glacial meltwater promoted high β-diversity within the watershed. Under a scenario of decreasing glacial runoff, we expect a reduction in both environmental filtering and dispersal limitation, inducing a taxonomic homogenization of the aquatic fauna in glacierized catchments (i.e. decrease in β-diversity), and consequently a reduction in regional diversity.

RS02 - Oral

INHERITED HYPOXIA: A NEW CHALLENGE FOR REOLIGOTROPHICATED LAKES UNDER GLOBAL WARMING

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The precise role of global and local environmental forcings on hypoxia dynamics over the long term remains mainly unknown due to a lack of historical monitoring. In this study, we used an innovative paleolimnological approach on three large European lakes to quantify past hypoxia dynamics and to hierarchies the contributions of climate and nutrients. Even for lake ecosystems that have been well-oxygenated over a millennia-long period, and regardless of past climatic fluctuations, a shift to hypoxic conditions occurred in the 1950s in response to an unprecedented rise in total phosphorus concentrations above 10±5 µg P L^{-1}. Following this shift, hypoxia never disappeared despite the fact that environmental policies succeeded in drastically reducing lake phosphorus concentrations. During that period, decadal fluctuations in hypoxic volume were great, ranging between 0.5 and 8% of the total lake volumes. We demonstrate, through statistical modelling, that these fluctuations were essentially driven by climatic factors, such as river discharge and air temperature. We suggest that controlling river discharge may be a complementary strategy for local management of lakes fed by large river systems.

RS02 - Oral

CLIMATIC CHANGE-INDUCED ECOSYSTEM SHIFTS AND RESILIENCE MECHANISMS IN STREAM COMMUNITIES OF FRANCE

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Mechanisms behind the predicted threats of global warming to stream biodiversity remain largely uncertain. We identified current trends and drivers of change for freshwater communities over a large spatial and temporal scale already revealing a strong ecosystem shift. We analysed diversity and composition shifts in stream invertebrates communities during the last three decades in relation to geographic elements and human stressors over the French river network (circa 1000 km in longitude and latitude). We observed a 42% increase in the taxonomic richness of stream invertebrate communities, largely caused by climate change. As a local mechanism, a bottom-up food web productivity response to rising temperature was responsible for this strong increase in site diversity. Stochastic assembly processes of both environmental and dispersal related stochasticity increased the regional scale diversity. Thus, stream invertebrate communities show strong resilience to environmental changes thanks to: local responses to productivity changes (resource resilience); landscape heterogeneity and preserved species pools (refugia resilience); and dispersal processes (recruitment resilience). For the French stream invertebrate communities, up to now the resilience mechanisms seem to outweigh the predicted threats. From this knowledge emerge recommendations to enhance the temperate streams' resilience to cope with further global changes.

RS02 - Oral

A CENTURY OF HUMAN-DRIVEN CHANGES IN THE CARBON DIOXIDE LEVELS OF LAKES

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All of the processes that govern the concentrations of carbon dioxide (CO_{2aq}) in lakes are theoretically sensitive to the consequences of global change. To date, the field, laboratory and modeling studies have yet led to inconsistent conclusions. We developed a sediment proxy, and we used this proxy to reconstruct CO_{2aq} for the past 130 years for three large lakes that have been affected by climate warming and changes in trophic status. Initially C-neutral to the atmosphere, all three lakes have fluctuated between near-equilibrium and supersaturation. The phosphorus concentrations of the lakes have been the dominant drivers of CO_{2aq} variability for a century. The nutrient-driven control of CO_{2aq} was chemical rather than metabolic and acted through calcite precipitation. Over the last 25 years, climatic control of CO_{2aq} has exceeded that of nutrients, and has promoted higher CO_{2aq}, by decreasing hypolimnetic carbon storage. This long-term perspective challenges the current knowledge on the processes and environmental drivers of long-term CO_{2aq} variability in lakes.

RS02 - Poster

FORECASTING CYANOBACTERIAL OCCURRENCE AND IMPORTANCE IN LAKES: A CASE STUDY WITH PLANKTOTHRIX RUBESCENS IN LAKE GENEVA

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Among the multiple forms of cyanobacteria, the phycoerythrin-rich species *Planktothrix rubescens* is well adapted to temperate, deep and large lakes. In Lake Geneva, the biomass of this filamentous and microcystin-producing species has become the dominant cyanobacteria species during the last decade. Air as well as water temperature influences on the occurrence and development of cyanobacteria are also particularly relevant to consider in the context of the climate global change, which may be particularly marked for lakes in the Alpine region, with a rate of warming twice as large as the global average. The impact of climate change on *P. rubescens* was analysed through two different approaches, by using extreme air temperature events as a proxy for future climate and the Multi Adaptive Regresssion Splines (MARS) model to predict future *P. rubescens* biomass. These methods allowed us to figure out whether Lake Geneva will still sustain important biomass of *P. rubescens* in the forthcoming years until the end of this century. The outcomes strongly suggest that this cyanobacterium may indeed gain in contribution by respect to the total phytoplankton community, provided nutrients (i.e. phosphorus) are not limiting. Additionally, the results point out that spring is the key season, during which air temperature and nutrients become the determinant factors for outbreaks of this species for the following seasons.

RS02 - Oral

LONG-TERM WILDFIRE IMPACTS ON STREAM CANOPY COVER INFLUENCES STREAM MACROINVERTEBRATES

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Contrary to past assumptions, recent studies have shown that increasing severity and frequency of fires along with a warming climate drive shifts in vegetation, emphasizing the need to understand the long-term recovery of riparian vegetation in the response of stream ecosystems to fire. In the northwest USA, many streams fringed by conifers burned with high severity, retaining an open canopy even 10-15 years postfire. We hypothesized that the higher light availability to these streams results in increased abundance, biomass and production of macroinvertebrates relative to streams with greater canopy cover. We tested this hypothesis using a nested, multi-factor 'snapshot' analysis of twelve streams along a gradient of canopy cover, and with a temporal examination of two paired streams with contrasting riparian recovery. Canopy cover is negatively correlated with macroinvertebrate abundance (slope=-71.4, R^2=0.30) and biomass (slope=-36.3, R^2=0.18) among the twelve streams. Additionally, R-strategists such as Chironomidae and Baetidae correlated positively with light availability. In the two-stream comparison, biomass was ~2x greater in the stream with higher light availability. The next step will be to include secondary production of macroinvertebrates into the analysis. The results suggest that long-term effects of wildfire on canopy cover plays an important role in stream food webs.

RS02 - Oral

CLIMATE CHANGE AND LEAF LITTER DECOMPOSITION IN STREAMS: DOES SHREDDER DIVERSITY MATTER?

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Climate change is predicted to increase average temperatures and the frequency of extreme weather events, and thus might alter freshwater community composition through effects on climate-sensitive species. However, potential effects on aquatic decomposers, and consequently on the key ecosystem function of leaf decomposition, have not been extensively assessed.

We examined the potential effects of climate change on leaf decomposition in a field experiment in two pristine streams in the Palatinate forest, south-western Germany. We compared bulk leaf decomposition rate (LDR) and the leaf processing efficiency (LPE) of detritivores in enclosures containing three diversity treatments, where species loss was simulated in a sequence based on climate sensitivity.

A reduction in shredder diversity resulted in an increase in both LPE per unit shredder biomass and LDR (when shredder biomass was constant across treatments). Thus, shredder identity was more relevant than diversity regarding potential effects of climate change, with evidence that, the loss of climate sensitive species has potential to alter the key process of leaf decomposition.

RS02 - Oral

PREDICTING THE HABITAT EXPANSION OF THE INVASIVE ROACH (RUTILUS RUTILUS), IN GREAT BRITAIN

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The roach is influential ecologically and has a preference for water temperatures >12 ^{o}C. Here, we attempt to predict its habitat expansion in response to global warming, hypothesing its increase in Great Britain. Historical data for air temperature over different time scales (annual, seasonal, monthly and daily) and for the presence of roach in Great Britain were used to create four Ecological Niche Models. Mean seasonal air temperature (EncRoach-S) was the best predictor. Using EncRoach-S two future climate scenarios were tested: a sensitivity test (i.e. incrementally increasing temperature values by 1^{o}C), and using air temperature data from UKCIP 11-member ensemble of climate change projections for 2031-2040, 2061-2070 and 2091-2100. Both approaches predicted an increase in habitat suitability in Great Britain with rising air temperatures but the extent of change differed for England, Wales and Scotland. In England, the rate of expansion was initially slow but rapidly increased mid-century leading to 88% coverage by the century end. In Wales, there was a greater increase by the century end and a similar trend in Scotland. This study supports the conjecture that a rise in air temperature over the next few decades will lead to an increase in potential roach habitat.

RS02 - Oral

A TALE OF TWO RIVERS: LONG TERM PERSISTENCE IN THE LONGITUDINAL DISTRIBUTION OF HYDROPSYCHID CADDIS LARVAE IN THE RIVERS USK AND LOIRE

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It has been widely predicted that the altitudinal and latitudinal distribution of animals will change in the face of ciimate warming. In rivers, this should involve expansion upstream of warm-adapted species from the lower reaches, and the retreat upstream of cool-adapted species. Caddis flies of the family Hydropsychidae have one of the best described and most consistent longitudinal sequence of species in European rivers, and temperature has been implicated as a cause. We took advantage of two data sets on these species from a Welsh river (the Usk, from the late 60s) and a large French river (the Loire, from the 70s) and resurveyed them using the same methods as previously. In the Usk there were also detailed historical temperature data for some sites and contemporary temperature data were collected. The sequential distributions of caddis species in the two rivers were essentially unchanged. There has been only a modest increase in water temperature in the Usk (particularly in the extreme headwaters), and perhaps this is yet insufficient to expect changes in distribution. It is also possible that other important habitat features, such as stream hydraulics, may prevent substantial longitudinal changes in response to environmental temperature.

RS02 - Oral

AUTUMNAL PHENOLOGY: LIMNOLOGICAL CHANGES IN THE FORGOTTEN PART OF THE YEAR

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There has been much interest in, and many studies on, the vernal phenology of lake systems. Despite this interest in phenology during the spring, very few studies have examined whether there are changes taking place in the timing of events at the end of the summer.

Here we examine changes in phenological and physical events over nearly 50 years using long-term in-lake and meteorological datasets from the two basins of Windermere, England’s largest lake. These data suggest that in years with greater autumnal air temperature overturn is delayed, and that the recent rising trend in air temperature has been accompanied by a gradual lengthening of the stratified season. The extended stratification means water is no longer freely mixing throughout the lake depth during these periods and hence there is a more favourable light climate for phytoplankton than in cooler autumns. These shallower mixed layers are correlated with an increase in overall autumnal phytoplankton abundance in both lake basins, although morphological differences in the two basins drive subtly different phenological changes. The implication is that a warmer climate will bring an extended growing season for many stratified lakes around the world.

RS02 - Oral

SHIFTING SEASONS IN THE PELAGIC: EXPANDING OUR ECOLOGICAL PERSPECTIVE

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Changes in the seasonal timing of biological events are often cited as conspicuous biological responses to ongoing climate change. Though the majority of evidence for these phenological changes comes from terrestrial ecosystems, they are also widely reported from long-term studies of lake communities. Using examples drawn from studies in the English Lake District, I will show how shifts in seasonal timing differ among species, types of event, and trophic levels. This work highlights ways in which we must develop the science of phenology in freshwaters, in order to more fully understand the ecological importance of change. Firstly, there is a need to move beyond the prevailing food chain paradigm to a more food-web oriented approach. Secondly, I will introduce the GloboLakes project (http://www.globolakes.ac.uk/) to illustrate that we can use increasing capabilities in satellite remote sensing to better understand the potential role of spatial heterogeneity in mediating the impacts of changing phenology, and make wider global assessments of change in ecologically-distinct water body types.

RS02 - Oral

PATTERNS AND DRIVERS OF COMMUNITY-LEVEL PHENOLOGICAL CHANGE IN THE ENGLISH LAKE DISTRICT

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Phenological changes, such as shifts in the timing of the spring phytoplankton bloom, have been detected in a number of lake systems and can be linked with the impacts of localised eutrophication and broad-scale climatic shifts. However most studies consider either individual species at a single location, or generalise across multiple trophic levels at large spatial scales. Relatively little attention has been given to the community-level response, in and among lakes. Here, we present a long-term (30 year) community level study of plankton phenology from four lakes in the English Lake District, UK. Each lake has a different morphology and trophic status, which can potentially impact upon the physical and chemical conditions experienced by the resident plankton. We examine the influence of local-scale nutrient availability versus broad-scale temperature and stratification drivers on the seasonal timing of peaks in plankton abundance across all lakes. This work informs our understanding of phenological change at different spatial scales, comparing general community trends across all lakes, with species responses within a community, and those across communities in a similar geographical location.

RS02 - Poster

CONQUERORS DUE TO CLIMATE CHANGE: APPEARANCE OF MEDITERRANEAN AQUATIC MACROINVERTEBRATE SPECIES IN HUNGARY BY USING DIFFERENT PATHWAYS

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Rising temperatures, as a consequence of climate change, alters species distribution, resulting in the expansion or contraction of geographical ranges. Inthe last decade several Mediterranean aquatic insect species were newly recorded in the Carpathian Basin, such as *Erythromma lindenii* (Odonata), *Anisops sardeus* (Heteroptera), *Ilybius pseudoneglectus* and *Berosus hispanicus* (Coleoptera). The Carpathian Basin is a relatively separated biogeographical area enclosed by the high mountain series of the Carpathians. Accordingly, the possibility for natural expansion of aquatic macroinvertebrates to the basin is presumably restricted to river valleys. Based on new records, literature and museum collection data the most possible pathways for expansion of the newly recorded species could be identified. *Anisops sardeus* expanded its area from south, along the floodplain of River Tisza. The appearance of *Ilybius pseudoneglectus* could be explained by the connection of the Adriatic coast and Hungary through floodplains of the rivers Kupa, Sava and Drava. *Erythromma lindenii* and *Berosus hispanicus* arrived in the Carpathian Basin from south-east, along the Körös river system, although their appearance in Hungary should have been expected from south or south-west. Our results support that southern species extended their ranges northward, however, not in all cases through the most presumable pathways.

RS02 - Oral

ELEVATED TEMPERATURES INTERACT WITH SUSCEPTIBILITY TO HYPOXIA TO COMPROMISE CLIMATIC REFUGIA

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Large-scale effects of climatic fluctuations can be masked by local microclimatic variability allowing species to retain their ranges. However, as temperature modifies both abiotic and biotic processes, the fate of refugial populations may depend on interactions of temperature with susceptibility to other factors, rather than on the impact of temperature alone.

We used laboratory experiments to determine thermal sensitivity of a glacial relict mysid shrimp, *M. salemaai*, and quantify the effect of temperature on survival and regulation of aerobic metabolism in progressive hypoxia. The resulting temperature and oxygen sensitivity thresholds were then validated in the field.

Survival of *M. salemaai* in reduced oxygen conditions was significantly lower at higher temperatures, even though same temperature did not cause mortality on its own. Results of respiration assays suggest that this was a consequence of impaired capacity at elevated temperatures for regulating oxygen uptake in hypoxic conditions.

These results show that climatic refugia offered by the thermal stability of hypolimnia can be jeopardised by the interaction of warming with oxygen depletion. Importantly, our findings demonstrate that biological effects of climate warming can depend more strongly on interactions of temperature with other factors than on the effects of elevated temperatures alone.

RS02 - Poster

GLACIER RETREATING: INSIGHTS FROM GLACIER-FED STREAMS IN THE ITALIAN ALPS

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Biodiversity in glacier-fed streams is very likely to change as a function of glacier retreating that affects thermal and hydrological conditions of glacier-fed streams. About 30 glacial sites were investigated in the Southern Alps (Italy), distributed along a wide 'glacial influence' gradient (%GCC range= » 20-90). The kryal and glacio-rhithral zoobenthic community was characterized (more than 60 species of chironomids were identified) and spatio-temporal patterns of macroinvertebrates were described in relation to environmental variables. Data from the last five years suggest that the systems more affected by glacier retreating underwent significant changes in alpha and beta diversity. The relative abundance of Diamesinae is decreasing with a joint increase of less cold stenothermal Orthocladiinae coming from downstream reaches. Evidences of local extinction and shift from deterministic to more stochastic community composition are reported.

RS02 - Oral

THE IMPACT OF CLIMATE CHANGE ON THE MIXING PATTERNS OF DRINKING WATER RESERVOIRS IN DIFFERENT REGIONS OF GERMANY IN WINTER AND SPRING

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Long-term data of more than 30 German drinking water reservoirs revealed similar increasing trends of average monthly water temperatures of the upper layers, particularly in spring, and tendencies of an earlier beginning of the summer stratification. Already in the past, ice was rarely observed on reservoirs at altitudes below 300 m, particular in western regions of Germany under atlantic influence, although their winter temperatures fell slightly below 4°C. Since the end of the 1980s, winter temperature minima were mostly higher than 4°C but the monomictic nature of the dams still remained. Reservoirs at elevations above 500 m, especially those in the more continental eastern part, still regularly showed ice covering with, however, shorter duration and earlier ice break-up. They were and are still dimictic. This mixing pattern was also typical for reservoirs in the medium altitude range between about 300 m and 500 m before approximately 1990. Since then the frequency of completely ice-free winters and, thus, monomixis is increasing. Finally, an evaluation of phytoplankton data make evident that these changes of spring mixing are of great but regionally different impact for timing, yield and composition of the spring phytoplankton mass development.

RS02 - Oral

"FOR THE LOSER NOW, WILL BE LATER TO WIN, FOR THE TIMES THEY ARE A CHANGIN'..." – CURRENT AND FUTURE DISTRIBUTION PATTERNS OF EUROPEAN CADDISFLIES

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In the framework of the EU funded project BioFresh (www.freshwaterbiodiversity.eu) distribution data of adult caddisflies (Trichoptera) from all over Europe were collected. Over 60 experts and institutions contributed about 600,000 occurrence records, which sufficiently cover Central and Western Europe. Out of about 1,500 known species and sub-species in Europe we evaluated 260 widespread ones regarding future distribution patterns under different climate scenarios. We present selected results of these analyses like range shifts and changes of biodiversity patterns. Additionally we discuss strengths and limitations of climate change modelling in respect to the zoogeography of selected species. We analyse Trichoptera biodiversity hot spots and centres of micro-endemism to set priorities regarding future conservation.

RS02 - Oral

CHANGES IN TAXONOMIC, FUNCTIONAL AND PHYLOGENETIC DIVERSITY UNDER CLIMATE CHANGE: LONG-TERM STUDY OF STREAM FISH IN FRANCE.

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Although functional features and evolutionary history of species are increasingly being used as complementary descriptors to understand the assembly of communities and their responses to global changes, few studies have focused simultaneously on temporal changes of distinct facets of biodiversity. Based on national monitoring data collected over the last decades in France, here we explore temporal changes in stream fish by comparing more than 300 resurveyed communities between an initial period (1980-1993) and a contemporary one (2004-2012). Using functional information (e.g. morphological, life history, or alimentation traits) and a dated phylogeny recently reconstructed from mitochondrial genomes for French fish species, we quantified temporal changes in taxonomic, functional and phylogenetic diversity using a single mathematical framework that allowed us straightforward comparisons between those facets. Our results reveal complex spatial patterns and only partial congruence between the observed changes in each diversity component, thus highlighting the crucial need to adopt multi-facetted approaches to characterize and understand community responses to climate change.

RS02 - Oral

EXTREME EVENTS IN RIVERINE SYSTEMS DUE TO CLIMATE CHANGE; HYDROLOGICAL AND BIOLOGICAL RESPONSES.

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Extreme events are statistically rare or unusual weather or climatic occurrences (e.g. extreme precipitation, temperature, wind) leading to extreme natural impacts (e.g. fluvial floods, hydrologic droughts, cryosphere-related effects and fire) on the environment. Extreme events result from natural climate variability, but a changing climate is likely to lead to changes in the frequency, intensity, spatial extent, duration, and timing of weather and climate extremes. Ecological impacts depend on the occurrence of extreme climatic events, the extent of exposure to the effects of the event and the vulnerability of the system. Using information from experimental mesocosms extreme droughts were shown to cause substantial loss of species and food web links but still preserve several network properties. On the other hand examining streams with long pre-disturbance data, extreme floods can reset community structure and allow the re-establishment of species, which had previously become extinct or new colonizers previously unrecorded. Nevertheless the resilience of most taxa, including salmonids, was high. Different flooding regimes can lead to different ecological responses and it is important that these are taken into account in riverine management. River restoration and mitigation should incorporate approaches that could limit the impact of extreme events.

RS02 - Poster

RAINFALL AND TEMPERATURE INFLUENCE IN LIMNOLOGICAL CONDITIONS IN AN OLIGOTROPHIC CYANOBACTERIAL DOMINATE SUBTROPICAL LAKE.

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Global climate variability promote changes in ecosystems. Subtropical lakes functions and importance consists a gap of dataset and little information is available about the effects of weather changes. This study aims to identify the relation of changes in rainfall and air temperature with trophic relevant parameters. Peri Lake situated in a subtropical coastal protected area (Brazil), which is used to drinking-water supply, was sampled from Mar/07 to Jan/15.Rainfall has decreased promoting a decrease in lake water level. C. raciborskii is dominant with high densities (23 to 220 × 103 ind. mL $^{-1}$) which result in low occurrence of other species and in STX concentration (0.31±0.31 μg.L^{-1}). Significant difference was observed to chlorophyll-*a* and pCO_2 that increase in recent years. Chlorophyll-*a* showed strong positive correlation with total N and P, and pCO_2. Air temperature, precipitation and wind speed was correlated positively with total P. The decrease in water level of Peri Lake, due to decrease in rainfall in recent years, reflected in nutrients and chlorophyll-*a* increase and changing trophic status (oligo to mesotrophic). Thus, our results showed that even small changes in rainfall and temperature influence lake conditions, especially in trophic relevant parameters, which affect aquatic metabolism and cyanobacteria density.

RS02 - Oral

TRANSCRIPTOMIC RESPONSE OF THE AQUATIC PLANT ELODEA NUTTALLII TO MERCURY AND ULTRAVIOLET RADIATION

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Our project aims to investigate the influence of enhanced UV radiation on the response of the aquatic plant *E. nuttallii* to interacting stresses.

In the present work we exposed *E. nuttallii* to UV (0.55 Wm^{-2} UV_{BE}) for 6 h and to Hg for 24 h or to both for combined treatment. We analysed Hg content, oxidative stress response, effect on pigment content, as well as the transcriptome. UV radiation decreased Hg uptake in shoots as compared to plants exposed to Hg alone. Pigments tended to decrease in response to UV and Hg, and a cumulative effect of combined treatment was observed. Looking at oxidative stress enzymes, we observed an opposite effect of combined treatment: peroxidase activity was significantly decreased by UV and Hg treatments alone, whereas a combination of both abolished this effect. Results of RNA-Seq confirmed results obtained from analysis of pigments and stress response. In conclusion, we were able to show that UV exposure influences accumulation and tolerance to Hg.

RS02 - Oral

ARE AREAL DISPERSERS GOOD ADAPTERS? ASSOCIATION OF LARGE SCALE SPATIAL AUTOCORRELATION OF SEMI-AQUATIC INSECT TRAIT DISTRIBUTION WITH CLIMATE

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Traits of freshwater organisms have shown potential to identify and disentangle impacts of stressors. Although several studies suggested traits that may indicate vulnerability to climate change, the empirical relationship between assemblage trait composition and climate has been rarely examined. We investigated and compared the association of the spatial autocorrelation of semi-aquatic insect assemblage trait composition with climate on a large scale (Germany). Six assumed climate-responsive traits from five different orders of semi-aquatic invertebrates that are areal dispersers were selected, comprising 782 species and 395 genera sampled in 4,752 stream sites during 2006 and 2007. We checked for the amount of spatial autocorrelation in trait composition that is associated with 35 bioclimatic indices. On an average, bioclimatic indices explained more than 50% of the significant spatial autocorrelation for the majority of the traits while explaining the highest amount of spatial autocorrelation for temperature preference and maximal body size, and the insect orders Plecoptera, Diptera and Ephemeroptera. We show that climate is the predominant driver of large scale spatial autocorrelation of the semi-aquatic insect assemblage trait composition and thus climate change may alter their spatial pattern, especially for large insects and insects inhabiting cold water streams.

RS02 - Oral

CHANGE, STABILITY AND ECOLOGICAL CONDITION: IMPLICATIONS FOR THE CONSERVATION OF EUROPE'S TRICHOPTERA UNDER A CHANGING CLIMATE

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Ongoing anthropogenic climate change is rapidly altering environmental conditions and having considerable impacts on the distribution and ecology of species. However, changes in climate are predicted to be heterogeneous. Over the coming century, decreased precipitation and increased temperatures are consistently projected for southern Europe, while increased variability in precipitation and temperature are projected for northern Europe. At the same time, aquatic insects in the order Trichoptera (caddisflies) are functionally diverse, important for the maintenance of ecological processes, and are likely to be highly responsive to changes in climate. With this in mind, we drew on modelled distributions for 200 caddisfly species under current and future climate scenarios and determined areas of change and stability across Europe. We found a decrease in the average spatial distribution per species and an overall northward drift of peak caddisfly diversity across scenarios. We are also exploring the ecological condition and characteristics of areas of climatic stability. Our findings have implications for both identifying climate change refugia as well as devising proactive approaches to conservation for freshwater biodiversity.

RS02 - Poster

RESPONSES OF MACROINVERTEBRATE SHREDDERS ALONG AN ARIDITY GRADIENT IN MEDITERRANEAN HEADWATER STREAMS

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Climate change projections for Mediterranean regions show an increase in aridity. Studies on the effect of this process in stream ecosystems functioning are scarce, particularly regarding the riparian vegetation-detritivore shredders trophic link in permanent streams. We hypothesized that the shredders guild may be negatively affected by an increase in aridity, through a likely decrease of the quantity and/or quality of leaf litter inputs to streams. We analyzed the effect of environmental factors, many of them related to aridity, on shredder diversity, density and biomass from 23 headwater streams along an aridity gradient in southern Spain. Streams belonged to three climatic (perhumid-humid, subhumid and semiarid) and two lithology (siliceous and calcareous) categories. Local richness was higher in subhumid streams and significantly different from semiarid ones, but the greatest regional richness was found in the latter. Both local richness and density showed a significantly positive relationship with increasing humidity. Furthermore, local richness significantly decreased with increasing mean air temperature. The amount of benthic particulate organic matter influenced positively shredder richness, density and biomass, but this pattern was conditioned by lithology. These results suggest a relevant role of climate on the shredder guild, which may have important implications for future climate change scenarios.

RS02 - Oral

CURRENTOLOGY AND TEMPERATURES OF LAKE GENEVA WATERS DURING 50 YEARS

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The records of temperatures at several depths, 0m to over 200m were collected since the years 1960. Starting with 20 « boreholes », the number reduced over the years to one central point. Using these data provided by CIPEL and another set of numerous records, we succeeded to find out the currents and the changes of temperatures, as well as the behaviour of chemical pollutants - nitrate, phosphate, etc-. As for temperatures cycles and trends, non linear warming as well as the main impact of the Sun 11 years cycle, and El Nino events were accurately prooved. Using spatio-temporal geostatistics, statistics, and machine learning tools, maps and cross sections of temperatures were drawn.

New data sets delivered by CIPEL/ INRA for more recent years allowed to update the work mainly performed in 2010. Moreover, following the isocline curves, we could show the influence of Coriolis acceleration for the water currents, and compare with the Poincaré waves. It fits with the first maps of L. Kreitmann, who described the drifts of fisher nets in 1933.

RS02 - Oral

RISING RIVER TEMPERATURES IN GERMANY:TRENDS, PATTERNS AND DRIVERS

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Maintaining optimum river temperatures is crucial for maintaining river health as it drives several important biogeochemical processes. Recently, rising air temperatures have seen concomitant changes in river temperatures in some parts of the world. However, given the limited number of case studies and the complex nature of climate-hydrological interactions, it is difficult to draw an inference on regional river warming trends and its drivers. To address this gap, a long term analysis of stream temperature trends for 767 sites across Germany was performed. Results show that German rivers have undergone a significant average warming of 0.0352 °C yr^{-1} (S.E.=0.002) with upto 75% of the sites having warmed significantly. Seasonally, these trends were most pronounced in summers. Air temperature was seen to be a better explanatory variable, explaining 67% of the river temperature trends, than discharge (41%). Comparison of trends across landscape regions showed that mostly slow-flowing rivers had the highest mean warming trend. Correlation of river temperature trends showed a weak correlation with catchment size. These results highlight that air temperatures play a greater role in governing the direction of these trends than discharge, altitude or catchment size, suggesting that climate change is a significant driver of river warming.

RS02 - Poster

ECOSYSTEM RESPONSES TO CLIMATE VARIATIONS OF THE HIGH ALPINE LAKE CADAGNO OVER THE LAST 100 YEARS

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Lake Cadagno is a small meromictic alpine lake situated at 1921 m (a.s.l) in the Piora Valley, Swiss Alps. Responses to climate variations and modification of specific physico-chemical parameters in the water column were studied over the last 30 years. From different sets of measurements made since 1985, changes with time of temperature, conductivity, dissolved oxygen concentration, pH, redox potential, sulfates, nitrates and phosphates concentrations were investigated. Between 1985 and 2012, dissolved oxygen, nitrates and pH showed a significant change with time indicating a tendency to acidification of the lake waters. Changes in meteorological data such as air temperature and total precipitation did not show any significant variation with time.

Possible responses of the biological parameters to climate changes were investigated through the observation of the populations of different diatom species found in sediments over the last 100 years. The analysis showed a significant shift in the relative abundance between diatoms of *Fragilaria* spp. and other genera like *Stephanodiscus* and *Cyclotella* suggesting an increase in time of the yearly ice-free period of the Lake. Interestingly new taxa for the Lake were also identified, *Aneumastus* sp., *Craticula* sp., *Gyrosigma* sp., *Meridion* sp. and *Reimeria* sp..

RS02 - Poster

A EUROPEAN MULTI LAKE SURVEY: CAPTURING CYANOBACTERIAL ABUNDANCE AND DIVERSITY ALONG GRADIENTS OF TEMPERATURE AND NUTRIENTS

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Eutrophication and climate change are important drivers of cyanobacterial blooms. What is insufficiently clear, however, is how these two drivers interact in promoting blooms. For this purpose, a European multi lake survey (EMLS) is organized within the framework of two European COST actions, CyanoCOST and NETLAKE. The EMLS will sample lakes in different geographical and climatic regions all over Europe in summer 2015. Standardized protocols for sampling and sample processing, in part adapted from the US National Lakes Assessment will be applied. Participants from nearly 30 European countries, together sampling 100s of lakes received tuition in use of these protocols in a Training school in May 2015. Dedicated labs are assigned to analyze parameters like nutrients, cyanotoxins and phytoplankton flowcytometry. Using variance partitioning we will investigate how much nutrients, temperature and/or their interaction explain variation in cyanobacterial abundance and diversity over all – and dedicated subsets of - sampled lakes. This survey will provide a highly valuable dataset of standardized, comprehensive data on the development of cyanobacterial blooms and their environmental drivers. The EMLS can contribute to the management and control of cyanobacterial blooms, also in a changing European environment and help ensure ecologically-resilient freshwater ecosystems.

RS02 - Oral

RESPONSE OF N2O EMISSIONS TO ELEVATED WATER DEPTH REGULATION: COMPARISON OF RHIZOSPHERE VS. NON-RHIZOSPHERE OF PHRAGMITES AUSTRALIS IN A FIELD-SCALE STUDY

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Emissions of nitrous oxide (N_2O) from wetland ecosystems are globally significant and have recently received increased attention. However, relatively few direct observations of these emissions from aquatic systems in response to depth-related changes in sediment ecosystems have been conducted, despite these areas most likely being hotspots of N_2O production. Changes in water depth and *P. australis* growth both had the potential to disrupt the distribution of porewater dissolved NH_4^+, NO_3^- and NO_2^- in profiles, and NO_3^- have strong surface-aggregation tendency and decreased significantly with depth. When compared with NO_3^-, NH_4^+ and NO_2^- fluxes from the rhizosphere were more sensitive to the effects of water depth, and both fluxes increased significantly at a depth of more than 1 m. Similarly, N_2O emissions were obviously accelerated with increasing depth, with those from the rhizosphere further accelerating with increasing water depth, but being more readily controlled by *P. australis*. Pearson's correlationanalysis showed that water depth was significantly related to N_2O emission and NO_2^- fluxes, more interestingly, N_2O emissions were also strongly dependent on NO_2^- fluxes. The results presented herein provide new insights into inorganic nitrogen biogeochemical cycles in freshwater sediment ecosystems.

RS03 - Oral

EFFECTS OF SMALL IMPOUNDMENTS ON LEAF LITTER DECOMPOSITION AND METHANE DERIVED CARBON IN THE BENTHIC FOOD WEB IN STREAMS

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Leaf litter decomposition is an important process that provides energy to biotic communities. Additionally, methane gas (CH_4) has been identified as an important alternative source of energy in freshwater food webs. However, very little is known about the effect of small impoundments on leaf litter decomposition and methane derived carbon in streams. In this study, we tested the effect of small impoundments on leaf litter decomposition rates and methane derived carbon. CH_4 concentrations were measured and correlated with $\delta^{13}C$ values of chironomids. Leaf litter decomposition was significantly lower in study sites located immediately above the impoundments. Chironomini larvae had lower mean $\delta^{13}C$ values (–29.2 to – 25.5 ‰), than Tanypodinae larvae (– 26.9 to – 25.3 ‰). No significant relationships were established between CH_4 concentrations and $\delta^{13}C$ values of chironomids ($p > 0.05$). Mean $\delta^{13}C$ values of chironomid larvae (– 26.8 ‰) were similar to those of sedimentary organic matter (SOM) (–28.4 ‰) than tree leaf litter (–29.8 ‰). In conclusion, this study demonstrates that small impoundments may have a negative effect on leaf litter decomposition in streams, and that CH_4 has limited influence on the benthic food web in stream impoundments.

RS03 - Oral

COMPONENT ELEMENTS OF THE CARBON CYCLE IN THE MIDDLE AND LOWER YENISEI RIVER

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The key elements and ecological processes associated with the carbon cycle of the river ecosystem were studied along the middle and lower Yenisei River at section ca.1800 km in the summer of 2012. The study involved the microscopic analysis of bacterio- and phytoplankton communities, measurement of nutrient contents and dissolved and particular organic carbon concentrations and estimation of primary production and respiration rate of planktonic community. The net primary production for different sections of the Yenisei River were estimated and ecological factors, which determined production and destruction processes in the river were analyzed.

RS03 - Oral

METABOLISM OF A COASTAL LAKE IN RESPONSE TO FLUCTUATING CONTINENTAL AND MARINE HYDROLOGICAL FORCINGS

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Ecosystems located at the land–ocean interface are key elements modulating the final export of carbon from continental ecosystems to the sea. Their inherently high variability makes it necessary to rely on long data series to reach solid conclusions regarding their ultimate role in the processing and transport of carbon delivered from the catchments. In this study we analyse the metabolism of a coastal lake from a high-frequency dataset of water chemistry covering 6 years. The meromictic, oligotrophic, Lough Furnace is the last of a set of lakes located in a peatland catchment in west Ireland (Burrishoole catchment), which is continuously monitored by automatic water quality monitoring stations. We investigated the role of freshwater (catchment inputs) and marine (tides) drivers on daily metabolism by applying the free-water diel method to dissolved oxygen measured every 2 minutes. The ecosystem respiration rates were very low despite the humic character of the waterbodies. The rates of primary production were also low, and were mostly driven by light availability and discharge from the catchment. Tidal influence was minor. The variations in primary production were the main determinant of the lake net metabolic balance, which shifted seasonally from autotrophy to slight heterotrophy.

RS03 - Oral

FLOATING MACROPHYTES REDUCE GREENHOUSE GAS EMISSIONS IN A TROPICAL LAKE

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In general, tropical aquatic systems are underrepresented in global datasets of greenhouse gas (GHG) emissions. In these systems, aquatic macrophytes may play an important role in modifying gas exchanges between water and atmosphere. The aim of this study was to investigate carbon (C) turnover and GHG emissions from a small water harvesting lake in Southeast India and analyze the effect of floating macrophytes on GHG emissions. During field campaigns, we determined carbon dioxide (CO_2) and methane (CH_4) emissions with gas chambers, water and sediment C mineralization rates and physico-chemical parameters both, in the open water and between water hyacinths. The annual whole lake C release of this tropical lake added up to 478.7 t C (area 0.61 km^2). The C emissions from areas covered by water hyacinths were reduced by 57% in respect to the open water. However, water C mineralization rates were not significantly different between both areas contradicting observed differences in C processing by microbes. We conclude that the increased occurrence of water hyacinths and other floating macrophytes could change GHG emissions on a global scale by reducing the atmospheric exchange of climate-relevant gases and thus play a major role in the regulation of GHG in the atmosphere.

RS03 - Oral

ORGANIC CARBON BURIAL EFFICIENCY IN A EUTROPHIC LAKE UNDERGOING OLIGOTROPHICATION

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Sequestration of autochthonous organic matter in lake sediments is a function of both production and decomposition, and recently, there has been considerable focus on burial efficiency.

However, within a non-steady state system (i.e. lake recovering from eutrophication) it is proposed that productivity plays a major role on OC burial rate.

We consider the extent to which reduced nutrient concentrations reflect OC sequestration in a highly eutrophic, stratifying lake (Rostherne Mere, UK), comparing dynamics of OC flux from trap data to longer-term burial rate from a dated sediment core. Automated sequencing traps at two depths (10m and 22m) over a 5 year period (2010-14) were used to estimate pelagic OC flux down the water column. Analysis of trap time series data implied significant overtrapping (5-yr average ~200 $gCm^{-2}yr^{-1}$), especially during winter, with evidence of seasonal autochthonous sediment resuspension and allochthonous riverine inputs. Correction values (estimated by two independent methods) were used to offset the influences of overtrapping and confirmed through comparison to monitored net ecosystem production (NEP) over 2 years. Evidence of oligotrophication in the sediment core, changing P levels and the impacts of extreme annual meteorological variability confirmed the importance of changing inputs driving burial efficiency in non-steady state systems.

RS03 - Oral

ELUCIDATING ECOLOGICAL CONTROLS UNDERPINNING CARBON STORAGE IN SMALL WATER BODIES: AN EXPERIMENTAL APPROACH

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There is increasing awareness of the disproportionate intensity of carbon cycling and storage in small water bodies compared to larger aquatic systems. Coupled with increased estimates of their global coverage it is likely these ponds and wetlands play an unexpectedly important role in the cycling of carbon in inland waters. Limited previous research has focused on agricultural and aquaculture impoundments. Little is known about carbon cycling in natural ponds that are common place in lowland agricultural landscapes. Recent research has focused on sediment accumulated in mature systems, demonstrating the significant rates of carbon burial, on average 149 g m^2 yr^{-1} organic carbon. Distinct variations between neighbouring and superficially similar ponds have also been recorded and attributed to the spatial heterogeneity of past and contemporary macrophyte communities, themselves expressions of an individual ponds hydrology. This study focuses on experimental ponds with the aim of utilising historic ecological data alongside sediment carbon measures to characterise the ecological controls underpinning carbon storage in these habitats. This study also aims to understand the heterogeneity of carbon storage across an individual pond, assessing the accuracy in extrapolating values obtained from sediment cores to a whole pond.

RS03 - Oral

FRESHWATERS IN THE SUN: HOW DRYING AND DAMMING SHAPE CARBON CYCLING ALONG MEDITERRANEAN RIVER NETWORKS

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Catchments located in Mediterranean areas will suffer the highest reductions in surface runoff as a consequence of global change, implying an even strongest pressure on ecosystems already exposed to recurrent extended droughts and intensive damming. However, we still lack the required knowledge to constrain the sensitivity of the freshwater carbon cycle to external perturbations. Here, we summarize the main findings from the CARBONET and CARBASSES projects, both focused on carbon cycling in Mediterranean catchments.

The results stress the importance of the interplay between lotic and lentic systems in these highly regulated river networks, with a prominent role of the myriad of small weirs scattered along river courses. During the summer low flows, these discontinuities become hotspots for carbon processing, with peaking methane emissions and bacterial activity. In contrast, dry river beds in temporary rivers, a typical and very extended feature of Mediterranean river networks during summer, become hotspots for carbon dioxide emissions. The same happens with the dry belts of temporary ponds, an extremely abundant but often neglected landscape feature in the Mediterranean. In contrast to expectations, during summer low flows the river network process both highly aged organic carbon and recently in-stream produced materials.

RS03 - Oral

QUANTIFYING THE CARBON STOCK OF POND SEDIMENTS ACROSS A LOW-LAND FARMSCAPE: THE HIDDEN 'CROP'

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The volume of carbon stored within small aquatic systems is frequently missed from carbon budgets, causing uncertainties in carbon budget models. We analysed the sediment carbon content of 40 ponds across the lowland farm-scape of Druridge Bay, Northumberland (UK). The ponds across the region were grouped into four broad ecological types: ponds in arable or pasture fields, those naturally vegetated, and in amongst sand dunes, each characterised by distinct plant communities. A total of 80 sediment cores were taken; one core from each pond (n = 40), in order to assess the spatial heterogeneity across the landscape, and a further 10 cores from every 10

th pond (n = 40), to assess the heterogeneity of sediment carbon content within individual ponds. Each sediment core was dissected every 1 cm and analysed for total carbon and nitrogen using an elemental analyser. Total carbon content varied between ponds of the four differing ecological characterisations with carbon content highest in those of permanent, naturally vegetated ponds. While the large spatial heterogeneity observed has implications for accurately quantifying the role of small aquatic systems in the carbon budget, the high levels of organic carbon found in this study highlights the frequently overlooked carbon capture capability of small aquatic habitats.

RS03 - Oral

QUALITY PARAMETERS OF ORGANIC CARBON DIFFER IN THEIR EFFECT ON MICROBIAL CARBON TURNOVER IN AQUATIC ECOSYSTEMS

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Organic matter quality was recently observed to play a major role for the microbial processing of organic sources in aquatic ecosystems. In general, the quality of a source can be defined by the complexity of its biomolecular structure and its nutrient composition (stoichiometry). In particular, the stoichiometry, ratio of C:N:P, has often been discussed to modify the resource use by microbes. In an experimental approach, we aimed to disentangle the effects of both quality parameters on the turnover of particulate organic carbon (POC) in stream sediments. Treatments included two algae sources of differing stoichiometry and beech leaves characterised by a more complex molecular structure. The microbial mineralisation of both ^{13}C-labelled POC sources was investigated via respiration (^{13}C-CO_2 emission) and compound specific analysis (^{13}C-phospholipid fatty acids). Addition of algae to sediments enhanced overall carbon mineralization independent of algae stoichiometry whereas mineralization of beech leaves was only enhanced in presence of nutrient enriched algae. Observed differences in carbon turnover coincided with shifts in microbial community composition. In conclusion, activities as well as community composition were influenced by POC quality. However, a nutrient effect could only be observed for the mineralisation of more complex carbon sources implying a linkage between both quality parameters.

RS03 - Oral

NET CARBON BALANCES IN THE MAIN SPANISH WETLANDS TYPES: DETERMINING FACTORS AND TEMPORAL PATTERNS

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The role and importance of wetlands in the global carbon cycle is nowadays a relevant research concern. Wetlands can act either as source or sink of carbon, thus contributing in a significant way to the atmospheric carbon balance. The project CARBONSINK, funded by the Spanish ' Fundacioìn Biodiversidad', aims to evaluate the potential role of some of the main Iberian wetland types to act in carbon sequestration and thereby contribute to the mitigation of climate change. In this project two different types of wetlands, with quite different ecological features, were studied as models. Mediterranean coastal wetlands located in the eastern Iberian coast and saline endorheic lakes from “La Mancha Huìmeda Biosphere Reserve” (Central Spain) were surveyed by in situ and laboratory determinations, using both field observations and experimental approaches. The studied systems showed significant differences in the rates of processes related to the carbon balance. These varied among the different studied wetlands but also seasonally, as they acted as net sinks or sources of carbon depending on environmental variables such as temperature, salinity and trophic status, which were also influenced by the management modes and the conservation status.

RS03 - Oral

CONNECTING STRUCTURES AND PROCESSES DRIVING THE LANDSCAPE CARBON DYNAMICS OVER SCALES

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Carbon sequestration and greenhouse gas fluxes of terrestrial and freshwater aquatic ecosystems are important to the global carbon balance and can strongly affect future climate trajectories. It is becoming increasingly clear that freshwaters are not passive conduits, but constitute environments with extensive and highly variable rates of carbon exchange, production, and consumption. The young moraine landscape, e.g. in North-East Germany, is an ideal model landscape to study the links between aquatic and terrestrial ecosystems because its areal fraction of small standing inland waters is very large. Within the joint ZALF-IGB Leibniz-project 'LandScales', we aim to better understand the C dynamics in such complex structured moraine landscapes with small water bodies, so-called kettle holes. The predominantly temporary and highly eutrophic water bodies possibly play a pivotal role as hotspots for organic C transformations on the landscape level. For example, frequent redox changes have the potential to affect sources and sinks of carbon on the landscape scale. Here, we will present our conceptual approach, method development and some results, to highlight the advantage to link terrestrial and aquatic scientists of various disciplines to evaluating C cycling on the landscape level.

RS03 - Poster

COUPLING HIGH FREQUENCY DISSOLVED OXYGEN AND FLUORESCENCE MEASUREMENTS FOR ESTIMATING MAJOR COMPONENTS OF LAKE METABOLISM

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Lake metabolism is often monitored by high-frequency dissolved oxygen (DO) measurements, because a major component in DO changes is related to the net ecosystem production (NEP). However, physical and chemical processes also contribute to these changes, which makes it difficult to disentangle major metabolic processes such as gross primary production (GPP) and ecosystem respiration (R) by fitting dynamic metabolic models (MM) to DO time-series. Bayesian parameter inference can improve identifiability through including existing knowledge. Present knowledge about metabolic parameters, however, seems to be too vague to achieve a significant improvement in the estimation of GPP and R. The autotrophic biomass is a key component in both GPP and R. However, the autotrophic biomass cannot be simulated with sufficient accuracy within the MMs themselves due to the large number of drivers regulating growth. Therefore the often available high frequency phytoplankton fluorescence data on have a high potential to support identification of individual metabolic components. We introduce a Bayesian calibration and uncertainty analysis approach that can incorporate approximations of active autotrophic biomass derived from fluorescence data into the analysis of lake metabolism. The result is an estimation for individual metabolic components that is in line with the observations of fluorescence.

RS03 - Poster

LEAF LITTER PROCESSING AT THE END OF MONDEGO (PORTUGAL) RIVER CONTINUUM

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The importance of leaves in fluvial-estuarine areas as source of nutrients to the aquatic food webs is still not known. Here we assess the decomposition of alder (Alnus glutinosa) and poplar (Populus nigra) leaves and associated microbial, meio- and macrofauna at the end of Mondego River continuum. Leaves were exposed in coarse and fine mesh bags for 21 days. Oscillations in water salinity could be observed during the conditioning period (5 – 18 ppt). No differences were found in mass loss between meshes, which suggests a weak or nonexistent influence of macroinvertebrates in the breakdown process of both leaf types. Higher decomposition rates (0.097 vs 0.065 k day-1, poplar vs alder) and respiration (10%) were found in the most recalcitrant leaf, poplar, after 21 days incubation. Microbial communities were dominated by bacteria in both types; fungal biomass was not detected. Meiofauna community was richer and more abundant in poplar. This may suggest that this group has a crucial role in the dynamics of organic matter (particularly the more recalcitrant one) and nutrients in these fluvial-estuarine waters.

RS04 - Oral

DENDRITIC NETWORK STRUCTURE AND DISPERSAL AFFECT TEMPORAL DYNAMICS OF DIVERSITY AND SPECIES PERSISTENCE

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Landscape connectivity structure, specifically the dendritic network structure of rivers, is expected to influence community diversity dynamics by altering dispersal patterns and subsequently the unfolding of species-interactions. However, previous compara tive and experimental work on dendritic metacommunities has studied diversity mostly from an equilibrium perspective. Here we investigated the effect of dendritic versus linear network structure on local (α-diversity), among (β-diversity) and total (γ-diversity) species community diversity dynamics over time. Using a combination of experiments and individual-based models, we demonstrate the general importance of spatial network configuration and basic life history trade-offs as driving factors of different diversity patterns in linear and dendritic systems. Generally, dispersal and species interactions unfold differently in dendritic versus linear metacommunities over time. Specifically, we experimentally found that community diversity patterns were shaped by an interaction of dispersal in the network structure and local species interactions, using microcosms that allowed for active dispersal of 14 protists and a rotifer species. α-diversity remained higher in dendritic networks over time, especially at highly connected sites. β-diversity was initially greater in linear networks, due to increased dispersal limitation, but became more similar to β-diversity in dendritic networks over time. We then assessed how much of the patterns observed in the experiment may be due network structure only, using individual-based metacommunity models. Starting with a neutral metacommunity model, we found that species dispersal and network connectivity alone may well explain β-diversity dynamics and initial dynamics in α-diversity. However, additional mechanisms, such as variation in carrying capacity and a competition-colonization trade-off, were needed in the model to also capture the detailed temporal diversity dynamics empirically observed, such as the decline in γ-diversity and long-term dynamics in α-diversity.

RS04 - Oral

IMPACTS OF MIXING ON THE STRUCTURE OF FRESHWATER COMMUNITIES AND TROPHIC FOOD WEBS

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In freshwater ecosystems, water mixing can exert a strong impact on biological, physical and chemical processes. This is particularly true for shallow lakes which are very sensitive to wind-induced mixing that cause sediment resuspension and therefore changes in the level of turbidity and nutrient concentrations. These last changes are likely to have consequences on phytoplankton structure and dynamics. In order to understand the consequences of mixing on the structure of the aquatic food-web, outdoor experiments were conducted during summer 2012, using 15m^3 mesocosms with wave generators. We created two levels of mixing, high vs. low. High mixing corresponded to an intensity enable to mix the entire water column and generate sediment resuspension. In contrast, low mixing supported only surface wavelets and no sediment resuspension was provoked. During 9 weeks, standard physical, chemical and biological parameters were monitored weekly. Our results suggest deep modifications of the communities' structure due to mixing. Not only high mixing induced sediment resuspension changing the turbidity levels and affecting cells according to their buoyancy, but also it induced a cascading effect on physical and chemical properties which seems to play a selective role on the type of communities of phytoplankton and zooplankton.

RS04 - Poster

LEAF LITTER BREAKDOWN IN GUINEAN STREAMS: INSIGHT INTO THE RELATIVE CONTRIBUTION OF DECOMPOSERS IN THE TROPICS

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Leaf litter breakdown in two headwater forest streams in south of Guinea was examined in order to test current hypotheses on the relative contribution of decomposers at low latitudes. Two common leaf species (*Albizia zigia* and *Millettia rhodantha*) decomposed at high rates (0.025-0.038 and 0.066-0.076 day^{-1}, respectively) even though decomposers' abundance and/or activity appeared to be low. The discrepancy in breakdown rates between leaf species was consistent with their difference in chemical composition (C:N ratio). Microbial breakdown exceeded invertebrate-driven breakdown by one order of magnitude. Leaf-associated sporulation by aquatic hyphomycetes however showed late increases and low maxima. In contrast, the abundance of detritivore invertebrates (mostly shrimps) peaked earlier and their very low density was compensated by their large body size and potentially high efficiency in leaf fragmentation. Overall, the low diversity and poor contribution of invertebrates to leaf breakdown relative to microorganisms in these tropical streams, when compared to their temperate counterparts, were in accordance to previous findings. The loss of species and climate warming may have serious implications on the trophic structure of tropical streams and the whole ecosystem functioning.

RS04 - Oral

ISOTOPIC METRICS OF FOOD WEBS COULD PROVIDE A NEW GENERATION OF INDICATORS TO ASSESS RIVER HEALTH: A STUDY AT THE SCALE OF WHOLE FRANCE

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To date, biological indicators used to assess river health are mainly based on assemblage structure (species composition), and poorly incorporate the functional features of ecosystems. Food webs, as networks of species linked by trophic interactions, integrate both structural (via the species) and functional (via the interactions) features of ecosystems.

We propose to take advantage of this duality for assessing the 'ecological status' of rivers in a more comprehensive way.

In our project we address this issue by developing isotopic metrics of food webs, and examining their suitability to assess river health. For that, we described the food webs of 57 French streams analysing carbon and nitrogen stable isotopes of organic matter sources, macroinvertebrates and fish. We calculated the food web metrics and examined their responses to three environmental factors (fluvial gradient, geology and climate) under low and high anthropogenic pressures (related to river morphology and/or organic pollution). The project aims at giving a representative picture of the stream food webs of France, and at selecting the metrics displaying the highest sensitivity to human pressures in a monitoring perspective.

Preliminary results let us think that food web metrics constitute a highly promising area of research to assess river health.

RS04 - Oral

THE COLONIZATION HISTORY OF BEAVER POND SYSTEMS AND ECOSYSTEM FUNCTIONING IN STREAMS

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Recovering from a near extirpation, beaver populations are expending rapidly in large parts of the northern hemisphere. By building dams, beavers convert stream stretches into systems with strongly lentic characteristics. These modifications can affect rates of ecosystem processes such as leaf decomposition, algal growth and efficiency of mercury methylation downstream of the ponds. This study evaluates the role of age and colonization history (encompassing patterns of use and reuse) of ponds constructed by the Eurasian beaver *Castor fiber* in regulating these processes in Swedish streams. In 12 beaver systems located in three regions, we measured leaf decomposition, algae growth and methylation efficiency. Half of the systems were 'pioneer', inundated for the first time since beaver extirpation and half were 'reused', reconstructed during recolonization of an older site. Rates of all measured processes were altered downstream of pioneer beaver systems, but not in reused systems. Our results show that pioneer inundation by beavers can significantly affect ecosystem functioning, but that this effect is negligible when dams are reconstructed on previously used ponds. We therefore expect that the recovery and expansion of beavers in the boreal system will only have a transitional effect on some important ecosystem processes in streams.

RS04 - Oral

THE ECOLOGICAL CONSEQUENCES OF INTER-INDIVIDUAL TROPHIC VARIABILITY THROUGH CHANGES IN CONSUMER-DRIVEN NUTRIENT CYCLING

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Species-centered approach of ecological networks hinders a full appreciation of the genuine complexity of food webs structure and ecosystem dynamics. Individual trophic specialization (ITS) is a relevant component of intraspecific biodiversity, yet its environmental determinants and ecologicalconsequences remain scarcely understood. A field-based study was conducted to quantify the magnitude of ITS in ten populations of *Lepomis gibbosus* sampled in two consecutive years. We then experimentally modulated ITS of *L. gibbosus* to assess the indirect effects of ITS on ecosystem functioning through changes in nutrient cycling. Specifically, a laboratory experiment was conducted over a 9-week period and individuals were fed with food items contrasting in nutritional quality (three modes) and proportion (generalist, intermediate, specialist). Our results showed that ITS in wild populations was dependent upon environmental factors and associated with morphological variability. We further found that changes in excretion rate among individuals were determined by the quality of the resource intake. We also demonstrated that specialization can modify the role of individuals in nutrient cycling and subsequently affect critical ecosystem processes. In conclusion, considering inter-individual variability appears necessary to provide a more realistic understanding of the complexity of the food web structure and functioning.

RS04 - Oral

DO STREAM FOOD WEBS CHANGE ACROSS A GRADIENT OF URBAN INTENSITY?

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Considerable emphasis has been placed on understanding the causes and responses of water quality, hydrology, benthic invertebrates and fish tourbanisation, however linking all these aspects in a food web assessment are less common. Food webs were investigated in 10 1st and 2 nd order spring-fed streams across a gradient from low intensity residential housing to buried streams in commercial and light industry districts. Preliminary data indicates that food web complexity and other food web metrics decreased markedly across the gradient. Benthic invertebrate shredders and predators were poorly represented in more urbanised streams, while fish density and biomass was influenced by the high proportion of diadromous species which occurred in more urbanised streams which were closer to the sea. A holistic approach investigating whole food webs may offer greater insights into urban stream health and help target restoration efforts.

RS04 - Poster

THE EFFECT OF PHENOTYPIC PLASTICITY AND CLONAL SORTING ON ECOLOGICAL AND EVOLUTIONARY DYNAMICS IN BI- AND TRI-TROPHIC SYSTEMS

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Predation is a primary force driving eco-evolutionary changes. Prey species have evolved different inducible defence strategies. These adaptions lead to changed phenotypes which reduce predation risk. In bi-trophic interactions, inducible defences have been shown to stabilize community structures, as they dampen predator-prey oscillations. However, some predators have evolved inducible counter strategies, which partly allow to overcome prey defences. Aside from phenotypic plasticity, genetic diversity stabilizes communities. The effect of trait variability in inducible defences, inducible offences and genetic diversity on community structures has not been studied up to now. We here present as system which allows studying these effects. Using bi- and tri-trophic chemostats with the algae *Chlorogonium elongatum*, different strains of the herbivorous ciliate *Euplotes octocarinatus* together with their predator *Lembadion bullinum*, we aim to identify the effects of trait variation in predator-prey systems on population dynamics. The combination of empirical data with theoretical modelling will reveal eco-evolutionary feedback loops on three trophic levels.

RS04 - Poster

LAND USE INFLUENCES THE ASSIMILATED RESOURCES AND NICHE SIZE OF BENTHIC MACROINVERTEBRATES IN HEADWATER STREAMS

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Changes in land use, resulting from the replacement of native vegetation by cultivation and grazing systems, have great potential to influence the trophic relationships in headwater streams. Our objective was to evaluate how trophic niches of macroinvertebrates are influenced by land use. We hypothesized that changes in land use might increase trophic niches, selecting generalist organisms. We compared three areas in the Brazilian Savanna (Cerrado): streams with native vegetation, surrounded by pasture and by sugarcane cultivation. Macroinvertebrates, categorized into functional feeding groups (FFG), and availablecarbon sources (CPOM, FPOM, seston, leaves, periphyton, algae), were sampled and evaluated for the isotopic composition of $\delta^{13}C$ and $\delta\ ^{15}N$. We calculated Bayesian ellipses area and the relative contribution of each resource to each FFG. FFG in the pasture and sugar cane streams had the largest trophic niches, which correspond to a more generalistic feeding behaviour confirmed by the mixing model diet analysis. In contrast, the FFG in native vegetation streams had narrow trophic niches, indicating a higher specialization. In the native vegetation streams, each FFG uses primarily a unique resource; while in the pasture and sugar cane streams had higher variation in the $\delta^{13}C$ values, confirming the assimilation of different resources for each FFG.

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RS04 - Poster

THE EFFECT OF MACROPHYTE ABUNDANCE ON PLANKTON FOODWEB IN EUTROPHIC SHALLOW LAKES OF DANUBE DELTA (ROMANIA)

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The Danube Delta is located at 45°0′N latitude, 29°0′E longitude in the eastern part of Romania, at the confluence of the Danube River with the Black Sea. The area includes hundreds of shallow lakes, connected by surface and underground channels. While some lakes are dominated by phytoplankton, recording frequent algal blooms, others are dominated by macrophytes, where competition for resources and provisioning of shelter for grazers (zooplankton, young fish), have a beneficial role for water quality. Considering the competition between the primary producers, we hypothesize that lakes with higher macrophytes abundance could keep cyanobacterial development under control, and hence this could become a management tool to prevent nuisant toxic algal blooms. The sampling campaigns were carried out seasonally in 2013 (May, July and September), in 26 lakes. According to the macrophytes coverage, the selected lakes were classified in three categories: (1) low (<25%), (2) medium (25-50%) and (3) high coverage (>50%). During 2013, the phytoplankton biomass ranged between 0.90 - 81.3µgL^{-1} (chlorophyll a content). The results highlighted cascading effects in plankton food web by changed composition and abundance of phyto and zooplankton in each category of ecosystems.

RS04 - Oral

CYANOBACTERIAL BLOOMS AFFECT THE GENETIC STRUCTURE OF DAPHNIA POPULATIONS

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Cyanobacterial blooms are among the strongest indicators of the degradation of freshwater environments, one of the reasons being their ability to produce toxins and other bioactive secondary metabolites. Both toxic and nontoxic cyanobacteria, which represent among the most important primary producers in freshwater ecosystems, may differentially alter aquatic food webs depending on their interaction with zooplankton.

Contradictory results are often reported in the literature about the interactions between cyanobacteria and zooplankton in freshwaters. Our purpose was to study the dynamics of eight *Daphnia galeata* genotypes from Lake Greifensee, Switzerland, under the presence of toxic/nontoxic cyanobacterial strains, over ten weeks. The hypothesis behind this study was that old (eutrophic) *Daphnia* genotypes are less sensitive to cyanobacteria and their protease inhibitors than the new (oligotrophic) ones.

The interaction between toxic cyanobacterium *Microcystis aeruginosa* PCC 7806 together with a non-toxic variant and eight *Daphnia* genotypes hatched from older or newer ephippia was studied. The dynamics of the *Daphnia* genotypes over time was assessed by microsatellites analysis and the expression of several genes encoding for digestive proteases was measured.

One specific old strain was the most successful one during the experiment, but several intriguing results about other genotypes were observed in the tested conditions.

RS06 - Oral

MORPHO-GEOMETRIC ANALYSIS OF BRACHIONUS (PALLAS, 1766) AND KERATELLA (GOSSE, 1851) SPECIES ASSOCIATED TO THE WETLANDS OF THE ATLANTICO DEPARTMENT- COLOMBIA

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The rotifers polymorphic feature has led to mistakes in their identification and classification. Therefore it is imperative the use of increasingly precisetechniques like Geometric-Morphometrics (GM). We will work in the department of the Atlántico-Colombia on the *Brachionus* and *Keratella* genus; the identification of rotifer samples will be performed with the iconographic material like *Koste, Paggi*, and others. GM analyzes will be conducted to species with more than 30 specimen. Each specimen will be photograph with a digital-camera, process by the trusses-method and Thin plate spline (TPS). the species homologous points will be determine and from them, we will obtained the coordinates, which will be process to have an estimate of the magnitude and direction of the morphological differences or deformation of TPS, a Principal Component Analysis will be also perform. Finally a canonical variables analysis will be perform to determine the relationship between changes in the morphology of rotifers and variations in the concentrations of organic salts of each wetlands. The present work aims to quantify the morphological variations, by homologous structures in Brachionus and Keratella species in the study area and their possible relationship with the values in the concentrations of organic salts of each system.

RS06 - Poster

CHIRONOMID FAUNA (DIPTERA, CHIRONOMIDAE) OF THE KOLVA RIVER (PECHORA BASIN, RUSSIA) UNDER OIL CONTAMINATION

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Larvae of chironomids closely reflects the freshwater environment where they live. For this reason they are good environmental indicator and used widely in monitoring water ecosystem. The taxonomic composition of chironomids of a river in Pechora basin and its tributaries under the oil pollution is presented. The list of chironomids includes 121 species and forms from 5 subfamilies. The larger number of species is typical for subfamilies Chironominae (57) and Orthocladiinae (43). The greatest species richness (93 species) were observed in the river, slightly lower (75 species) in streams, minimum (8 species) in the lake. A mosaic distribution of the chironomid fauna in the watercourses was stated. In comparison with previously conducted similar studies in 1995 and 1997 42 species were added to recent lists. Long-term qualitative and quantitative changes of the larval Chironomidae in the composition of zoobenthos in relation with oil pollution are traced. Species diversity and abundance of chironomids increase with moderate oil pollution and decrease under the heavyone. The most common and numerous in the river basin were *Orthocladius* gr. *saxicola*, *Tanytarsus medius*, *Procladius ferrugineus*, *Microtendipes pedellus* and *Polypedilum scalaenum*.

RS06 - Oral

ANTHROPOGENIC DISTURBANCES AFFECT HABITATS AND BIOLOGICAL ASSEMBLAGES IN HYDROPOWER BASINS: TROPICAL EXPERIENCE UNDER A GLOBAL CHANGE SCENARIO

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Anthropogenic disturbances at local- and catchment-scales result in habitat loss, species extirpation, alien species introduction and reduction of ecosystem services. The objectives of this joint study in the neotropical Brazilian savanna (Cerrado biome) were to: (a) evaluate the effects of differing levels of land use, riparian vegetation condition, and riparian human disturbance on sediment transport and potential siltation of hydropower reservoirs, (b) identify the most vulnerable areas and the major landscape and hydrological pressures on hydropower basins, (c) estimate how many and which sites are in poor and good condition, independent from their biology, (d) correlate site condition with fish and macroinvertebrate assemblage condition, and (e) assess the consequences of severe drought resulting from global climate change. The information we collected is being used to support resource management and conservation strategies. The process of collecting, interpreting and presenting this data has the added benefit of building technical, managerial, and political capacity in local citizens, graduate and undergraduate students.

RS06 - Oral

DO CHANGES IN THE BIODIVERSITY OF FRESHWATER COMMUNITIES PROPAGATE TO ECOSYSTEM FUNCTIONING?

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Land use can affect the diversity of microbial and invertebrate decomposers, which play a central role in providing ecosystem functions such as organic matter breakdown (OMB). We determined the impact of land use on microbial and invertebrate communities in 30 low-order streams in a region of contrasting land use (forest, agricultural, vinicultural and urban). In addition, we explored the relationship between taxonomic, functional diversity and ecosystem functioning. OMB and microbial communities were determined from leaf bags deployed in the streams and macroinvertebrates were sampled. 21 bioecological traits of invertebrates were used to calculate the functional diversity (FD) of communities using Rao's quadratic entropy. Beside land use, physicochemical parameter were better predictors of community changes than habitat structure. Land use affected the taxonomic diversity of both microbial and invertebrate communities, whereas the FD of most traits did not differ among land use types. Moreover, land use effects did not propagate to ecosystem functioning in terms of OMB. Our results suggest that functional diversity buffers OMB from land use effects.

RS06 - Poster

THE ECTOPARASITE PISCICOLA GEOMETRA (HIRUDINEA: RHYNCHOBDELLIDA) REPORTED IN THE PRUSIAN CARP (CARASSIUS GIBELIO) (CYPRINIDAE) IN THE SMALL RESERVOIRS LOCATED WITHIN THE LOWER BASIN OF THE JIU RIVER (ROMANIA)

G. Ionelia Claudia

Piscicola geometra (linnaeus, 1761) is the most common fish leech affecting a wide range of host fish in case of both natural and breaded populations. In March 2014, we made a field trip as a result of monitoring fish populations in the small reservoirs located within the catchment basin of the PreajbaValley, a small tributary of the Jiu River, where there were caught 47 fish specimens belonging to the species: *Scardinius erythrophthalmus*, *Lepomis gibbosus*, *Abramis brama*, *Carassius gibelio*, *Perca fluviatilis*. The collected fish samples were subjected to ichtiopathological examination, namely clinical examination and parasitological examination, in the parasitology laboratory of the Sanitary Veterinary Directorate of Dolj County. The ectoparasite was detected only at *Carassius gibelio* on the gills and the ventral side of the body as parasitic sites, causing bleeding and ulcerations due to the suction cups. An important factor in causing this parasitosis is water temperature; the invasion decreases when the water temperature increases. The destruction of the macrophyte vegetation and the prevention of fish species ingress from one basin to another, given that they communicate through rubble surge tanks, are some prophylactic measures meant to prevent piscicolosis.

RS06 - Oral

BENTHIC INVERTEBRATES' RESPONSES TO PHYSICO-CHEMICAL WATER QUALITY: CALCULATION AND VALIDATION OF TAXON-SPECIFIC THRESHOLDS

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Benthic invertebrates show significant responses to a suite of environmental stressors. Among these are non-point source pollutants, such as nutrients and organic matter, following intensive land use. However, the information on critical threshold concentrations at which taxa decline or increase in frequency and abundance is missing for the large majority of taxa. For 473 benthic invertebrate taxa, we derived genus- and species-level thresholds, reflecting aprubt changes in abundance along gradients of nine fundamental water quality parameters (oxygen, chloride, nutrients and organic load). Calculations were done using TITAN (*Threshold Indicator Taxon Analysis*) and based on a dataset of 779 river sites in Germany. Threshold values were validated using a smaller set of 172 additional river sites and compared with background and orientation values defined as quality criteria for German rivers by the water authorities. For the first time, we provide taxon-specific thresholds based on a set of high quality, field-derived data. Our findings contribute towards a greater understanding of how water pollution affects riverine biota. The calculated thresholds can act as a robust, empirical basis for establishing assessment criteria, critical loads and other regulatory frameworks and tools in water management practices.

RS06 - Oral

EFFECT OF REDUCED IMPACT LOGGING AND SMALL-SCALE MINING DISTURBANCES ON STREAM FISH ASSEMBLAGES IN FRENCH GUIANA

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Deforestation and mining are recognized as major threats to biodiversity, but in addition to the well known impacts of clear cutting and industrial mining, the impact of cryptic threats such as small-scale gold-mining and reduced impact logging remain little known. Here, we quantify the impact of those disturbances on 201 fish assemblages dispersed throughout French Guiana (139 pristine forest sites, 16 sites subjected to reduced impact logging, 24 sites with ongoing small-scale gold-mining and 22 sites formerly gold-mined). We showed, a marked impact of gold-mining on fish taxonomic structure. This effect was of strong magnitude and remained significant after mining activity ceased. In contrast, the logging effect was of low magnitude, although significant. From a functional point of view, gold-mining drives species assemblages towards a decrease in the richness of small-sized stream habitat specialist species and favours larger ubiquitous species. In contrast, logging negatively affected only the richness of phytophagous species. These results show the detrimental effect of small-scale gold-mining on fish assemblages as well as the slight effect of reduced impact logging. Since gold-mining is one of the most widespread threats throughout the Amazonian region, particular care should be given to controlling this, often illegal, activity.

RS06 - Oral

NON-NATIVE SPECIES INTRODUCTIONS BLURRED HISTORICAL FUNCTIONAL BIODIVERSITY PATTERNS OF FRESHWATER FISH ACROSS THE WORLD

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In the current context of global biodiversity loss, colossal efforts have been devoted to understand how biodiversity is threatened by human's activities that are responsible from most species introductions and extirpations. To date, introductions and extirpations have been considered from a taxonomic point of view (i.e. species richness and species identity), but their influence on functional biodiversity remains poorly studied. Determining the congruence between taxonomic and functional facets of biodiversity is an urgent issue to understand how the taxonomical changes (i.e. introductions and extirpations) had modified the functional diversity of the communities. We here measured eco-morphological characteristics on more than 9,600 freshwater fish species and assessed the functional structure of fish assemblages in more than 800 river basins across the world. Quantifying introductions and extirpations effect on fish functional diversity reveals a significant increase in the most invaded river basins. Such trend did not match known spatial patterns of anthropogenic changes in taxonomic diversity. Our findings suggest that the functional diversity increase through introductions exceeds the increasing in taxonomic diversity. The emergence of new functional strategies supported by the non-native species might modify the functioning of the most invaded river basins across the world.

RS06 - Poster

ENVIRONMENTAL CHANGE IN GROUNDWATER-DEPENDENT HABITATS: RESPONSE OF BENTHIC, HYPORHEIC AND PHREATIC INVERTEBRATE COMMUNITIES TO HIGH AND LOW FLOW EVENTS

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Variability in hydroclimatology is a primary influence on the distribution of benthic communities in lotic ecosystems; however, its influence on organisms occurring in hyporheic and phreatic habitats is less well understood as they are not often included in freshwater monitoring or research programmes. This study assessed the composition and distribution of invertebrates occurring in paired benthic, hyporheic and phreatic habitats in a lowland chalk aquifer in southern England over four years. More than one hundred invertebrate species, including some new to the British Isles, were identified using morphological and molecular techniques. During normal conditions, community composition was found to be associated with depth, suggesting distinctive assemblages in each habitat. However, community composition was found to fluctuate between these habitats during periods of hydrological disturbance in response to both direct and indirect changes in environmental parameters. The communities recorded in each habitat responded differently to these disturbance events suggesting that traditional monitoring may be an insufficient measure of lotic status. A greater understanding of the distribution and requirements of fauna inhabiting hyporheic and phreatic habitats, and their response to environmental change is essential for the conservation of these species and management of lotic ecosystems.

RS06 - Oral

FUTURE HYDROPOWER DAMS AND THEIR CONSEQUENCES FOR THE GLOBAL FRESHWATER MEGAFAUNA

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We are facing a major boom in hydropower dam construction. Economic development, increasing electricity demand, and mitigation of climate change have stimulated dam building activities globally, especially in emerging economies in Africa, South America and Southeast Asia. Besides the advantages of this technology, however, a number of direct and indirect consequences for freshwater ecosystems include changes in natural sediment, flow and thermal regimes. From an ecological point of view, this leads to the loss of habitat types, restricts dispersal pathways for aquatic organisms, and alters biodiversity. The charismatic freshwater megafauna, i.e. all animals (fish, amphibians, mammals) that weigh more than 45 kg, is especially susceptible to flow alteration, habitat loss, and fragmentation. We combined, at the global scale, comprehensive information on future hydropower dams with the contemporary distribution patterns of freshwater megafauna species (www.freshwaterbiodiversity.eu). Based on these data, we identify hotspots of the freshwater megafauna, their threat status, and the potential consequences of future hydropower dams. These results not only allow identifying those areas that deserve major attention in respect to conservation and management but also help raising awareness for the critical status of freshwater biodiversity in general.

RS06 - Oral

TAXON-SPECIFIC UPPER AND LOWER WATER TEMPERATURE OPTIMA IN BENTHIC INVERTEBRATES: LIMITS AND PROSPECTS FOR PREDICTING SPECIES OCCURRENCES

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Temperature is one of the key environmental variables that can affect species in aquatic ecosystems. Exceeding thermal optima (upper or lower) will lead to the loss of species' performance. To date, information on the upper and lower ends of water temperature optima is missing for the large majority of benthic invertebrates. In our study, we aim to bridge this gap by deriving upper and lower water temperature optima for benthic invertebrate taxa, using a dataset which includes species data and temperature measurements of 417 taxa at 1,477 river sites in Germany. For 49% of all analysed taxa, either a lower or upper temperature optimum was determined. Taxon-specific temperature optima were validated by predicting the occurrence of taxa at 512 sites and calculating the amount of true positives (TP), true negatives (TN), false positives (FP) and false negatives (FN). Validation results revealed a high TP rate (0.94) for taxa with a calculated upper temperature optimum and a high TN rate (0.80) for taxa with a calculated lower temperature optimum. Limits and prospects of calculated upper and lower water temperature optima for the prediction of taxon occurrences will be discussed.

RS06 - Oral

MISFORTUNE NEVER COMES ALONE: THE ROLE OF BIODIVERSITY IN STABILIZING ECOSYSTEMS EXPOSED TO MULTIPLE STRESSORS

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Regime shifts are surprisingly common and there is increasing evidence they are more predictable than their non-linearity suggests. Eutrophication is often the main driver behind regime shifts in shallow waters and recent studies suggest that global warming could reinforce this effect. We studied this combination of stressors in a mesocosm experiment in the summer of 2014. We inoculated 192 x 200L mesocosms with a standardized bacterioplankton and phytoplankton community then with zooplankton communities from 16 different ponds, within the same nutrient range but varying from low to high zooplankton diversity. Over five months, communities were exposed to factorial treatments of two temperature regimes (ambient and ambient +4°C) and four different nutrient treatments (low, high, increasing from low, decreasing from high). We measured Chlorophyll a and turbidity daily and sampled bacterioplankton, phytoplankton and zooplankton communities every three days in all mesocosms to monitor ecosystem responses and relate these to zooplankton diversity. We also evaluated the effect of treatments on local adaptation in *Daphnia magna*. Our first results indicate that treatments strongly impacted ecosystem state and functioning, community compositions and even genetic composition within populations.

RS06 - Oral

INTRODUCING SCALE HIERARCHY IN MULTI-STRESS MODELS: TOWARDS A BETTER ASSESSMENT OF HUMAN IMPACTS ON RIVER ECOSYSTEMS

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Assuming that the structure and dynamic of stream habitats are determined by the surrounding watershed, streams structures are now consensually considered as hierarchical systems.

Understanding the functioning of river ecosystem requires taking the organisation of its spatial nested hierarchy into account.

Although few studies attempted to assess the response from biological organisms to pressures and driving forces at different spatial scales, they failed at describing the pressure data as a real hierarchical context.

Our objective was to introduce the hierarchical process of pressures and to test if the relations between local scale pressures and biological organisms were influenced by physiographic patterns.

We therefore developed a hierarchical model that relates benthic macro-invertebrate index to hydromorphological and physico-chemical local pressures and assumed

that, due to streams hierarchical organization, organisms may respond differently to a specific pressures pool, according to broader scale characteristics of the studied site.

Our results show a significantly improved understanding of macro-invertebrates response to human pressures in precise geographic areas with specific natural conditions and catchment-scale pressures.

We demonstrated that taking the

regional geographical and driving forces patterns in consideration improves the capacity of understanding the response of biological organisms to local environmental pressures.

RS06 - Oral

HEAT SHOCK PROTEIN EXPRESSION IN DIAMESA LATITARSIS (DIPTERA, CHIRONOMIDAE) UNDER NATURAL CONDITIONS

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Harsh environmental conditions make life difficult in high alpine streams. *Diamesa latitarsis* (Diptera, Chironomidae) found ways to cope with those stressful conditions (e.g. low temperatures). However, research on adaptations in alpine stream insects is still rare. This study aims at demonstrating molecular adaptations through heat shock proteins (*hsps*) as they are conserved representatives of the molecular stress-response. Individuals

of *D. latitarsis* were collected hourly from 9 am to 4 pm in two collateral streams at 2208 m a.s.l., one glacier- and one groundwater-fed (kryl and krenal). *Hsp70* and its constitutive form *hsc70* were measured on mRNA level using RealTime qPCR. Expression patterns were significantly higher in the kryal stream, suggesting an adaptation to its harsher conditions. Furthermore, *hsc70* showed about 7-fold higher expression levels than *hsp70* in both streams, indicating that the isoform might be more involved in stress-management than previously thought. However, more studies under field conditions, with careful consideration of the diurnal rhythmicity of this protein family, are essential to fully grasp the mechanisms behind heat shock protein stress-response. Ultimately, the better understanding of aquatic insects' survival strategies will help to forecast the development of alpine insect-communities under the proposed climate change scenarios.

RS06 - Oral

ARE 'NATURAL EXPERIMENTS' USEFUL IN ASSESSING MULTIPLE-STRESSOR IMPACTS IN STREAMS?

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Most studies on multiple-stressor impacts in streams have focused solely on anthropogenic stressors. However, human stressors often play out against natural stress gradients which may profoundly modify the way that human-induced stressors affect ecological responses. We demonstrate this by using examples from studies on the relative importance of an anthropogenic (forest drainage) and a natural (naturally acidic stream water) stressor on stream communities. Our study design was a replicated 'natural experiment' mimicking a factorial set up.

The additional impact of forest drainage had no effect on diatom richness, antagonistic effect on bryophytes, and additive effect on invertebrate richness. Diatom β-diversity decreased with increasing stress while bryophyte β-diversity responded mainly to drainage. Beta-diversity of leaf-decomposing fungi was lowest in the naturally acidic disturbed sites, suggesting that human disturbance simplifies fungal assemblages in naturally stressful conditions. Leaf decomposition rates did not differ between circumneutral and naturally acidic reference sites but the effect of drainage was more pronounced in acidic than in circumneutral streams. In a nutrient-addition experiment, nutrients enhanced leaf decomposition rates more in circumneutral than in naturally acidic sites. Overall, our results show that well-replicated natural experiments can provide a powerful tool for assessing multiple-stressor impacts at realistic spatial scales.

RS06 - Poster

PECULIARITIES AND COMMUNITY STRUCTURE OF BENTHIC MACROINVERTEBRATES IN DYSTROPHIC AND DYSEUTROPHIC LAKES IN LATVIA.

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Mires cover almost 5 % of the territory of Latvia. Present study is based on historical macroinvertebrate data from lakes of Teici Nature Reserve and North Vidzeme Biosphere Reserve. Bog lakes are unique freshwater habitats affected by specific environmental factors such as brown water, high acidity, bottom covered with peat and lack of macrophytes. These factors cause low biodiversity and the macroinvertebrate species number and density is lower in comparison to other lentic habitats.

Altogether, macroinvertebrate samples were taken in 13 lakes of Teici Nature Reserve and 3 lakes of North Vidzeme Biosphere Reserve. Samples were collected using Ekman-Berge grab sampler from the littoral and profundal zones. Some of the studied lakes are dyseutrophic with mineral substrates and inflow of nutrients. Dyseutrophic lakes show higher diversity and biomass of benthic macroinvertebrates than dystrophic lakes. Chironomids, oligochaetes andcaddisfly larvae are the most diverse groups in studied lakes. The most abundant benthic invertebrates of dystrophic lakes are chironomids and ghost midges *Chaoborus flavicans*. The highest diversity and abundance of macroinvertebrates are found at the overhangs of coastal vegetation in the bog lakes.

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RS06 - Poster

BENTHIC MACROINVERTEBRATE COMMUNITIES IN RAISED BOG DYSTROPHIC WATERBODIES WITH DIFFERENT HYDROLOGICAL REGIME IN LATVIA

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The aim of the study was to compare the benthic macroinvertebrate community structure at small waterbodies of raised bogs in fen with near natural hydrological regime and in fen with drained territories near to peat extraction fields. Study was conducted at two Natura 2000 areas and Restricted Nature Reserves, Cena Mire and Melnais Lake Mire, which are located in the central part of Latvia. 5 small waterbodies were studied at each fen, were 4 replicates were taken with hand net from the littoral zone vegetation. Waterbodies were characteristic with low pH and conductivity. At near natural waterbodies inCena Mire the shoreline was covered with typical fen vegetation and in the littoral zone with *Carex* sp., *Sphagnum* spp.,*Batrachospermum turfosum*, filamentous Chlorophyta, but in drained areas of Melnais Lake Mire - *Pinus sylvestris*, *Ledum palustre, Calluna vulgaris* and in littoral zone - *Eriophorum* spp., *Carex* spp., *Sphagnum* spp. At both territories dominant benthic macroinvertebrate groups were Diptera (Chironomidae, *Chaoborus crystallinus*), Odonata, Coleoptera, Heteroptera, Hydrachnidia and Trichoptera. Benthic macroinvertebrate communities differed in the composition of functional feeding groups and the drained territory was characteristic with significantly higher productivity. Study was done in the frame of the ESF project PuReST No. 1DP/1.1.1.2.0/13/APIA/VIAA/044.

RS06 - Oral

MULTIPLE AGRICULTURAL STRESSOR IMPACTS ON STREAM INVERTEBRATES: DNA BARCODING EXTENDS THE RESOLUTION OF CLASSICAL ECOSYSTEM ASSESSMENTS

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Many freshwater ecosystems and their biodiversity are subject to multiple anthropogenic stressors. Stressor responses are often studied using community measures and higher-order taxonomic groupings as species identification is often difficult. However, species even in the same genus may have very different ecologcial tolerances. DNA barcoding can improve species identification, provide information on intraspecific genetic variation and thus population vulnerability and adaptability. In this study, we sampled 43 stream sites in New Zealand spanning gradients of the agricultural stressors fine sediment and nutrients. First, we used morphology-based data to investigate macroinvertebrate community responses to stressors. Then, we used DNA-barcoding data (COI gene) to specifically test whether two important indicator taxa, *Deleatidium* spp. (n=520) and *Potamopyrgus* spp. (n=305), consisted of several unrecognized species differing in their responses to stressors. Finally, we tested whether stressors impacted on intraspecific genetic diversity. While *Potamopyrgus* spp. consisted of only one species, *Deleatidium* spp. consists of 12 molecularly identified species, whose stressor response profiles differed significantly. *Potamopyrgus antipodarum* and one *Deleatidium* species showed higher intraspecific genetic variation in stressed streams, while other species did not show any response in molecular diversity. Overall, our results highlight the potential and importance of including genetic methods in freshwater monitoring programs.

RS06 - Oral

AGRICULTURAL LANDSCAPES AND THE EFFECT OF PESTICIDES IN TROPICAL STREAMS.

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In highly biodiverse tropical countries, there is a strong conflict between the conservation of highly diverse ecosystems and economically important productive areas. In Ecuador, the current agricultural practices involve extensive use of pesticides, which effects on the ecosystem are not yet understood in tropical streams. To increase our knowledge on the effect of widespread used pesticides in tropical rivers of Ecuador, we studied streams in the Chocó biogeographic region, a hotspot of world's biodiversity. We chose three different land uses: Pristine montane rainforest, organic farms that included forest patches, and Palmito (*Euterpe edulis*) harvested lands (with extensive use of Endosulfan used as insecticide, and Glyphosate a herbicide). We studied three streams at each land use. All the studied streams had similar size and altitude above sea level. We took quantitative and qualitative samples of macroinvertebrates and periphyton. We also measured sediment, physic-chemical variables and quantified the presence of pesticidesused in Palmito farmlands. Our results show a direct relationship between the decline of certain macroinvertebrate groups (e.g. *Anacroneuria, Leptonema and Campylocia*) and the use of pesticides in the Palmito croplands. Furthermore we found that diversity losses in the streams crossing organic farms are negligible at macroinvertebrate and periphyton level.

RS06 - Oral

IS DIVERSITY IMPORTANT AGAINST ENVIRONMENTAL FLUCTUATIONS? – A DECOMPOSITION EXPERIMENT WITH AQUATIC FUNGI

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Here we tested if species-rich fungal assemblages are functionally more efficient in leaves degradation under environmental fluctuations than those of species-poor assemblages. We manipulated temperature fluctuations in laboratory microcosms in which oak leaf discs were inoculated with monocultures of aquatic hyphomycetes or random mixtures of three or eight species and subjected to different temperature regimes, including three constant temperatures and temperature fluctuation regimes. Temperature regime and identity of fungal species inoculated in monoculture microcosms significantly affected decomposition rates: decomposition was slowest at the lowest temperature and on single species treatments when compared with mixed assemblages with eight species across all temperature regimes. A functional saturation seems to occur in the presence of a low (three) number of fungal species. Litter decomposition was not inhibited by temperature fluctuating regime when compared with constant temperature conditions. Ecosystem function seems to benefit from the presence of multiple over single assemblages under environmental changes.

RS06 - Poster

ADAPTIVE PLASTICITY VERSUS CLONAL SELECTIVITY: WHICH IS THE MOST IMPORTANT DRIVER OF CLADOCERAN SURVIVAL IN THE PRESENCE OF FISH?

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Phenotypic plasticity has long been suggested to be a key factor explaining Cladocera ability to respond to changes in biotic environment (e.g. predation). On the other hand, recent studies showed that adaptive plasticity explains only a small fraction of the intra-specific variability in an important trait such as body length in *Daphnia* sp. across a gradient of fish predation. This suggests that the long-term persistence of Cladoceran species is mainly achieved through genetic adaptation. However, plasticity might still facilitate short-term population persistence but its importance in population responses to changes in environmental pressures remains largely unknown. We conducted a mesocosm study to assess the relative importance of adaptive plasticity (response to fish kairomones) and clonal selection in *Ceriodaphnia pulchella*, using fishless enclosures, enclosures with planktivorous fish, and enclosures with fish confined in net cages. Our results indicate that only 17% of the size variability in *Ceriodaphnia* was associated to adaptive plasticity after 4 weeks of experiment. This plasticity was sufficient to induce an increase in *Ceriodaphnia* biomass. In parallel, we present a theoretical model aimed at understanding the role of adaptive plasticity on clonal coexistence and rapid evolution within populations.

RS06 - Oral

INDIVIDUAL-LEVEL TRAIT DIVERSITY AND CLASSICAL SPECIES-LEVEL METRICS EXPLAIN ECOSYSTEM FUNCTIONING IN A COMPLEMENTARY APPROACH

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Global environmental change can influence ecosystem processes directly or through changes in the composition of natural communities. An important aspect of community composition is represented by traits, namely individual-level features of organisms. Although theory predicts that diversity in traits should relate in a more straightforward way to ecosystem processes than species-derived diversity, trait diversity (TD) metrics are often neglected in the literature. Furthermore, the majority of published TD metrics are designed for species-level trait values, despite the undisputed importance of intraspecific variation in multidimensional trait space. Since an individual-level perspective requires new concepts for TD, we propose two novel metrics for trait richness (TOP = Trait Onion Peeling) and evenness (TED = Trait Evenness Distribution). Together with an existing measure of trait divergence (FDis), they represent a validated set of TD metrics combining inter- and intraspecific trait variation and showing the expected behaviour when tested with simulated and real individual-level phytoplankton data. This study contributes to the expansion of functional ecology towards individual-level dynamics and enables to compare the contribution of species- and individual-level metrics in explaining ecosystem processes. A complementary approach might explain how biodiversity change mediates the effect of environmental change on ecosystem functioning.

RS06 - Oral

HOST-PARASITE INTERACTIONS IN CONTAMINATION SCENARIOS: EXPOSURE OF TWO FUNGICIDES CAUSE DIFFERENT OUTCOMES IN A DAPHNIA-METSCHNIKOWIA RELATIONSHIP

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Interactive stress scenarios between natural and anthropogenic stressors can influence natural populations, bringing uncertainty in the assessment of associated risks. Our goal was to study the simultaneous effects of contamination and parasitism to evaluate the outcome of this multi-stressorinteraction. Thus, we exposed two *Daphnia galeata* genotypes (the host) to contaminant (fungicide) or parasite (yeast *Metschnikowia bicuspidata*) challenges, or both, during 21 days. Fungicides copper sulphate and tebuconazole were the selected contaminants, given their common use and detection in agroecosystems. Copper reduced *Daphnia* survival, whilst tebuconazole decreased its reproduction. Simultaneous exposures to parasite and contaminant revealed different outcomes: a) the effects of copper and parasite were mostly independent; b) tebuconazole suppressed infection in the studied period. Additional experiments, which followed the host throughout its life span, confirmed that the infection does not occur later in time in the presence of this fungicide. Given the importance of host-parasite relationships, these findings are ecologically relevant. Therefore, our results show that the interplay between contaminants and parasitism can lead to different interaction outcomes, thus confirming the need of developing more studies with ecologically complex scenarios.

RS06 - Oral

DYNAMICS OF AN EXPERIMENTAL MICROBIAL INVASION

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Ecological dynamics underlying species invasions have been major foci in macroorganismal ecology, but we know little about the ecology of microbial invasions. We studied the roles of propagule pressure, nutrient supply, and biotic resistance to invasion by the invasive alga, *Prymnesium parvum*, using microcosms containing natural freshwater microbial assemblages. We also characterized the response of the receiving microbial community to invasion. Microcosms were subjected to a factorial design with two levels of nutrient-induced diversity and three levels of propagule pressure, and incubated for seven days. Successful *P. parvum* invasion occurred in microcosms with high propagule pressure, while community diversity played no role in invasion success. Invaded communities experienced distinctive changes in taxonomic composition with decreased abundances of diatoms and cercozoans and increased numbers of fungi. Many of these changes mirrored those observed during a natural *P. parvum* bloom. The role of propagule pressure is particularly relevant for *P. parvum* in the southern US, since it can form large, sustained blooms with intense downstream propagule pressure. Human impact and global climate change are causing widespread environmental changes that may facilitate *P. parvum* establishment in southern US systems. Coupled with strong propagule pressure, many more systems could be at risk of invasion.

RS06 - Poster

EFFECTS OF HYDROMORPHOLOGICAL CHANGES ON THE STRUCTURE OF BENTHIC MACROINVERTEBRATE COMMUNITIES IN STREAMS

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Hydromorphological changes, particularly flow and channel modification, represent one of the main pressures that act on the structure and functions of stream systems. Despite the efforts to answer the Water Framework Directive (WFD) requirements, sound indicators for assessing the hydromorphological component of ecological river quality do not currently exist. This study addresses the complex relationship between hydromorphological attributes and the biological components of streams at different spatial scales, from microhabitat to catchment scale. We hypothesise that changes in stream morphology and hydrology influence both directly and indirectly the microhabitats and the benthic macroinvertebrate communities, generating the homogenization of physical habitat and the reduction of abundance and species diversity, subsequently affecting the flows of matter and energy, and also the ecosystem services that these provide. Using the data gathered in accordance with the AQEM and RHS protocols the ecological status of 11 streams (from pristine to heavily altered) within Prahova Catchment, Romania was assessed based on biological, physico-chemical and hydromorphological components and, subsequently, the effects of stream bed and banks changes were discussed. We hope our results will allow adaptation and further development of the WFD classification scheme related to surface waters beyond its current reliance upon biological and physico-chemical elements.

RS06 - Oral

ONCE A LAND OF BIG WILD RIVERS: EUROPE'S BIG-RIVER MOLLUSCS AS KEYSTONE SPECIES OF COLLAPSED ECOSYSTEMS

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Native riverine ecosystems have been almost completely destroyed throughout Europe. Natural dispersal mechanisms have been disrupted, leading big-river molluscs and associated fishes to the brink of extinction. Long-lived and specialist species have suffered most heavily. The catastrophic decline of freshwater and riparian molluscs is a global process, just older and thus more advanced in Europe.

Arguably, Europe's wealth was triggered through harnessing and transforming its rivers. Between the Mediterranean and Boreal regions, Europe was once a land of big wild rivers carrying an enormous energy load, thus being major migration pathways for plentiful wildlife and spreading seasonally over huge floodplains. Improvements in the ecological condition of Europe's rivers and lakes are certainly being carried on in spite of several drawbacks. However, recovering the functionality of big rivers is more than a matter of clean water and fishways. The extinction of native species and the spread of invasive ones impose a heavy toll on ecological restoration. In addition, too many European freshwater ecologists have never seen or even conceived a wild river with its native fauna. Once revered and now thoroughly tamed, it may be time to rethink what European rivers should be.

RS06 - Oral

EXPLORING THE USE OF PHYTOPLANKTON DIVERSITY AGAINST WATER NUTRIENT POLLUTION AND FOR WASTEWATER TREATMENT PURPOSES

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Nutrient pollution reduces the quality of water and alters the diversity, structure and functioning of freshwater systems. Whereas strong correlations between nutrient pollution and phytoplankton biodiversity have been established (e.g., eutrophication), and the importance of diversity for the proper functioning of freshwater environments is well documented, studies about the capacity of phytoplankton biodiversity to counteract nutrient pollution ofwater are scarce. We experimentally explored the impact of the functional diversity of phytoplankton communities *on their capacity to use nitrogen as a resource using* set of microcosm experiments in which we manipulated the functional diversity of phytoplankton diversity and measured nitrogen uptake, a function directly related to water quality and nutrient pollution. Should our results validate the general hypothesis towards more functionally diverse systems resulting in an improved reduction of nutrient pollution through a more efficient uptake of nutrients, our findings would represents a valuable contribution to the study of the relationship between biodiversity and ecosystem functioning, a discipline vital to human development as it explores the importance of biodiversity as provider of ecosystem services. Ultimately, our findings will be transferred to the wastewater industry sector to enhance current wastewater treatment and make them more environmentally friendly.

RS06 - Oral

SPATIAL AND TEMPORAL PATTERNS OF BROWN TROUT POPULATION VARIATIONS IN FRANCE: EFFECTS OF FLOW AND HABITAT CONDITIONS

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Restoration of ‘more ecologically friendly’ flow regimes should rely on a good knowledge of relationships between hydrological components and ecological processes. Identifying direct relationships between seasonal flow components and population variations, and understanding how local habitat conditions could mediate this relationship, may constitute a basic step toward the definition of environmental flow regimes. We investigated how year-to-year seasonal flow characteristics and spatial habitat variables could interact to explain year-to-year changes in brown trout abundances in 112 sites in France. Using information theoretic approach and general linear modelling, we identified spatial habitat and seasonal hydrological variables which explained 0+ proportion, total and 0+ brown trout density variations. We showed that changes in total and 0+ densities were mainly linked to changes in both high and low levels during emergence period (daily flows exceeded 10% of the time, maximal flow over a 3 day period and minimum flow threshold reached during 7 continuous days) and to a lesser extent to local habitat conditions (i.e. river size), whereas 0+ proportions were only linked to high and low flow variability during emergence period. To conclude, flow seasonality needs to be considered in the understanding of brown trout population dynamics, particularly during emergence for 0+.

RS06 - Oral

PATTERNS OF PLANKTON IN HYPEREUTROPHIC LAGOON: EFFECTS OF SPATIAL AND TEMPORAL FACTORS.

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The seasonal distribution of plankton in a coastal lagoon Küçükçekmece, İstanbul/Turkey has been studied through a dataset, comprising the taxonomic composition and the abundance distribution of both phyto and zooplankton, Chlorophyll-a, and environmental variables measured during a one-year time series of monthly intervals. According to the environmental variables lagoon was determined as a hypereutrophic character (TSI=77.86) due to pressure of intensive industrial and urban wastes. During the study period Chlorophyll-a values were determined between 0.89-849 µg L^{-1} (annual average 68.30 µg L^{-1}). The phyto and zooplankton communities were characterized by the presence of freshwater, estuarine and marine species with a total of 117 taxa (59 taxa of phytoplankton and 58 taxa of zooplankton) identified. The phytoplankton annual period dominated by Chlorophyta (37%) and Rotifers made up the highest percentage of the total zooplankton, comprising 64.6% of all samples. According to statistical results, both time of sampling (seasons) and sampling sites jointly had significant effect both on phyto and zooplankton densities.

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RS06 - Oral

EPIDEMIC DIVERSITY: PARASITE-MEDIATED CLONAL REPLACEMENT IN DAPHNIA

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Members of the crustacean genus Daphnia display surprisingly high genotypic diversity, given how populations are typically dominated by one of few clones. Clones can asexually attain 80% of a lake's population. Where parthenogenesis occurs year-round, these genotypes could achieve lasting dominance, but they even persist. This diversity may be explained by negative frequency dependent selection, whereby common clones incur population-lessening costs, opening niche space for rare clones. Parasites are often proposed as the agent of this selection, as they should evolve to specialize on common hosts and eventually impose large costs. We investigated this phenomenon using long term data from the parasite-host system in Greifensee, Switzerland, where Daphnia are parasitized by the Ichthyosporidian Caullerya mesnili. This data set combines fine temporal scale Daphnia genotype data with infection status from 2001 until 2013, comprising over 20,000 Daphnia during 10 Caullerya epidemics. We found that the Daphnia community is nearly completely divided into two alternating subsets, one of which only occurs during epidemics and one of which occurs only between epidemics. In support of our hypotheses, the 'epidemic' clones are nearly always detected on exactly one sampling date, while those which appear between epidemics may persist for many years.

RS06 - Oral

UNRAVELLING THE EFFECTS OF HYDROLOGY AND TEMPERATURE ON FISH IN A MEDITERRANEAN REGULATED RIVER: A PREREQUISITE TO ADJUST ENVIRONMENTAL FLOWS

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The Durance, located in the southeast of France, is a highly regulated river, mainly for hydropower production and irrigation purposes. Nevertheless, the river still has an impetuous character and a significant fluvial dynamics when floods exceed dams' capacity. The fish assemblage of the Durance River is monitored annually since the early 1990s'. In this study, we analyzed the responses of the fish assemblage to inter-annual changes in the seasonal hydrology and temperature on 6 sites from the middle and lower Durance monitored between 1995 and 2011. Despite the high degree of flow regulation, the fish assemblage variability was mainly linked to natural flow events resulting in dam spill-over, and in particular to the magnitude of spring floods. Temperature influenced fish assemblage structure by promoting certain species at the expense of other less thermophilic ones. Understanding the effects of flow and thermal regimes on the fish assemblage at different sites and over the long term is a key step to go toward sustainable management of water resources, especially for the adaptation of environmental flows.

RS06 - Oral

'TOXIC IN CROWDS' – EXPLORING THE REGULATION OF MICROCYSTIN PRODUCTION USING SMALL SCALE MESOCOSMS

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Toxic cyanobacterial blooms are increasing in prevalence globally. Of the known cyanobacterial toxins the hepatotoxic microcystins are the most notorious. Laboratory studies have shown correlations between microcystin quotas and a multitude of physiochemical variables including nutrients, temperature and pH.

However, results are often ambiguous and usually induce only 3- to 4-fold changes in microcystin production. Recent field-based studies by our research group manipulating *Microcystis* cell densities in mesocosms resulted in an increase of ca. 20-fold in intracellular microcystin over a 5 hour period. Further in-depth studies are required to establish whether this is related to cell density or other bloom-related variables that can be mutually correlated with cell density. In this study three separate mesocosm experiments were undertaken investigating the effect of pH, light vs. dark, and nitrogen. Experiments were undertaken in 55 L mesocosm and lasted 6 hours. Samples were collected for microcystin, nutrients, microscopy, molecularanalysis and a suite of physical parameters were measured *in-situ*. These data are being used to examine the environmental conditions which *Microcystis* cells are exposed to. The results of this study could provide valuable insight into the environmental triggers of microcystin production.

RS06 - Poster

THE CHANGES IN PHYTOPLANKTON COMMUNITY COMPOSITION IN RESULT OF HUMAN ACTIVITY.

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Ecological conditions of territories under pressures of pollution (agriculture, mining activity, urbanization) cause degradation of ecosystems. An example of ecologically adverse effect on an aquatic ecosystem is River Voghji of Syunik region, where the mining activities conducted without being controlled in accordance witn international environmental standards and with no consideration of the assessment of impact on environment. Study of phytoplankton community of River Voghji, revealed a large number of species - indicators of different types of pollution, more than 40% of the species that belong toβ-mesosaprobs. The filamentous and large-forms of greens and blue-green algae were dominating in phytoplankton. The development of these species demonstratess of heavy metal pollution on the river. The planktonic algae not only indicators of water quality, but also helps water purification from various types of pollution. Research of phytoplankton of the Voghji river in 2014, showed that compared with previous years, the quantitative parameters of algae, especially the biomass has increased. Changes in qualitative structure of algae increase in quantitative indices, expansion of a variety of blue-green types, especially their toxic forms, such genera as Phormidium, Microcystis, Aphanizomenon, Oscillatoria, Chroococcus and Anabaena are the evidence of permanent pollution of an ecosystem of river Voghji.

RS06 - Poster

ENVIRONMENTAL DRIVERS OF FISH COMMUNITY STRUCTURE IN RIVER MOUTHS OF LAKE MICHIGAN, USA

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Spatial patterns of fish community structure can be affected by environmental conditions. We investigated such associations in 15 protected river mouths that spanned 230-km of shoreline along eastern Lake Michigan, USA. We refer to these protected river mouths as lakes because they are lake-like habitats that connect tributaries to Lake Michigan. We sampled littoral fish assemblages using electrofishing (*n* = 5-6 transects per lake). At each transect, we characterized environmental conditions by measuring physical (e.g., temperature and turbidity), chemical (e.g., specific conductivity and nitrate), and habitat variables (e.g., percent coverage of submersed aquatic vegetation and number of docks along shoreline). In total, we captured 3,080 fish representing 45 species. Using multivariate ordination techniques, we found evidence that: (1) environmental conditions among lakes varied spatially along a gradient of water quality, (2) fish community structure varied spatially with southern lakes distinct from the others, and (3) fish community structure in southern lakes was associated with high specific conductivity and turbidity (surrogates of poor water quality). Our results suggested that environmental drivers affect fish community structure in Lake Michigan river mouths, which has conservation implications for predicting effects of anthropogenic disturbance and setting targets for ecological restoration.

RS06 - Oral

GROWTH RATES OF PLANKTONIC ORGANISMS IN THE KARCHAGHBYUR RIVER (ARMENIA) UNDER THE CONDITIONS OF THE INFLUENCE OF SMALL HYDROPOWER PLANT

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The aim of the present study was to investigate the growth rates of planktonic organisms in the Karchaghbyur river under the conditions of the influence of the small hydropower plant (SHP). Observations, measurements and samplings were done in the sites situated in the upstream and downstream from the SHP located on the river in October-December 2013, January, February and May 2014.

Due to the operation of the SHP located on the Karchaghbyur river, the following changes occurred in the river water and thermal regimes: a decrease in the river velocity and an increase in the water temperature. All of this also caused changes in the growth rates of planktonic organisms: an increase in the growth rates of zooplankton led to a decrease in the quantitative and qualitative parameters of phytoplankton in Fall and Winter months. In May, the growth rates of phytoplankton increased because the river velocity was more favorable for the growth of phytoplankton.

Summarizing the results of the study, it’s possible to state that an unstable ecosystem was formed in the downstream from the Karchaghbyur river SHP because the quantitative and qualitative composition of trophic levels in food chains underwent changes due to the operation of the SHP.

RS06 - Oral

DISTRIBUTION PATTERNS OF PHYTOPLANKTON FUNCTIONAL GROUPS IN CONNECTED/ISOLATED RESERVOIRS IN AN URBAN DRINKING WATER SYSTEM

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Eighteen reservoirs belonging to an urban drinking water system (Zhuhai city, South China) were investigated in the dry and flood seasons of 2013 to evaluate how hydrological connectivity may affect the specie richness and functional composition of phytoplankton. Eleven among the studied water bodies are connected through pipelines and seven are isolated. Twenty one phytoplankton functional groups were identified in the studied reservoirs. Cluster analysis showed that phytoplankton similarity is higher among connected reservoirs than among isolated ones. The average α-diversity is high in the connected reservoirs, but the average β-diversity is much higher in the isolated reservoirs. The highly connected reservoirs (larger amount of water transported and shared) had very similar dominant functional groups. Connected reservoirs with less water exchange rate shared the same dominant functional groups but showed a much more diversified composition of non-dominant species. However, some isolated reservoirs with comparable trophic state showed even higher similarity in their phytoplankton functional groups composition regardless of connection. The functional diversity of phytoplankton was higher in the flood season than in the dry season for all the investigated reservoirs. Our results show that the functional diversity and similarities among phytoplankton assemblages in the studied reservoirs were related to both their hydraulic connectivity and to their trophic state.

RS07 - Oral

ECOLOGICAL CHARACTERISATION OF AN UNKNOWN FAUNA USING DNA TAXONOMY – AN EXAMPLE WITH HIMALAYAN HYDROPSYCHIDAE (INSECTA: TRICHOPTERA)

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In isolated regions like the Hindu Kush-Himalaya, taxonomic difficulties can obstruct studies on spatial and ecological patterns of diversity. We combined molecular tools and ecology in order to investigate the distribution of an unknown fauna of hydropsychid caddisflies along altitudinal gradients and explore potentially influencing factors.

A total of 655 larval specimens from 34 tributaries within four different Nepalese river systems were examined. Phylogenetic analysis of the mitochondrial cytochrome c oxidase I (COI-1 and COI-2) and the nuclear gene 28S RNA were used to delineate independently evolving lineages ("GMYC species") applying the general mixed Yule-coalescent (GMYC) model.

Estimation of species diversity within the family of Hydropsychidae, based on 497 COI-2 mtDNA sequences, resulted in 29 GMYC species. High levels of species turnover among river systems indicate high ß-diversity, i.e. site-to-site variation across geographical ranges in the Hydropsychidae community, and a great degree of regional endemism. Within each system, community composition was found to vary greatly along the altitudinal gradients, with many GMYC species associated with narrow specific altitudinal ranges.

Overall, the results support the utility of DNA taxonomy approaches for biodiversity assessment of poorly studied groups or regions and highlight its further application to explore fundamental questions in freshwater ecology.

RS07 - Poster

DETERMINANT FACTORS TRIGGERING THE DIVERSITY OF GASTROPOD POPULATIONS WITHIN THE LOWER BASIN OF THE DANUBE

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The distribution of the gastropods in inland water bodies is determined by the zonality of the hydrographic network. Within the territory of Romania, there are defined 11 hydrological zones according the altitude of the Carpathians. These influence and determine the character of the inland water bodies and, consequently, the distribution and diversity of the gastropod populations. Under these circumstances, there were identified 107 species within the lower basin of the Danube. The diversity of the ecosystems from this hydrographic basin imposes a specific structure and distribution of the gastropod populations: in the mountain torrents and streams – 14 species, in the sub-mountain and hill sectors of the rivers – 6 species, in the plain rivers – 2 species, in the glacial lakes and alpine marshes – 1 species, in the lakes from the hilly and the plain regions – 16 species, in the salty and brackish lake ecosystems – 18 species, in the lower sector of the Danube from the Romanian territory – 83 species. Compared to the European malacofauna, the gastropods from the lower basin of the Danube represent 32 % of the total number of species, which highlights the importance of the Danubian – Carpathian space for the gastropod fauna.

RS07 - Oral

DISPERSAL STRENGTH DETERMINES META-COMMUNITY STRUCTURE IN A DENDRITIC RIVERINE NETWORK

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In this study, we used aquatic invertebrate communities to investigate the relationship between local and regional factors in explaining distance decay relationships (DDRs) in fragmented dendritic stream networks. The study was conducted in 28 sites across seven dryland streams distributed within a 400 km^2 section of the Upper San Pedro River basin, southeastern Arizona, USA. We combined fine-scale local information (flow and habitat characteristics) with regional-scale information to explain DDR patterns in community composition of aquatic invertebrate species with a wide range of dispersal abilities. We used a novel application of a landscape resistance modeling approach (originally developed for landscape genetic studies) that simultaneously assessed the importance of local and regional ecological factors as well as dispersal ability of organisms.We found evidence that both local and regional factors influenced aquatic invertebrate DDRs in dryland stream networks, and the importance of each factor depended on the dispersal capacities of the organisms. Local and weak dispersers were more affected by local-scale factors, intermediate dispersers by landscape-level factors, and strong dispersers showed no discernable pattern. This resulted in a strongly hump-shaped relationship between dispersal ability and landscape-level factors, where only moderate dispersers showed evidence of DDRs. Unlike most other studies of dendritic networks, our model results suggest that overland pathways, using perennial refugia as stepping-stones, might be the main dispersal route in fragmented stream networks. We suggest that using a combination of landscape and local distance measures can help to unravel meta-community patterns in dendritic systems. Our findings have important conservation implications, such as the need to manage river systems for organisms that span a wide variety of dispersal abilities and local ecological requirements. Our results highlight the need to preserve perennial refugia in fragmented networks, since they may ensure the viability of aquatic meta-communities by facilitating dispersal.

RS07 - Oral

DISPERSAL CAPACITY AND BROAD-SCALE LANDSCAPE STRUCTURE SHAPE BENTHIC INVERTEBRATE COMMUNITIES ALONG STREAM NETWORKS

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For river benthic invertebrates it remains unclear how dispersal as a key trait influences species´ distribution patterns and meta-community structure. Based on 1,466 benthic invertebrate samples across Germany we compared dispersal capacity and community dissimilarity between headwaters and mainstems for highland and lowland streams, respectively. Dispersal capacity of benthic invertebrates varied greatly along the stream networks and increased with stream size in both highland and lowland streams. Increasing dispersal capacity from headwaters to mainstems leading to homogenization of communities in highland but not in lowland areas suggests that both dispersal capacity and landscape structure interact to determine community structure in these networks. We interpret these results as indicating a potential species sorting (SS) to mass effect (ME) transition in networks with a gradient in connectivity, but in highly connected environments, these transitions do not occur. Our results therefore stress the importance of considering dispersal traits and landscape features, as well as habitat control to better understand the (meta-)community structure across various landscape types.

RS07 - Oral

RECIPROCAL SUBSIDIES BETWEEN RIVERINE AND TERRESTRIAL RIPARIAN HABITATS ACROSS FLOODPLAINS OF DIFFERENT AGES IN GLACIER BAY, ALASKA

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Reciprocal resource fluxes between the stream and terrestrial ecosystems were investigated in five catchments at different stages of floodplain development in Glacier Bay, southeast Alaska. Due to recent glacial recession, this area provides a natural laboratory for examining the key processes driving community assembly and fluxes between these ecosystems. Stable isotope (SIA) (13C and 15N) and gut contents dietary analyses were carried out for juvenile Dolly Varden and Coho salmon, aquatic invertebrates, and terrestrial invertebrates (SIA only). A major goal was to determine how reciprocal resource fluxes have changed over time as landscapes increase in age and the composition of riverine and terrestrial communities is altered

SIA indicates that juvenile fish sourced their diet from terrestrial subsidies at all sites, whereas for riparian consumers there was a switch from terrestrially derived prey to aquatic invertebrates as catchments increase in age. Isotopic ‘niche space’ (a proxy for trophic diversity) showed elevated trophic diversity for juvenile salmonids and invertebrates at some sites. Gut contents analysis of fish showed an increase in richness of food sources at sites with higher trophic niche width. We suggest that site-specific differences may have more of an impact on diet than site age alone.

RS07 - Oral

CONTRASTED ALPHA- AND BETA- DIVERSITY PATTERNS BETWEEN EUROPEAN AND AMAZONIAN STREAM FISH ASSEMBLAGES

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Up to now, biodiversity studies have mainly focused on taxonomic measures of diversity based on species richness (alpha-diversity), or changes in community composition between places (beta-diversity). These studies have investigated both alpha and beta-diversity along environmental gradients or neighbouring localities, or compared patterns at macroecological scales. Since the last decade complementary descriptors of biodiversity have been developed such as functional diversity metrics based on morphological or ecological species traits. Nevertheless, the consistency between those metrics and their variation across space remains understudied. We here compared taxonomic and functional diversity patterns of stream fish assemblages at regional and local scales in two distinct areas belonging to different realms and climate zones (France and French Guiana). We showed that despite a higher regional and local taxonomic and functional diversity and a stronger species turnover between sites in French Guiana, French fish assemblages were more functionally dissimilar regardless of sites distances. Tropical freshwater fish assemblages are thus composed of speciose assemblages that functionally overlap between localities. On the contrary, European assemblages host a few species and those species-poor assemblages are therefore more functionally distinct between each other. Those results pledge for distinct biodiversity management approaches according to the considered region of the world.

RS07 - Poster

SPATIO-TEMPORAL DISTRIBUTION OF AMMONIA-OXIDIZING ARCHAEAL COMMUNITIES IN TWO PERI-ALPINE LAKES

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Despite their essential role in the nitrogen cycle, the dynamics and structure of ammonium oxidizing archaea (AOA) remain poorly known in freshwater ecosystems particularly in deep lakes. We evaluated, in this study, the spatio-temporal dynamics of AOA in two deep peri-alpine lakes with contrasting environmental conditions (the oligotrophic lake Annecy vs. the mesotrophic lake Bourget). Using both Denaturing Gradient Gel Electrophoresis and qPCR approaches, we determined the structure of AOA and abundances of archaeal *amoA* gene in both lakes, at two depths (epilimnion and hypolimnion) and monthly during 24 months (2007-2008). The *amoA* gene abundances varied between 0.0064×10^3 and 9×10^3 in Lake Annecy and between 0.001×10^3 and 4.7×10^4 in Lake Bourget, with the highest values observed in the hypolimnion. Stronger differences in the temporal dynamics of *amoA* gene were observed between depths than between lakes. In the epilimnion, *amoA* gene displayed seasonality with the highest values observed in winter. In contrast, the archaeal *amoA* gene dynamics did not exhibit any clear seasonal trend in the hypolimnion. The preliminary results suggest the involvement of different environmental parameters in the temporal dynamics of AOA in both lakes. The canonical correspondence analysis will allow to estimate the percentage of the variance explained by these variables.

RS07 - Poster

IMPORTANCE OF TRANSITIONAL AND SATELLITE HABITATS IN MAINTAINING MACROINVERTEBRATE DIVERSITY OF A SHALLOW MARSH SYSTEM

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Freshwater marshes as core habitats are often surrounded by a wide spectrum of related transitional and isolated satellite (alder-swamp, old silted oxbow, ephemeral puddles) habitats. Contribution of these kinds of habitats to species richness of the whole marsh system is poorly known. We hypothesized that the transitional and satellite habitats have unique aquatic macroinvertebrate fauna and therefore remarkably contribute to the biodiversity of the marsh ecosystem. Faunistical samplings were made in three seasons (spring, summer and autumn) from a total of 93 sampling points in the three habitat types (core, transitional and satellite) in a Hungarian marsh system. More than 5000 specimens belonging to 259 species-level taxa of aquatic macroinvertebrates were captured during the sampling campaign. Numbers of taxa were higher in transitional habitats than in core and satellite habitats (197, 166, 122, respectively). There was a considerable overlap between the core and transitional habitat types, while satellite habitats were different from the others based on their species composition. ß-diversity features, species replacement and dissimilarity, were high in case of every pairwise of habitat types based on Simplex (SDR) method. We can conclude that transitional and satellite habitats, with a large core water body can maintain together the highest diversity.

RS07 - Oral

QUANTIFYING THE EFFECTS OF ENVIRONMENTAL AND GEOGRAPHICAL FACTORS ON MACROINVERTEBRATE COMMUNITY ASSEMBLY IN SPRINGS

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Springs are peculiar habitats from an ecological point of view. They are multiple ecotones between aquatic (ground, surface and interstitial waters) and terrestrial ecosystems. The 'mosaic' ecotonal structure results in a number of microhabitats that often sustain high species richness, and therefore these environments can be considered as hotspots of aquatic biodiversity. For many species each spring represents a habitat island, where dispersal is supposed to be limited. Furthermore these environments usually occur in clusters, along the intersection between aquifers and ground surface. For these reasons the analysis of the relative importance of local environmental and bio-geographical drivers is particularly interesting. We sampled 18 springs in the Northern Apennine (Italy) between 433 and 1614 m a.s.l., characterised by different lithology and microhabitat types. Macroinvertebrate communities were analysed, data on environmental variables (pH, water temperature, conductivity, major nutrients' concentrations, spring types) and on geographical parameters (altitude, latitude, longitude, orientation) were collected. Information on 36 taxonomic units were gathered, mainly represented by Plecoptera, Trichoptera, Diptera, and Coleoptera. Variance partitioning was used to reveal the relative contribution of environmental and geographical factors. The relationship between the similarity in taxa composition among sites and their mutual geographic distance was also investigated to assess the role of dispersal.

RS07 - Oral

HOW RESOURCE COMPETITION DETERMINES DIVERSITY OF PRIMARY PRODUCERS – RADIAL MESOCOSM EXPERIMENTS CAN SIMULATE THE BENTHIC-PELAGIC INTERACTION IN RIVERS.

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In many systems benthic and pelagic primary producers compete for light and nutrients along two opposing vertical fluxes: pelagic algae shade the benthic habitat and influence the light supply to benthic algae; conversely, benthic algae intercept the nutrient flux from the hyporheic zone to the pelagic habitat and thus influence the nutrient supply to pelagic algae.

We constructed radial mesocosms to experimentally analyse the resource competition between benthic periphyton and phytoplankton in running water ecosystems. The mesocosms consist of a pelagic habitat, a benthic layer and a bottom compartment. We show results of two two-factorial experiments, in which nutrients were directly supplied to the pelagic habitat or they were supplied via the bottom chamber; passing the benthic periphyton before reaching the pelagic habitat. As the second factor we varied the incoming light intensity in the first and the concentration of nutrient supply in the second experiment.

Both experiments were conducted with water from two different sites of the River Holtemme (Harz mountain area, Germany), respectively. Thereby, one site represents pristine conditions; the other site is highly impacted by multiple stressors. The main focus of the results lies on respective algal biomasses, algal stoichiometry and functional diversity of algal communities.

RS07 - Oral

AQUATIC INSECTS OF SPRING FENS: INDIVIDUAL SPECIES RESPONSES TO THE MAIN ENVIRONMENTAL GRADIENTS

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The role of local environmental conditions in structuring insect assemblages at springs is relatively well explored. In contrast, there are virtually no data on how these gradients affect populations of individual species, thus which species determine the response of the entire assemblages.

We selected seven independent predictors (amount of calcium + magnesium, discharge, water temperature, proportion of inorganic substratum, FPOM, CPOM, and mean air temperature in July) and analysed their effects on populations of 34 insect species inhabiting most frequently the Western Carpathian spring fens (at least 25 sites out of 59).

We found that discharge and water temperature were the most influential predictors (40% of species). Generalists responded mainly to discharge and also to organic substratum (FPOM, CPOM). Spring-fen specialists were affected by water temperature or mineral richness or both factors. A considerable number of specialists, however, did not respond to any analysed predictor and their populations were probably determined by different factors.

We provided the first information about individual species responses to abiotic conditions at spring fens, though for eight species no clear response was identified.

This study was financially supported by Czech Science Foundation P505/11/0779.

RS07 - Oral

HABITAT CONTRAST AMONG SPRING PATCHES, SPRING BROOKS AND NEARBY STREAMS: CHANGES IN TRICHOPTERA ASSEMBLAGES ALONG THE GRADIENT OF MINERAL RICHNESS

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Spring fens can be classified as inland islands, due to their spatial isolation and specific, relatively stable environmental conditions. Spring fen communities consist of inter-patch dispersers (fen specialists) and matrix-derived species (habitat generalists, i.e. occupy also other aquatic habitats in the surroundings). The share of matrix-derived species is a measure of the habitat contrast between an island and its matrix, which increases along with a higher proportion of fen specialists.

A strong environmental gradient playing the main role in structuring biotic communities in fens is represented by the variation in water pH and concentration of bivalent cations, i.e. the gradient of mineral richness. The whole range of this gradient occurs in the study area located in the Western Carpathians.

We aim to test the hypothesis that the habitat contrast between the fen sites and the streams in surrounding matrix vary along this gradient. We also compared the contrast between streams and two spring-fen mesohabitats (i.e. spring patches and spring brooks) using Trichoptera assemblages as they express both high abundance in spring fens and a wide range of habitat specialisation. As the mesohabitats differ in their species composition and environmental conditions, a different proportion of matrix-derived species should be expected.

RS07 - Oral

ENVIRONMENTAL CONTROLS ON RIVER ASSEMBLAGES AT THE REGIONAL SCALE: THE IMPORTANCE OF NETWORK POSITION

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Our objective was to explore regional patterns in riverine benthic invertebrate assemblages in relation to their position along the river network and examine differences in composition, biodiversity (alpha and beta diversity), and environmental drivers. We applied methods used to examine the elements of metacommunity structure to faunal distribution patterns at the regional extent. This enabled a comparison between best-fit distributional patterns in faunal composition for 168 low-mountain stream invertebrate assemblages in central Germany. We assessed the most influential environmental factors structuring regional faunal composition and alpha diversity, comparing between headwaters, mid-sized streams and large rivers, using boosted regression trees. Faunal composition patterns were mostly Clementsian, with little difference between the different sections of river network, but environmental drivers of composition varied considerably between these sections and with alpha diversity. Prediction of faunal composition was weaker in large rivers than headwaters and mid-sized streams, and the importance of space was greater, suggesting a weakening in species sorting. Furthermore, catchment size was more important in predicting composition patterns than richness, indicating a stronger downstream transition in composition than alpha diversity. Our findings further emphasise the importance of considering the alternative ways in which anthropogenic stressors are operating to affect biodiversity patterns.

RS07 - Poster

TROPHIC DESCRIPTORS OF A SERIES OF RESERVOIRS IN CANTAREIRA SYSTEM (SÃO PAULO, SP, BRAZIL)

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This study was conducted in five reservoirs of the Cantareira System, the most important source of water supply for 9 million inhabitants of São Paulo city (Brazil). The System consists of five reservoir (Jaguari, Jacarei, Cachoeira, Atibaia and Paiva Castro) interconnected by channels and tunnels. This research aimed to compare the water masses from the point of view of the trophic state, and verified how the phytoplankton community responds to these trophic conditions. We collected integrated water column samples for physical, chemical variables and phytoplankton analysis in 19 sampling points from the reservoirs in two periods. The System showed a trophic gradient. The Jaguari reservoir was classified as supertrophic/eutrophic, the Jacarei as eutrophic/mesotrophic and Cachoeira, Atibaia and Paiva Castro as mesotrophic/oligotrophic. A total of 180 taxa were identified, belonging to the class Cyanophyceae, Chlorophyceae, Zygnemaphyceae, Bacillariophyceae, Dinophyceae, Euglenophyceae, Chrysophyceae and Cryptophyceae. A trend of increased phytoplankton density (390,134.7 ind.mL^{-1} to 1,152,470.2 ind.mL^{-1}) can be observed with increasing trophic conditions. It was observed in the reservoir Jaguari an occurrence of invasive species *Ceratium furcoides* (Levander) Langhans 1925 with high abundance (46.3 %).

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RS07 - Oral

ASSEMBLAGE PREDICTABILITY AND BETA DIVERSITY IN STREAM ECOSYSTEMS: ASSESSING THE EFFECTS OF ENVIRONMENTAL HETEROGENEITY, ISOLATION, AND PRODUCTIVITY AT A CONTINENTAL SCALE

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We used macroinvertebrate data collected from 3,706 streams in 69 ecoregions across the USA to assess how both assemblage predictability (precision of multi-taxon niche models) and beta diversity (compositional dissimilarity among sites) varied with regional environmental heterogeneity, isolation (drainage density), and productive capacity (total nitrogen [TN] and total phosphorus [TP]). For reference quality streams, assemblage predictability declined with increasing isolation (drainage density = 0.1-0.7 km/km^2) and TN (asymptote ~300 µg/L, range = 20-500), but was unrelated to environmental heterogeneity. Models that included degraded sites were ~10% less precise than reference site only models. For reference-quality streams, beta diversity (adjusted for alpha diversity, gamma diversity, and region size) increased with TN (asymptote ~300 µg/L), TP (range = 5-50 µg/L), isolation, and environmental heterogeneity. Across all streams, beta diversity increased with both TN (asymptote ~300 µg/L, range = 20-5000) and TP (asymptote ~200 µg/L, range = 5-800) but was only weakly related to isolation and environmental heterogeneity. These results imply that the importance of different processes in community assembly vary with both natural environmental setting and human-caused increases in productivity. Increased productivity is thought to promote stochastic assembly/disassembly, but null model analyses implied that increasing nutrients/productivity was associated with environmental filtering.

RS07 - Poster

EFFECTS OF ENVIRONMENTAL FACTORS IN VARIOUS SPATIAL SCALES ON AQUATIC MACROINVERTEBRATE COMMUNITIES IN DIFFERENT TYPES OF RUNNING WATERS

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A great number of publications deal with the effects of environmental factors on macroinvertebrate communities at different spatial scales. However, the rate of these effects in case of different types of running waters is poorly known. Thus, we compare the effects of these factors on aquatic macroinvertebrate communities in four different types of running waters (streams in hilly regions, rivers in hilly regions, streams in plain regions and rivers in plain regions). Ten watercourses from each types with good ecological quality in different geographical regions in Hungary were sampled. The effects of almost 40 environmental factors belonging to different spatial scales were analyzed by multivariate statistical methods. Based on the NMDS ordination the species compositions were indeed different in all types, however a minimal overlap was noticeable. The partial redundancy analysis indicated that the effects of the environmental factors on the community structure depended on the spatial scale in each types of watercourses.

RS07 - Oral

PHYTOPLANKTON COMMUNITY STRUCTURE IN SOUTHERN CHILEAN LAKES IN RESPONSE TO MIXING REGIME AND ANTHROPOGENIC PRESSURES

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Thermal stratification is known to strongly influence phytoplankton composition, as mixing conditions determine light, nutrient and temperature regimes. Therefore, sedimentary records of phytoplankton species shifts may provide information of past stratification conditions in response to climate change. We studied spring and early summer phytoplankton composition in 47 (ultra)oligotrophic southern Chilean lakes using HPLC pigment analysis, next generation sequencing (NGS) of the 18S rRNA gene, and microscopy, and quantified their relationship with stratification conditions, water chemistry and physical lake characteristics. Emerging patterns were compared with surface sediment diatom assemblages. Factors related to light climate and mixing regime as well as catchment characteristics were significantly related to the distribution and abundance of the main phytoplankton groups as inferred by HPLC and NGS, and could also explain turnover patterns in diatom community structure. Planktonic diatom associations were highly similar to sub-fossil communities observed in surface sediment samples, which allows a more quantitative inference of lake conditions based on improved auto-ecological knowledge of diatom species. Although diatoms dominating fossil assemblages still occur today, no modern analogues of pre-industrial diatom assemblages from Chilean lake sediment cores were observed, suggesting that ongoing human influences interfere with climate-induced changes in these systems.

RS07 - Oral

THE ROLE OF DISPERSAL FOR THE MAINTENANCE OF DIVERSITY IN EXPERIMENTAL PLANKTON COMMUNITIES

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Dispersal is an important mechanism, regulating diversity. By allowing new species to enter communities, ongoing colonization compensates for local extinctions. Furthermore, dispersal facilitates compositional responses of local communities to environmental change through species sorting with potential effects on ecosystem function. More diverse communities have been shown to express higher and more temporally stable ecosystem functioning than less diverse ones, resulting in a consistently higher level of ecosystem functioning over time.

In a new experimental approach, we used outdoor mesocosms to investigate the combined effect of connectivity and productivity in both presence and absence of mesozooplankton on phytoplankton diversity and functioning in experimental freshwater systems. In order to capture the temporal succession of the communities, the experiment lasted for three months.

First results suggest that phytoplankton biomass was highest and diversity lowest in communities not connected to the regional species pool in the absence of mesozooplankton. Disconnected communities were dominated by few species through monopolizing shared resources. Conversely, connectivity increased diversity while the presence of mesozooplankton rendered the communities much more dynamic.

RS07 - Oral

INFLUENCE OF MICROBIAL CONDITIONING ON LEAF INVERTEBRATE COLONIZATION AND FOOD PREFERENCE OF TRIPLECTIDES SP. IN AN ATLANTIC FOREST STREAM

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Microbial conditioning can substantially alter the palatability of leaf litter in tropical streams, which are usually of low quality. The objective of this study was to evaluate the influence of conditioning time on invertebrate colonization and food preference of the tropical shredder *Triplectides* sp. (Trichoptera, Leptoceridae). Leaves of *Miconia chartacea* were incubated in an Atlantic Forest stream (Southeast Brazil) and samples were collected after 7, 15, 30, 45 and 60 days of incubation. The decomposition process was slow with almost 80% of leaf mass remaining after 60 days. However, leaves were rapidly colonized by aquatic hyphomycetes and the production of conidias was higher at time 30. Leaf toughness values decreased considerably at time 45. The invertebrate assemblages observed after 45 and 60 days were more similar than those observed at the initial incubation times and shredder biomass was higher at time 60. Larvae of *Triplectides* sp. showed preference for leaves with higher conditioning times. The results indicated that microbial conditioning altered the quality of leaves of *M. chartacea* by reducing leaf toughness and suggest that leaves from tropical streams may require higher conditioning times to become more attractive to detritivores.

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RS07 - Poster

USING UNDERWATER DIGITAL PHOTOGRAPHY TO ASSESS THE HABITAT STRUCTURE OF ZOOPLANKTON COMMUNITIES

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Submerged aquatic vegetation (SAV) are considered hotspots of zooplankton diversity. They play an important role as refuge for zooplankton against fish predation and UV radiation in shallow lakes. SAV sampling methods are destructive and time consuming, hindering the assessment of the SAV-zooplankton relationship. The aim of this study was to analyse the relationship between SAV cover and structure using submerged upward photographs and zooplankton community composition and functional diversity (FD). We sampled SAV biomass and zooplankton at 25 stations in a fluvial shallow lake together with submerged upward photographs along a gradient of SAV abundance. Zooplankton functional traits were used to estimate community FD by calculating indexes such as functional evenness and dispersion. Our results suggest that SAV structure and biomass explain, respectively, 7.5% and 7.2% of de variation in zooplankton community composition and 3.4% and 19.7% of zooplankton FD. This is the first study using underwater photographs to assess SAV structure in natural aquatic environment. Our results show a promising avenue to assess the SAV-zooplankton relationship in a non-destructive way.

RS07 - Oral

BENTHIC DIATOMS IN TEMPERATE ATLANTIC STREAMS: TEMPORAL AND SPATIAL VARIATION

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Diatoms are key elements for bioassessment of running waters, therefore, the characterization of underlining biological structural data concerning interannual and spatial variation aside with anthropogenic degradation is of the uttermost importance.

Ninety one spring samples over three years (2007, 2011 and 2012) covering the entire range of degradation from three river basins in central Portugal (rivers Vouga, Mondego and Lis) were studied. A homogenous mix of sites from the three sampling years on one hand, and of the three river basins on the other hand was shown on the ordination plot of a multidimensional scaling analysis (MDS – PRIMER 6), using Bray-Curtis similarity measure. Nevertheless, PERMANOVA showed that 2007 diatom assemblage was statistically different from 2011 and 2012 (pseudof=3.25, $p<0.001$). Average dissimilarity (SIMPER analysis) between 2007 and 2011 and 2012 was 78% and 80%, respectively. This dissimilarity refers to relative abundance differences between years and not to changes in assemblage composition. The diatom assemblages of the three river basins were also statistically different (PERMANOVA - pseudo=2.41, $p<0.001$). SIMPER analysis resulted in a dissimilarity value around 80% between the three river basins and once more it was not the composition in taxa that differed between the river basins but their relative abundance.

RS07 - Poster

TESTING PHYTOPLANKTON AND ALGAL PERIPHYTON FUNCTIONAL GROUPS IN RELATION TO ENVIRONMENTAL CONDITIONS

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We explore the performance of functional classification schemes of phytoplankton (Kruk, et al 2010; Salmaso&Padisák 2007, Reynolds, et al 2002) and algal periphyton, and taxonomic groups in their community composition predictive ability in relation to environmental conditions. We proposed a new functional approach for algal periphyton that consider morphological traits and main taxonomic level (total of 30 groups). We analyze the biomass of algal groups in relation to environmental variables (including zooplankton) in a total of 16 lakes in Uruguay, Argentina and Denmark. We first performed a Principal Component Analysis with environmental variables (including zooplankton) resulting in 4 groups: Clear, turbid by resuspension, turbid by phytoplankton and intermediates lakes, and checking its significance (ANOSIM-Euclidian, Ra = 0.903, p = 0.0001). We tested phytoplankton and algal periphyton groups in relation to these types of lakes. Also, Detrended Correspondence Analysis was performed to evaluate the composition predictive ability of each classification scheme in relation to environmental conditions. Taxonomic classifications (genus and species) had low predictive capacity, while functional approaches by Reynolds and Salamaso&Padisák for phytoplankton and the proposed functional classification scheme for periphyton, exhibited a high predictive performance, reflecting a close link with the ecological function of both algal communities.

RS07 - Oral

IMPACT OF ARTIFICIAL LIGHT ON AQUATIC-RIPARIAN ARTHROPOD ASSEMBLAGES

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The dramatic increase in artificial light at night (around 6% per year) requires a better understanding of the ecological consequences of artificial light in order to develop new and urgently needed lighting policies. The influence of artificial lighting on species interactions across aquatic-terrestrial boundaries is of particular importance in freshwater ecosystems. We conducted a field experiment in an agricultural drainage ditch in Northern Germany in which we altered the natural photoperiod using artificial lights and investigated the responses of aquatic and terrestrial arthropods. We found a clear attractive effect of artificial light at night on freshwater and terrestrial flying insects. Moreover, artificial lighting affected the composition of ground-dwelling arthropods, particularly spiders, in the riparian zone. Our experiment is among the first to quantify how artificial light at night can alter the composition and trophic interactions of arthropods across ecosystem boundaries. The proper management of artificial light thus becomes fundamental for the effective conservation of ecosystems.

RS07 - Oral

ENVIRONMENTAL FACTORS AS KEY DRIVERS FOR MOUNTAIN LAKES BIODIVERSITY

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Alpine lakes are mainly threatened by pollution and climate change causing biodiversity losses, or changes in the composition of their communities. These changes may be significant, so that mountain lakes can be used as early-warning sites to assess the effects of anthropogenic stressors. However, Alpine lakes being not WFD-relevant because of their dimensions, still needs an adequate coverage within the national monitoring programs as they serve in the regulation of the water balance and may represent a secondary source of pollution to lowland ecosystems.

In this context, a research study has been performed in the Stelvio National Park (Central Alps, Italy) in 2011 to assess the ecological status of some lacustrine environments through their chemistry, and macroinvertebrates and diatoms communities. The final aim of this study was to foster conservation practices of water resources in the international context of the promotion of sustainable development under climate change impact.

Samples were collected following a European wide standardized sampling protocol, through littoral handle netting, direct stones brushing, and outflow water sampling. Results showed a strong dependence of the composition of the biological community on climate and hydro-chemistry.

RS07 - Oral

MECHANISMS OF SPECIES PERSISTENCE IN STREAMS METACOMMUNITY

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Although several studies have examined long-term trends in biodiversity change at local scales, few have used appropriate data and analyses in order to understand possible mechanisms influencing this change. Here we use data from a metacommunity of invertebrates from ten streams monitored over 24 years to assess temporal changes in biodiversity and to test mechanisms hypothesized to regulate extinction-immigration dynamics, including i) abundance-based mechanisms (population size), ii) metapopulation dynamics (rescue-effects), iii) sampling from the regional pool (island-mainland dynamics), and iv) niche-based mechanisms (habitat specialisation).

As with previous studies, we found no change in local (alpha) diversity through time, but systematic compositional change, implying compensatory dynamics. Species were buffered from local extinction as a result of population size and the fraction of sites occupied (i.e. rescue-effect). Conversely, immigration was mainly influenced by niche-based mechanisms, with specialists showing lower immigration probabilities. This resulted in a decreasing representation of specialists over time. Regional sampling processes had only minor influences.

Overall, our results suggest that niche and abundance/dispersal-based mechanisms differently affect species extinction and immigration in metacommunities. Population persistence appeared regulated by multiple hierarchical processes where species-specific niche factors combine with internal (metacommunity) and external (regional pool) dynamics to shape biodiversity changes through time.

RS07 - Oral

FINE SCALE PATTERNS OF MACROINVERTEBRATE COMMUNITIES AND HABITAT FEATURES IN A SMALL URBAN CHANNEL

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Streams are mosaics of habitat patches that sustain biota through suitable conditions and resources. The species-sorting perspective implies that species organise according to differences in patch quality - however this pattern has been found to be scale dependent.

Which habitat features and at what scales, drive invertebrate community composition? Sampling at a small grain size while retaining the ability to aggregate samples in a spatially-explicit structure will address this question.

In summer 2013 and 2014 a fine scale (0.5 x 1m) systematic gridded survey was conducted of the Broxburn, an urban stream in central Scotland. The spatial context of each sample was retained to reflect the directional effect of flow. Depth, flow velocity, substrate organic matter and other habitat features were recorded in each cell. Invertebrates were sampled from a subset of grid cells and identified to species (EPTC) or family (Diptera).

This talk will present the key environmental drivers of species composition and the contribution of patch juxtaposition and spatial location within the channel. Patterns of taxa presence and abundance are discussed in relation to habitat features. The impact of disturbance and habitat simplification from engineering work on the spatial organisation of the invertebrate community is also discussed.

RS07 - Poster

BETA DIVERSITY IN CERRADO PONDS: OBSERVED PATTERNS DERIVED FROM GENERALIZED SLOSS CURVES

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Beta-diversity variation within metacommunities is an important topic to understand the processes that shape ecological systems. Otherwise, the pond conservation problem in rural areas could be stated as how beta-diversity among them determine if a collection of large or small-ponds need to be conserved. We used SLOSS curves approach to deal with this question on the study of 71 waterbodies in Cerrado near Goiânia (Brazil) based on standardized samples of phytoplankton, macrophytes, odonates, water-bugs, water-beetles, fishes, amphibians and semi-aquatic birds. Besides the use SLOSS curves to evaluate pond-area effects, we generalized its use to the trophic state of the pond, using the chlorophyll concentration as a surrogate. We developed a null model based on random distribution of samples in relation to both area and trophic state. For all groups, small-to-large curves produce higher species accumulation curves than large-to-small, supporting that small-ponds harbour higher beta diversity, possibly related to environmental heterogeneity. Patterns are less evident for trophic state, but curves from lower-to-higher chlorophyll produces higher species accumulation, except for water-bugs. Higher beta diversity in less productive ponds may be related to the selection of highly efficient species and may help to understand the community assembly of these systems.

RS07 - Oral

ELEVATION IN TROPICAL SKY ISLANDS AS COMMON DRIVER IN STRUCTURING GENES AND SPECIES OF FRESHWATER ORGANISMS

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Tropical ecosystems are remarkably rich and host the highest concentration of species. Such high level of biological diversity is associated to multiple factors. Among them, an often-neglected factor lies in the diversity of habitats occurring along the tropical elevation gradient. Using mayflies as model, we investigated which ecological factors—among which elevation—were associated with structuring of both communities and genetic lineages. We first performed an analysis of variance using distance matrices, among 31 mayfly communities sampled across four tropical sky islands, to establish spatial factors that structure species assemblages. Second, we used restriction-site-associated DNA sequencing in four species widely distributed along the elevation gradient to identify spatial drivers of genetic structuring. Our results highlight elevation as a major structuring component for both species and genes. We propose that the ecological and genetic boundaries between lowlands and highlands are induced by strongly contrasting but stable conditions along the elevation gradient of tropical sky islands.

RS07 - Oral

SPATIAL DYNAMICS PLANKTONIC IN THE LAGO GRANDE CURUAÍ IN THE AMAZON BASIN, BRAZIL

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The floodplains of the Amazon are highly productive ecosystems considered as hotspots of biodiversity. They are also among the most threatened ecosystems by climate change and anthropogenic pressures. These changes alter the river and plain dynamics and biogeochemical cycles, becoming imperative to understand them and their relation with the biodiversity. This research aims to present of the spatial dynamics of the planktons in the floodplain of Curuai in the west of the Amazon basin, Brazil. This area is composed of more than 20 lakes interconnected by channels, which remain during the hydrological cycle. The Principal Component Analysis showed that the plume of sediment pH, conductivity and nutrients are very important for biogeochemical processes in the flood plain during the flooding period. Planktonic organisms are in 18 functional groups represented by≥5% species biovolume in the 26 sample units. The Canonical Correspondence Analysis showed cumulative explanation of 20.8%, Axe 1: turbidity; codons X_2 and Y and the axe 2: pH, conductivity and oxygen; codons W_1 and S_1, Pearson correlation between Spp.-Envt >90% and significance<0.05. Were more representative in sample units 25, 15 and 41. Exclusively to axe 1 sample unit 5 and axe 2, sample unit 14. The spatial distribution showed that these points are next the shores of lakes of the floodplains.

RS08 - Poster

EFFECT OF CLIMATIC AND HYDROLOGICAL CONDITIONS ON THE EMERGENCE OF CADDISFLIES (TRICHOPTERA) OF THE ALPINE STREAM

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Emergence is a key phase in the life cycle of aquatic insects. Its timing mainly depends on the local climatic and hydrological conditions. This study is a part of the 'Ritrodat' project, in which a wide range of environmental factors of the Alpine stream – the Oberer Seebach in Lunz am See, Lower Austria was monitored for 25 years. In this work we evaluate samples of emerging caddisflies from two pyramidal traps, one of which was in the permanently submerged part of the river bed and the other one on the gravel sediments, which were flooded periodically - at elevated water levels. We compare the basic characteristics of emergence (timing, intensity, synchronization, sex ratio) in these two different habitats and their dependence on the actual hydrological and climatic conditions. During the 22 sampling periods we have caught a total of 1290 individuals of 26 species from 12 families. In the permanently flooded trap we have caught 25 species of 12 families and in the upland trap 11 species of 5 families have been caught. The dominant species are *Micrasema minimum, Ecclisopteryx guttulata* and *Rhyacophila vulgaris*. At the species *Micrasema minimum* we have caught only females.

RS08 - Oral

OCCURRENCE AND MASS DEVELOPMENT OF MOUGEOTIA SPP. (ZYGNEMATACEAE) IN LARGE, DEEP LAKES

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Over the last decades, mass developments by the filamentous conjugating green alga *Mougeotia* have been followed in three large peri-alpine lakes(Lake Geneva, Lake Garda, Lake Maggiore) and in the sub-tropical Lake Kinneret. The aim of this study is to highlight annual and interannual patterns of *Mougeotia* biomass in the studied lakes and select key environmental parameters that may favour and maintain its mass development. Our results confirm former studies that planktic *Mougeotia* favours meso-oligotrophic conditions and becomes dominant when annual mean total phosphorus concentrations in the epilimnion fall below 20 $\mu g l^{-1}$. This triggering factor has effect with interactions of other environmental circumstances such as the water column stability. Physiological and morphological features of the taxon make it a successful competitor under stratified conditions. Results also showed that in three out of the four studied lakes, the annual peak was higher when the annual population development started earlier. Focusing on Lake Geneva, depth and strength of the thermocline, as well as wind speed in the beginning of summer that can cause nutrient replenishment and mix the epilimnion are key factors in the blooming of the taxon.

RS08 - Oral

FISH RESPONSES TO LOCAL HYDROMORPHOLOGICAL ALTERATIONS IN FRENCH LAKES

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Lake morphology and hydrology determine the quality and quantity of habitats available to biological communities. Therefore hydromorphological alterations such as the artificialisation of lake shorelines and the control of water flows constitute threats for the ecological integrity of lake ecosystems. In the context of the European WFD, fish-based indicators developed to assess the ecological status of French lakes failed to integrate the effects of hydromorphological degradation. The recent acquisition of data describing the riparian and lakeshore conditions has represented an opportunity to address the relationships between fish communities and local hydromorphological alterations.

Analyses were conducted on 64 natural lakes and 312 reservoirs. To account for the inherent variability of the response to hydromorphological pressures between lakes, a hydromorphological typology that better characterises the types and distribution of lakes across France was first developed. For each lake type, the influence of hydromorphological stressors on fish was then modelled. Fish metrics based on trophic regime, reproduction and feeding habitat, both in terms of abundance and biomass, were found to significantly respond to disturbances, especially when only the small individuals were considered. This study represents a first step towards an improved fish-based index responding to both eutrophication and hydromorphological stressors.

RS08 - Oral

INTERACTIONS BETWEEN SUBMERGED AQUATIC PLANT AND FLOW AND SEDIMENT: EFFECTS OF PATCH SIZE AND TROPHIC CONDITIONS IN CALLITRICHE PLATYCARPA

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In lotic ecosystems, submerged aquatic plants have important effects on hydrodynamic and sediment processes, acting as

ecosystem engineers. These effects depend on plant morphology and patch structure. As nutrient availability in the ecosystem is also recognised to alter both sediment characteristics and plant traits, the trophic level may have important cascading effects on the plant-flow-sediment interactions. This study aimed to test the effects of plant and patch properties on flow and sediment characteristics in contrasting trophic conditions. In a field study carried out on *Callitriche platycarpa* in two channels with low and high trophic level, we measured 3D velocity profiles, sediment characteristics (grain size, organic matter content, and nutrient concentration in interstitial water) and plant morphology along the main axis of patches of increasing length.The effects on hydrodynamics, sediment characteristics and nutrient concentrations in interstitial water (for instance accumulation of $NH_4^{\ +}$ and reduction of NO_3^- in interstitial water within patches) were highly dependent on patch size and trophic level. This study emphasizes the role of trophic level on sediment and biogeochemical processes mediated by submerged aquatic vegetation with possible important consequences for vegetation dynamics and nutrient cycles.

RS08 - Oral

MIGRATING SAND RIPPLES CURB SEDIMENT METABOLIC ACTIVITY

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Migrating bed forms are proposed hot spots of carbon turnover in rivers because they retain organic matter and have intensive pore water exchange. However, mechanical disturbance in the constantly shifting sediments may stress communities and their activity. In laboratory experiment we investigated the effect of migrating ripples vs. stable sediments on microbial respiration and bacterial production at oligotrophic conditions. Interaction of disturbance with sediment organic matter (SOM) was tested by enriching sediments collected from migrating ripples with different qualities and quantities of organic particles (fish feces, leaf-litter fragments). Mechanical disruption in migrating ripple sediments curbed microbial respiration to similar low activity for all SOM quantities and qualities. In stable sediments respiration showed fast resilience from mechanical stress within 3 days. Timing of resilience was similar for all SOM treatments but level of respiration was related to SOM quality. However, microbial community reaction to mechanical disturbance was complex, since bacterial production increased in migrating sands and increase interacted with SOM quality and time of exposure to disturbance. With the proliferation of migrating sand ripples by massive catchment erosion, suppressed mineralization of SOM in migrating ripples has implications for stream metabolism from reach to catchment scale.

RS08 - Oral

PHYTOPLANKTON ABUNDANCE AND DIVERSITY IN THE CONGO RIVER AT HIGH AND LOW WATERS

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The Congo river is the second largest in the World in terms of freshwater discharge (1457 km^3 y^{-1}) and in terms of drainage basin (375106 km^2). In this study we sampled the Congo river mainstem and major tributaries along the 1700 km stretch from Kisangani to Kinshasa, during the high water and low water periods. Phytoplankton was analysed using a combination of microscopy with HPLC analysis of marker pigments. During high water, phytoplankton biomass in the mainstream was low (mean Chl a = 0.8 mg m^{-3}). Most tributaries presented lower Chl a, with someexceptions, as the Oubangui river (3.6 mg m^{-3}). At low water, phytoplankton development in the R. Congo mainstem was higher (Chla 1.1-7.7 mg m^{-3}). Phytoplankton was essentially composed of green algae (mostly coccal green algae and some desmids), diatoms (mostly *Aulacoseira* spp.) and filamentous cyanoprokaryotes. In some samples euglenophytes (mostly *Strombomonas* spp.) and chrysophytes appeared with greater abundance and diversity. In the low water period, phytoplankton was, as typical in most large rivers, dominated by diatoms, whereas the high water phytoplankton was dominated by coccal green algae, both in the main river and tributaries.

RS08 - Oral

PHYSICAL PROCESSES CONTROLLING SPATIAL VARIABILITY OF CHLOROPHYLL-A IN THE LARGE LAKE GENEVA

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Chlorophyll-a concentrations in Lake Geneva were extracted from MERIS satellite data using the FUB/WeW algorithm. The analysis of the chlorophyll-a maps showed a consistent circular low concentration zone in the center of the lake for about one week in autumn 2009. The three-dimensional hydrodynamic model Delft3D-flow, validated with field data of temperature and current, was run over the same time period. Our analysis suggests that physical processes and in particular the large vortex observed in the center of Lake Geneva play an important role in the spatial heterogeneity of phytoplankton biomass. The study finally emphasizes the benefit of using jointly remote sensing data, field observations and numerical models to provide a better understanding of spatial lake ecosystem dynamics.

RS08 - Oral

PHYSICAL VERSUS BIOLOGICAL FACTORS – WHO DRIVES MICROBIAL ORGANIC MATTER DECOMPOSITION IN A SANDY LOWLAND STREAM?

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Oxygen concentrations can be critically low in forested aquatic systems receiving high organic matter input. Low oxic conditions are hostile for shredding invertebrates, hence, litter decomposition is limited to microbial processing. We hypothesize that leaf-associated microbial activity and leaf decomposition are lower under low oxic conditions. Leaves of Alnus glutinosa were exposed in fine mesh bags (mesh size 250 µm) in the well oxygenated benthic zone and buried in the low-oxic hyporheic zone at a depth of 2–5 cm of a sandy lowland stream for 62 days. Leaf mass loss was independent from the oxic conditions. Interestingly, the fungal community switched from a dominance of terrestrial species, associated to the leaves prior to immersion, to aquatic hyphomycetes after 3 weeks. Although benthic respiration rates were significantly higher, both zones had a similar leaf stoichiometric dynamics. This pattern suggests together with comparable bacterial abundance and ergosterol content a similar behavior of the microbial decay processes. Leaf toughness was also comparable between the zones, indicating that microbial activity processed the leaf mesophyllum rather than the vascular strands. Our results suggest that differences in oxygen concentrations did not result in microbial organic matter decomposition variability, and thus, carbon flow within the ecosystem.

RS08 - Oral

SURFACE THERMAL PATTERNS OF LAKE GENEVA FROM 2008 TO 2012

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We characterized the spatial and temporal variability of the lake surface water temperature (LSWT), surface heat flux as well as the heat content of Lake Geneva for 3.2008-12.2012. This was accomplished using AVHRR data for LSWT and the weather prediction model, COSMO-2, for the meteorological data. Available bulk models for different components of the surface heat flux were combined (using all possible combinations), from which we determined the best surface heat flux model. Calibration considered the temporal evolution of the heat budget, estimated using two time series of vertical temperature profiles (from Lake Geneva's large and small basins). EOF analysis was used to assess the relationship between the variability of the LSWT and meteorological forcing. The dominant EOF mode (explains 74% of the observed variance for wind speed, 78% for evaporative heat flux and over 90% for other parameters) shows uniform patterns associated with the annual cycle. Their temporal amplitudes reveal a time lag between total surface heat flux and LSWT variation. Further, the analysis showed good correlation between wind forcing and evaporative heat flux.

RS08 - Oral

TURBULENCE AS AN ORIENTATION AID? IMPLICATION OF A FLUME TANK EXPERIMENT

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Turbulence is known to be a structuring component in aquatic systems influencing the distribution of invertebrates and affecting the prey-encounter rate. Higher abundance of invertebrates can be found in areas where turbulences were highest such as in the wake of boulders or in the bottom boundary layer. Butturbulence may also serve as an orientation aid in three-dimensional water bodies. In a lab-based flume tank experiment, the benthopelagic mysid, *Gastrosaccus australis*, was used as model organism to test the effects of turbulence on their swimming behaviour and distribution. The mysids displayed positive rheotaxis and favoured areas of shear when turbulence was present. In the absence of turbulence they preferred areas of reduced flow to avoid displacement. In slack water, the mysids displayed directional swimming movements which appeared to be systematic, most likely exploring or foraging. These different swimming responses might be an adaptation of *G. australis* to its pelagic habitat at night. Actively tracking shear could serve as an orientation aid, facilitate foraging, or reduce sinking rates. By moving to reduced flow areas in an absence of turbulence, mysids could avoid downstream displacement and hence remain within their favoured habitat.

RS10 - Oral

ENVIRONMENT-SPECIFIC WATER QUALITY GUIDELINES FOR SUSPENDED SEDIMENT

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Suspended sediment (SS) is a common cause of impairment of freshwaters. However, there is little evidence as to what should be regarded as an appropriate SS regime for different environments. We compare the SS regimes of ten systematically-selected contrasting reference-condition temperate river ecosystems that were observed through high-resolution monitoring between 2011 and 2013. The results indicate that mean SS concentrations vary spatially, between 3 and 29 mg L^{-1}. The observed mean concentrations were compared to predicted mean concentrations (probability of membership to one of five concentration ranges) based on a model developed by Bilotta et al. (2012). Predictions are a function of the natural environmental characteristics associated with each river's catchment. This model predicted the correct or next closest SS range for all of the sites. Mean annual SS concentrations varied temporally in each river, by up to three-fold between a wet and a dry year. This variability could be predicted well for all but one site, by modifying the input data to take into account the mean temperature and total precipitation in the year for which the prediction is to be made. The findings demonstrate that water quality guidelines for SS should recognise natural spatial and temporal variations.

RS10 - Oral

STABILIZING EFFECTS OF PHYTOPLANKTON DIVERSITY IN SMALL FARMLAND PONDS

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All kinds of ecosystems can be subject to sudden regime shifts through so called tipping points. Small farmland ponds and shallow lakes can be used as exemplary systems for research on such non-linear dynamics, because of their wide array of ecological states and variety of uses for ecosystem goods and services. To investigate the role of phytoplankton diversity in relation to tipping points, a number of small farmland ponds in Belgium were sampled in the 2003 and in 2013, which allows a comparison between their current state and the state from a decade ago. Key changes in the plankton community as well as the surrounding land use and different abiotic factors were put in relation to detect possible indicators or early warning signals for approaching regime shifts as well as triggers of such changes. To disentangle the tight connections between habitat properties and the different trophic levels of food webs, we took a close look at nutrient stochiometry, phytoplankton functional groups, zooplankton communities and land use or conservation status surrounding the ponds.

RS10 - Poster

THE FATE OF SOIL CARBON AND NUTRIENTS 70 YEARS AFTER RESERVOIR FILLING. AN ECOLOGICAL PERSPECTIVE

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About 500 dams creating large water reservoirs have been built in France since 100 years. Compared to natural lakes, the ecology and carbon budget of these water bodies are influenced by the submerged soils and vegetation, as well as by the artificial management of the water level. The fate of soil carbon and nutrients 70 years after dam establishment has been studied at the Sarrans reservoir, Central France. After the filling by water, soils evolved in relation to their position in the landscape and that of the lowest water level. Along a catena from the uppest water level to the former river bed, and compared to adjacent natural soils, we distinguished (1) mineral soils devoided of C and clay in the tidal zone, (2) temporary hydromorphic soils in the lower part of the tidal zone, which have lost part of original their C and nutrient content, (3) soils covered by sediments of terrestrial origin on gentle slopes, and (4) thick sediments in the bottom. At the reservoir scale, our budgets suggest a strong and long lasting influence of eroded and submerged soils on the trophic level and carbon budget of the reservoir.

RS10 - Poster

SMALL WATER BODIES IN A LOWLAND LANDSCAPE: A LIMNOLOGICAL CHARACTERIZATION ON DIFFERENT SPATIAL SCALES

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The significant role of small water bodies has greater practical meaning for the planning of landscape management when considering how to control the processes of self-cleansing of the environment. In this study the limnological features of ponds located in a typical agricultural area of the Wielkopolska macroregion (western Poland) was demonstrated. A feature of this area is traditionally highly developed agriculture, and the share of arable land is over 70%. Data was collected from two different spatial scales of surface waters: 'small' (< 1 ha) and 'large' (> 1 ha) of water bodies located in a natural agricultural landscape of different use (farmed arable, pastoral, rural). Over a 10 year period (2004-2013) over 200 small water bodies were studied. We found a high degree of variability of most limnological characteristics as well as biotic features (chlorophyll a, macrophyte cover, zooplankton richness). Locality can explain part of this variation for physico-chemical variables but less for morphometric and biotic. Our results suggest that the diversity of hydrobiont groups does not directly relate to a low scale of anthropogenic transformation of the landscape.

RS10 - Oral

EFFECTS OF CATCHMENT LAND USE ON BIOLOGICAL TRAITS CONTINUE DOWN THE RIVER!

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Catchment land-use intensification and conversion of native vegetation to farmland threatens aquatic ecosystems worldwide by increasing exports of nutrients and fine sediment into streams, rivers and estuaries, resulting in a decline of aquatic biodiversity and ecosystem quality. Using a survey-based approach and biological traits, the effects of catchment land-use intensity on benthic invertebrate communities along a freshwater-marine gradient were investigated in 21 New Zealand rivers and their estuaries, covering a broad range of catchment land-use intensities. Three trait categories were directly related to the gradient of catchment development, while eleven trait categories responded to increasing deposited fine sediment levels, which, in turn, were related to catchment development. Fine sediment was the most pervasive physicochemical predictor correlated with changes in invertebrate trait prevalences. Only one trait category was related to a nutrient predictor. Importantly, the effects of catchment development intensity did not decrease towards the ocean for any of the response variables studied, indicating that no dilution effect due to an increasing marine influence occurred. Consequently, aquatic resource managers needs to consider the entire source-to-sea continuum when making decisions to avoid or minimize adverse effects of human land-use activities on freshwater, estuarine and coastal habitats.

RS10 - Oral

HYDRO-ENVIRONMENTAL SUSTAINABILITY OF THE GRAMAME RIVER BASIN SPRINGS IN PARAIBA, BRAZIL

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This study has aimed to determine the hydro-environmental sustainability areas's level surrounding the springs located in the Gramame basin river, Pedras de Fogo in the Paraíba state, Brazil. Therefore, it was necessary to develop an environmental diagnosis of the study area (around the springs); present a system of sustainability assessment for those catchment areas; determine the springs' sustainability index and analyze the hydro-environmental sustainability of the areas surveyed. Four springs were chosen for the development of this research: Cacimba da Rosa e Cabelão, in the intermediate zone between urban and rural; Nova Aurora e Fazendinha, in the countryside. It was used the radar chart type, by which it was possible to dynamically compare all variables. Thus, it was considered that the larger of the area in the triangle formed on the chart, greater is the indicator sustainability. Therefore, it was elaborated a framework of 20 indicators to assess the hydro-environmental sustainability of the areas studied. Weights were assigned 0-1 for the results obtained for each indicator. The methodology applied in this study stood out both for the ease of use, as the clarity in the representation of the results by measuring the condition and sustainability areas.

RS10 - Oral

MULTIPLE-SCALE EFFECTS OF STREAM CORRIDORS ON BIOLOGICAL AND CHEMICAL CHARACTERISTICS OF SMALL STREAMS

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Stream corridors are places of intensive interactions between terrestrial and fluvial ecosystems. Character of these bands adjacent to stream channel is frequently modified by hydromorphological degradation and it is also primary objective of restoration projects.

Catchments of 23 small stream sites were studied in terms of land use pattern (CORINE) and stream corridor characteristics (classification based on aerial photos analysis). Studied sites included variety of point pollution sources, land uses, hydromorphological degradations and their pressure magnitudes. Environmental parameters were collected across spatial scales in lateral and longitudinal dimensions. Lateral dimension (stream corridor) included vegetation type at the bank zone and land cover in adjacent buffer zone. Stream corridor characteristics were summarized within longitudinal zones of stream network defined by different upstream distances from studied sites.

Relationships among corridor scores, chemical and macroinvertebrate characteristics were analyzed. Water chemistry (e.g. nutrients) and trait-based characteristics of macroinvertebrate communities were related to corridor/catchment features.

Ecological value of stream corridors was estimated by newly developed system based on remote sensing data. This can be used for evaluation of scale dependent drivers of stream biota. Multiple-scale analyses of patterns in stream corridors may support planning, realization and evaluation of stream restorations.

RS12 - Poster

RESTORATION OF FRESHWATER BODIES AS RIVERS AND STREAMS USING CONSTRUCTED WETLANDS IN THE HIGHLANDS OF JALISCO MEXICO.

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In order to generate sustainable alternatives to remedy the organic pollution by discharges of untreated domestic wastewater rural to freshwater bodies, in this paper we study and evaluate constructed wetlands (CW) in Jalisco (Mexico). The natural wetlands act as a biofilter removing contaminants from water, the CW can be designed to emulate these features, recreate and improve the structure and function of natural wetlands. They have a rich microbial community for biochemical transformation of pollutants, are biologically productive and self-sufficient. The recovery of polluted rivers and streams begins channeling wastewater before it is incorporated into water bodies, first enter a clarifier effluent system, which separates both light substances such as fats and oils float, as heavy materials (sand and metals) by sedimentation, then the effluent enters the CW which primarily requires temperature of 10 to 25 °C and retention periods of 3 to 5 days. The process works by gravity with minimal operating costs and maintenance. The results show significant reductions of pollutants, for which the treated water can be reused in irrigation, reclamation of aquatic life in freshwater bodies and artificial recharge.

RS12 - Oral

GHOST PONDS : RESURRECTING LOST PONDS TO ASSIST AQUATIC BIODIVERSITY CONSERVATION.

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Ponds are increasingly recognised as hotspots of aquatic biodiversity. Research has focused particularly on newly created ponds, and also on the restoration of existing ponds (which can substantially enhance the diversity value of existing ponds). Here, we investigate a novel approach – the excavation of 'ghost ponds'. This involves digging down into the historic sediments of ponds which had been previously been completely filled in during agricultural land reclamation. Such ghost ponds are abundant in several regions of the UK, and their 'resurrection' could play an important part in restoring the rural pond landscape. We investigated the potential viability of the historic seedbank of ghost ponds, and how this might act as a time capsule for species and genetic diversity. Excavated ghost ponds were rapidly colonized by aquatic macrophytes, and our data strongly suggests recruitment of at least some species from the previously buried seedbank. The development trajectories of ghost ponds is overall closely aligned to that of ponds restored following sediment extraction. Given their rapid recolonization, and general location in marginal parts of agricultural fields, the restoration of ghost ponds could be an effective way to boost both landscape scale diversity and connectivity between aquatic habitats in the agricultural landscape.

RS12 - Oral

RESTORATION OF THE LARGEST NATURAL LAKE IN FRANCE: FOLLOW THE PHYCOERYTHRIN-RICH PHYTOPLANKTON GROUPS!

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The largest natural lake in France (e.g. Lake Bourget) suffered eutrophication during the second part of the 20th century. Following important measures taken since 1970, it has been partially restored and is now oligo-mesotrophic. The monitoring during the last two decades of the phytoplankton community assemblage has constituted an efficient health indicator of this ecosystem. Here we focus on phycoerythrin (PE)-rich groups. Between 1995 and 2008, Lake Bourget was characterized by the proliferation and bloom of the cyanobacterium *Planktothrix rubescens*. After 2009, it disappeared completely and never reappeared since. In parallel, picocyanobacteria represented by *Synechococcus* spp. have contributed more and more to the total biomass during recent years following the reoligotrophication and the disappearance of *P. rubescens* and it has also been observed that this community distributes deeper. Concomitantly to the abrupt phytoplanktonic biomass decline observed after 2009, a new phytoplanktonic community arose containing mixotrophic genera, such as *Dinobryon* spp., *Rhodomonas* spp., and *Cryptomonas* spp. The Cryptophytes revealed intriguing distribution and dynamic patterns. All in all, PE-rich groups have been important groups in the disturbance or functioning of Lake Bourget. They are likely to constitute bio-indicators of trophic and/or global changes in large and deep lakes.

RS12 - Oral

STRATEGIC PLANNING OF RIVER REHABILITATION PROJECTS

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We use multi-criteria decision analysis (MCDA) techniques to support the transparent communication of the expected achievement of societal objectives in river management with a focus on river rehabilitation. In a first part, we apply the techniques to support the assessment of the trade-off between the expected gain in ecological value and ecosystem services versus costs for specific river rehabilitation projects. In a second part, we illustrate the application to the spatial prioritization of such projects. We show the similarity of the suggested methodology at its highest hierarchical level to cost-benefit analysis, but also emphasize that it makes it possible to include lower hierarchical levels within the same framework. The suggested methodology thus provides a unique framework from ecological river assessment to the support of societal decision making in river management. The conceptual considerations are supported by their application to specific sites and prioritization within the Thur and Töss catchments in Switzerland.

RS12 - Oral

EVALUATION OF THE IMPACT OF MODIFICATIONS OF THE LITTORAL ZONE OF LAKES ANNECY AND GENEVA ON LOCAL MACROZOOBENTHOS AND FISH COMMUNITIES

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Following a significant decline of reedbeds in Lake Annecy, protection measures against the action of waves have been implemented in 2012 in the southern part of the Lake. About at the same time, 2.3 ha of the Lake Geneva littoral in Neuvecelle was filled to yield additional land.

The aim of this study was to evaluate the impact of these lake shore modifications on the macrozoobenthos and the fish fauna. Hence, benthos and fish were sampled using a replicated sampling of different littoral habitat structures. A reference sampling was performed in 2012 during the modification work for Lake Annecy, and prior to the modifications for Lake Geneva. The final sampling to evaluate the impact was performed two years after the modifications in 2014.

No significant effect on fish fauna could be observed in Lake Annecy. However, a greater diversity and abundance of macrozoobenthos was observed behind the wave protections.

In Lake Geneva, the modification of the littoral habitat caused a diversity loss for the littoral fauna in the lake. However, the diversity has increased very locally due to the creation of two compensatory measures (0,08 ha).

RS12 - Oral

"CAN WE QUANTIFY AND VALUE THE EFFECT OF RESTORATION ON THE ECOLOGICAL STATE OF RIVERS?"

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While the number of river restoration projects increases, decision tools for river management and integrative methods for valuing river restoration effects are scarce.

For this purpose, we analyzed the suitability of river assessment protocols to quantify and value the effect of restoration in two Swiss rivers. We used the multi-attribute value theory to integrate several indicators, including morphological, chemical and biological indicators (fish, macroinvertebrates, macrophytes, ground beetles, riparian vegetation), and propagated uncertainty about environmental conditions throughout the framework.

The morphological state of the studied rivers improved with restoration, and large improvements were detected for ground beetles, fish, followed by riparian vegetation, macroinvertebrates and macrophytes. Water quality could be a limiting factor preventing larger improvements.

Propagation of uncertainty showed that the positive effect on the physical and biological states were mainly significant. Improvements were, however, uncertain in some cases for macroinvertebrates and riparian vegetation. However, the overall ecological state of the studied rivers improved significantly with restoration.

We demonstrated a positive effect of restoration on biodiversity and the ecological state of the studied rivers. Integrative valuation using multi-attribute value theory showed to be a useful framework, and propagation of uncertainty helped to evaluate the measured improvements.

RS12 - Poster

PHOSPHORUS THRESHOLD FOR THE SHIFT BETWEEN GRASS-AND ALGAE-STABLE STATES IN GEHU LAKE

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This paper studied the phosphorus threshold for the shift between rass-and algae-stable states under natural conditions . The correlation analysis on the environmental factors showed that the total phosphorous in water body had better liner relationships with phytoplankton chlorophyll a and Secchi depth, and principal component analysis indicated that total phosphorous and nitrogen in the water body were the two main components affecting the water quality, among which, total phosphorous was the maximum weight source and played a determinant role in the shift between grass-and algaestable states. The total phosphorous threshold for grass-stable state shifting to grass-algae intermediate statewas 61 $\mu g \cdot L^{-1}$, and that for grass-algae intermediate state shifting to algae-stable state was 115 $\mu g \cdot L^{-1}$.

RS12 - Oral

LAKE ORTA 25 YEARS AFTER THE LIMING INTERVENTION: WHAT PHYTOPLANKTON ASSEMBLAGES COULD TELL US ABOUT THE RECOVERY OF THE LARGEST ACIDIC LAKE IN THE WORLD.

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Lake Orta (N. Italy) became the world's largest acidic lake, after a dramatic industrial pollution, dating back to the late 1920. The lake was limed in 1989-1990: since then, a recovery of the chemical and biological conditions gradually took place.

Concerning phytoplankton, the gradual decrease of the chlorophytes and the noticeable increase of the diatoms, reappearing in the pelagic phytoplankton after decades, were the most outstanding features of the post-liming assemblages.

However, the most recent study, carried out in 2001, pointed out that, comparing the assemblages of lakes Orta and Maggiore , the complete recovery was not yet reached. In particular, a decadal comparison (1990-2001) beetwen the two ecosystems, shows that, although the taxa number increased in Lake Orta after the liming, some differences in terms of functional diversity are clear.

Since 2001 detailed taxonomic analyses are lacking. However, between 2005 and 2013 some samples , analysed in both lakes using *in vivo* fluorimetry, show that the dominance of chlorophytes is still a distinctive trait of Lake Orta, although the importance of the diatoms is now greater than in previous years and their dynamics is following a pattern comparable with that observed in Lake Maggiore.

RS12 - Oral

THE RHÔNE RIVER PHYSICAL RESTORATION: A DATA-RICH CASE STUDY AND ITS LESSONS FOR ECOLOGICAL MONITORING

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Identifying general ecological conclusions from restoration experiments is often complicated by the weaknesses of monitoring strategies. We provide an overview of an original restoration case study (hydrological changes in the Rhône River in France) and discuss the lessons learnt from the project concerning ecological monitoring.

The restoration started in 1999 and has combined so far minimum flow increases in four reaches (total length 47 km) and the dredging and/or reconnection of 24 floodplain channels. The restoration was a success story that led to more lotic and diverse aquatic communities. Due to the many sites involved, the magnitude of physical changes and the availability of ecological data (many fish and macroinvertebrate taxa monitored over long periods), the project was a unique opportunity to assess monitoring strategies. An analysis of statistical power revealed that, even in the data-rich situation of the Rhône, temporal variations across surveys were high and the probability to detect a moderate change (50 - 200%) in a given taxon abundance was typically 15%. These results can be used to optimize monitoring strategies depending on the expected effect size and population characteristics.

RS12 - Oral

IMPACT OF FISH FARM OPERATIONS ON THE SEDIMENT PHOSPHORUS QUANTITY AND QUALITY OF A SHALLOW EUTROPHIC LAKE

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The operation of fish culture cages in a lake introduces an additional source of phosphorus via food waste and excreta. A significant portion of this load may accumulate in the lake sediments with the potential to be released back into the overlying water-column. It is important to understand the availability of the sediment phosphorus pool as it has the potential to delay the recovery of eutrophic lakes for many years following the implementation of measures that reduce external load.

Investigations were carried out at Esthwaite Water, a shallow eutrophic lake in the English Lake District where cages for rainbow trout (*Oncorhynchus mykiss*) were present in the south basin of the lake between 1981 and 2009. To determine the impact of the fish farm on sediment phosphorus quantity, quality and internal load, surface sediment samples were collected seasonally for one year from the north basin (control site) and south basin of the lake. The samples were analysed for total phosphorus concentration and underwent a sequential extraction procedure to determine the concentration of different phosphorus species, including: labile, iron-oxyhydroxide adsorbed, organic and apatite-bound. A mass balance approach was also taken to quantify the current internal load for the two basins.

RS12 - Oral

QUANTIFYING THE RESTORATION OF HABITAT COMPLEXITY AND ITS EFFECTS ON MULTIPLE ORGANISM GROUPS AND ECOSYSTEM FUNCTIONING

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Large-scale habitat restorations have recently been undertaken in a river catchment in northern Sweden, including rehabilitation of large habitat structures (massive boulders, large woody debris) originally removed to facilitate timber floating. To more thoroughly assess ecological responses to the restoration, we first quantified variability in hydrogeomorphological complexity across 20 stream reaches in the catchment, including degraded, reference, and both low- and high intensity restored reaches. We quantified relationships between increasing habitat complexity and the responses of three organism groups (macrophytes, diatoms and invertebrates), retention of organic matter (FPOM), ecosystem functional paramaters (leaf decomposition, algal productivity) and detritivore functional diversity. Macrophytes and diatoms responded more strongly to the restoration than invertebrates. Deposition of FPOM increased along the complexity gradient, as did leaf decomposition mediated by invertebrates. The increase in invertebrate-mediated decomposition was associated with shifts in the functional composition of detritivore assemblages. There were no change in algal productivity at local scales. Our findings emphasise the value of assessing restoration in relation to the actual variable restored (habitat complexity), and indicate that macrophytes and aspects of functional diversity and ecosystem functioning may be better than traditional, macroinvertebrate-based measures of community structure for assessing the efficacy of stream restoration projects.

RS12 - Oral

THE CALANOID - CYCLOPOID BATTLE FOLLOWING IMPROVED WATER QUALITY IN THE SCHELDT ESTUARY.

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Water quality of the Scheldt estuary has considerably improved in recent years, especially in the upstream, freshwater reaches. Within the zooplankton community, the copepod *Eurytemora affinis*, typically abundant in brackish water and quasi – absent from freshwater before 2007, has since then developed substantially in freshwater reaches, presently representings 90 % of the freshwater estuarine mesozooplankton community abundance.

Considering that, at present, water quality in the freshwater reach of the Scheldt estuary is comparable, but not better, than that in the brackish water reach, why is *E. affinis* is developing so successfully in freshwater?

Along with increasing abundance of *E. affinis* presence in freshwater reaches, abundances of cyclopoid copepods have drastically decreased in abundance in the freshwater area. We investigated whether this decrease in cyclopoid populations was due to improving water quality or to competitive exclusion by *E. affinis.*

We analyzed population dynamics of zooplankton in the Scheldt estuary over a period of eleven years (2002-2012) using multivariate statistics.

Oxygen concentration, salinity, temperature, ammonia and silica concentration were the most influent predictors of both *E. affinis* and cyclopoidcopepods distribution. It seems cyclopoids are favoured by poor water quality while *E. affinis* needs a minimum oxygen concentration of 4 mg.l $^{-1}$.

RS12 - Oral

DISPERSAL AND COLONIZATION OF NEW HABITATS BY FRESHWATER MACROINVERTEBRATES: A CASE STUDY OF POND CREATION IN THE ALPS

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In the context of climate change, we developed a methodological framework to prioritize areas for the creation and restoration of small waterbodies in alpine landscapes. The principal aim is to enhance the connectivity between alpine ponds and to promote the resilience of populations of cold stenotherm species potentially threatened by warming. In the framework of the Swiss national program 'Adaptation to climatic changes', we tested this methodology and selected a site for digging a new pond in the Alps (Canton Valais, Switzerland).

Dispersal of aquatic insects in the terrestrial environment through adult’s flight plays a crucial role in the colonization of newly created habitats. A better understanding of the dispersal ability of aquatic invertebrates is needed to allow an optimal efficiency of conservation measures such as wetland creation and restoration. We tested the potential colonization success of the future pond by aquatic cold stenotherm species in the selected site. The migration success has been assessed through trapping by modeling water surface, and a

review of the literature has been done to identify the potential methods of marking/recapture to precisely determine the distance of dispersal of the studied species.

RS12 - Oral

UNUSUALLY DEEP HABITAT USE BY NORTHERN PIKE (ESOX LUCIUS) IN AN OLIGOTROPHIC POST-MINING LAKE RELATED TO SPECIFIC DISTRIBUTION OF ITS PREY-FISH

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Northern pike is one of the most widely distributed freshwater fish with a key position in many northern hemisphere waters. It is considered a visually oriented, exclusively daytime, sit-and-wait predator, preferentially occupying structurally complex littoral habitats. In oligotrophic post-mining Medard Lake (area 375 ha, max. depth 50 m) northern pike was first reported in 2010 and it was the single fish species reported in the lake. In spring 2011 stocking of maraena whitefish (*Coregonus maraena*) started in the lake and lasted until spring 2014. Although invertivory was still most common among pike individuals short after stocking of maraena in 2011, maraena larvae were also found in the diet, being the first prey-fish of northern pike in the lake. Since their second year of life, maraena showed characteristic preference for deep (up to 30 m) pelagic habitats and consequently shift from mainly shallow benthic habitats (3-9 m), towards deep benthic (20-25 m) and pelagic habitats (18-24 m) well below thermocline was reported for northern pike. We assume that the first experience with prey-fish determined strong predator-prey relationship among northern pike and maraena, finally resulting in very unusual habitat use in northern pike.

RS12 - Oral

USING EDDY CORRELATION AND MICROPROFILING TO ASSESS THE EFFECTS OF OXYGENATION IN A TIDALLY INFLUENCED, SHALLOW ESTUARINE SYSTEM

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Eutrophication and increased organic matter loading to the upper Swan River (Perth, Australia) led to significant periods of anoxia during the last decades. This resulted in severely diminished water quality, enhanced nutrient release, and fish kills. To mitigate these issues, an oxygenation system was installed 39km upstream of the Indian Ocean delta in 2009. In 2010, we investigated how the side-stream oxygenation system affected the local oxygen dynamics. Eddy correlation and a lander microprofiler were used to estimate benthic oxygen fluxes and to characterize the oxygen distribution at the sediment-water interface (SWI), respectively. Measurements were obtained over a two-day period during which the oxygenation system was on (24 hr) and then turned off (~36 hr). Both methods resolved very comparable fluxes and suggest that oxygenation had a negligible effect on bulk benthic oxygen flux. However, oxygenation had a considerable positive effect on sediment oxygen conditions. A consistently oxic SWI was maintained during the 24-hr ‘on’ period; conversely, tides controlled the oxygen distribution during the ‘off’ period, resulting in highly variable and frequently anoxic conditions. This novel study highlights how oxygenation can enhance water quality in eutrophic, tidally influenced systems by facilitating an oxic SWI and decreasing nutrient release.

RS12 - Oral

RESTORED AND REPOPULATED?! AMPHIPODS AND THEIR PARASITES IN A NOVEL URBAN ECOSYSTEM

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In Europe's largest and most expensive river restoration programme, the Emscher River and its tributaries are transformed from dead waste water channels into semi-natural river sections. This ecological setting in the Ruhr Metropolis of Germany provides an excellent framework for analysing biological processes during population (re)establishment in novel urban ecosystems. In a collaborative project of the Mercator Research Center Ruhr (MERCUR) the population dynamics of indigenous and non-native amphipod species in conjunction with their parasites are investigated. Our research focuses on factors influencing the colonization success of novel urban ecosystem, in particular the genetic diversity of native compared to non-native species, their contrasting dispersal potentials and the impact of parasites on their hosts during colonization. Answers to these questions are important to understand restoration dynamics in novel urban freshwater ecosystems and associated consequences on ecosystem function.

RS12 - Poster

THE EFFECT OF SMALL PH SHIFTS ON THE PHOSPHORUS ADSORPTION AND DESORPTION BEHAVIOUR OF FLOODPLAIN SEDIMENTS WITH DIFFERENT HYDROLOGICAL CONNECTIVITY

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Large river floodplain systems play a key role in the transport, transformation and storage of nutrients, especially phosphorus. The introduced phosphorus is either subject to short-term storage mediated by plants and algae or to long-term storage mediated by sediment deposition or adsorption. Sorption–desorption processes within the sediment are influenced by the mineral composition of the sediment, which is susceptible to changes in pH and redox conditions. Flood events and primary production can alter the pH of the surface water and influence the phosphorus adsorption mechanisms. The magnitude of the impact depends on the hydrological connectivity of the floodplain area.

The present study was conducted to evaluate the impact of two different pH ranges (6.5 – 7.5 and 7.5 – 8.5), which can occur in the system, on the phosphorus (P) retention on floodplain sediments. The chosen sites represent a connectivity gradient from 140 days to 1 day of connection and differed in fine sediment texture and organic matter content. Core samples were collected from six sampling sites in the floodplain system 'Untere Lobau' and batch sorption experiments followed by desorption measurements with H_2O or oxalate were performed.

RS12 - Oral

TEN YEARS OF A SHALLOW LAKE RECOVERY PROJECT – PILSEN, CZ

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A recovery project of a shallow lake Bolevec in Pilsen started in 2005. Bolevec (43 ha, 0,86 mil. m^3, mean depth ~2m) is important recreational locality. Water quality worsened during 1999-2000 as a result of long term anthropogenic pressure crowned by grass carp introduction and total disappearence of submersed macrophytes. The project included fish stock manipulation, Al coagulant treatments and support of aquatic macrophytes. About 90-95% of planktivorous and benthivorous fish biomass was eliminated by seining and electrofishing and predators were enhanced. Predominantly Al coagulants were used repeatedly in small doses: bioavailable P concentrations decreased bellow 20 $\mu g.l^{-1}$. 15 species of native submersed macrophyteswere planted in enclosures. In 2008 the ecosystem changed into a littoral one (transparency ~3m). Submerged macrophytes *(Myriophyllum spicatum, Elodea nuttallii)* expanded during 2011 when their roots overcame P shortage in Al treated sediment layers. Since 2012 was plant biomass intensively harvested. True „stable state' could not be reached due to many factors: life cycles of aquatic plants, attacks of herbivors disbalancing between plants and filamentous algae, etc. Moreover, risk of cercarial dermatitis threatens the recreational use. So continuous evolution of the ecosystem is observed and recommendations for the managers are permanently formulated.

RS12 - Oral

SHORT-TERM ABIOTIC TRANSFORMATIONS OF WATER AFTER FERROUS SULPHATE APPLICATION: MESOCOSM FIELD EXPERIMENT IN CHAROPHYTE DOMINATED LAKE

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In a consequence eutrophication of lakes the decline of abundance and diversity of charophytes was noted. One of most popular methods the lake restoration is use of chemical coagulants of phosphates on the base of iron. Iron is a useful chemical element to combat internal phosphorus loading. However, the influence of iron and especially sulphuric acid – base substance (pH<1.0) on charophytes are not yet known. In our study in 7 mesocosms located inlake, during 9 weeks of 2014 (start in the peak of vegetation season), were analysed physical and chemical features of water and biomass of *Chara hispida* L. The coagulant was added at the concentration from 50 to 200 mg Fe m^3. Aim of study was to test how different dose of $Fe_2(SO_4)_3$ transform the abiotic features of water, especially pH and alkalinity, concentrations of calcium, magnesium, sulphate, iron and bioavailable nutrients. The experiment was based upon the mesotrophic lake located in national park where large areas of charophyte meadows are preserved. The main effect was rapid, but short drop of pH and alkalinity and a number of chemical transformations.

RS12 - Oral

THE IMPORTANCE OF THE HISTORICAL BACKGROUND OF A RIVER CATCHMENT AND THE ECOLOGICAL IMPLICATIONS FOR RESTORATION AND MANAGEMENT

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The River Ehen located in West Cumbria has the largest population of the endangered freshwater pearl mussels (FWPM) in England and is a designated site protected by European law. There has been an assumption in considering the upper Ehen catchment as an unspoiled and wild environment because knowledge of the catchment prior to the 1950’s had been lost. Sponsored by United Utilities the Freshwater Biological Association has carried out a six month investigation into the historical, anthropogenic activities that affected this catchment in the last two-hundred years. We have rediscovered that the catchment has undergone many physical and chemical changes from the beginning of the 19th Century onwards. Industrial mining and agricultural activities have played an important role modifying the hydromorphological regime and distorting the aquatic ecosystem. It is surprising how much the Ehen has been damaged and altered by man’s historic activities and how the FWPM has subsisted on this pressures. Current UK conservation strategies are focused on captive breeding and restoration. However prior to the development of a restoration plans it is essential to understand what happened historically in order to achieve the most effective management of the river catchment and the FWPM.

RS12 - Oral

THE ROLE OF POND RESTORATION FOR BIODIVERSITY CONSERVATION IN UK AGRICULTURAL LANDSCAPES

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In the UK, ponds in agricultural landscapes are currently dominated by overgrown, highly terrestrialised ponds which may be severely reducing landscape-scale aquatic diversity. Such ponds can be restored by tree and mud removal, but studies focusing on the consequences of pond restoration for biodiversity conservation are largely lacking. To fill this research gap, we undertook a before-after-control-impact study of three agricultural marl-pit ponds focusing on short-term responses of water chemistry and biological communities.

Pond restoration comprised the partial removal of surrounding trees/scrub and accumulated organic muds from two ponds in 2011. Monitoring of the ponds and of a third control pond (moderate terrestrialisation) was conducted for two years pre- and post-management on a monthly (April-September) to bi-monthly (October-March) basis. Invertebrate samples were collected bi-annually in spring and late summer and aquatic macrophytes and amphibians were observed on all site visits.

Pond restoration resulted in a substantial shift from an O_2-poor, macrophyte-free column to a more oxygenated, macrophyte-dominated condition. Substantial increases in biodiversity were evident across multiple taxonomic groups, with changes most pronounced in the most highly terrestralised pond. We conclude that pond restoration and subsequent management could play an important role in increasing aquatic biodiversity within intensively farmed agricultural landscapes.

RS12 - Oral

THE MEASURES OF WATER QUALITY IMPROVEMENT AND ECOLOGICAL RESTORATION IN LAKE CHAOHU, A LARGE EUTROPHIC SHALLOW LAKE IN CHINA

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Lake Chaohu is the fifth large freshwater lake and is located in Anhui province, China. Eutrophication has been very serious since 1970s. The water body often breaks out cyanobacteria blooms from the western due to drive of wind and current. The measures of water quality improvement and ecological restoration include (1) external nutrients control, (2) uncovered hillside rehabilitation in the outcast phosphorus mine, (3) inflow rivers ecological restoration, (4) the wetlands restoration along the lakeshore, (5) cyanobacteria blooms removal by machine, (6) dilution by water from Yangzi River. Theresults showed water quality of this lake was significantly improved， and also enhanced ability to resolve outburst affairs of water pollution.

RS13 - Oral

LONG TERM EFFECTS OF THE INVASIVE SIGNAL CRAYFISH, PACIFASTACUS LENIUSCULUS, ON NATIVE LOTIC MACROINVERTEBRATE COMMUNITIES.

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Signal crayfish (*Pacifastacus leniusculus),* one of the most widespread invasive species in Europe, are considered to be keystone organisms in lotic and lentic habitats due to their size, population densities and functional role. Their recent rapid range extension and invasion of freshwater ecosystems potentially has significant implications for native fauna and ultimately the ecological integrity of freshwater ecosystems. To complement existing research, characterised by investigations of localised crayfish effects mostly in lentic settings, we investigated the long term impact of signal crayfish invasion on native lotic macroinvertebrate communities in three biogeographically distinct regions of England. Community composition and populations of individual taxa from sites on 8 rivers historically invaded by signal crayfish and 7 sites with no record of signal crayfish were examined. Following crayfish invasion, communities displayed distinct changes compared to pre-invasion and control rivers. These changes were largely driven by reductions in Hirudinea, Gastropoda and Isopoda species. Invasions were associated with regionally variable effects on specific taxa reflecting biogeographical differences and complex trophic interactions. Results from this study provide clear evidence that the implications of crayfish invasion on native communities in lotic ecosystems represent long term and spatially extensive perturbations that modify community assemblages and reset community trajectories.

RS13 - Oral

RAPID PHYSIOLOGICAL ADAPTATION TO LOW OXYGEN IN INVASIVE POPULATIONS OF QUAGGA AND ZEBRA MUSSELS

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Novel biotic or abiotic conditions can cause invasive species to evolve rapidly in the new habitat and is an important factor when predicting species invasions. Zebra mussels (

Dreissena polymorpha

) have a relatively long invasion history in Western Europe, whereas quagga mussels (

D. rostriformis bugensis

) began spreading about a decade ago. In an previous invasion to North America, quagga mussels repeatedly colonized stratified lakes at greater depth than zebra mussels. This might require quagga mussels to be more tolerant to low oxygen conditions in the deep than the zebra mussels. In the near future, the same invasion pattern might repeat itself in European stratified lakes. Therefore, using a fully factorial design, we tested survival of different zebra and quagga mussel populations from Western Europe with four oxygen levels and two temperature regimes. Surprisingly, survival differences among oxygen and temperature treatments depended more on population origin than on species identity. This finding suggests that populations had undergone rapid and convergent adaptation to local conditions after invasion, in particular to low oxygen. Our results suggest that rapid evolutionary adaptation to low oxygen conditions needs to be considered when predicting the further spread of zebra and quagga mussels.

RS13 - Oral

THE TROPHIC IMPACT OF DIKEROGAMMARUS VILLOSUS ON NATURAL RIVER COMMUNITIES

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The successful invader *D. villosus* is assumed to prey on other invertebrate taxa. Changes in species diversity and community structure seem to be associated with its appearance. Although the predaceous behaviour of *D. villosus* was observed in laboratory experiments, its trophic role in natural food webs is not well studied. We therefore investigated trophic position and diet use of *D. villosus* in benthic communities of the Rivers Elbe and Rhine by analysing stable isotope signatures. Because there were no trophic enrichment factors (TEFs) for *D. villosus*, we measured themin laboratory experiments. The TEFs for carbon differed strongly between plants and animal diet, whereas the TEFs for nitrogen were more similar. *D. villosus* had a relatively low trophic position in both food webs, indicating its function as primary consumer or omnivore. A mixing model (SIAR) indicated its intense use of leaves and only minor relevance of other invertebrates. Long-term monitoring data in the rivers showed a very slow and continuous change in the benthic community composition that could not be explained by *D. villosus* invasion alone. Therefore, the few negative correlations between the densities of native taxa and the invader cannot be assumed to be caused by predation.

RS13 - Oral

SHORELINE MORPHOLOGY DETERMINES THE CONTRIBUTION OF INVASIVE SPECIES TO ECOSYSTEM FUNCTION IN A LARGE RIVER

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The shores of large rivers used for navigation are dominated by engineering structures that may not only affect the diversity of native communities but may also determine the effect of Neozoa on ecosystem functioning. We analysed the spatial distribution of diversity and secondary production of benthic macroinvertebrates and tested whether the numerical and functional dominance of invertebrate Neozoa systematically differs among three common types of engineering structures at the Elbe River (Germany). Species richness, biomass and secondary production was significantly higher at the shore than at main channel and was related to habitat variables such as high proportions of macrophytes and FPOM and higher intra-annual variation in flow velocity. The contribution of Neozoa, especially those of invasive Crustacea to weighted biomass and weighted secondary production was systematically related to the proportion of artificial boulders used to construct the studied shoreline structures. In identifying habitat structure as an important driver of the structural and functional impacts of Neozoa, these results may help to control Neozoa populations as well as to limit the risk of secondary invasions.

RS13 - Oral

MODELLING PREDATION TO PREDICT THE IMPACT OF INVASIVE SPECIES: A LOOK FORWARD ON THE COMPARATIVE FUNCTIONAL RESPONSE APPROACH

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Because management costs increase and management efficiency decreases with time since species introduction, invasion science needs reliable methods to prioritize future invasion events through the identification of likely future invaders and the prediction of their impact. Based on the assumption that invasive predators more efficiently exploit resources than trophic analogs from the recipient ecosystems, it has been proposed to compare their functional response (FR), namely the relationship between resource use and availability, to explain or predict ecological impacts. The framework of this so-called comparative functional response approach allows scientists to address various challenging issues in invasion science, and the results obtained with current invaders are consistent with known field impacts. However, most of the experiments carried under the comparative FR approach involve a range of prey densities but a single predator individual. This is ignoring that predators rarely forage alone in nature. Mutual interference between predators can decrease the intake rate of each individual, which generates predator dependence in the FR. We illustrate how accounting for interference can shape FR comparisons and therefore promote the extrapolation of results to natural populations. We address this issue through investigations on the amphipods and gobies of Ponto-Caspian origin that are currently invading France.

RS13 - Oral

THE PHYSIOLOGICAL RESPONSE OF DIKEROGAMMARUS VILLOSUS AND GAMMARUS ROESELII TO DIFFERENT FOOD QUALITY

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The successful invasion and establishment of *D. villosus* in European rivers is assumed to be facilitated by ecological traits like a long reproductive period, short generation time or a high growth rate. To support those beneficial traits an efficient energy metabolism and a positive energy balance is a prerequisite. Moreover, it has been shown that *D. villosus* consumes different food sources of varying quality. We therefore assume that *D. villosus* can more effectively use different food sources than its potential competitors. To assess the effect of food quality, weestimated the physiological performance (feeding, excretion and growth) of the invasive *D. villosus* and the common species *G. roeselii* in a laboratory experiment. The 'Scope for Growth' (SFG) was determined as a measure for the theoretical amount of energy available for growth after all energetic requirements for maintenance metabolism are covered. Additionally, we quantified the ratio of RNA:DNA as an indicator of growth.

In accordance with our assumption, the SFG indicates that *D. villosus* is able to compensate differences in food quality, whereas the energybalance of *G. roeselii* is affected. However, on the contrary, the ratio of RNA:DNA suggests a negative effect of low food quality on *D. villosus*.

RS13 - Oral

SYMPATRY WITH THE DEVIL? TROPHIC INTERACTIONS BETWEEN NATIVE AND INVASIVE SALMONIDS

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Multiple rapid declines in native salmonid populations have been observed after invasive trout introductions. Only few populations of the marble trout (*Salmo marmoratus*), an endemic and endangered salmonid of the Adriatic basin, persist in Slovenia. One of these occurs in sympatry with the rainbow trout (*Oncorhyncus mykiss*). Previous work did not reveal any difference between the growth and survival rates of the native trout living in allopatry and those of the native trout living in sympatry with the rainbow trout. To gain a better understanding of these results, we explored the trophic ecology of these salmonids during three consecutive years in two headwater sectors: one with marble trout in allopatry (MTa) and one with native (MTs) and invasive species (RTs) in sympatry. Using stable isotope analysis, we found a trophic niche displacement between MTa and MTs with a higher trophic level for MTs suggesting a higher piscivory rate for MTs. Furthermore, the comparison between MTs and RTs revealed a higher trophic level for MTs. Trophic similarities between MTs and RTs were variable over time and explained by the size-distribution of populations. We also investigated a potential biological resistance of the native salmonid against one of the worst freshwater invasive species.

RS13 - Oral

THE EFFECTS OF SEASON ON THE TROPHIC NICHE WIDTH OF INVASIVE AND RESIDENT FISH SPECIES IN ALMUS RESERVIOUR, TURKEY

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Many invasive species have been introduced into reservoirs and may disrupt interactions within an already complex and poorly understood reservoir food web. Successful invaders are generally expected to have broader niches and to be more plastic than non-invasive species due to their ability to use a wide range of habitats and resources. We analyzed isotopic niches width of native and invasive species of Almus reservoir seasonally (winter, spring and summer),Turkey in 2011. Results showed that isotopic niche width was highly variable: invasive species, such as *Silurus glanis* and *Oncorhynchus mykiss*, and native species such as *Capoeta banarescui* had the broadest isotopic niches, suggesting increased plasticity in benthic and pelagic resource use while other native and invasive had the narrowest. Stable isotope analysis revealed substantial trophic niche overlap among *Capoeta banarescui and Cyprinus carpio*, and between *Silurus glanis and Atherina boyeri*, *Barbus plebejus*. Niche overlap between native and invasive species increased in spring and decreased in summer. A generalist trophic ecology provide significant advantages on invasive species and native *C. banarescui*, allowing them to exploit a variety of novel resource and seasonal variation in prey availability.

RS13 - Oral

INTERSPECIFIC COMPETITION BETWEEN THE INVASIVE AMPHIPOD ECHINOGAMMARUS BERILLONI AND TWO NATIVE GAMMARUS SPECIES

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In recent years, the invasive amphipod species *Echinogammarus berilloni* has nearly displaced the native species *Gammarus pulex* and *G. fossarum*, migrating upstream the river Alme catchment of the Paderborn karst plateau (NW Germany). In this study, we examined the details of competition between the invasive amphipod and the native species for preferred habitats (leaf packs). We hypothesized that *E. berilloni* colonizes leaf packs at higher densities than the native species and that this leads to displacement of the native species in the long term.

In our field experiment, standardized packs of alder leaves were exposed on the stream bed within three reaches across the headwater front of the invading species at sites of different water flow velocities. Results revealed that all species preferred leaf packs placed at low current. However, with the invader present, the native species switched to leaf packs at sites with high current and were observed only sporadically at low current. The resultssupport the hypothesis that *E. berilloni* is capable of out-competing the native *G. fossarum* and *G. pulex* for preferred habitats *.* The mechanisms of displacement by the invader are discussed.

RS13 - Oral

EXOTIC PARASITES INTRODUCED FROM INVASIVE AMERICAN RED-EARED SLIDERS IN NATURAL ENVIRONMENTS: ANOTHER THREAT FOR EUROPEAN FRESHWATER TURTLES?

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Alien species are considered as one of the major causes of biodiversity loss after habitat destruction. When introduced, species may become invasive following a combination of non-exclusive factors such as competitive exclusion and lack of their natural enemies (predators and/or parasites), among others. Furthermore they can also transmit their own parasites, which in turn may have harmful effects on the survival of local biodiversity. Among the world's worst invasive alien species, the American red-eared slider *Trachemys scripta elegans* was exported from the USA as a pet in the second half of the twentieth century and released into the wild, mainly in Europe and Asia. It has since established feral populations which may outcompete indigenous freshwater turtle species such as the European pond turtle *Emys orbicularis*. However, little is known about parasite introduction and transmission from exotic to native turtle species. We have investigated parasite richness in both invasive and natural terrapins from Southern European freshwater ecosystems. Our DNA barcoding study, based on analysis of the COI gene, revealed an unexpectedly high diversity of non-native platyhelminth parasites within *E. orbicularis* in natural environments. This suggests flatworms were first introduced by *T. s. elegans* and secondarily transmitted to indigenous turtles.

RS13 - Poster

LONG-TERM BIOMONITORING OF NEOZOAN INVERTEBRATES IN LAKE GENEVA

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The quantitative expansion and depth distribution of a well-established gammarid (*Dikerogammarus villosus*) since 2004 and of two more recent neozoans (*Chelicorophium curvispinum, Corbicula fluminea*) was investigated at two locations in Lake Geneva. *D. villosus* shows a high inter-annual and depth variability since 2004 between 0 and 5 m, almost excluding the native gammarid (*Gammarus pulex/fossarum*) from these littoral habitats. This displacement of indigenous species to greater depths induced a niche partitioning between *D. villosus* and other gammarid species. *C. curvispinum* presented an exponential trend between 2010 and 2012 (> 10’000 ind. m^2 in 2012 on the eastern site) then regressed. The colonisation of *C. fluminea* was relatively slow (max. 135 ind. m^2), probably limited by an unsuitable stony substratum in the littoral zone. Our results confirmed the numerical expansion of non-indigenous species in Lake Geneva representing up to 40 % of the benthic invertebrate richness and up to 95 % of the abundance. This constant increase in exogenous species contributes to a homogenization of the freshwater fauna in the littoral habitat, mainly driven by a biodiversity loss and an increase of suspension feeders.

RS13 - Oral

HYDROCHEMICAL AND HYDROBIOLOGICAL CONDITIONS OF LOCALITIES INVADED BY BRYOZOANS PECTINATELLA MAGNIFICA (LEIDY, 1851). A CASE STUDY FROM BR TREBOŇSKO, CZECH REPUBLIC

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During 2012 and 2013, 21 localities of invasive bryozoans *Pectinatella magnifica* ocurrence were found in Trebon region.

These localities included waterbodies from eutrophic fishponds to oligotrophic sand-pits. Physical, hydrochemical and hydrobiological parameters werestudied. Control localities (with absence of *P. magnifica*) significantly differed from localities with *P.m.* in the most of parameters. *P. magnifica* forms colonies in large numbers on localities with above-average qualitative parameters: balanced oxygen and pH regime, low concentration of suspended solids (Secchi depth over 1m, turbidity to 9 NTU) and nitrogen forms (TN to 1.5 mg L^{-1}), chlorophyll-a concentration to 36 µg L^{-1}, zooplankton density to 30 ind L^{-1} and biomass to 1 mg of wet weight L^{-1}. *P. magnifica* was also found in brown humic waters. While sites with *P. m.* occurrence often include lakes under nature protection or with recreational use and low intensity of fishery management (without formation of massive cyanobacterial water blooms, oxygen regime fluctuations etc.), ponds missing invasive bryozoans are mostly represented by strictly eutrophic, semi-intensive fishponds.

RS13 - Oral

A MACROECOLOGICAL APPROACH TO ASSESS ALIEN SPECIES INVASION DRIVERS IN ITALIAN FRESHWATERS

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Within the LifeWatch European e-Science infrastructure for biodiversity and ecosystem research a showcase on alien species was launched and coordinated by LifeWatch-Italy. Here we present the results relative to the role of propagule pressure, and abiotic and biotic variables as determinants of alien species occurrence among different taxonomic groups across several natural freshwater habitats in Italy. We determined that abiotic variables were good predictors of alien species occurrence: in fact,

together with propagule pressure, expressed as the proximity to major inhabited areas, and differences in the receiving community, expressed as the native species richness, they play a crucial role in determining the number of alien species. Furthermore, we found evidence of an influence of body size in determining the invasion success. This is the first study providing broad-scale support for the correlates of the occurrence of alien species across a wide range of taxa. Considering that many previous studies did not formally consider propagule pressure, our results may explain the apparent idiosyncrasy in results from species-specific studies. Moreover, by using the predictions of our model, we addressed the probability of the occurrence of alien species in freshwater habitats across the whole country, to be used for conservation planning.

RS13 - Oral

NATURE LOCATOR: GEOSPATIAL SMARTPHONE APPS AND THE USE OF CROWD SOURCING FOR THE RECORDING OF NON-NATIVE INVASIVE SPECIES

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Obtaining accurate and timely data about the presence and distribution of invasive species is of paramount importance when it comes to assessing impact and formulating an appropriate response. But data provision is often patchy and records are usually unverifiable and lacking accurate geographic reference.

The Nature Locator project has addressed these problems by combining the development of smartphone applications with the power of crowd-sourcing data collection. The apps enable data to be collected by non-scientists in the field. Critically, each record collected is verifiable being comprised of a photograph, subject specific metadata and being accurately geo-located by using the phone's GPS system.

AquaInvaders supports the recording of 30 high priority, freshwater INNS including *Pacifastacus leniusculus*, *Neovision vison* and several Ponto-Caspian invertebrates including *Dikerogammarus villosus.*

PlantTracker allows the recording of 21 INNS including *Impatiens glandulifera* and *Fallopia japonica*.

This approach to data collection/verification has led to:

- Enhanced accuracy of records owing to photographic evidence and GPS based geolocation
- A significant increase in the number of UK records collected (PlantTracker has generated over 10,000 verified records since its launch)
- UK-wide recording coverage
- Large-scale public engagement/media interest
- Increased public awareness of INNS
- Real-time access to data

RS13 - Oral

DO WATER QUALITY IMPROVEMENT AND INVASIVE ALIEN SPECIES AFFECT MACROINVERTEBRATE DIVERSITY?

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In this study, we investigated the reciprocal link between water quality and invasive alien species (IAS) as well as their combined effects on diversity of macroinvertebrate communities. Between 1999 and 2009, up to 4-fold decreases of nutrient concentrations indicated water quality improvement of rivers and lakes in Belgium. Despite the high pollution tolerance often ascribed to IAS, the proportion of alien taxa in the macroinvertebrate community was lower in 1999 than in the 2000s. Based on statistical models, it was found that poor water quality negatively affected the proportion of aliens in macroinvertebrate communities. The number of native taxa in large and small rivers was higher in the 2000s than in 1999, demonstrating a net positive effect of water quality improvement on IAS and macroinvertebrate diversity in general. Because water quality improvements promoted both native and alien taxa, no biotic homogenization at the river basin scale was observed, despite very high proportions of alien macroinvertebrates present in large rivers. Multiple-site similarities of community composition indicated more heterogeneity in the 2000s than in 1999. This study shows that due to water quality improvement and alien species establishment macroinvertebrate diversity increased in lowland rivers, both at the local and regional scale.

RS13 - Poster

DO NON-NATIVE SPECIES LIMIT NATURALS' LIFE?

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Biological invasions are now considered one of the major causes threatening the conservation of biodiversity. It can devastate all the ecosystem. This study aims to determine the impact of a non-native species on the distribution of resident species in two streams, named Maşukiye and Mahmudiye, in the Marmara Region of Turkey. Two streams have been sellected because of their similarities with regard to habitat, bottom structure and water quality. Two sites were choosen in each streams; one from upper part of the streams which is away from the human impact and the other one is from downstream. The catch was performed with anelectroshock device and several species belonging to the family of Cyprinidae, Gobidae, Cobitidae, Poeciliidae are determined in both streams. However, rainbow trout-*Oncorhynchus mykiss* (Walbaum, 1792) has only been caught from Maşukiye's upper section and it has been determined that the specimen's population established in Maşukiye Stream by escaping from a nearby fish farms or releasing intentionally. While the species composition in both streams' lower stations resemble each other, the stations in the upper streams show dissimilarities in fish species occurrence. The effect of non-native rainbow trout population on resident fish species will be discussed.

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RS14 - Oral

ECOLOGICAL INSIGHTS AND SURPRISES FROM LONG-TERM MONITORING PROJECTS.

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Most long-term monitoring projects set out with clear objectives related to specific program goals. Over decadal time periods, data generated from such monitoring programs can provide novel ecological insights and surprises beyond the realm of initial goals. This talk highlights some insights and surprises from three different long-term monitoring programs having different initial goals. A 15-year monitoring of an experimental flow program gave insight on the importance of a long-term perspective in ecological management and surprises on ecological resilience following catastrophic disturbance. Second, a 14-year dataset on two reference alpine streams gave insight on climate change effects on river ecology in relation to glacial legacies. Surprises arose from the similar role of external drivers in temporal response patterns in each system. Lastly, a 15-year dataset from a high mountain lake/river network gave insight on how spatial landscape features affect temporal ecological response patterns in the system. Here, ecological surprises emerged in how the network functions in light of these spatial scale dynamics. A key determinant to gain insights and detect ecological surprises is through the careful design and long-term implementation of monitoring programs that set the foundation for concurrent research.

RS14 - Oral

CHARACTERISATION OF REFERENCE CONDITIONS FOR UNUSUAL RIVER TYPES

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Monitoring and assessment of ecological status is challenging particularly for unusual river types. Under the Water Framework Directive all EU Member States are obliged to develop a river typology upon which type-specific reference conditions can be defined to enable accurate evaluation of ecological status. Four categories of unusual rivers were identified as being omitted from the development of the national Irish river typology in 2005: 1) low conductivity, naturally acidic rivers, 2) highly calcareous rivers with calcium precipitation, 3) groundwater-dominated rivers, and 4) rivers strongly influenced by lakes, i.e. lake outlets. All four groups present potentially challenging environmental conditions for aquatic biota and so may host communities different to those expected according to type-specific reference conditions defined for other river types. There is a paucity of information across Europe determining if these rivers represent distinct river types, sub-types or if they warrant modification of metrics/assessment tools when assessing their ecological status. The aim of this study is to characterise reference conditions for these unusual rivers using macroinvertebrates, macrophytes, and phytobenthos, and assess the effectiveness of current metrics in determining their ecological status.

RS14 - Poster

COMPARISON OF SEVERAL INDICATORS BASED ON DIATOMS AND BENTHIC MACROFAUNA TO TRACK A PESTICIDES REDUCTION PROGRAM IN THE CHARMILLES STREAM (GENEVA, SWITZERLAND).

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The Charmilles stream, with its wine-producing watershed, does not meet the requirements of the federal ordinance for water protection (‘’Ordonnance sur la protection des eaux, or OEaux’’) for pesticides and copper. Since 2007, the Service de l'écologie de l'eau from canton of Geneva (SECOE) evaluates the biological and physico-chemical quality of the Charmilles stream. These analysis are realized within the framework of the 62a project set up by the canton and the confederation, with the aim to reduce the pesticide concentrations.Biological indices (IBCH [1] DI-CH [2,] SPEAR Index [3]), analysis of the benthic community and diatom ecological guilds[4] have been proven to be relevant and responsive tools to assess the recovery of ecosystem, whereas species abundance, taxonomic density and the ecotoxicological method GamTox[5] produce results which are difficult to interpret.

RS14 - Poster

HYDROMORPHOLOGICAL FEATURES OF GREEK LAKES: FIRST RESULTS FROM THE MONITORING NETWORK

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In the context of the Water Framework Directive, the Greek National Water Monitoring Network for lakes comprises 24 natural lakes and 26 reservoirs. The Greek Biotope - Wetland Centre monitors lake water bodies, using biological, physicochemical and hydromorphological quality elements. With regard to morphological parameters, lake bathymetry and habitat surveys are undertaken. Moreover, hydrological data, such as water level fluctuations, are regularly recorded and lake hydrological features (e.g. water volume, residence time) are calculated. This study aims to present the first results of lake hydromorphology monitoring during 2013 and 2014. Preliminary analysis illustrates that Greek lakes exhibit a variety of hydromorphological features. These seem to be mainly associated with their location in the Mediterranean region and with the human activities affecting them. Further considerations are discussed, including the need to better understand the links between morphology, hydrology and biology. The study is financed by ERDF - Operational Program Environment and Sustainable Development and national funds.

RS14 - Poster

FISH POPULATION EVOLUTION OF NAM THEUN 2 RESERVOIR IN LAO PDR

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The aim of this study is to characterize the fish population evolution of Nam Theun 2, a large neo-reservoir of Lao PDR. Since its impoundment in 2008, annual experimental fishing using gillnets are performed at rainy and dry seasons in reservoir, transition and river areas. Since 2012, three sampling stations within the reservoir were added, and the temporal factor improved by adding two surveys in intermediate seasons. The first year following impoundment, the species richness and the abundance increased inside the reservoir, decreased the second year and stabilized the following years; the meanweight caught was similar along the monitoring. Some species with high adaptive ability dominated the new assemblage: *Hampala macrolepidota, Parambassis siamensis* (ubiquitous species) and *Oreochromis niloticus* (exotic species).The data from the improved monitoring showed that habitat highly structured the assemblage: light forest habitat presented a lower species richness than open areas and dense forest. The density and weight from the catches were higher at dense forest zones than at other habitats. The small individuals dominated at all habitats. Density of *Parambassis siamensis* increased annually and characterized the assemblage of open areas with *Cirrhinus molitorella* (species common in transition areas), when *Hampala macrolepidota* characterized the dense forest areas.

RS14 - Poster

SONDE DATA ANALYSES INFER SIGNIFICANT DIFFERENCES IN METABOLIC RATES BETWEEN VÕRTSJÄRV PROPER AND SOUTHERN STATION

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Lake metabolism and primary production are driven concomitantly by a large set of ecological variables that can alter their ecosystem states. The primary aim of this study was to set the metabolic differences of net ecosystem production, gross primary production and community respiration between Võrtsjärv Proper and Southern part. This study we conducted in 2012 during the ice-free season in a large, shallow, and eutrophic Lake Võrtsjärv by using high-frequency measurements of dissolved oxygen. Sonde data exhibited high variability between two parts of the lake, which varied frequently across temporal and spatial scales. Lake metabolism at the central station shifted between ecosystem states of net autotrophy and net heterotrophy in late spring and early summer. As expected during the remaining period net heterotrophy dominated firmly. Southern part received rich loadings of organic matter from feeding river Väike Emajõgi and the lake maintained net heterotrophy constantly. Consequently, we aim to contrive further high-frequency of measurements, so to assert the findings from our research.

RS14 - Oral

SENTINEL LAKES: A NETWORK FOR THE STUDY AND MANAGEMENT OF MOUNTAIN LAKES IN THE FRENCH ALPS

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High-altitude lakes are vulnerable ecosystems that require protection and sustainability management, although their overall functioning is still poorly understood. In France protected area managers and scientists are cooperating to address this problem. The creation of a mountain lake observatory at the scale of the French Alps will be a priority to provide an evaluation and decision support tool to the management of protected areas. It will require a standardized monitoring of the lakes from the northern Alps to Corsica to have a set of data (physicochemical, biological…) which are consistent on the whole territory before extending them to other mountain ranges. Once validated and analyzed by scientists, the data will constitute a key component for sharing information between different stakeholders in the framework of this network. The network allows the synergy between multidisciplinary research and managers on identified studied sites. The goal is both to detect modifications in the ecological state of lakes (modifications which could be linked to changes in 'lake-uses' (tourism, fishing, etc) and progress on the understanding of specific ecological process in order to, *in fine*, apply the adapted remediation. Monitoring of a large number of mountain lakes and sharing the results within the network will also enable better protection and management of these habitats. Asters, Conservatoire d’Espaces Naturels de Haute-Savoie, has the mission to encourage exchanges and to coordinate scientific activities of this network.

RS14 - Oral

DEVELOPING PHYLOGENETICALLY BASED BIOMONITORING METHODS: A TEST WITH DIATOMS

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Diatoms include a great diversity of taxa and are recognized as powerful bioindicators in freshwaters. However using diatoms for bioassessment is costly and time consuming because most of the indices necessitate species-level identification. Simplifying diatoms-based assessment protocols focused the attention of many researchers in recent years. The increasing availability of genomic data and phylogenies can benefit to the development of new bioassessment methods making use of those tools, where a clade plays the role of a species if relevant. Indeed, closely related species are more likely to exhibit similar environmental sensitivity because of phylogenetic constraints and inheritance. Such patterns have been reported recently for sensitivity to a variety of pollutions for two important groups of bioindicators used for freshwater monitoring: benthic macroinvertebrates and diatoms. We introduce a method to extract clusters of species sharing similar characters but also being phylogenetically related. We apply this method on the general pollution sensitivity (IPS specific sensitivity value; Coste, 1982) of 158 species of diatoms and, by tuning the method settings, we generate different clade-based derivatives of the traditional IPS index. Finally we estimate traditional and derived IPS scores for 2119 communities of diatoms to compare and assess the performances of these new indices.

RS14 - Poster

SENSOR-BASED SYSTEM MONITORING OF PHYSICAL – CHEMICAL PARAMETERS OF A HYPERTROPHIC FISHPOND – NETLAKE SITE IN SOUTH BOHEMIA, CZECH REPUBLIC

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Fishpond Dehtář is situated in South Bohemia, Czech Republic. It is a large hypertrophic pond (area 228 ha, volume 4.712 mil m^3) used for fish (common carp) culture. Semi-intensive fishery management is applied, including fertilization and supplementary fish feeding. Three stationary monitoring stations were installed within the COST CZ project, a part of NETLAKE COST Action (ES 1201). Data have been collected from mid-May 2014. Concentrations of dissolved oxygen, water temperature, global radiation, rainfall, direction and wind speed and photosynthetically active radiation (PAR) were measured. Additionally, water chemistry and plankton (phytoplankton, zooplankton) samples have been taken bi-weekly near all monitoring stations. High nutrient and organic compounds loading, combined with relatively high average depth (2.6 m; common Czech fishpond is about 1.0 m), caused strong stratification and intensive fluctuations of main environmental parameters, esp. of oxygen concentrations. In summer, very low oxygen concentrations (< 2 mg l^{-1} in most part of water volume) were recorded during the time of low intensity of PAR (mostly after the windy period). In some cases, anoxic conditions were persistent for several days. Without application of continual monitoring systems, we would not be able to understand water quality changes, necessary for effective fishery management planning.

RS14 - Oral

CITIZEN CRANE: AN EXAMPLE OF COMMUNITY ENGAGEMENT, HELPING ASSESS THE ENVIRONMENTAL USE OF THE RIVER CRANE, A TRIBUTARY OF THE RIVER THAMES.

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Citizen Crane represents recognition that with appropriate training, members of a local community can derive science based evidence to assist managers meet EU environmental obligations under the Water Framework Directive.

At SEFS8, the implementation of EU legislation covering the Habitats, Birds and Habitats Directives was discussed in the context of community use of the River Crane, a tributary of the River Thames. The positive outcome of partnership working was emphasised, where a previously heavily polluted river had become a haven for wildlife. Communication between different regulators and the public is facilitated by the Crane Valley Partnership (CVP)

http://cranevalley.org.uk/ . The Citizen Crane project is a union of two citizen science initiatives, the FORCE led phosphorus monitoring project and the Zoological Society of London (ZSL) coordinated, Riverfly Monitoring Initiative (RMI).

During 2015, it is hoped to assess the impact from over 150 surface water outfalls. Identification of such sources of pollution should aid regulators in their management of the river.

Linking volunteer collected water quality data with the invertebrate sampling undertaken by the Citizen Crane volunteers, it is possible to compare parts of the River Crane and derive an index of ecosystem health.

RS14 - Oral

INTEREST OF HIGH FREQUENCY MEASUREMENT TOOLS FOR TRACE METAL MONITORING IN FRESH WATERS

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This presentation aims to describe how high frequency measurements are paramount for the determination of water quality, especially to link chemical and ecological data. An online trace metal monitoring system using voltammetry has been developed and used for a few years, detecting Mn, Zn, Pb, Cd and Cu. It allows (i) to reduce any contamination and/or evolution of the sample before analysis, (ii) to determine metal speciation (electrolabile *vs* total concentrations) and (iii) to have an analysis every hour in order to see daily variations and exceptional events. A new automatic filtering sampler (for offline spectroscopic analysis) has also been developed and will be presented. The case study of the Marque River in July 2014 is a good example of the interest of these systems: easy recognition of daily cycles for total Zn and Pb during the dry periods and great sharp variations of all metal fractions during rainy events has been for instance underlined. The comparison of electrolabile and total metal concentrations (from the voltammetric system) and the total dissolved one (filtering sampler) have also permitted to characterize the metal speciation: Pb seems mainly associated to suspended particulate matter while Zn is rather linked with colloids and/or organic ligands.

RS14 - Poster

PRELIMINARY ASSESSMENT OF EUTROPHICATION ON THE BRACKISH SHALLOW LAGOONS (BALIK LAKES AND UZUNGÖL, KIZILIRMAK DELTA) FROM TURKEY

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Kızılırmak Delta is located in the Central Black Sea region of northern Turkey and covers an area of 56,000 ha which includes various of ecosystems such as the sea, river, lagoons, reeds, marsh, meadow, pasture, forest, dune, and agricultural areas. The delta is one of the most important coastal wetland complexes of the Black Sea, with its rich biodiversity and critical habitat for globally endangered bird species. The delta is a multipurpose wetland ecosystem that makes important contributions to the local economy through fishing, reed cutting, and grazing activities. Despite the fact that the Kızılırmak Delta fulfills the international criteria for the wetland category, lagoon ecosystems have been heavily affected by the Bafra Plain Irrigation Project and by the increasing agricultural land use during the last three decades. Within the scope of Irrigation Project, drainage channel has been established the vicinity of the lagoons since 1986. These human practies has bring out drastic water regime changes, nutrient loading and eutrofication in the lagoons. During the summer-fall periods in 2013, a monthly monitoring has been implemented in Balık Lake and Uzungöl (i) to measured abiotic factors of the lagoons, (ii) to evaluate the consequences of eutrofication on the ecosystems. Seven stations have been studied to identify water quality, macrophytes and fish community and to assess ecological status with the frame of WDF. Research supported by Hacettepe University Scientific Research Project Coodination Unit with the project of 013.D05.601.001.

RS14 - Poster

PHYTOPLANKTON DYNAMICS IN A SHALLOW KARABOĞAZ LAGOON FROM KIZILIRMAK DELTA, TURKEY

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Karaboğaz Lagoon is a shallow, nutrient replete system, suffering from high level of aquatic submerged macrophytes , over fishing and agricultural drainage input. Phytoplankton was evaluated based on one year monthly monitoring from fall 2008 to late summer 2009 at six stations representing eastern and western basins of the lagoon. Lagoon divided into two basin, characterized by a lateral salinity gradient. Here, we analyzed the abundance and distribution of primary producer and investigated the biochemical factors driving observed changes. Over the study period, a total of 203 taxa belonging to 7 divisio (Cyanophyta, Chlorophyta, Cryptophyta, Euglenophyta, Pyrrophyta, Basillariophyta, Chrysophyta) were recorded. The lagoon showed a pronounced algal periodicity. Phytoplankton community was generally dominated by Chlorophyta, Bacillariophyta and Chrysophyta. The westernbasin had the lowest mean salinity values and generally highest phytoplankton abundance, in which, blooms of Chlorophyta were common with *Monoraphidium contortum* and *Scenedesmus bijuga* being the most abundant species. The mixomesohaline eastern basin had lowest density andChlorophyta-Bacillariophyta were dominat in the community with *Monoraphidium contortum, M. komarkovae, Schroederia setigera, Navicula* sp. and *Cyclotella meneghiniana*. This study has also provided substantial evidence that the phytoplankton abundance and community are governed by environmental conditions (e.g. salinity, macrophytes coverage) which vary periodically in the lagoon. Research supported by the Scientific and Technological Council of Turkey with the project of 108Y058.

RS14 - Oral

MONITORING OF FRESHWATER ECOSYSTEMS: CONTRIBUTION OF LEAF LITTER DECOMPOSITION

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According to the European WFD, European rivers should reach a good ecological status by 2027. Yet, the monitoring required by water policies does not consider ecosystem functioning. Our aims were (i) to use leaf litter decomposition as a proxy for the assessment of functional integrity of streams, and (ii) to propose a multi-index approach taking into account the quality of both communities and ecosystem processes. We surveyed ninety streams in lowland areas from southwestern France, along a gradient of impacts mostly of agricultural origin. Leaf decomposition driven by shredders and microorganisms was evaluated *in situ* while biotic indices, mainly involving benthic macroinvertebrates and diatoms, were extracted from the National Water Agency database. Microbial decomposition was mostly not affected by the gradient of impacts, in contrast with invertebrate-driven decomposition. Biotic indices and decomposition parameters were only weakly related suggesting complementarity rather than redundancy of these indicators. In conclusion, a multi-index approach targeting both functional and structural components of stream ecosystem integrity may enhance the evaluation of our freshwaters.

RS14 - Poster

BIOLOGICAL WATER QUALITY ASSESMENT IN YALAKDERE (YALOVA) WITH USE OF BENTHIC MACROINVERTEBRATES

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This study is aimed to determine the water quality of Yalakdere in Yalova province, using its own benthic macroinvertebrates. The site of the study, Yalakdere was formerly supplying Hersek Lagoon, but then was oriented to west as a result of tectonic effects. Since transfering freshwater from Yalakdere to Hersek Lagoon with a canal system is planned, it is crucial to determine the water quality of Yalakdere.

Samples of benthic macroinvertebrates collected monthly from 4 different sites between April 2013 and March 2014. BMWP and ASPT Spanish version metrics are used to determine the water quality.

Temporary meteorological drought was observed to be the reason for the reduction in the number of benthic macroinvertebrate communities and the disappearance of the low-toleranced taxa. Regained normal water flow lead to increase in water quality class.

It is concluded that these metrics depending on benthic invertebrates are appropriate for determination of biological water quality of Yalakdere and the community structure of benthic invertebrates might also be a good indicator to determine water quality.

RS14 - Oral

DISTRIBUTION OF DISSOLVED CO2 AND O2 IN THE 8 EUROPEAN WATER FRAMEWORK DIRECTIVE LAKE TYPES IN ESTONIA

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Nowadays automated monitoring buoys are widely applied. Day-to-day variation and distribution of dissolved oxygen (DO) in different lake types is already well known. However, data on dissolved CO_2 are still rare, because the relatively low reliability and accuracy and high price of CO_2 sensors. Recently, the usage of CO_2 sensors has increased although mostly in the upper mixed layers of lakes. Continuous profile measurements of CO_2 are still very scarce. In year 2014 we measured DO and CO_2 every 10 to 30 minutes during one week at up to four different depths in all 8 Estonian lake types, according to European Water Framework Directive. In case of fully mixed lakes only two depths were measured. In case of stratified lakes two sensors were placed in the epilimnion, one in the metalimnion and one in the hypolimnion. CO_2 differed largely between lakes. The highest CO_2 value in the surface layer (11.9 mg/L) was measured in highly calcareous polymictic Lake Äntu Sinijärv, but the record highest value (45 mg/L) was measured near the bottom of hypertrophic stratified Lake Erastvere. Lowest near bottom CO_2 concentrations were measured in Lake Peipsi, which is the 5th largest lake in Europe.

RS14 - Oral

EFFECTIVE FLOODPLAIN MONITORING USING CLOSE-RANGE UAV PHOTOGRAMMETRY AND REMOTE SENSING

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Floodplains are highly diverse and dynamic ecosystem mosaics sensitive to natural and man-made impacts. Their successful conservation and management requires information at different scales, ranging from habitat patches to the entire floodplain at high temporal and spatial resolution. Currently, information is largely achieved through ground surveys, which can be time-consuming, financially expensive, logistically challenging or even impossible under high flow conditions. To address these issues, we deployed a light-wing UAV equipped with capable sensors (RGB and near infrared) and developed a photogrammetric and remote sensing approach as an efficient and flexible monitoring tool for an array of floodplains in the Simme valley (Canton Bern), subject to environmental impacts such as channelization, hydropower production and restoration.

Results demonstrated the utility, efficiency, and success of multi-temporal close-range UAV based photogrammetry and remote sensing to assess, evaluate and monitor floodplain changes such as habitat availability, hydrological- and sediment dynamics qualitatively and quantitatively at a high level of detail even under harsh conditions where access is restricted. Overall, this approach provides timely and critical information at different scales on how floodplains respond to altered flow regimes or floodplain encroachments as a prerequisite for their conservation and management.

RS14 - Oral

CALIBRATING METAL CONTENTS IN CAGED GAMMARUS FOSSARUM TOWARDS ECOLOGICAL DISTURBANCE: IDENTIFYING THRESHOLD CONCENTRATIONS ABOVE WHICH MACROINVERTEBRATE POPULATIONS COLLAPSE

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Contamination levels of aquatic ecosystems and ecological effects must be assessed, as stated by the WFD. However, linking both issues remains difficult, yet necessary to implement restoration. Recently an active biomonitoring approach has been developed using caged *Gammarus fossarum* to assess trends of bioavailable contamination levels in freshwater systems. This new tool overcomes most drawbacks associated to other currently used methods, allowing an accurate comparison of contamination levels between stations, seasons or years.

Our study aimed at calibrating this active biomonitoring tool in order to interpret bioavailable contamination levels in term of risk for ecological disturbance. For this, a national scale investigation has been performed to obtain the bioavailable contamination levels and ecological indices (diversity and abundance) for 117 sites representative of French watercourses.

Concentrations of 11 metals quantified in *G. fossarum* have been analysed against ecological indicators. No link was revealed between bioavailable contamination levels and global ecological indicators used for WFD implementation; in contrast, clear relationships were established with sensitive macroinvertebrate abundances. This allowed determining thresholds for five elements above which populations are endangered. These ecological impairment thresholds are discussed accordingly to the bioavailable background accumulated contamination values previously determined in *G. fossarum* at the French national scale.

RS14 - Poster

RESTORING WETLANDS TO REMOVE AGRICULTURAL POLLUTION IN SURFACE WATERS: ASSESSMENT AND MONITORING THROUGH PARTIAL TRIADIC ANALYSIS (PTA).

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Since 2011 to 2012, several wetlands were constructed in order to remove non-point source pollution from irrigation return flows in the Flumen riverwatershed, a territory intensively used for agriculture and pig farming in NE Spain. In this study, we assessed the seasonal patterns of NO_3^-, NO_2^- and NH_4^+ in one of those wetlands in order to identify the source of pollution concentration peaks analyzed. During 2014, water samples were collected at various points along the wetland at different dates related to agricultural activities in the area. We used the partial triadic analysis (PTA) to investigate the pollution inputs and to study its seasonal variability. The PTA characterized the wetland in terms of water quality and identified those areas to consider for a best performance. Upstream sampling stations clearly differ from those located downstream in terms of water quality. Also, the PTA identified a key NO_3^- input point. PTA is a statistical tool that allowed us to jointly analyze the spatial and seasonal wetland efficiency and to reveal input pollution zones. In this way, we obtained a more comprehensive wetland knowledge, which will be essential when taking measures to improve its effectiveness and functioning.

RS14 - Poster

HABITAT PREFERENCES OF RIVER LIMPET (ANCYLUS FLUVIATILIS) ON THE RIVER BOTTOM IN DEPENDENCE ON ITS LIFE CYCLE AND THE SEASON

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River limpet is a typical snail on the rocky bottoms of streams and rivers. We observed its population in a small lowland stream Hloučela (the Czech Republic) for two years. Quantitative samples were taken four times a year in two habitats, in the riffle and the pool (3467 ind.). At the same sampling terms we observed the number and the shell-size of snails on each side of individual stones taken from the river bottom (210 stones, 1830 ind.). We studied the changes in abundance and size structure of the population in both habitats during a year and which sides of stones snails prefer depending on their shell-size, life cycle and season.

The distribution of river limpet is dependent on the season: in spring snails are more abundant in the pool than in the riffle. The size structure of the population on both habitats differs: the largest individuals are concentrated in the riffle. Microhabitat preference depends on the season and the life cycle: in the pool snails prefer the tops of stones over the whole year, in the riffle they move down during the winter. The lower sides of stones are also preferred by adult snails for egg-laying.

RS14 - Poster

FISHING OR SNORKELING? HOW TO BEST SAMPLE FISH ASSEMBLAGES AT A LARGE SCALE

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In rivers, fish assemblages are connected by dispersal of individuals at large spatial scales (10-100 km) and are influenced across space and time by changes in flow or temperature. Current sampling protocols, mainly made by electrofishing of reaches ~1km long, do not allow assemblages to be characterized at a large spatial and temporal scale. We developed a new sampling protocol of fish assemblages over dozens of kilometers, based on SPA (snorkeling point abundance) samples made during snorkeling surveys. We compared pairs of snorkeling and electrofishing surveys (median delay between protocols = 1 day) in large and small rivers over a two-year period (n = 5 pairs of surveys). Higher abundance, occurrence and species richness were collected by electrofishing. However, point fish assemblages (observed within surveys) demonstrated a consistent structure between the two protocols that was related to species habitat use (e.g. depth, water velocity). Fish assemblages were highly variable between surveys, regardless of the sampling method. However, when pooling all surveys, fish abundance spatial structure along the rivers was more similar between protocols. Overall, snorkeling SPA samples provides a useful alternative to electrofishing when assessing fish assemblage at large scales.

RS14 - Oral

ASSESSING THE ECOLOGICAL STATUS OF POLISH LAKES: THE ROLE OF PARTICULAR BIOLOGICAL QUALITY ELEMENTS IN LAKE CLASSIFICATION

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The lake monitoring programme compliant with the Water Framework Directive has been introduced in Poland since 2007. Methods for three Biological Quality Elements (BQEs), phytoplankton (PMPL), macrophytes (ESMI) and phytobenthos (IOJ), are internationally intercalibrated. Biological and physico-chemical monitoring data from about 700 lake-years surveyed in 2008-2013 were analysed. All the lakes were sampled for physico-chemistry and phytoplankton (four times a year from March to September); 57% of the lakes were surveyed also for macrophytes (once a year) and 42% for phytobenthos (once a year). The assessment results based on PMPL, ESMI and IOJ showed significant inconsistencies between the three BQEs: phytoplankton gave the most stringent and phytobenthos the most lenient status classes, in general. Moreover, the classification based on phytobenthos corresponded least to water quality parameters that may indicate the limited indicator value of this BQE for lake assessment or inappropriate sampling design.

RS14 - Oral

WATER QUALITY ASSESSMENT OF A TEMPERATE MID-SIZE RIVER LOCATED IN A HEAVILY EXPLOITED WATERSHED (OGLIO RIVER, NORTHERN ITALY)

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From 2009 to 2012 the chemical (i.e. nutrients) and biological (i.e. macroinvertebrates and macrophytes) quality of the Oglio River (Northern Italy) was investigated. Nearly 50 sites were monitored seasonally along the 154 km river course. The system under investigation lays within the Po Plain: main pressures are hydrological discontinuities, hydroelectric power plants, water abstraction from agriculture, diffuse N pollution and lack of lateral wetland areas. Aims of the work were to identify nutrient dynamics, in particular nitrogen, and to relate these dynamics with river biota. Results suggest a limited effect of artificial water diversions on chemical quality and a significant effect of nitrate rich groundwater ingression. Irrigation withdrawals

diverted nearly 100% of the river flow, averaging 60 m^3 s^{-1}, which was replaced by groundwater, with flows to the riverbed up to 0.33 m^3 s^{-1} km^{-1} and loads of nitrate up to 5000 kg per day. Simultaneously, the alteration of the river biotic communities were mainly addressed to hydromorphological constraints and to a minor extent to physico-chemical characteristics. We conclude that river chemical and biological water quality is affected by both large (i.e. land use) and small scale (i.e. water abstraction) factors.

RS14 - Oral

DEVELOPING A PHYSICAL AND CHEMICAL TYPOLOGY OF THE FRENCH FRESHWATER NETWORK: A NEW INSIGHT ON BENTHIC COMMUNITIES DISTRIBUTION.

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Qualifying rivers in a large territory like France requires simplification in order to be easily understandable. Indeed several river typologies based on many criteria have been extensively proposed; but few studies have focused on the natural physico-chemical characterization of water and particularly on how it impacts biological communities. This study proposes to develop such a typology according to a straightforward and effective methodology based on data classification with Hierarchical Cluster Analysis and data characterization with ordination techniques (Principal Component Analysis and Canonical Correspondence Analysis). We also refer to an extensive dataset of low-impacted sites gathered among operational partners of the mainland country and encompassing twenty-three physico-chemical variables, as well as diatoms and macroinvertebrates listings, from 2003 to 2008.

Classification and characterization of physico-chemistry shed light on a clear dichotomy in streams according to water-hardness. The ordination of diatomic communities is significantly constrained by this segregation as well as macroinvertebrates to a lesser extent. The same procedure implemented again on each of these two groups exposes mainly the longitudinal gradient. Although geochemical background is already known to shape biological communities, our present typology underlines the need for a better understanding of their response to water chemistry impairments.

RS14 - Poster

HORIZONTAL SPATIAL HETEROGENEITY OF WATER QUALITY AND SEDIMENT OF MULTI-SYSTEMS RESERVOIR (SÃO PAULO STATE, BRAZIL): NITROGEN AND PHOSPHORUS

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Important for the water public supply of the São Paulo City (Brazil), the Cantareira System consisting of five reservoir connected by channel and tunnel. Due to intense uses added to incipient health coverage of watershed, this study aimed to compare the trophic status of water bodies and compare (inter and intra reservoirs) the N and P concentrations. To characterize the water mass integrated samples were collected (surface portion, of the 2 to 5 meters deep) and to sediment the surface portion (the first 4 cm), in 19 stations distributed between the reservoirs. For data analysis were used linear regression, cluster analysis, PCA and ANOVA One Way. In water mass of values ranged of 179.4 to 900.1

µg/l (DIN), 4.5 to 47.3 µg/l (total phosphorus - TPw), 0.9 to 14.1 µg/l (Chlorophyll a) with a TSI of oligotrophic to supertrophic. DIN/TPw ratio ranged of 19 to 380. For the sediment the values ranged from 1.2 to 4.1 of g/kgDW (total Kjeldahl nitrogen - TKN), 217.5 to 548.1 mg/kgDW (total phosphorus - TPs), and the TKN/TPs ratio of 7 to 29. The data suggest spatial heterogeneity in the water quality and sediments, with the decrease of the trophic gradient in the amount downstream direction.

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RS14 - Oral

PREDICTING REFERENCE CONDITIONS FOR RIVERS BIOASSESSMENT IN THE ABSENCE OF REFERENCE SITES THROUGH A COMBINATION OF BOOSTED TREES AND ENVIRONMENTAL FILTERS

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Modern bioassessment methods of water bodies require the definition 'reference conditions' which should be given by sites showing no or only 'very minor' human impacts concerning hydromorphological and physicochemical conditions. However, minor impacts are very difficult to find in many European water bodies (as in other regions of the world) due to the historical anthropogenic alterations. So, here we propose an alternative approach, based on environmental filters and species preferences combined with boosted trees to predict new abiotic reference values and true reference communities (diatoms and invertebrates) for river sites in a highly disturbed area, where no reference sites are available. To test it, we used a database composed of diatom and macroinvertebrate communities' composition and abiotic data covering the entire Portuguese territory (except islands) and the the period between 1993 and 2012 (spring-summer, autumn and winter). It included: 549 diatoms samples and 984 macroinvertebrates samples from 506 sites. From those, 167 samples and 218 samples for diatoms and macroinvertebrates, respectively, are rivers and streams located in the littoral region of central Portugal. We found that expected communities for the highly disturbed sites, contained ca. 50% more taxa than the presently observed. The assessment of sites through indices with new boundaries adjusted to the new reference condition resulted in poorer classifications to present condition at the littoral sites. Those assessments were also better correlated with pressures than with previous assessment methods. This study brings thus a new insight to solve the problem of the lack of true reference sites.

RS14 - Oral

MONITORING OF FAECAL INDICATOR BACTERIA IN STREAMS AND SEDIMENTS IN A RURAL AGRICULTURAL CATCHMENT

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Faecal coliforms including *Escherichia coli* are commonly used as faecal indicator bacteria (FIB) of recent contamination of water bodies with human or animal waste. Studies have shown that aquatic sediments can also contain elevated levels of FIB that these can persist in sediments for months, and can re-contaminate the water column during high flows. There is little work, however, on contamination of sediments in agricultural catchments and none relating to the impact of streamside fencing on levels.

Sediment samples were collected from three headwater tributaries in a catchment in intensive cattle production is the main agricultural practice, in NE Ireland, in April, July, and October 2013 and 2014. Samples were also collected from a catchment in a site which has no intensive agriculture. Preliminary data showed that all sites in agricultural catchment were heavily contaminated with faecal coliforms (including *E. coli*) and that values were highly variable both between tributaries and from site to site.Values were highest where cattle had access to the stream. Concentrations were significantly lower in a fenced stream than in two unfenced streams. Future work will include investigations of the conditions under which FIB are resuspended, and persistence of pathogenic bacteria in sediments.

RS14 - Oral

LONG-TERM CHANGES OF WATER QUALITY OF LAKES UNDER LOW ANTHROPOGENIC PRESSURE

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Long-term series of data from lakes remaining under low anthropogenic pressure demonstrate natural year-to-year variability of water quality parameters resulting from e.g. weather conditions. In the frame of the national water monitoring network in Poland, nine non-impacted lakes were constantly studied in the years 1999-2014 with high sampling frequency (6-7 times a year). Inter-annual changes of eutrophication parameters (total phosphorus, total nitrogen and chlorophyll a, Secchi disc visibility and biomass of phytoplankton) are analysed. Additionally, year-to-year results of ecological classification based on phytoplankton and macrophytes, which have been regularly monitored since 2007, are compared. The observed range of natural changes of physico-chemical parameters and biological metrics gives significant implications for lake monitoring strategy and the procedure of ecological status assessment.

RS14 - Oral

IS PASSIVE SAMPLING SUITABLE FOR MONITORING THE CONTAMINATION OF SURFACE WATERS? RESULTS FOR FRENCH RIVERS INFLUENCED BY VARIOUS ANTHROPIC PRESSURES

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The Water Framework Directive requires monitoring of the quality of surface waters. Passive sampling has shown high benefits to assess water contamination compared to conventional grab sampling.

The aim of our study was to assess the contamination pattern of 6 French rivers influenced by agriculture, former-mining, urban and industrial activities. We report the results of a one month *in situ* exposition of passive samplers: DGT, POCIS and passive SBSE, designed to target 6 trace metals, 30 pharmaceutical drugs and 26 pesticides.

Contamination patterns were obtained for each watershed including both the number of quantified pollutants and their levels of concentrations. Maximum concentrations of trace metals were measured for the former-mining watershed, with a maximum value of 62.7 µg L^{-1} for Zn. For organic pollutants, 31 substances were quantified at least once. Carbamazepine showed maximum concentrations in 3 rivers; the maximum value reached 425 ng L^{-1} in the most urbanised watershed. For herbicides, chlortoluron concentration reached 178 ng L^{-1} in the most agricultural watershed.

As a result, the combination of these 3 passive sampling techniques allowed us assessing the anthropic chemical pressures onto surface waters and provided reliable information on the concentration of urban tracers mainly measured at ultra-trace levels.

RS14 - Oral

TAXONOMIC SUFFICIENCY IN FRESHWATER ECOSYSTEMS: EFFECTS OF TAXONOMIC RESOLUTION, FUNCTIONAL TRAITS, AND DATA TRANSFORMATION

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Taxonomic sufficiency (TS) has been proposed as a way to balance the need to indicate the biology of the organisms present with time and effort needed for species identification in ecological studies. TS has been applied most often to macroinvertebrates, but tests of its usefulness are lacking for other freshwater groups.å We analyzed the effects of taxonomic resolution, functional groupings, and data transformation on multivariate community patterns in periphyton, macrophytes, macroinvertebrates, and fishes. The applicability of TS differed strongly among taxonomic groups, depending on the average taxonomic breadth of the species sets, but was universally applicable within taxonomic groups for different habitats. Numerical data resolution had more pronounced effects on community patterns than taxonomic resolution. Functional surrogates based on biological traits were strongly correlated with taxonomic community composition, but generally revealed lower environmental correlations than taxonomic surrogates. Aggregation to family or order was suitable for quantifying biodiversity and environmental gradients, but multivariate community analyses required finer resolution in fishes and macrophytes than in periphyton and macroinvertebrates. Sampling effort in environmental-impact studies and monitoring programs would be better invested in multiple taxonomic groups, quantitative data and number of spatial and temporal replicates than in taxonomic detail.

RS14 - Poster

THE SENSITIVITY OF PLANKTON COMPOSITION INDICES TO DIFFERENT TROPHIC CONDITIONS

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Applying the plankton indicators for the water quality assessment has a long tradition. In recent years, due to the implementation of Water Framework Directive many phytoplankton-based methods for ecological classification of lakes were developed in European countries. However, the WFD omits zooplankton, which not only controls phytoplankton population by grazing but also has a potential as valuable water quality indicator. We demonstrate the response of indices, based on phyto-, zooplankton and their combination to different nutrients concentrations in lakes. The study was carried out in selected water bodies of north-eastern Poland in 2012-2013. Integrated samples were collected from the epilimnion at the deepest part of each lake, during the summer stagnation period. Analysis of plankton communities included taxonomic composition and abundance. Following indices were calculated: biomass of Cyclopoida, ratio of the cyclopoid to the Cladocera biomass, percentage share of cyclopoid in the total biomass of Crustacea, phytoplankton trophic index, ratio of zooplankton to phytoplankton biomass and ratio of Cladocera to Cyanobacteria biomass. Water transparency (Secchi disc), total phosphorus, total nitrogen and chlorophyll *a* concentration were used as proxies of eutrophication. The results can serve for development of integrated assessment method based on phyto- and zooplankton.

RS14 - Poster

MASURIAN LAKES BETTER OR WORSE – 40 YEARS ZOOPLANKTON INVESTIGATIONS

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Eutrophication is one of the major problem in European surface waters and is also the most important threat to the majority of Polish lakes. In our study, we demonstrate changes in the taxonomic composition, abundance and biomass of zooplankton taking place during the last 40 years in selected Masurian lakes (north-eastern Poland) of different trophic status. The results obtained in the years 2012-2013 were compared with the historical ones from 1976-1987 collected from the same lakes, using the same methods. Samples were taken from the epilimnion layer from the deepest part of each lake, during the summer stagnation period. The values of zooplankton trophic indices based on qualitative and quantitative composition and the Carlson trophic state indices (TSI's) calculated for the sampling periods 2012-2013 and 1976-1987 were compared. The results of the study can serve as a support for development of a method for ecological status assessment based on zooplankton.

RS14 - Oral

CHIRONOMID COMMUNITY DYNAMICS IN ENOL LAKE (PICOS DE EUROPA NATIONAL PARK, SPAIN)

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Grab samples from Enol Lake (1080 m.a.s.l., Picos de Europa National Park, Spain) were collected to evaluate the chironomid community composition, structure and spatial and temporal variability. We obtained 3 replicate samples at 4, 8, 12, 16 and 20 m water depth four times per year (May, July, September and November) in two consecutive years (2013 and 2014), with a total of 120 samples analyzed. A total of 19 taxa were identified, although the dominant taxa in all samples were *Paratanytarsus*, *Chironomus*, *Tanytarsus* and *Procladius choreus*. *Chironomus*and *Stictochironomus* taxa abundance increased with depth while the more abundant taxa in the littoral were *Paratanytarsus*,*Endochironomus* and *Corynoneura*. Seasonal changes concern many chironomid taxa, although it is more relevant in the case of*Corynoneura*, *Tanytarsus* and *Procladius*. Spatial changes are mostly related to the presence of macrophytes and algae, especially *Chara*, as chironomid composition and abundance are very different in samples from macrophyte-rich and poor areas.

RS14 - Oral

EUTROPHICATION RESEARCH IN LAKE PRESPA (GREECE): EMPIRICAL EVIDENCES AND FORESIGHTS

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Lake Prespa in Greece is a freshwater ecosystem rich in biodiversity and endemic species. The increased external input of nutrients is denoted as the main threat for the water quality and the stability of the lake ecosystem. These concerns have initiated a long-term environmental monitoring program which aims to unravel the (biogeochemical) processes which determine the lake water quality under eutrophication stress. In order to understand the landscape-scale interactions, multiple biogeochemical indicators are monitored in tributary streams, drainage tiles from agricultural lands and discharging groundwater and laboratory experiments are carried out. Recent monitoring results show that the cumulative nutrient input from the watershed leads to the development of harmful algal blooms in the lake during warm periods. Furthermore we see a building up of organic and nutrient-rich sediments and the loss of oxygen from the bottom waters of the lake in summer which may accelerate further nutrient recycling processes. Much is yet to be understood concerning the interactions that can occur between nutrients along the stream-wetland-lake system within the watershed.

Our study illustrates that biogeochemical knowledge about the functioning of the system can be a helpful tool to guide large-scale water management schemes and will contribute to their effective deployment.

RS14 - Poster

IMPACTS OF ENVIRONMENTAL FACTORS ON ZOOPLANKTON SPECIES DIVERSITY: KOCAÇAY LAGOONS (DALYAN AND ARAPÇIFTLIĞI), TURKEY

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Lagoons are valuable ecosystems, providing various services, such as fishing, recreational activities, land reclamation, as well as hosting high biodiversity. Although, in Turkey, lagoons cover a coastal area of more than 36000 ha, few studies have been conducted to examine the effects of environmental factors on zooplankton biodiversity. Therefore, being one of the coastal areas affected by intense anthropogenic pressure, Kocaçay Delta, which is located in the Coast of Marmara Sea, was investigated. In this context, environmental factors controlling zooplankton community structure were assessed in the

two lagoons, Dalyan and Arapçiftliği, situated in the Delta. Between December 2013 and November 2014, water chemistry and zooplankton samples were collected eight times from three stations in each lagoon, by using a tube sampler.

Mean salinity was 7‰ and 21‰

in Dalyan and Arapçiftliği, respectively. The preliminary results showed that, calanoid copepods were dominant in both lagoons. In addition, ongoing high nutrient flow from Karacabey region triggers eutrophication in lagoons, thus causing low water transparency (~ 30cm Secchi Depth). Even though analyses are still ongoing, the first findings suggested that environmental parameters (e.g. salinity) were affecting the species diversity in the lagoons.

RS14 - Oral

REMOTELY SENSED WATER QUALITY INDICATORS FOR THE GEMS/WATER DATABASE

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Deterioration of surface water quality is a socio-economic and environmental threat in many parts of the world. The UNEP Global Environment Monitoring System (GEMS) Water Programme aims to improve water quality monitoring capabilities in participating countries worldwide, and to collect a centralized knowledge basis for water quality assessment at regional to supranational scale. However, the strategic value of such information prevents many countries from sharing it with the international community. Earth observation is identified as a key technology to overcome this roadblock and provide globally consistent, reproducible estimates of optically distinctive parameters such as chlorophyll-*a*, suspended matter and turbidity.

We develop a GEMS/Water pilot service using Sentinel-2 and Landsat-8 data in the scope of the ESA DUE project SPONGE. In collaboration with committed National Focal Points (NFP), we identify service requirements, define test sites and coordinate simultaneous in situ and satellite observations. Existing GEMS/Water monitoring locations are selected that represent a wide variability in environmental conditions. The service implementation and product design is based on existing and proven methods for aquatic remote sensing, which will be adapted for the use with Sentinel-2 and Landsat-8 where necessary. Validation and service performance assessment will finally enable a comprehensive evaluation of GEMS/Water compliance.

RS14 - Oral

THE LEVEL OF CONGRUENCE IN RIVER TYPOLOGY AMONG FISH, MACRO-INVERTEBRATES, DIATOMS, AQUATIC MACROPHYTES AND PHYTOPLANKTON.

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The river typology defined by the Water Framework Directive (WFD) is based on type-specific reference conditions for hydro-morphological, physico- chemical and biological elements. However Biological elements inhabiting aquatic ecosystems differ from each other in terms of their ecological preferences and tolerances as certain type descriptors can be ecologically relevant to some of the biological components and irrelevant to others. The level of congruence in river typology was tested on a country scale. In the analysis all relevant biological elements of the WFD were included as fish, macro—invertebrates, aquatic macrophytes diatoms and phytoplankton. For the typology delineation we used Self – Organizing Maps(SOM) followed by Regression Tree(RTR) analysis. The different biological elements in some cases define common congruent types although the extent of delineation differs from each other's. Based on these results a bottom up biologically validated river typology could be established, which enables the simplification and rationalization of the decision making processes during water basin management plans.

RS14 - Poster

NANOSCOPIC SAXS ANALYSES OF SPIROGYRA SP. AS GREEN FLEMENTOUS ALGAE

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The freshwater filamentous alga *Spirogyra sp.* are taking much interest because of their potential value in biotechnological researches. They can be used to synthesise eco-friendly metal nanoparticles (NPs) such as Au, Ag and PtNPs. They have also potential usage for biofuel production and removal of fluoride from ground and surface waters as algal biosorbent. The other important biotechnological application of these ubiquitous alga is known that methanol extract of *Spirogyra varians* are inhibitors of a *-glucosidase* enzyme and it has potential value in many areas of disease (diabetes, obesity, hyperlipoproteinaemia and hyperlipidaemia) control and treatments.

The chlorophycean alga, *Spirogyra sp.* was collected from Gölbaşı Lake in Ankara,Turkey and left overnight in betadine solution to remove surface contaminants and then repeatedly washed by distilled water and used as experimental material in SAXS (Small Angle X-Ray Scattering) analyses. SAXS is an essential method used to unravel structure details with characteristic dimensions at length scales of up to 100 nm and beyond. Small and wide-angle X-ray scattering (SWAXS) experiments were performed with a Kratky compact Hecus system equipped with a linear collimator and an X-ray tube (l_{CuKa} = 1.54 Å), operated at a power of 2.5 kW (50 kV and 50 mA).

At the end of the study, it was obtained that nanoscopic morphologies related with nanostructured and multi-segmented aggregations in the content of flament, chloroplast, replicate end walls, plasma membrane rosettes and loose spiralling of chloroplasts may be detected and investigated by SAXS analysesand these results may be used to identify and characterize different species. So, the process of conjugation and sextual reproduction in *Spirogyra* clones may be also followed by nanoscopic time resolved SAXS analyses.

In the next phase of our researches, it was planned to detect structural changes during optic responses of these biosamples against to visible and UV light.

RS14 - Oral

FINDING STARTING POINTS FOR THE IMPROVEMENT OF MULTIMETRIC APPROACH OF WATER QUALITY CLASSIFICATION WHEN THE DATA SERIES ARE SHORT

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Implementation of the Water Framework Directive and achieving its objective of good ecological status of all water bodies it is an ongoing process. Its success depends on the robustness of the classification schemes currently used by the monitoring system. Good quality, long-term data series gathered in a certain environmental context are key stones for the development of reliable indicators able to capture the change in the ecological status of aquatic ecosystems.

Our study is based on the quantitative row data provided by the Romanian national monitoring system concerning the structure of benthic invertebrate communities, phytobenthos and the values of an extensive set of physicochemical parameters for lotic water bodies in the Litoral basin, a small water basin with distinctive typology of water bodies and short data-series.

Here we show that the ordination analysis by non-metric Multi-Dimensional-Scaling (nMDS) provides an appropriate tool against which the validity of the ecological status and quality classes of water bodies set up based on biotic multimetric monitoring indexes could be tested. Our results represent a prerequisite to further assist scientific development of an effective, context-based monitoring system and improve the quality of the decision making for water bodies in the basin.

RS14 - Oral

RESPONSES OF AQUATIC BIOTA TO PRESSURES FROM IMPOSED WATER LEVEL ALTERATIONS IN LAKES

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Hydromorphological modifications such as water level fluctuations via water regulation, or shoreline modification are considered to be a major pressure on lakes.

Such alterations impact lake littoral zones, affecting the structure and composition of macrophyte and littoral macroinvertebrate communities and thus lake-wide ecology. Given that the littoral zone holds the majority of a lakes biodiversity, this area is critical as a habitat and food resource for aquatic and riparian organisms.

Stresses imposed by these activities are understood in principle; however, key knowledge gaps remain. This research aims to improve understanding of the empirical relationships between hydromorphological pressures and loch ecology.

I will be introducing recent work on the isoetid, *Littorella uniflora* (Shoreweed). This is a small evergreen, amphibious plant that is common and almost ubiquitous on the shores of Scotland's lakes. There is a need for better understanding of this macrophyte in order to mitigate population decline elsewhere in Europe and to determine response to pressure. In addition the remarkable ability of *Littorella uniflora* for rapid morphological change in response to various stress factors, including water stress, makes it a model species for research into impacts of water level fluctuation.

RS14 - Oral

GENETIC DIVERSITY WITHIN A MULTI-CONNECTED RIVERINE WETLAND

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The effect of hydrological connectivity on the genetic structure of aquatic plants is often simplified in the literature, whereas the few available studiesoutlined complex genetic patterns unrelated simply to an upstream downstream gradient. We studied the genetic structure of the aquatic plant *Berula erecta*, using 12 microsatellites, in a former river channel having three contrasting connections to the rivers: 1 point where the Ain river overflows the wetland during floods (upstream extremity) and 2 other points where Rhône river supply the wetland: one temporary connection in the middle area and one permanent connection at the downstream end. A strong genetic structuration occurred, with two sub-populations separated by a zone where both were intermingled. In this buffer zone, water coming from the upstream end of the wetland meets water coming from its downstream part. Plant drift is not the only determinant of genetic structure of aquatic plants in wetlands. Backflows are crucial for bringing individuals upstream, outlining the complex effect of hydrological connectivity on plant genetic diversity. This high complexity of floodplains lateral connectivitythat guarantees a preservation of the genetic variability of aquatic plant populations is strongly threatened in the context of river anthropization.

RS14 - Oral

PERIPHYTON ON DIFFERENT ARTIFICIAL SUBSTRATA FROM SAVA LAKE AS BIOINDICATOR OF WATER QUALITY – FIRST REPORT

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Sava lake is the reservoir in the Belgrade region being used for recreational activities and connected to the other reservoir used for drinking water supply. The sensitivity of periphyton to environmental conditions including anthropogenic stressors makes it an important bioindicator. In this research we studied growth of periphyton on four different artificial substrata (glass and ceramic tiles, yew and willow tree tiles). Samplers with tiles were attached to floating buoy and submerged at 3 different depths (50, 80, 140 cm) in period from 11th July to 9th September 2014, and collected weekly. Qualitative and quantitative analyzes of the algae, chlorophyll a (Chl a), dry mass (DM), ash-free dry mass (AFDM) and physico-chemical variables were assessed. Finally, we analized Autotrophic Index (AI) and estimated classification of periphyton based to the index proposed by Lakatos. Maximal detected values for Chl a was 12.34 mg/m^2 (on yew tree tiles), for DM 27.83 g/m^2 and 10.04 g/m^2 for AFDM (on glass tiles). The periphyton was dominated by Chlorophyta and Cyanobacteria. Obtained AI values (>400, and higher) points to predominance of heterotrophic organisms in periphitic community, which was mainly confirmed by Lakatos index, indicating increase of organic pollution during summer period.

RS14 - Oral

A NEW ALGORITHM FOR AUTOMATIC DETECTION, SIZING AND CHARACTERIZATION OF TOXIC CYANOBACTERIA IN FRESH WATER USING SPLINE CURVES, PATTERN RECOGNITION AND MACHINE LEARNING

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The detection, quantification and measurement of toxic filamentous cyanobacteria in light microscopy is time consuming and often affected by manual or semi-automated methods. Here we show a new automated method able to overcome these complications, which has required the problem solving of several steps. First, we developed a pre-processing algorithm to highlight filaments of interest from the background that may contain other phytoplankton and dust. Then, we developed a spline-fitting algorithm to recombine interrupted sections and crossing filaments. The same spline curves were used to perform an accurate morphometric analysis of every single filament and to extract specific patterns from cyanobacteria surface. In addition, we identified 18 specific patternindicators that were used to tune a machine-learning algorithm for the recognition of five toxic filamentous cyanobacterial genera in freshwaters *: Anabaena, Aphanizomenon, Cylindrospermopsis, Limnothrix and Planktothrix. ,* and. Overall, the presented algorithm responds to the need of rapidly assessing freshwater quality, producing an output with important information on the cyanobacterial fraction present in natural and artificial freshwater systems. Finally, the validation of this method was performed using freshwater samples from Latium (Central Italy) volcanic lakes, sedimented in Utermöhl chambers and analyzed comparing automated *versus* manual results.

RS14 - Oral

SEASONAL DYNAMICS OF PLANKTOTHRIX RUBESCENS (DE CANDOLLE EX GOMONT) ANAGNOSTIDIS ET KOMÁREK AFTER A SEVERE ALGAL BLOOM IN MULTIPURPOSE WATER RESERVOIR VRUTCI (SERBIA)

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An intensive *Planktothrix rubescens* bloom occurred in the Vrutci multipurpose reservoir in December 2013, disrupting the regular water supply in the Town of Uzice for 43 days. The reservoir was formed in 1984 at 621 m altitude. It has a volume of 50 million m^3 and a maximum depth of 60 m. In the last 20 years, the water quality was monitored only once a year, making the determination of the causes of the algal bloom very difficult. Monthly monitoring of the phytoplankton population and basic physicochemical parameters was conducted during 2014. During winter circulation, TP and Chl a were uniformly distributed, with average concentrations of 40 µg/L and 15 µg/L, respectively. During thermal stratification, phosphorus was accumulated in the metalimnion, reaching a maximum concentration of 180 µg/L at 6 m depth in the near dam profile in August. The abundance estimate range was from 72 cell/mL in September to 251920 cell/mL in June. The biomass estimate range was from 4,5 µg/L in September to 10239,5 µg/L in July. The total share of *P. rubescens* in the phytoplankton population reached its maximum (99,74%) at 6 m depth in January and the minimum value (17,13%) was observed in September.

RS14 - Oral

THE APPEARANCE OF POTENTIAL HARMFUL CYANOBACTERIA IN RESERVOIRS MONITORED AUTOMATICALLY WITH A FLUOROMETRIC DEVICE

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The water of reservoirs in middle Europe used for drinking water production is increasingly threatened by the growth of potential harmful cyanobacteria. Cyanobacteria are known for the ability to produce toxins which pose risks to human beings. Therefore the production of drinking water needs an effective risk assessment and management to determine the appearance and the content of cyanobacteria. The filamentous cyanobacteria Planktothrix rubescens is well-known for its microcystin production and as a buoyant organism not easy to grasp. Water sample analysis is costly due sampling and laboratory work. We present here a real-time measurement of in vivo fluorescence with multispectral pigment excitation for the determination of Planktothrix rubescens. The method discriminates different algae classes in mixtures of natural microalgae. Measurement and data evaluation are carried out in automatic online mode and monitor 24/7 the water intake in a continuous mode.

RS14 - Poster

MONITORING THE WATER QUALITY OF THE RIVER CRANE, A TRIBUTARY OF THE RIVER THAMES

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The study aims to develop an assessment methodology from which mitigation strategies can be implemented to effectively rehabilitate the Crane, reducing the negative effects on public health and benefiting over half a million inhabitants within the catchment. This study focuses upon the analysing the sediment plumes of contamination around outfalls. The Environment Agency (EA) identified incidents of unauthorised discharge or disposal and surface water outfall from misconnections. Source Apportionment GIS (SAGIS) data indicates failures attributed to point source and diffuse pollution, sewage discharge and runoff from urban pollution. Citizen Scientist monitoring focuses on the phosphate levels, 20-40% arising from urban run-off. According to SAGIS data, the average P level was 0.21 mg/L in 2013 revealing a moderate status; however, evidence from the EA denotes a poor status for the Crane from 2012-2014. Heavy metals levels are monitored through sampling by EA at two locations in the lower catchment. All metals examined were above a concentration of 0.01ug/l, with the exception of mercury. The average zinc concentration was 10.9µg/L (using data from June-August 2014). Improving water quality to achieve good ecological and chemical status by 2021 is an ambitious target; nonetheless strategies implemented are positive steps in the right direction.

RS14 - Poster

INTERDISCIPLINARY ASSESSMENT OF THE INFLUENCE OF ANTHROPOGENIC ACTIVITIES OF THE ENVIRONMENTAL QUALITY OF RIVER BASIN OF THE MIDDLE TIETÊ - SÃO PAULO STATE / BRAZIL

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This work conducted over a seasonal year, the diagnosis of water quality at different sites of important stream at middle Tietê basin, São Paulo State-Brazil through the parameters included in the IVA (Index of Water Quality for the Protection of Aquatic Life and Aquatic Communities) and IQA (Index of Water Quality) established by CETESB-Brazil. According to the readings, were notable variations in water quality between the water samples analyzed, which occurred due to their geographical locations and the influence of seasonality on the concentration of pollutants. It was observed very high levels of various contaminants, especially phosphorus and total nitrogen, surfactants, fecal coliform and chlorophyll-a, and some kinds of metals, such as copper and lead.

This work contributes to the environmental diagnostic of important hydrographic basin of Middle Tietê/São Paulo State-Brazil and can support public policies and mitigation measures that aim at guarantee of quality of the water supply for the population of the region.

RS14 - Poster

APPLICATION OF CYANOBACTERIA BIOREPORTERS FOR ENVIRONMENTAL NUTRIENT BIOAVAILABILITY IN LAKE GENEVA

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The development, validation and application of biological sensors plays an important role in monitoring of nutrient availability in aquatic ecosystems. The biological sensors (or bioreporter) are genetically modified cyanobacteria to sense their environment at the level of gene expression. The introduction of a reporter gene allows connecting the interaction of the tested chemical to an easily recordable output signal such as luminescence. Previous studies highlighted that only a small fraction of the chemically determined concentrations of a nutrient may actually be bioavailable to the phytoplankton community in general. Here we use three cyanobacteria bioreporters for the assessment of nitrate (*Synechocystis* sp. strain PCC6803), phosphate and iron (*Synechococus* sp. strain PCC7942) seasonal bioavailability in Lake Geneva. Bioreporters thus provide a biological assessment of nutrients that cannot be achieved by conventional analyses. Together with dissolved nutrient concentrations our results will shed light on the seasonal phytoplankton dynamic in Lake Geneva.

RS15 - Poster

BIODIVERSITY CHANGES IN LAKES FROM A SUBARCTIC MINING REGION IN QUÉBEC, CANADA: INTEGRATION OF PALEOECOLOGY AND MOLECULAR TECHNIQUES

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The Labrador Trough surrounding Schefferville, Québec, Canada has undergone intense industrial change beginning in the mid-1930s. Iron-ore mining and town development has been associated with loadings of heavy metals in lakes surrounding the town of Schefferville, as well as eutrophication in at least one lake located within the town site. However, unlike many other mining regions that also experience aquatic acidification, the Labrador Trough is geologically well buffered, such that decreased pH has not occurred in these lakes. In 2012 and 2013, we collected sediment cores encompassing the last 150 years from five lakes with different degrees of metal contamination in the Schefferville region. We used geochemical analyses and radiometric dating to identify key time periods of metal loading and relate this to knowledge of historical land use change. Cladoceran zooplankton communities were enumerated using subfossils as well as through the isolation of diapause resting stages. We then used DNA barcoding to identify resting eggs to species-level and better understand patterns in dormancy through time and across these lakes. Combining these molecular approaches with mixed-effect modelling provides a comprehensive understanding of the impact of mining contamination in this region on aquatic biodiversity.

RS15 - Oral

PALEOLIMNOLOGICAL EVIDENCE OF GLOBAL SPREAD OF HYPOXIA IN FRESHWATERS CAUSED BY LOCAL ANTHROPOGENIC PRESSURES

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The recent development of seasonal or persistent hypoxia in many lakes and coastal environments severely stresses ecosystems. Hypoxic conditions are recorded in lakes when varve sediments start to be preserved once thresholds in oxygen-depleted conditions are crossed. Here, we compiled the time when varves started to be preserved in lakes over the last 300 years from 365 sites across the world as an indication of the global evolution of hypoxia on continents, and compared these data with anthropogenic and environmental variables compiled for each of these 365 watersheds. Our results show that continental hypoxia started spreading worldwide before AD 1900, mainly because of local growth in population density, human footprint and land uses, leading to eutrophication. No significant correlation was found with changes in precipitation or temperature. No sign of general return to past well-oxygenated conditions are observed despite implementation of local restoration programs and implementation of policies limiting nutrients yields since several decades in Europe and North America.

RS15 - Poster

COMPARISON OF CURRENT AND MEDIEVAL PLANKTONIC RESPONSES TO CLIMATE WARMING IN TWO PERI-ALPINE LAKES (LAKES GENEVA AND BOURGET)

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We tested the hypothesis that local human activities modulate plankton responses to climate warming. We therefore reconstructed long-term (1500 years) changes in the planktonic communities for two peri-alpine lakes to compare lakes ecological responses under low (Medieval Warm Period - MWP) and strong local human pressures (post-eutrophication phase), based on analyses of sedimentary pigments and cladoceran subfossil remains. Role of climate variability as compared to more local perturbations was quantified and identified using statistical modelling. Plankton community structure has been stable over the last ~1500 years, despite large climatic variations in the MWP and Little Ice Age. Depicted communities show that both lakes, despite large and deep, hosted a large, littoral-dominated biodiversity. Unprecedent changes occurred over the last century, because of lake eutrophication, and their amplitude largely exceeded that of those observed over the whole previous millennium. Cladoceran populations had shifted from littoral to pelagic species with a clear dominance of Daphnia longispina. Although both lakes are currently re-oligotrophicated, the pelagic dominance structure has been maintained, and has responded to climate variability with a higher amplitude than the littoral-dominated communities that dominated during the MWP. Results indicate that lakes under stronger local human pressures are more vulnerable to climate warming.

RS15 - Oral

MULTI-DECADAL VARIABILITY IN METHANE CYCLING IN A SMALL FOREST LAKE INFERRED FROM FOSSIL ZOOPLANKTON Δ13C ANALYSIS

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Small humic forest lakes can have high methane concentrations and high contributions of methane-derived carbon to their food webs. However, little is known about the multi-decadal variability of methane cycling in small lakes and how it responds to environmental chan ges. We reconstructed past variations in the importance of methanogenic carbon in the pelagic food web of a small boreal lake in Finland by analysing the stable carbon isotopic composition ($\delta^{13}C$) of chitinous zooplankton remains in the sediments. The $\delta^{13}C$ values of zooplankton remains show several marked shifts (ca. 10 ‰) during past centuries, coinciding with forest and agricultural land-use changes in the catchment. These shifts can only be explained by substantial changes in the proportional contribution of methane-oxidizing bacteria to zooplankton diet. The in-lake mechanisms leading to the observed shifts may include changes in primary productivity changing the availability of phytoplankton, or changes in the wind-induced mixing of the water column changing the methane concentrations and the abundance of methane-oxidizing bacteria available for zooplankton. Our study demonstrates the sensitivity of carbon cycling in small lakes to anthropogenic impacts and the potential of $\delta^{13}C$ analysis for detecting changes in ecosystem functioning that could be overlooked using conventional biomonitoring or palaeoecological studies.

RS15 - Oral

HOLOCENE CARBON DYNAMICS IN LAKE BAIKAL: A PALAEOLIMNOLOGICAL APPROACH

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Inland waters act as an important control on the global carbon cycle. Deep tectonic lakes may provide a key link between short-term and long-term carbon cycles as buried carbon is essentially locked away from the atmosphere over geological timescales. Here we investigate Holocene carbon dynamics in one of the world's most important lake ecosystems, Lake Baikal, Siberia. A multi-decadal organic geochemistry record (%TOC; $\delta^{13}C$, C/N ratios) was determined on Holocene sediments. Radiocarbon age-depth modelling, undertaken using 'Bacon', allowed carbon mass accumulation rates (CMAR; g cm^{-2} yr^{-1}) to be calculated at a centennial scale resolution. CMAR were highest during the early Holocene (11.7 – 8 kyr BP) before pollen-inferred taiga forest stabilised catchment soils. CMAR fluctuated considerably at this time; peak values of 12.5 g cm^{-2} yr^{-1} were observed at 10.4 kyr BP before a rapid decline to c. 4.8 g cm^{-2} yr^{-1} at 10.1 kyr BP. An abrupt decline in CMAR between 4.4-4.0 kyr BP was coeval with rapid hydrological changes in elsewhere in the world, linked to major shifts in large-scale ocean-atmosphere dynamics and widespread aridity. Palaeoecological evidence highlights that carbon dynamics in Lake Baikal are in part regulated by slow and fast disturbances occurring at regional to global scales.

RS15 - Oral

RESPONSE OF LACUSTRINE PROTISTAN ASSEMBLAGES TO CLIMATIC AND ANTHROPOGENIC PRESSURES, A PALEOLIMNOLOGICAL VIEW BASED ON SEDIMENTARY DNA

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Based on the coupling of paleolimnology and high-throughput sequencing of DNA, we analyzed the sediment records of two lakes (Lake Bourget, France and Lake Igaliku, Greenland) to reconstruct the past dynamics of protistan assemblages in these lakes. From these long-term data (i.e., 2700 years), we aimed at deciphering the relative importance of climate fluctuations and local anthropogenic pressure (eutrophication) as drivers for protistan communities, which represent a key biological compartment in lacustrine systems. The results showed that all protistan groups were retrieved from sedimentary archives, allowing to detect a high diversity (total richness: 1308 phylogenetic units) among fungi, alveolata, stramenopiles, viridiplantae, and rhizaria. We investigated the presence of temporal tipping points in the protistan community structure by using multivariate tree regression and bayesian change points analyses. The detected change points were related to transitions between climatic periods for both lakes (medieval warming and little ice age), however, in Lake Bourget, the most significant rearrangement in protistan communities was induced by the strong eutrophication (from the 1950s). Changes in protistan assemblages were mainly drived by pigmented taxa in both lakes.

RS15 - Poster

RELATIONSHIPS BETWEEN STABLE C AND O ISOTOPE VALUES OF CHAROPHYTE CARBONATES AND LAKE WATERS. A CASE-STUDY OF TWO MORPHOLOGICALLY DIFFERENT CHARA SPECIES

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Photosynthetic activity of charophytes (*Characeae* family) leads to precipitation of autochthonous $CaCO_3$ deposited in lacustrine sediments. These macroalgae can be preserved in lacustrine calcareous sediments as remains of thalli encrustations and gyrogonites serving as a potential archive of palaeonvironmental conditions. The study subjects were two charophytes of contrastive morphology, *Chara tomentosa* L. (a large species) and *Chara globularis* Thuill. (a small species), studied in five lakes of western Poland (July 2012). At three study sites in each lake, the whole thalli of 10 individuals and ambient water were sampled for isotope analyses. Our study revealed that trends in shifts in stable isotope signatures betweencarbonates and waters were for $\delta^{18}O$ values similar in both species, while for $\delta^{13}C$ values were opposite.*Chara tementosa*, precipitated carbonates isotopically heavier than $\delta^{13}C$ of water DIC. By contrast, the small species, *Chara globularis*, turned out to be significantly ^{13}C-depleted as compared to water DIC. These species-related isotope signatures were repetitive at each site and in each lake, what seems to be significant in the context of the use of the results in palaeoecological analyses.

RS15 - Oral

NITROGEN ISOTOPE ENRICHMENT IN LAKE SEDIMENTS OF PHOSPHORUS-LIMITED LAKES

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Lake ecosystems are significantly affected by increased anthropogenic nutrient supply. Nowadays, especially nitrogen supply is concerning, since besides rivers and groundwater, also atmospheric deposition contributes substantially to total nitrogen load. Since the total available nutrient pool drives the growth and biomass of planktic organisms, changes in past nutrient load of lakes should also be reflected in sediment cores. Primary production in temperate lakes is mainly phosphorus limited and additional nitrogen does not necessarily lead to biomass increase. However, additional nitrogen may be tracked in the isotopic composition of organic matter due to isotopically distinguishable nitrogen sources. In order to investigate the magnitude of N input in Bavarian lakes and shifts of potential nitrogen sources, we took sediment cores in two lakes of different trophic state. Both lakes showed a similar increase of 30% in total nitrogen concentrations as well as in $d^{15}N$ signals during the last decades. Trends towards heavier nitrogen isotope values could point to an increase of isotopically enriched nitrogen from agricultural sources. Organic carbon concentrations indicate that the meso-eutrophic lake may have increased productivity with increasing nitrogen concentrations, while the oligotrophic lake did not show signs of significantly enhanced productivity possibly due to higher phosphorus limitation.

RS15 - Poster

LOCAL HUMAN PRESSURES INFUENCE GENE FLOW IN A HYBRIDIZING DAPHNIA SPECIES COMPLEX

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Anthropogenic environmental changes are considered as critical drivers of the genetic structure of populations and communities through the facilitation of hybridization between syntopic species. However, the mechanisms by which environmental perturbations trigger changes in the genetic structure of populations and communities, such as the evolutionary consequences of the hybridization processes (i.e., directionality of hybridization and pattern ofmitochondrial introgression) over the long-term, remain largely unexplored. Herein, the modification of the genetic structure of hybridizing members of the *Daphnia longispina* species complex were reconstructed over the last 100 years for three large temperate lakes under strong anthropogenic pressures, relying on paleogenetic analyses of resting egg banks. Drastic changes in the genetic structure of the *Daphnia* community, associated with hybridization events between *D. longispina* and *D. galeata*, were detected in Lake Geneva and Bourget. In Lake Bourget, these changes were related to successful establishment of *D. galeata* at increased phosphorus levels and higher sensitivity of *D. longispina* to fish predation pressure. In Lake Geneva, the pathway of hybridization under eutrophication was rather a function of the original taxonomic composition of the population. Lakes seem to require at least a meso-oligotrophic status to allow a *D. galeata* population to establish, since no *D. galeata* genotypes were found in the egg bank of oligotrophic Lake Annecy. In contrast to the general pattern of unidirectional hybridization in this species complex, bidirectional hybridization was recorded in Lakes Geneva and Bourget. In addition, bidirectional mitochondrial introgression is reported. Finally, our results demonstrate complex genetic trajectories within this species complex and highlight the irreversibility of the changes in the genotypic architecture of populations driven by local human pressures, with extensive hybridization not necessarily leading to a large and homogenous hybrid swarm.

RS15 - Poster

DOES DAPHNIA ADAPT TO OLIGOTHROPHICATION? EXPERIMENTAL EVIDENCE USING THE RESURRECTION APPROACH

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Many lakes worldwide became eutrophied during the last century, mainly via anthropogenic nutrient release. This changing environment resulted in dramatic changes to the algal community, promoting “blooms” of cyanobacteria, which are poor food for zooplankton. It is not clear whether this is due to mechanical disruption, nutritional deficits, or toxicity. Lake Greifensee (Switzerland) began eutrophication in 1917 and reached the highest peak in 1974, after which, a constant decrease followed, until the present time. The peak eutrophic period was accompanied by an increase in the toxic cyanobacterium Microcystis. We use a “resurrection ecology” approach to investigate the evolutionary response of Daphnia to this alga. In a fully factorial life-history experiment we evaluate the response of hatched Daphnia to the presence of wild-type toxic Microcystis and a non-toxic knock-out. These “resurrected” clones represent genotypes present in the lake during periods of high and low eutrophication. We therefore test for adaptation to the presence of Microcystis per se, as well as disentangling the effects of its toxin from other cyanobacterial problems. We hypothesize that clones hatched from more eutrophic times cope better with Microcystis and its toxin. We hope to show that rapid evolution enables Daphnia to react quickly to changing environments.

RS15 - Oral

ENVIRONMENTAL EVOLUTION OF LAKE MORAT (SWITZERLAND) INFERRED FROM PHOTOSYNTHETIC PIGMENT STRATIGRAPHY OF THE SEDIMENTARY RECORD

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Over the last 100 years various stresses have led to rapid ecosystem disturbances in most European lakes. However, the timescale and specific conditions of these effects for individual lakes are rarely known. Sediment archives are valuable tools for tracking baseline evidence of change and its evolution. Lake Morat (surface area of 22.8 km^2) has undergone strong eutrophication which persists even after a significant decrease in nutrient inputs since 1986. The present research consisted of a multy-proxy analysis based on photosynthetic pigment concentrations (chlorophyll a, b, carotenoids) in thesedimentary record determined by HPLC, to define the onset of eutrophication and its evolution. The sediment core was dated by ^{137}Cs and ^{210}Pb. Pigment analysis revealed four different trophic periods, with a shift towards eutrophy starting in the 1930s and pigment concentrations higher than before. The period until 1986 suggests the most intense phase of eutrophication with high abundance in cyanobacteria. Following, there is a shift in lower trophic level with a change in algal composition, before a new trend to increased productivity occurring since 2001. These results clearly indicate systems responses to change of conditions. Fluctuations of specific pigment markers are discussed to better understand the impacts and improve lake management.

RS15 - Poster

PALEOECOLOGY AND PALEOLIMNOLOGY OF THE LAST MILLENNIA IN THE SOUTHERN PYRENEAN FLANK: PRELIMINARY RESULTS

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High-mountain lake sediments are among the better-suited archives to record recent environmental changes at a resolution suitable for comparing past and present trends, as well as to help improving future predictions. Here we present the preliminary results of a high-resolution, multiproxy study of sediments from several high-mountain lakes and ponds from the southern Pyrenees (Lòssa, Bassa Nera and Sant Maurici), aimed at unraveling the main paleoecological and paleolimnological trends of the last millennia and their potential climatic and anthropic drivers. Paleoclimatic events are deduced from physico-chemical proxies (limnogeology, geochemistry), paleolimnological trends are inferred from diatoms, and landscape transformations are reconstructed from pollen and spores. These results are compared with previous studies on pre-Pyrenean lakes (Montcortès, Estanya) to obtain a more regional picture.

Paleoecological records are further correlated with the tree ring-records available for the southern Pyrenees and the historical instrumental records of the more relevant climatic parameters for calibration purposes. The expected output is a thorough reconstruction of the limnological and ecological history of the lakes and their catchments, useful to disentangle natural from anthropogenic drivers of change, and to provide a baseline paleorecord suitable to improve lake/landscape conservation management strategies at local and regional scales.

RS15 - Oral

REVISITING MEROMICTIC MONTCORTÈS LAKE: HAS THE MIXING REGIME CHANGED?

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Montcortès lake is located in the Southern Central Pyrenees (Spain). It has varved sediments, which are valuable high resolution paleontological archives. Based on them we want to assess climatic variability of the last 500 years using different paleoclimatic proxies.

After the first limnological cycle studied in 1976 this lake was classified as typical meromictic and posterior sedimentological studies seemed to support this finding. Nonetheless, in 1978 a mixing event was observed during winter months.

This study investigates eventual occurrence of changes in the stratification regime of the water column, i.e. meromixis – monomixis transitions and their reflection in the sediment record, during the last century. The question is whether such shifts were climatic or anthropic driven and if this information would offer some insights to predict possible shifts of the lake’s limnological cycle under current climate change. In this study we compare available limnological and sedimentological results with current stratification behaviour of the lake (2013-2015). Seasonal cycle assessment includes vertical profiles (radiation, pH, temperature, oxygen) and water sampling (alkalinity, major ions and nutrient concentrations), phytoplankton and photosynthetic pigments. The lake remained stratified with an anoxic hypolimnion and then mixed completely up for two months.

RS16 - Oral

CRYPTIC GENETIC DIVERSITY AND EVIDENCE FOR TEMPORAL DIFFERENTIATION IN THE ALPINE FRESHWATER INSECT BAETIS ALPINUS (EPHEMEROPTERA, BAETIDAE)

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Alpine stream ecosystems are highly dynamic and show pronounced ecological variation at small temporal and spatial scales. At the same time, they are at high risk due to the ongoing climate change. To gain insight into the processes influencing intra-specific diversity of alpine taxa, we investigated the population genetic structure of the alpine mayfly *Baetis alpinus* among streams with contrasting glacial and groundwater hydrology in two Swiss headwater basins and over 2 consecutive years. Using both the mitochondrial cytochrome C oxidase I gene and 10 microsatellite loci, we found three highly differentiated lineages within the single morphospecies. These lineages occur sympatrically over large spatial scales with no obvious geographic pattern, but their relative frequency varied strongly at small geographical scales. Intriguingly, we also found strong seasonal frequency shifts in the distribution of the three lineages, suggesting that the lineages differ in their life-cycles. This cryptic genetic variation within this broadly distributed morphospecies highlights the need to understand the causes and consequences of cryptic species diversity in alpine stream taxa.

RS16 - Oral

GENETIC VARIABILITY OF A NON-MODEL FRESHWATER POPULATION ALONG HOLTEMME RIVER: INSIGHTS FROM A FIELD STUDY

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Human land use including cities, agriculture industry and others may impact on aquatic ecosystems by multiple stress including eutrophication, morphological changes and the emission of micropollutants. Many of these stressors were shown to exert strong effects on ecological communities as a consequence of both synergistic and antagonistic effects on organisms. Further, they can also interact and induce unexpected consequences thereby changing natural dynamics. Field studies addressing ecological effects of multiple stressors, however, are scarce. Here we used the amphipod *Gammarus pulex* to test the hypothesis that changes in the intraspecific structure of natural populations correlate with land-use driven factors such as concentrations of micropollutants. The hypothesis was tested by collecting monthly samples of *G. pulex* from four sites stressors along the Holtemme River, Germany. In total 24 specimens per site and date were analysed using 5 microsatellite loci. Even if we found similar dynamics in the genetic variability of amphipod populations inhabiting along the river, we observed a decreasing genetic variability towards downstream in our transect. Our results emphasize the need for high temporal resolution when addressing stressor effects on the intraspecific structure of ecological populations.

RS16 - Poster

MOLECULAR-GENETIC AND MORPHOLOGICAL STUDY OF CANTHOCAMPTUS STAPHYLINUS JURINE (HARPACTICOIDA, COPEPODA) IN EUROPEAN WATERS

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Harpacticoid *Canthocamptus staphylinus* (Jurine, 1820) (Harpacticoida, Copepoda, Crustacea) is ecologically plastic species widely distributed in the Palearctic freshwaters. It attracts attention as an object equivalent to group of cryptic species. Besides, *C. staphylinus* is interesting as one of three harpacticod species with unisexual reproduction (Sarvala, 1979). The purpose of our work is - to reveal morphological and molecular genetics distinctions among populations of *C. staphylinus*.

Genetics and morphometric variability of this species have been considered common. For morphometric researches, we used males and females from eight European populations: Finland, Estonia, Switzerland and five populations from Russia. Thirty two morphometric measurements and morphological characteristics were studied. And six of them significantly divided ($p<0,05$) studied populations.

For intraspecific variability study sequencing of CO1 gene was performed. We performed comparative microsatellite analysis using 11 different sites of DNA to study types of *C. staphylinus* replication.

Significant morphological variability in C. staphylinus was established. And molecular genetic analyzes will possibly help to clarify intraspecific structure of *C. staphylinus* from European waters.

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RS16 - Poster

EVALUATION OF MOLECULAR APPROACHES IN THE TAXONOMY OF ALPINE DIAMESA (DIPTERA, CHIRONOMIDAE)

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The genus *Diamesa* Meigen, 1835 is critical in biomonitoring fauna living in cold waters, some species being the sole inhabitants of the upper reach of glacial streams, so their scientific interest is enhanced by global warming. Identification requires high level of experience, feasible for adult males and pupae, more problematic for larvae, making a molecular-based approach desirable. During 2013-2014 specimens were collected and DNA extracted, afragment of 658 bp from *cox1* gene was amplified through PCR. The dataset was analysed adopting different approaches in order to test: *a*) the validity of a DNA barcoding in species identification, *b*) the possible existence of cryptic species, *c*) the agreement of the obtained results with morphological features and morphometric measures. The preliminary results emphasize that species belonging to different species groups as the *D. dampfi, latitarsis, steinboecki* and *tonsa* groups can be correctly identified, the molecular-based results beingin agreement with identification based on morphological characters, while the separation of species belonging to other groups (*D. aberrata, bertrami, insignipes, zernyi)* are still problematic, due of the scanty material available at present. To sum up the achieved results are very promising, but analyses of more species are needed.

RS16 - Poster

IDENTIFICATION OF INTERACTIONS BETWEEN MICROORGANISMS AND THE DYNAMICS OF TOXIC CYANOBACTERIAL BLOOMS

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The Sulejów Reservoir, a large lowland reservoir in Central Poland, suffers regularly from the presence of toxic cyanobacterial blooms dominated by *Microcystis* genus. The use of quantitative data obtained using molecular methods from the long-time monitoring of *Microcystis* genotypes enabled understanding of how abiotic factors contribute to the formation of blooms and what is the role of toxic genotypes in this process. However, apart from the influence of abiotic factors, it is essential to gain the knowledge about the impact of biotic elements on cyanobacteria and their toxins. For this the use of sensitive molecular methods allowing quantitative tracing of the interaction between cyanobacteria and other organisms directly in water samples, particularly with regard to microorganisms such as bacteria and viruses, is indispensable. In 2013 the dynamics of *Microcystis* and their cyanophages from *Myoviridae* family were identified in Tresta Station. Their detection was possible only after the appearance of cyanobacteria in SU. Furthermore, bacteria homologic to *Sphingopyxis* (potential microcystins degraders) and *Aeromonas* genera (verified microcystins degraders in SU) were also quantified directly in water samples, and their identification was possible only after the appearance of microcystins in water.

Study supported by the National Science Centre (project no. UMO-2012/07/N/NZ8/00599 and UMO-2013/11/N/NZ8/00607).

RS16 - Poster

TRACING IMPACTS OF WASTEWATER-ASSOCIATED CONTAMINANTS ON THE GENETIC STRUCTURE AND DIVERSITY OF THE CADDISFLY SERICOSTOMA PERSONATUM

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Chemical water quality of central European freshwater systems has substantially improved over the last decades. However, wastewater-associated contaminants may still impact on sensitive freshwater organisms such as stone-, may- or caddisflies. These contaminants enter freshwater systems mainly via wastewater treatment plants (WWTP). While their influence on the species diversity has been studied over the last years, almost nothing is known on their effects on genetic diversity within sensitive species. This knowledge, however, is essential as genetic diversity provides the basis for adaptation to changing environments and thus largely determines population and species survival.

We performed a case study analysing the local effects of WWTPs on the genetic diversity within the caddisfly *Sericostoma personatum*. The study took place in the Ruhr catchment (north-western Germany). Specimens were collected up- and downstream of two WWTPs in a standardised fashion. A next-generation sequencing method called ddRAD (Double Digest Restriction Associated DNA Sequencing) was applied to generate thousands of genetic markers distributed throughout the genome. With ddRAD we screened for genomic regions showing signals of selection and tested whether WWTP had an impact on the population structure of *S. personatum*.

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RS16 - Poster

DIVERSITY, SPATIAL AND TEMPORAL DISTRIBUTION OF GENES INVOLVED IN CYANOTOXINS SYNTHESIS FROM DANUBE DELTA SHALLOW LAKES

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The mass development of potentially toxic cyanobacteria species all over the world appeared as an effect of long-term affected ecosystems. Due to intensification of cultural eutrophication in recent years, higher values of cyanobacteria biomass was registered in Danube Delta also, especially in Rosu-Puiu lakes complex. This study comprise the first molecular investigations of cyanotoxins biosynthesis genes, their types, spatial and temporal distribution in lakes during tree season every year, between 2012 and 2014. Cyanobacterial biomass (express as chl *a*) were low in May (0.30 μgL^{-1} in lake Trei Iezere, for example), increased in July (10.77μgL^{-1}, Rosulet) and reached a peak in September (16.43 µgL

- 1 in Rosu), before decreasing in late October. These considerable variations were signaled depending on season, year and lake. Primers used for PCR were selected from specific literature and preliminary tests reveals the presence of genes responsible for neurotoxins and hepatotoxins synthesis like saxitoxin (saxA) and microcistins (mcyE and mcyB) in some of the studied lakes and, until now, tests for genes responsible for anatoxins synthesis (anaC) were negative. Further survey will be focused on isolation and sequencing of these specific genes and to find the main factors that could govern the cyanotoxins synthesis.

RS16 - Oral

MULTISPECIES POPULATION GENETICS OF ALPINE LAKES AND PONDS - IMPORTANCE OF LOCAL SCALE MOLECULAR DATA

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Glacial lakes and ponds in the mountain ranges are very interesting and valuable, yet still understudied habitats. Although colonized only recently, they are inhabited by unique insect assemblages, which, together with their patchy distribution across mountain ranges and isolation by mountain ridges predestine them to be a very challenging model for population genetic studies. Previous research focused mostly on differences or relations among populations of distanced areas or mountain systems, however, the genetic structure of local populations within them remains unknown. Moreover, these studies investigated almost exclusively lotic habitats. In this study, we thoroughly sampled around 100 lakes and ponds in the Tatra Mountains (Slovakia/Poland), selected four model insect species, and analysed two mitochondrial markers. We aimed to describe genetic variability within mountain range in detail and compare genetic patterns of different aquatic species inhabiting the same alpine lake system in a small scale. We detected high genetic diversity, described similarities and differences among species studied and among lake subpopulations, but also discovered cryptic diversity. This study clearly proved usefulness and groundwork of molecular studies at a local scale and brought new information on the diversity of alpine aquatic biotopes.

This study was supported by the project VEGA2/0081/13.

RS16 - Poster

GENETIC STRUCTURE OF DIVING BEETLE A. GUTTATUS IN (SUB)ALPINE LAKES AND PONDS – THE ABILITY TO SPREAD AND IMPACT OF BARRIERS

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Geographically, the Tatra Mountains occupy small area, but include complicated system of valleys and numerous glacial lakes and ponds. These specific and valuable aquatic ecosystems with unique invertebrate assemblages represent very sensitive aquatic habitats. Although there are already many ecological and faunistic data on alpine lakes available, we still do not know much about genetic structure, communication or isolation of animal populations inhabiting these remote aquatic habitats. During years 2009 – 2014, we collected benthic samples from more than 100 lakes and ponds in the Tatra Mountains (Slovak-Polish border). For this study we chose a diving beetle *Agabus guttatus*, which is a typical representative of the Tatra's aquatic invertebrates. Total of 157 individuals were found at 29 localities situated in 14 mountain valleys and few sites from adjacent foothill. To describe genetic structure and demographic history, two mtDNA fragments (795 bp COI, 351 bp Cyt B) were used. The analysis of combined dataset recovered 21 haplotypes and phylogenetic analysis revealed three major clades. The AMOVA suggested statistically significant differences among and within valleys. The results also suggested ways of distribution and impact of geographic barriers on the populations of studied species. This study was supported by the project VEGA 2/0081/13.

RS17 - Oral

DEVELOPING AN IMPROVED SEDIMENT-SPECIFIC BIOMONITORING TOOL: COMBINING EXPERT KNOWLEDGE AND EMPIRICAL DATA

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The Proportion of Sediment-sensitive Invertebrates (PSI) index is a biomonitoring tool designed to identify the degree of sedimentation in rivers and streams. The index has a sound biological basis, using invertebrate sensitivity ratings that were determined following an assessment of faunal traits associated with a sensitivity or tolerance of fine sediment. Despite a moderate correlation with deposited fine sediment, comparable to other pressure-specific indices used for Water Framework Directive classification, the large variability in the relationship limits confidence in its application. In this study, sediment and invertebrate data, collected from a range of reference condition river and stream ecosystems (n=2252), is used to empirically-assign species sensitivity weights in an attempt to improve the performance of the PSI index. To maintain the index's biological basis, sensitivity weights were restricted to a range, based on their original sensitivity ratings. The optimum set of sensitivity weights were identified using non-linear optimisation, as those that resulted in the highest Spearman's rank correlation between Empirically-weighted PSI (E-PSI) scores and deposited fine sediment. Applying these optimum sensitivity weights to an independent test dataset (n=252) showed E-PSI to have a strongcorrelation with deposited fine sediment (r_s=-0.74, p<0.01), compared to a moderate correlation for PSI (r_s=-0.66,

p<0.01).

RS17 - Oral

HOW STRESSOR SPECIFIC ARE TRAIT-BASED ECOLOGICAL INDICES FOR RIVER MANAGEMENT?

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Using macroinvertebrates as ecological indicators for different stressors has a long tradition. However, when applied to field data, one often observes correlations between different macroinvertebrate indices that can be attributed to a) correlations of stressors and b) inherent correlations due to the sensitivity of taxa to different stressors. Ignoring the source of any given correlation leads to ambiguous conclusions about the impact of different stressors. Here, we demonstrate how to distinguish the causes of correlation by means of Monte Carlo simulations.

We exemplified this approach by analysing two existing indices (SPEARpesticides, Saprobic Index) and new indices for temperature, flow and pH stress. We found strong correlations between several indices in our study area at the Swiss Plateau. The probability that this correlation is only due to inherent correlation in the taxa sensitivities was low. The problem of inherent correlation between indices is more severe for the smaller taxon pool with lower taxonomic resolution. Correlation in the sensitivity of different taxa to different stressors leads to an inherent correlation in trait-based indices, which weakens their explanatory power. Our results highlight the importance of correlation analyses when using trait-based indices to guide river management, especially in regions with reduced biodiversity.

RS17 - Oral

FISH IN LAKE ECOLOGICAL ASSESSMENT IN EUROPE: QUO VADIS ?

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It is well established that fish are sensitive indicators of environmental degradation and offer the major advantage of integrating the direct and indirect effects of stress over large scales of space and time. Nevertheless, the use of fish communities as indicators of environmental quality is highly challenging, therefore fish community has been one of the most neglected aspect of lake ecological monitoring. This paper gives an overview on fish-based assessment methods in Europe. By now, 15 Member States have finalised fish-based lake assessment systems, five of these assessment systems have been recently intercalibrated in the Alpine and Northern region, while Intercalibration is still ongoing in the Central-Baltic region. In contrary, several countries of the Mediterranean region have currently renounced the use of fish in lake assessment (mainly due to a low species richness, dominance of invasive taxa, and high costs of sampling), this opinion being strongly debated within region. This paper seeks to answer questions:

- How lake fish ecological assessment systems are built and used across Europe?
- Which pressures are assessed and are the pressure-response relationships tested ?
- What are the main lessons and challenges of the lake fish methods` development and harmonization process?

RS17 - Oral

EFFECTS OF WITHIN SITE VARIABILITY OF DETECTION PROBABILITY AND ABUNDANCE OF MACRO INVERTEBRATES ON MULTIMETRIC INDEXES PERFORMANCE

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The sensitivity of a multimetric index to imperfect detection and aggregation of macroinvertebrates was assessed. For this purpose, we applied the index adopted in Italy for the evaluation of the quality status of water courses (STAR_ICMi) based on metrics used throughout Europe for biomonitoring purposes. Macroinvertebrate community was sampled in a near natural river (Trebbia River, Northern Italy) where organisms were collected with a surber net from June to late August 2013. Starting from the sampling results, artificial communities were generated for each sampling date, simulating communities on the basis of detection probabilities of each taxon and two levels of aggregation. The precision of STAR_ICMi index, calculated as percentile confidence interval, was higher for low aggregation level (mean value of 0.111) than for high aggregation level (mean value of 0.300). Abundance based metrics presented the highest coefficient of variation (CV) with high aggregation level (min 13.3% and max 34.7%), while considering low aggregation level, the CV ranged from 1.1 to 8.7 %. The CV of metrics based on presence/absence data varied from 1.9 to 9.3%. The present exercise not only responds to specific impositions by the European legislation but represents a critical step to improve and refine the biomonitoring tools.

RS17 - Poster

ASSESSING THE VALUE OF WATERBIRDS AS SURROGATES OF MACROINVERTEBRATE BIODIVERSITY IN MEDITERRANEAN WETLANDS

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Measuring and monitoring wetland biodiversity is vital for conservation and often relies on the use of surrogate taxa. Waterbirds are commonly used as flagships of biodiversity and are the subject of major conservation initiatives. Therefore, it is important to assess the extent to which waterbirds indicate the general biodiversity of wetlands. We explore the relationships between community composition and species richness of waterbirds and aquatic macroinvertebrates in 36 Ramsar wetlands in Spain to assess if waterbirds are good surrogates for other taxonomic groups. We found a limited concordance between assemblage patterns of both groups that may be related to their contrasting responses to environmental gradients. Furthermore, a negligible or inverse relationship in their patterns of richness was found, with wetlands with higher waterbird species richness showing significantly lower richness of Hemiptera and macroinvertebrate families, and no significance relationship with Coleoptera. Given the importance of the Ramsar convention for the conservation of an international network of wetlands, our findings underline the limited potential of waterbirds as aquatic biodiversity indicators in Mediterranean wetlands, and the need for caution when using waterbirds as flagships. An integrative analysis of different biological communities is a necessary precursor for successful conservation policies and monitoring.

RS17 - Poster

UNCERTAINTY ASSOCIATED TO THE NEW FRENCH MACROINVERTEBRATE-BASED MULTIMETRIC INDEX (I2M2): TOWARDS A PROBABILISTIC ECOLOGICAL INDICATOR

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To meet the Water Framework Directive requirements, a new multimetric index (I2M2) has been designed for the invertebrate-based ecological assessment of French wadeable streams. Integrating five taxonomy- and trait-based metrics selected for their high discrimination efficiency, low specificity, high stability in least impaired conditions and low redundancy, this index is meant to identify impaired reaches for 17 anthropogenic pressure categories potentially impairing water quality or habitat. Based on I2M2, any river reach is so far assigned a unique ecological quality class among 'Bad', 'Poor', 'Moderate', 'Good' and 'High'. Here we aim to assess the uncertainty that should be associated to the index, due to both the construction of the I2M2 and the successive normalized field and lab steps preceding its calculation (e.g. substrate mosaic description, field sampling, taxonomic identification, organism counting). With uncertainty assessment, any river reach may be assigned a probability distribution among the quality classes. Such a probabilistic indicator will better inform on the robustness of ecological assessment and will be much more helpful in identifying river management and restoration priorities.

RS17 - Oral

ECOLOGICAL INDEX BASED ON FRESHWATER PERIPHYTIC ALGAE FOR THE RÍO SAN JUAN: AN INTEGRAL TOOL FOR THE ANALYSIS OF WATER RESOURCES IN COLOMBIA.

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The ecological indices of rivers in Colombia are regularly based on algae and macroinvertebrates tolerance to pollution, which has inconsistencies. Here we present the application of a method to establish an index of ecological quality in freshwater. The method determines an environmental gradient from correlations between physicochemical variables and abundance of taxa through a direct relationship analysis. The scores attained in each sampling point are used in a standardized correlation for a model of weighted averages. This model and abundances are used to estimate the optimum and tolerance of each taxon; with this material we estimated the index of ecological quality based on periphytic algae. Subsequently, we classified all sites in the river using the index and concentrations of total nitrogen (TN) in a cluster analysis and defined categories of ecological status: good, fair and critical. The method can be used in other biological groups and geographical areas. Currently the index is part of a pilot governmental test for different rivers in Colombia, in our case the Río San Juan provides supply and agricultural applications and requires an appropriate strategy for the evaluation; we think that the index is useful for this task.

RS17 - Oral

USING BENTHIC DIATOM LIFE-HISTORY TRAITS TO ASSESS STREAM IMPAIRMENT RISK

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Benthic diatoms are widely used over the world to assess the quality of freshwater ecosystems. Their taxonomic diversity, life-history trait variety and ability to respond fastly to water quality degradation make them efficient ecological indicators. Even if diatom-based biotic indices are valuable tools in detecting the degradation/restoration of aquatic ecosystems, they do not clearly help to identify the nature of pressure(s) impairing *in situ* communities. In this context, we aimed at developing a diatom trait based tool that helps to estimate the probability that a specific pressure significantly impairs local communities. Autecological information on various traits (biovolumes, life forms…) was gathered from literature and expert advices for species caught in > 1500 sampling sites of the French RCS national river survey. Most of this information was fuzzy-coded to take into account within-species variation in life-history characteristics. The responses of metrics were assessed for several pressure categories related to water chemistry (e.g. herbicides, acidification) and habitat degradation, in an ecoregional framework. For each pressure category a Condition Tree Forest model was built using the risk level as the response variable and the trait-based metrics as the predictive variables. This work contributes to the development of a multi biological-quality-element based diagnostic tool.

RS17 - Poster

LEVEL OF HUMAN TRANSFORMATION AMONG MOST IMPORTANT FACTORS DETERMINING THE BIOMETRIC PARAMETERS OF MACROPHYTES IN SMALL FOREST VS. FIELD WATER BODIES

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75 ponds, varying in terms of catchment type (51 field and 24 forest ponds), the degree of degradation, physical-chemical features, morphometric parameters and the level of overshading were examined in order to demonstrate the impact of habitat conditions on plant biometric parameters (length, volume andbiomass). The samples were collected in plant beds representing different ecological types of hydromacrophytes – helophytes: *Phragmites australis* community, elodeids: *Ceratophyllum demersum*, nymphaeids: *Potamogeton natans*.

Most environmental parameters (e.g. trophic conditions, nutrient and chlorophyll concentrations) were higher among field ponds. Moreover, biometricfeatures of plant habitats also revealed a tendency to achieve higher values in the case of field ponds, where *Potamogeton natans* and *Phragmites australis* reached significantly higher values of plant volume in a water unit and *Ceratophyllum demersum* had a higher biomass of plant stems. An impact of human-induced alterations on small water bodies was confirmed by principle component analysis PCA, where a positive relationship between all three biometric measures of *Phragmites australis, Ceratophyllum demersum* and *Potamogeton natans* was obtained for field ponds of high trophic conditions.

RS17 - Poster

LARGE TAXONOMIC GROUPS OF PHYTOPLANKTON SHOW CONSISTENT, ALBEIT WEAK PATTERN OF ENVIRONMENTAL PREFERENCES

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To test for possible relationships between phytoplankton composition and productivity, and geographical and climatic variables (elevation, temperature, precipitation) we used the newly formed database of phytoplankton samples from the Czech Republic, containing 670 taxons from over nearly 700 samples of various types of stagnant waters (fishponds, alluvial backwaters, flooded sand- and gravel pits, lakes in abandoned quarries in former coal mines and reservoirs). As a surrogate of productivity, the number of cells/ml spanning over six orders of magnitude (from 10^1 to 10^7 for the number of cells) and data from conversion to biomass (biovolume) (from 10^2 to 10^9 microgram/ml).

The productivity is the fairly best predictor of species composition (productivity expressed as number of cells slightly better than as biovolume), followed by precipitation and temperature (Canonical Correspondence Analysis). The species optima estimated as weighted averages of corresponding environmental factors show consistent pattern according to large taxonomic groups: in particular, the cyanobacteria preferred on average the most, and Chrysophyceae the less productive environment, however, there were large differences in species preferences also within groups: the large taxonomic groups explained less than 30% of variation in species optima.

RS17 - Poster

THE POTENTIAL OF COLLABORATIVE EXPERIMENTS AMONG YOUNG SCIENTISTS: THE DOMIPEX PROJECT

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Collaborative experiments allow the study of large-scale patterns and processes and further provide predictive ability over site-specific studies carried out by reduced research groups. A successful collaborative environment includes a team of cooperative scientists, coordinated research methods, adequate communication, and a philosophy of respect. With this in mind, the Iberian Association of Limnology (AIL) launched the 1st Call for Projects (2013) in order to grant a team of two young scientists to lead a collaborative experiment during two years, open to the participation of all AIL young members.

The granted project was DOMIPEX (Dissolved Organic Matter in the Iberian Peninsula EXperiment). The main aim was to examine the variation in stream dissolved organic carbon and nitrogen uptake at different flow regimes (minimal summer flow vs initial peak of the expansion phase in autumn) by conducting experimental solute additions (acetate and nitrate) in streams across Europe. Nowadays, the project gathers together 42 young limnologists working in 11 study sites in Switzerland, Germany and Spain. Results of this collaborative monitoring project provide relevant considerations to researchers interested in developing collaborative experiments. Furthermore, it highlights the potential of young scientists to work independently and to develop a strong collaborative research environment.

RS17 - Oral

REMOTELY SENSED BIODIVERSITY INDICATORS FOR 300 LAKES WORLDWIDE IN 2002-2012

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Over almost ten years, the European Space Agency operated the largest Earth observation satellite built to date, ENVISAT. Its instruments provided optical, thermal and altimeter observations, and allowed for retrieval accuracies not previously achieved by spaceborne remote sensing. Using these observations, we created a comprehensive, publicly available database consisting of water quality and quantity parameters for more than 300 lakes. The Diversity II inland water database is designed to meet the requirements of the aquatic biodiversity community, but represents beyond this purpose the first globally consistent and reproducible knowledge basis of its kind.The database consists of water composition, level and temperature parameters. Water composition and lake surface water temperature are provided as monthly, yearly and a 9-year aggregated geophysical maps, and accompanied by tools that allow for generic analysis and display tasks. Water level estimates are provided as tables and time series. The potential of these products is demonstrated in the context of several case studies, wherein local experts assess the information content against the background of issues such as eutrophication and hypoxia, floating vegetation proliferation and the occurrence of cyanobacteria blooms. Qualitative links are established between those phenomena and biodiversity trends.

RS17 - Oral

A MULTI-FACETED ASSESSMENT OF LAKE FISH COMMUNITIES: IMPLICATIONS FOR CONSERVATION AND RESTORATION IN FRANCE

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Lake ecosystems and their biodiversity are increasingly threatened by human activities and the identification of the water bodies that should be protected and/or restored as a priority is urgently needed. In this context, we have investigated a new approach to identify the French lakes for which conservation and restoration measures should be implemented. Using abundance data of lake fish species obtained via a standardized sampling procedure, we have compared the current status of more than 250 French lakes to address specific management issues. A first step has consisted in developing an evaluation of ecosystem services (e.g. fishing interest of species) and lake natural heritage interest (e.g. proportion of native and threatened species). A multi-faceted approach of diversity was then applied to analyze the response of these criteria to environmental gradients (e.g. altitudinal, anthropogenic pressures), along with the taxonomic and functional diversity of fish communities. Finally, hindcasting modelling was used to estimate the deviation with the theoretical characteristics of the natural fish communities (i.e. in absence of stressors). This study represents a first stage towards the development of a management tool to complement the existing biological indicators applied in the context of the European Water Framework Directive.

RS17 - Poster

WATER QUALITY OF THE STREAMS AND LAKES FOR CANTON DE VAUD

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Information on the water quality for each watershed and lake is presented. This interactive document, available on the internet, is intended for a large public. (www.vd.ch/eau/ - De source sûre). Biological and chemical data are collected following the Swiss Confederation methods: the Modular Stepwise Procedure which includes a whole set of various modules. It was developed to facilitate standardized investigation and assessment of the state of watercourses in Switzerland. Amongst all these modules, the chemical/toxic effect, river morphology, benthic macroinvertebrates and physical appearances modules are applied in the Canton de Vaud since 2009.The results obtained are given as an ecological assessment on a timeframe of four years (2010-2013). Quality indexes for 163 locations on most of the streams as well as other information such as the size and position of each wastewater plant in the watersheds are illustrated. For the lakes assessment, chemical and biological data are collected according to european protocoles, because up to now, the lakes modules remain on process .The following parameters: total phosphorus, transparency, bottom dissolved oxygen, phytoplancton biomass and chlorophyll and benthic fauna into sediment are presented. Informations are also given on alien invertebrate species.

RS17 - Poster

TOWARD A BIOTIC INDEX FOR MONITORING IN ALPINE PONDS THE RESPONSE OF AQUATIC MACROINVERTEBRATES TO CLIMATE WARMING

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A monitoring of alpine ponds in the Macun Cirque (Swiss National Park) was initiated in 2002 to track changes in aquatic biodiversity in the Alps. Through the study of aquatic macroinvertebrates, we seek to illustrate with a biotic index two opposing trends: a decline of specialist species (boreo-alpine) and a rise of non-specialized species. Thanks to the literature we could group the majority of identified macroinvertebrates into two thermal preferences: cold stenotherm species (specialists) and other species (generalists). The biotic index developed here illustrates that the trend of these two categories was opposite during last 10 years (according to species richness and abundance). The Coleopterans seem to be the best candidates to illustrate these opposite trends. This work is a preliminary step towards a global index that reflects the evolution of macroinvertebrates in response to climate change. Several questions were raised such as: which metric is the best to use in the index, species richness or abundance? Which taxonomic group should be used? This has now to be further investigated, in additional alpine or subalpine sites.

RS17 - Poster

STUDY OF MACROINVERTEBRATE COMMUNITY IN THREE CONSTRUCTED WETLANDS:TANCAT DE LA PIPA,TANCAT DE MILIA AND TANCAT DE L'ILLA (ALBUFERA NATURAL PARK, VALENCIA, SPAIN)

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Constructed wetlands are important systems for water supply, floodwater retention and nutrient removal. As the natural wetlands, they play a fundamental role in the restoration of habitat and the preservation of biodiversity. However, there is little knowledge about the biodiversity that exists in these artificial environments, especially at the invertebrate community level. Tancat de la Pipa, Tancat de Milia and Tancat de l'Illa are 3 constructed wetlands within the Albufera Natural Park (Valencia, Spain). Due to their protection level and features, they represent an optimum field to test and study ecological and conservation aspects. The objective of this research was to study the macroinvertebrate community of these 3 systems during a year. We also studied their water chemistry and other environmental characteristics. By means of the IMN index, a biological estimator based on the trophic structure, the ecological state of the environments was analyzed. The results showed that there was a seasonal variation of macroinvertebrates community in all three constructed wetlands. Factors as habitat heterogeneity, water quality and trophic structure were the most important in order to understand the ecological dynamics and value the biodiversity of systems.

RS17 - Poster

CHRONIC EFFECTS OF TEMPERATURE AND NITRATE POLLUTION ON DAPHNIA MAGNA: IS THIS CLADOCERAN SUITABLE FOR WIDESPREAD USE AS A TERTIARY TREATMENT?

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Effluent clarification and disinfection are major challenges in wastewater management. The cladoceran *Daphnia magna* has been proposed as a cost-effective and ecosystem-friendly option to clarify and disinfect secondary effluents, but its efficacy has not been fully tested under different sewage conditions. The present study explores the effects of temperature and nitrate on the efficacy of *D. magna* as a tertiary treatment at twodifferent scales (individual assays and microcosms). Individual assays were employed to determine direct effects of temperature and/or nitrate on *D. magna* cultured in a suspension of organic matter. Using microcosms under the same environmental conditions, we explored the clearing efficacy of *D. magna* interacting with a natural microbial community. Individual assays revealed that *D. magna* mortality increased by 17% at 26ºC, 21% at >250 mg NO_3^-/l and by 60% at 26ºC and at >250 mg NO_3^-/l, and individuals displayed reduced body size, filtering rates and fecundity when compared to those at 21ºC and <40 mg NO_3^-/l. Improved performance underthese conditions was also mirrored in the microcosms, with a higher density of *D. magna* (>100 ind/l) at 21ºC and <40 mg NO_3^-/l compared to the number (0-21 ind/l) at 26ºC and/or >250 mg NO_3^-/l. In the microcosms at 21ºC and <40 mg NO_3^-/l, turbidity and the density of bacteria, protists and micro-metazoa decreased in relation to those at 26ºC and/or >250 mg NO_3^-/l. Each treatment developed a unique and characteristic microbial assemblage. This enabled us to determine protists and micro-metazoa vulnerability to *D. magna* grazing, and to re-define their tolerance thresholds for nitrate. In conclusion, this study increases our knowledge of how microbes respond to temperature and nitrate pollution, and highlights that *D. magna* efficacy as a tertiary treatment can be seriously compromised by variable environmental conditions.

RS18 - Poster

DOES THE ECOLOGICAL STATUS MATCH WITH CONSERVATION STATUS? CROSS WALKING BETWEEN THE WFD AND HD IN GREEK LAKES.

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The objective of the present paper is to find out synergies between the main tools in EU policy concerning the assessment of the ecological and conservation status across the Greek lakes. The ultimate objective of the Habitats Directive (HD) is to maintain or restore at favorable conservation status species and habitats of Community importance (Natura 2000). The aim of the Water Framework Directive (WFD) is to ensure sustainable management of water bodies such that a minimum ‘‘good ecological status’’ as a rule by 2015. Both directives use different assessment methodologies, thus the comparability between those two documents is an open issue. Regarding the Greek lakes the cross walking is more complicated since they serve multiple purposes for the society facing also various human interventions. A number of background relevant information has been used. It becomes clear that the achievement of favorable conservation status may not only depend on the ecological status but also on the number and the intense of the human pressures. Joint integrating monitoring projects should be applied creating metadata bases. This hopefully will lead to holistic management practices along with improved institutional capacity and public participation.

RS18 - Oral

IMPACT OF THE TERRESTRIAL ECOSYSTEMS ON PAN AND DAM TYPOLOGY AND DYNAMICS IN HWANGE NATIONAL PARK AND ITS PERIPHERY, ZIMBABWE

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Aquatic ecosystems are important ecosystems to conserve in their own right but also for their role in the savanna ecosystem. As a source of drinking water, wildlife and domestic fauna may impact the dynamics of these ecosystems with inputs of organic matter and nutrients from urine and faeces, and through bioturbation of the water. Therefore terrestrial fauna strongly modify the trophic status and underwater light region of these aquatic ecosystems. To study the dynamics of these aquatic ecosystems and their links with terrestrial ecosystems, we monitored 30 pans and dams in Hwange National Park and its periphery (communal zone and the forestry), Zimbabwe. Dams and part of the pans are fuelled by rain water and are temporary; the rest are pomped and permanent. The survey suggests different functioning of the pans, which might change according to the season in the relation to faunal activities. Data analysis shows that variability among pans and dams is best explained by water chemistry and phytoplankton and macrophytes abundance. Water chemistry is highly dependent on soil properties, evaporation and water run-off. Terrestrial fauna, in particular elephants, seem to play an important role in controlling the presence of primary producers through their impact on turbidity.

RS18 - Oral

A GLOBAL VIEW ON FUTURE MAJOR WATER ENGINEERING PROJECTS

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Human activities have altered how the world functions. During the past decades, we have globally, fundamentally, in the long-term, and in most cases irreversibly modified the geosphere, hydrosphere, atmosphere, and particularly the biosphere. And we are just at the beginning of this new epoch, often referred to as the Anthropocene. Indeed, there is general agreement that the transformation of our globe takes speed, with consequences that may threaten our own survival. We are probably not even able to imagine, or at least it sounds like science fiction, which alterations we will face in the coming decades to centuries.

In this presentation we will provide a comprehensive albeit in no case complete inventory of future major engineering projects that are either planned or under construction in freshwater systems worldwide. We focus on very large dams, major interbasin water-transfer and navigation projects, as well as on large-scale restoration schemes. The main goal is to raise awareness about the dimensions of and the challenges associated with future megaprojects that will change our freshwater environment. We discuss opportunities to mitigate the consequences of megaprojects based on the lessons learnt from projects in other infrastructure sectors.

RS18 - Poster

VARIETY OF THE RIVER GUIDING IMAGE – DEFINED FOR ECOLOGICALLY RELEVANT HABITAT FEATURES AT THE MEETING OF THE ALPINE, MEDITERRANEAN, LOWLAND AND KARST REGIONS

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Pristine river conditions hardly exist nowadays and a concept of a 'guiding image' is preferably used for the definition of the present-day potential natural state. Regional physiographic factors influence the local natural habitat features and biota. Therefore, we investigated the guiding images of four regions: alpine, lowland, mediterranean and karst rivers. The analysis was conducted only with ecologically important river habitat quality features. Differences among river habitat features of all investigated regions were observed. The major gradient among reference sites was observed for water flow and sediment habitat features. Differences were found between alpine and lowland rivers, but similarity between mediterranean and alpine rivers and between karst and lowland rivers. Another important gradient was observed for vegetation features, with the highest values for alpine and mediterranean rivers and lower for karst or lowland rivers. However, the simpler vegetation structure defined by lower feature values might be misleading due to the agricultural incentive in the past to remove all riparian vegetation for larger cultivable area. Its use as guidance should therefore be dealt with caution. The river guiding images in four major regions based on ecologically relevant river habitat features are suitable as guidance for more sustainable and cost-effective river management.

RS18 - Poster

A SCIENCE-MANAGEMENT INTERFACE TO IMPROVE THE TRANSFER OF SCIENTIFIC KNOWLEDGE IN FISH ECOLOGY AND FISHERIES MANAGEMENT INTO PRACTICES

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Activities in science-policy interface have only recently developed, and are therefore not well-known by management or science stakeholders. Interfacing is the critical missing link to connect scientists and policymakers; it enables much more efficient restoration and conservation actions, together with management decisions based on solid scientific backgrounds. Scientific knowledge applicable directly to specific issues is abundant, but is seldom used in management programs. SCIMABIO interface implements collaborative and dynamic approaches to address this situation.

SCIMABIO interface acts as a knowledge broker, pro-actively supporting and assisting managers in drafting policies and engaging actions. SCIMABIO assists stakeholders in their restoration projects, especially when dealing with ecological continuity and fish migration. We also propose a panel of research-based tools (mass-marking techniques, genetic markers, elemental and Sr isotopic composition in otoliths, PIT tags,…) to evaluate fish stocking practices in different types of environments and/or to provide knowledge on fish population dynamics or viability. Partnerships are developed with analysis platforms in genetics and otolith chemistry to propose managers advanced expertise in these fields. SCIMABIO interface also drives some innovative research projects in collaboration with academic research institutes and fish managers.

RS20 - Oral

END OF THE ROAD (OR STREAM)? WHAT DRIVES THREATENED NORTHERN RIVER BLACKFISH (GADOPSIS MARMORATUS) DISTRIBUTION IN THE UPPER CONDAMINE RIVER, QLD, AUSTRALIA

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Patterns of fish distribution are influenced by both biotic and abiotic variables acting at various spatial and temporal scales. An abundance of recent literature has focussed on potential ecological impacts related to future climate and land use. Upland fish species are especially vulnerable to alterations in the climatic regime; they are already restricted to headwaters, where future temperatures are likely to exceed their physiological thresholds, leading to local extirpations. It is therefore critical to understand key drivers of fish distribution in upland systems to effectively manage and conserve populations. We sampled blackfish abundance, as well as data on various physiochemical and habitat variables at electrofishing sites in the Upper Condamine River, QLD, Australia. Temperature data was also collected using *in situ* sensors throughout the basin and spatial statistical stream-network models were used to predict the temperature regime at unsampled locations. Ecologically relevant temperature metrics, along with physiochemical and habitat covariates were then used to identify the primary drivers of blackfish distribution at the reach scale. Results from this research provide the foundation for subsequent studies focussing on climate-change impacts on thermally suitable habitat throughout the basin, as well as predicted habitat losses or gains for this threatened species.

RS20 - Oral

LIFE HISTORY AND MULTISCALE HABITAT PREFERENCES OF THE RED LISTED BALKAN GOLDENRING (CORDULEGASTER HEROS THEISCHINGER, 1979) IN HUNGARIAN HEADWATERS

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Life-cycle and microdistribution patterns of *C. heros*, a charismatic species for nature conservation, are poorly known. Life history characteristics and multiscale habitat preferences of the larvae were followed for one year in monthly intervals by systematic samplings in eight headwaters, which resulted in various data on 2562 registered individuals. Based on the distribution of the consecutive larval instars, duration of elder stages and time of molt and emergence, the larval development of *C. heros* in the Mecsek Mountains lasts at least three but maximum four years. All three levels of the multihabitat structure [habitat (sites), meso- (riffle/pool sequence) and microhabitats (biotic and different particle sized abiotic types)] have significant effects on the spatial distribution of the larvae. Various densities and different population structures can be seen among thesites. Mesohabitat type and microhabitat diversity (heterogeneity within a pool or riffle) also show significant effects on the microdistribution. *C. heros* rather prefers pools with small or medium microhabitat heterogeneity and higher proportion of small particle sized substrates against the riffles, especially in younger stages; older larvae are less sensitive for these effects.

RS20 - Oral

HUMAN-MEDIATED TRANSLOCATION IMPACTS LINEAGE INTEGRITY OF CHUB (SQUALIUS CEPHALUS) AND ITS SISTER SPECIES CAVEDANO (SQUALIUS SQUALUS) BY HYBRIDIZATION

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European fish species distributions were shaped by glaciations and the geological history of river networks, until human activities abrogated the restrictions of biographical regions. The nearby origins of the rivers Rhine, Rhone, Danube and Po allow the examination of historical and human-influenced patterns on a small scale. I investigated these patterns in the widespread chub (*Squalius cephalus*) and its proposed southern sister species cavedano (*Squalius squalus*). A mitochondrial network constructed from Cyt b and CO1 sequenced showed a clear separation of chub and cavedano and a single common haplotype prevalent in chubs from Rhine and Rhone. The separation into two species was also supported by shape differences quantified by geometric morphometrics as well as traditional morphological traits . Bayesian clustering of microsatellite genotypes divided the individuals into five clusters corresponding to the Rhine, upper Rhone, lower Rhone, Danube and Po rivers. However, there was evidence for mitochondrial and nuclear introgression of chub into cavedano in southern Switzerland, presumably the result of hybridization following human-mediated translocations, e.g. by live bait or stocking. The desirable preservation of evolutionarily distinct lineages will thus require the prevention of such translocations.

RS20 - Poster

GROWTH AND PRODUCTION DIFFERENCES OF UNIONID MUSSEL POPULATIONS IN SOME HUNGARIAN LOCALITIES, WITH SPECIAL REGARD TO UNIO CRASSUS AND PSEUDANODONTA COMPLANATA

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Characteristic traits of Unionid mussel populations (Unio crassus, U. pictorum, Sinanodonta woodiana, Anondonta anatina, Pseudanodonta complanata) from river Tisza, and Lake Balaton were compared such as production, growth and biomass. River Tisza at Szeged (GPS: 46°15'48.21'N, 20°12'45.12'E) is a lowland, slow flowing river and very rich in mussels. All native Unionid species occur, mainitaing abundant populations. Moreover, the invasive Sinanodonta woodiana also occurs in the river, but is more frequent in the nearby tributaries, oxbows and ponds. Several localities of the river provide ideal habitats for mussels, hence the density can reach the 100-300 sp/m2 if the bottom type is suitable. Lake Balaton is also rich in Unionids, but the maximum and average size, as well as annual growth rate are lowers than in other localities. The differences between the growth characteristics of Unionids by habitat are analysed, with special regard to U. crassus.

RS20 - Poster

THE STUDY OF THE FIRST CASE OF RESTORATION OF THE EMYS ORBICULARIS (TESTUDINES: EMYDIDAE) BIOTOPES AND POPULATION IN LATVIA WITH THE HELP OF INDIVIDUALS FROM ZOOCULTURE IN SILENE NATURE PARK, DAUGAVPILS DISTRICT

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Emys orbicularis is a protected species of freshwater turtles of the European Union inhabiting Latvia which is the northern border of its distribution area. The main negative factors for *E.orbicularis* in Latvia are the overgrowing and degradation of aquatic habitats; depletion in numbers and fragmentation of populations. In order to preserve *E.orbicularis* in Latvia it is important to restore near-border populations of the species for genetic contacts with stronger southern populations of Belarus. A project called LIFE-HerpetoLatvia was carried out in near-border Silene Nature Park in 2010-2014. The research in aquaculture was supported by project #2013/0067/1DP/1.1.1.2.0/13/APIA/VIAA/060. 165 water bodies were examined in Silene Nature Park. We have found out that many ponds located in near-border Silene Nature Park were drained during the Soviet period, they became overgrown due to heavy contamination with nitrogen used in agriculture and *E.orbicularis* were very occasionally encountered there. Three pond systems in the amount of 16 water bodies were chosen and restored. The dynamics of pond parameters essential for *E.orbicularis* was studied in 2013-2014. We carried out all-seasonmonitoring of changes in the area, depth of the ponds, restoration of the vegetation cover in the shallow coastal zone. 42 young adults and semi-adults of *E.orbicularis* cultivated in the modernized aquaculture were released in wild for the first time in the history of Latvia.

RS20 - Poster

THE STUDY ON RESTORATION OF THE AQUATIC HABITATS AND POPULATIONS OF BOMBINA BOMBINA (ANURA: BOMBINATORIDAE) USING THE INDIVIDUALS FROM ZOOCULTURE IN TWO NATURA 2000 TERRITORIES IN DEMENE, LATVIA

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The Fire-bellied Toad *Bombina bombina* is a protected species of amphibians in the European Union residing in Latvia on the extremely northernborder of its area. The main negative factors for *B.bombina* in Latvia are the overgrowing of ponds, predation by the invasive species of fish *Perccottus glenii* and fragmentation of populations. In order to preserve *B.bombina* in Latvia it is important to restore near-border populations of the species for genetic contacts with stronger southern populations of Belarus. A project called LIFE-HerpetoLatvia was carried out in near-border Demene district in 2010-2014. The research in aquaculture was supported by project #2013/0067/1DP/1.1.1.2.0/13/APIA/VIAA/060. We have found out that various ponds located in Demene district were drained during the Soviet period while others were invaded by *Perccottus glenii,* they became overgrown by bushes and canes, as well as too dark an cold for *B.bombina*. Therefore, 27 isolated ponds were created or restored in two new Nature 2000 sites (14 in Katriniski and 13 in Strauti). The created ponds were shallow, the average depth was 0.5 m, with well insolated shores. The dynamics of pond parameters essential for *B.bombina* was studied in 2013-2014. We carried out all-season monitoring of changes in the area, depth of the ponds, restoration of the vegetation cover in the shallow coastal zone. 4 069 juveniles of *B.bombina* cultivated in the modernized aquaculture were released in the ponds in 2013-2014. The study in Katriniski and Strauti showed success of the actions in both territories: 1) high level of restoration of water plant ecosystems; 2) presence of vocalizing males and juveniles of *B.bombina*; 3) absence of *Perccottus glenii* in the ponds.

RS20 - Poster

THE STRENGTHENING OF THE POPULATION OR REWRITING OF THE EVOLUTION? THE STUDY ON THE METHODS OF RESTORATION OF THE SALMONIDAE POPULATIONS IN LATVIA AND THE EVALUATION OF MODERNIZATION PERSPECTIVES OF THEIR AQUACULTURE

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The restoration and strengthening of the natural populations of declined hydrobionts by their propagation and cultivation in the aquaculture and their release into nature are a traditional method of preservation of the populations of valuable fish species in Latvia. This method has been widely used for the restoration of the Salmonidae populations in the country: more than 5 072 000 juveniles of five species were released into nature in 2014. The Salmondiae species and their populations in Latvia are the result of a long evolution and natural selection under the dynamic influence of various natural factors. This evolution is still on its way nowadays. However, the conditions of the Salmonidae aquaculture in Latvia and the processes of selection of breeders, propagation, cultivation of juveniles and their release into nature are very different at all their stages from those of natural conditions and processes in Latvian rivers and lakes. Thus, by cultivating the Salmonidae juveniles in Latvia, the natural selection in nature is replaced by the artificial aquacultural selection. Therefore, the Salmonidae juveniles released in Latvia into nature are not identical to those ones grown in nature and may influence the natural Salmonidae populations in Latvia and their further evolution. The research was supported by the project 'Creation of a new scientific group for modernization of aquaculture technology'' # 2013/0067/1DP/1.1.1.2.0/13/APIA/VIAA/060. The study includes the analysis of the methods characteristic of Latvia of selection of the adult Salmonidae for breeding, their breeding, the conditions of cultivation in the aquaculture and release into nature in comparison with natural processes. Based on the results of the study, the directions of modernization of the Salmonidae aquaculture in Latvia have been proposed.

RS20 - Poster

VARIABILITY WITHIN PEARL MUSSELS POPULATIONS AND THEIR LIFECYCLE (IN CAPTIVITY)

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At Windermere, six populations of *Margaritifera margaritifera* are hold in an ARK. Their natural rivers are spread over a wide range of the U.K. geography. They are kept at the site provided with water from Lake Windermere. To hold FWPM in captivity has been shown to be successful since they managed to complete the whole reproductive cycle and viable juveniles have been collected every year. During eight years, each population showed remarkable difference from the others in its lifecycle, including the preference for host fish, infection and glochidia growth rates in the host species. This recalls the importance of the ARK, not only as a mechanism to safeguard the FWPM specie but to preserve/retain the different existing populations under acute stress in their natural habitats.

Adult mussel mortality rates have differed between populations but their conditions on arrival were also not the same, a possible delayed response to stress prior to translocation, or the translocation itself in to the hatchery, might explain these differences even after many years in captivity.

These marked differences between FWPM populations should be examined when attempting to rear and reintroduce mussels or when restoring their habitats, in order to maximize the effectiveness of the actions taken to protect the species.

RS20 - Oral

PRIORITIZATION OF 'AT RISK' FRESHWATER FISH SPECIES POPULATIONS IN SWITZERLAND FOR CONSERVATION PURPOSES

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Prioritizing sites that are important for biodiversity conservation is challenging for managers, mainly because of socio-economic constraints. While methods to set priorities have been developed for ecosystems, geographic areas or communities, tools for prioritizing populations still are scarce. In Switzerland, European grayling (*Thymallus thymallus*) is a native salmonid species at risk, whose conservation is a main issue for authorities. Methods to prioritize populations to conserve could then highly benefit managers. Here, after a literature review, we gathered information and computed 36 variables reflecting potential threats for 27 grayling populations widespread in Switzerland to develop a synthetic prioritization index. Variables included biological data relative to populations (e.g. effective population size, genetic diversity/divergence, avian predation), environmental site (e.g. pollution, flow alteration, morphology) and landscape characteristics (e.g. land uses, river fragmentation, susceptibility to climate change). Data were grouped in 4 'threat' categories and summarized by PCAs. Population scores on PCAs axes were then summed to give a global 'threat index'. This synthetic index allowed us to establish a hierarchical classification of sites, and to prioritize populations to be restored or conserved. This index could be adapted or complemented with other criteria, and developed for other species.

RS20 - Poster

BARBUS BARBUS (LINNAEUS, 1758) IN THE RIVER TIBER BASIN (UMBRIA-CENTRAL ITALY) 15 YEARS AFTER ITS INTRODUCTION.

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The purpose of the research was to analyse the distribution and abundance of *Barbus barbus* (Linnaeus, 1758), an exotic species introduced into the Tiber river basin in 1998, and to assess the impact on the status of the indigenous population of *Barbus tyberinus* Bonaparte 1839. Another aim was to assess the environmental characterization and the role of abiotic factors in the distribution and abundance of the two species. The study area comprised 92 watercourses of the Umbria portion of the river Tiber basin; our analyzes utilised data collected during the period 1999-2014, in 171 sampling stations. The results have confirmed that fish assemblage composition varied along the longitudinal gradient of the rivers according to environmental changes in a sequence in which the Danube barbel being located downstream in the respect of *Barbus tyberinus*. The results shown also that the rapid expansion of the Danube barbel in the study area seems to have had a strong impact on indigenous populations: in some stream reaches the abundance of the Danube barbel was considerably greater than that of the Tiber barbel. The results obtained constitute the essential premise to underpin conservation strategies in order to preserve native freshwater biodiversity.

RS20 - Poster

SOME REPRODUCTIVE CHARACTERISTICS OF ENDEMIC FRESHWATER FISH SPECIES SQUALIUS PURSAKENSIS LIVING IN THE STREAMS OF DARLIK BASIN (NW TURKEY)

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In this study, some reproductive features of endemic freshwater fish species, *Squalius pursakensis* in the streams of Darlık Reservoir thatprovides important part of water demand of city of Istanbul were studied. During the study period between October 2008 and September 2010, 1050*S. pursakensis* individuals were collected by electrofishing. Spawning period was between April and June. Total length at maturity of *S. pursakensis* was 9.515 cm for males and 10.162 cm for females. These lengths corresponded with the second age group for both sexes. Minimum egg number was in third age group with 789 eggs/individual and maximum egg number was in seventh age group with 17692 eggs/individual. Minimum egg diameter was 0.943 mm and maximum egg diameter was 1.547 mm both belonging third age group.

RS20 - Oral

CAPTIVE BREEDING OF THE FRESHWATER PEARL MUSSEL (MARGARITIFERA MAGARITIFERA) AND ITS IMPORTANCE IN ENHANCING CONSERVATION AND BIODIVERSITY PRACTICES

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Captive breeding, as one of the tools for conserving endangered species, has been used for vertebrate species in many parts of the world but there are few examples of captive breeding programmes that have provided major support for freshwater vertebrate and invertebrate species which have the highest rate of decline - almost double that of marine and terrestrial species.

Successful captive breeding provides an understanding of many aspects of the animal's biology. With the pearl mussel these include host specificity, physiology of the different stages in the life cycle and the specific environmental requirements of these stages. It also requires knowledge of differences between races or populations of the species from different rivers or even parts of them. The pearl mussel work carried out at the FBA's hatchery over the last 8 years and described in this paper is an illustration of the close complementary relationship between the experimental work needed to develop a captive breeding programme and ecological investigations and how the two approaches have complemented each other in aiding the conservation of this endangered species.

RS21 - Oral

ROLES OF CLIMATE THROUGH HYDROLOGY AND NUTRIENT ENRICHMENT ON ECOLOGY OF MEDITERRANEAN SHALLOW LAKES OF TURKEY USING MULTIPLE APPROACHES

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Mediterranean climate with natural annual and interannual oscillations of wet and dry periods leads to changes in the water balance, which strongly affects the functioning of shallow lakes with implication for major ions and nutrient balances. Over forty shallow lakes spanning over 5 latitudes from the warm temperate north to the semi arid to arid mid and south of Western Anatolian Plate of Turkey were sampled for physico-chemical, biological variables including fossil proxies in the sediment as well using well-established snap-shot sampling protocol as well as long-term monitoring two of the local lakes. The space for time substitute data showed that there are four relatively distinct groups of lakes according to altitude and latitudinal gradients. The coastal ones were more eutrophic compared to the upland ones, furthermore, southern coastal ones were also saline as well as eutrophic. On the other hand, northern upland ones were in clear water with macrophyte domination and large piscivorous fish. The saline and eutrophic ones were characterized with high net evaporation as well as temperature enhance as well as eutrophication. Long term monitoring data also showed the similar pattern that during the drought periods compared to wet periods salinity and eutrophiction increased several-fold. Salinity and availability of phosphorus appeared to be the most important controlling factor for plankton, fish and macrophye community both in contemporary and paleolimnologial fossil data.

RS21 - Oral

THE METHOD MATTERS: A GUIDE FOR INDICATOR AGGREGATION IN ECOLOGICAL ASSESSMENTS

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Ecological assessment requires the integration of physical, chemical, and/or biological quality elements. The choice of the aggregation method of such partial assessments into an overall assessment can considerably affect the assessment outcome. Current practice often only considers additive and minimum aggregation, although both have major drawbacks. Here, we introduce a toolbox containing current and new aggregation methods and illustrate the consequences of selected methods for ecological river assessment in Switzerland. We use multi-attribute value theory to arrange the quality elements into an objectives hierarchy and translate their individual assessments into value functions. We find that the choice of the aggregation method particularly matters, when elements with significantly different qualities are aggregated. Redundant quality elements often located at the lower levels of the objectives hierarchy should best be aggregated additively, allowing for compensation to increase the statistical significance of the results. Complementary sub-objectives that often occur at higher levels may be optimally aggregated with a mix of additive and minimum, which allows for some compensation but nevertheless penalizes for bad conditions. The comparison of commonly used aggregation methods with some which we believe have never been discussed in an assessment context before concurrently informs ecological assessment in theory and in practice.

RS21 - Poster

ORGANIC MATTER BREAKDOWN AS FUNCTIONAL INDICATOR IN LAKE ECOSYSTEMS: FIRST STUDY IN TWO FRENCH LAKES

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Developing efficient indicators of ecosystem functioning is becoming a priority within the context of increasing anthropogenic pressures and the need to preserve ecosystem services.

Regarding freshwater ecosystems, the EU Water Framework Directive have currently only led to the development of indicators based on community structures. These indicators are taxonomic specific and generally do not include functional processes. From this viewpoint, they provide only rough estimates of global functioning of ecosystems.

Here we present our work which aims to develop 'functional indicators' based on organic matter processing. As a first step, we investigated leaf litter processing in two connected French Mediterranean lakes and their shared tributary. We used oak and alder litter and compared the relative importance of microbial and macroinvertebrate (large mesh bag – LM) communities activities in this process. The results highlighted an upstream-downstream gradient in the decay rate (k) with a slight additional effect of depth. The main difference among-system was a change in the relative contribution of microbial and invertebrate communities in breaking down the organic matter, with a strong impact of invertebrates on rivers.

RS21 - Poster

ESMANAGE: INCORPORATION OF ECOSYSTEM SERVICES VALUES IN THE INTEGRATED MANAGEMENT OF IRISH FRESHWATER RESOURCES

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Incorporating the concept of ecosystem services into natural resources management requires knowledge on the chain of complex ecosystem processes and interactions that underpin the delivery of the various goods and services. Other challenges relate to valuation of ecosystem services and embedding the concept into policy. ESManage is a newly initiated project which addresses these challenges in an Irish context. The overall objective of this project is to harness the knowledge and tools required to embed the ecosystem services approach into policy and decision-making for sustainable management of freshwater resources. Specific tasks involve: a) synthesis of current knowledge on the freshwater resource capital in the context of ecosystem services, b) determination of the linkages between biological components/ecosystem services and drivers of change, c) simulation of water resources management scenarios from the perspective of water quality to allow valuation of ecosystem services. Finally, we will explore how the ecosystem services approach can best be embedded into policy and decision-making. This paper outlines the project tasks and investigations undertaken to date.

RS21 - Oral

DEVELOPMENT AND UNCERTAINTY ASSESSMENT OF THE INVEST NUTRIENT RETENTION MODEL

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Understanding and predicting the process of water purification by natural ecosystems is of great interest to water managers. With the growing trend of ecosystem-based management, there is a need for predictive tools that are both scientifically robust and simple enough to be used in an iterative way. The InVEST (Integrated Valuation of Ecosystem Services and trade-off) nutrient model was designed in line with this philosophy, aiming to represent in spatially-explicit way the delivery and retention of nutrients by natural landscapes. In this talk, we will present the latest developments of the model, as well as a portfolio of valuation approaches that can be used for ecosystem services assessments. The revised model includes the representation of surface and subsurface nutrient transport using a framework based on the hydrologic connectivity concept. We show how this model structure improves the representation of nutrient transport and facilitate uncertainty assessment. We present the testing and validation of the model for the evaluation of the nutrient retention service in the Llobregat catchment, Spain.

RS21 - Poster

COMMUNICATING THE VALUE OF SMALL PONDS IN CERRADO (BRAZIL)

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Freshwater biodiversity of the Cerrado biome is under the threat of the expansion of agriculture and a hydric crisis. Both processes highlight the importance of the small-ponds as source of water in rural areas. Based on a biodiversity study in 71 waterbodies near Goiânia (Goiás, Brazil), we developed a book for communicating the importance of their biodiversity and their role in providing ecosystem services, aiming the scholar community. The book was developed based on written reports of the scientists that directly studied those habitats, which allow to identify the most important concepts/situations that could be used as education opportunities. We tried to instigate the debate more than present complete conclusions. To do so, we constructed some characters and put them in problem-situations examining ecological processes and threats. The language and the art project were designed to attract young readers and instigate curiosity. The book is distributed freely for the public schools, teachers trained in its use and there is an evaluation of its use by both the students and teachers. The project highlighted the eager interest of the teachers in the material, most related to the near absence of literature on Cerrado biodiversity that could be readily used in schools.

RS21 - Oral

ASSESSING WATER-RELATED ECOSYSTEM SERVICES IN THE BLACK SEA CATCHMENT

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Following the enviroGRIDS European project that modeled water resources in the entire Black Sea catchment (2.2 mi. km^2) for the first time using the Soil and Water Assessment Tool, we are exploring in this work how we can transform this initial effort into an ecosystem services assessment. Two international commissions in the region focusing on the Danube River and the Black Sea are directly concerned by the water quantity and quality reaching this almost closed sea. Their concern typically translates into services such as water yield, sediment and nutrient retentions. These services were assessed using the InVEST package developed by the Natural Capital Project. The outputs of these analyses are presented as large-scale maps at 270m resolution and analyzed by countries and by sub-catchments. The created datasets will be shared on the enviroGRIDS geoportal (portal.envirogrids.net) as open data available to download or as web services. This brings a new regional contribution to the Global Earth Observation System of Systems that will remain in the future for other scientists and decision-makers to use and compare with their own results.

RS22 - Oral

WHAT IS THE RELATIVE IMPORTANCE OF ORGANIC TOXICANTS IN FRESHWATER ECOSYSTEMS?

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We studied the relative importance of organic toxicants for the ecological status of rivers. First, we conducted a large-scale analysis on the risks for algae, invertebrates and fish. Organic chemicals were likely to exert acute lethal and chronic long-term effects on sensitive invertebrate and algae species in 16% and 42% of the 4,000 European monitoring sites, respectively. The risk increased with the number of ecotoxicologically relevant chemicals analysed. As most monitoring programs only included a subset of these chemicals, our assessment still underestimated the actual risk. Second, we compared the risks from organic chemicals to those from three other stressors, namely habitat degradation, invasive species and excessive nutrients for Germany. At approximately 85% of the sites nutrients and habitat degradation exceeded ecological thresholds, whereas in approximately 50% of the sites the thresholds for invasive species and organic toxicants were exceeded. All sites, where data on the four stressors were available, displayed threshold exceedance from at least one stressor. Although habitat degradation and nutrients are dominant stressors, the risk of ecological effects from organic toxicants is prevalent and integrating freshwater ecology and ecotoxicology is pivotal to tackle the challenge of multiple stressors.

RS22 - Poster

ADAPTATION OF PERIPHYTIC COMMUNITIES TO COPPER AND SILVER IN AN ARTIFICIALLY-CONTROLLED EXPOSURE

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The microbial community provides a good level of biological organization to evaluate the toxic impacts on organisms with different levels of sensitivity. River biofilms, which are at the basis of aquatic systems, allow assessing the toxic effects of micro-pollutants in aquatic systems. A microcosm approach has been developed to analyse how bacterial periphytic communities adapt to chronic-metal-exposure . River biofilms were exposed to two concentrations (10 and 100 $\mu g.L^{-1}$) of Cu or/and Ag during five weeks. The adaptation of microbial communities was assessed by the pollution-induced community tolerance (PICT) approach, based on *β*-glucosidase activity in order to assess heterotrophic biofilm tolerance; by examining the bacterial diversity (high-throughput 16S sequencing) and through the occurrence and expression of genes involved in the silver (*silA*) and copper (*cusA* and *copA*) efflux. No PICT effect was observed on biofilms tested, but the biofilm exposed to $10 \mu g.L^{-1}$ of silver expressed co-tolerance to Cu. The bacterial periphytic communities expressed *silA* in silver-exposed biofilms. *cusA* was only detected in biofilms exposed to 100 $\mu g.L^{-1}$ of Cu and 10 $\mu g.L^{-1}$ of both metals whereas *copA* was never detected. The bacterial diversity has revealed the dominance of *Burkholderiales* in silver-exposed-biofilm and different modifications of the copper-exposed-biofilms with exposure concentrations.

RS22 - Oral

MODELLING THE EFFECTS OF PULSE EXPOSURE FOR SEVERAL PSII INHIBITORS AND ALGAE

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After crop application and precipitations, herbicides can fluctuate widely in watercourses. These pulses can exceed water chronic quality criteria, which aims to protect aquatic environment. A model was developed to evaluate the effects of successive pulse exposure on algae. The model proposed is based on two parameters: i) the typical growth rate of the algae, obtained by monitoring growth rates of several successive batch cultures in growth media, characterizing both the growth of the control and during the recovery periods; ii) the growth rate of the algae exposed to pulses, determined from a dose-response curve. We focused on herbicides photosystem II inhibitors atrazine, diuron and isoproturon and on the freshwater algae *S. vacuolatus* and *P. subcapitata*. We validated the model prediction based on effect measured in laboratory. The comparison between the laboratory and the modelled effects illustrated that the results yielded were consistent, making the model suitable for effect prediction of the photosystem II inhibitors on the algae *S. vacuolatus* and *P. subcapitata*. The application of the model proves that the longest peaks affect the cell density inhibition of algae the most. It is therefore crucial to capture these high fluctuations when monitoring of herbicide concentrations are conducted in streams.

RS22 - Oral

IMPACT OF CONTAMINANTS (PCBS, HAPS, METALS) IN WILD MUSSELS (MYTILUS GALLOPROVINCIALIS) FROM THE ALGERIAN WEST COAST AND DEVELOPMENT OF BIOMARKER INDEX FOR MONITORING POLLUTION

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Mussels *Mytilus galloprovincialis* are used as bioindicator organisms to detect and evaluate the toxic effects of chemical and organic contaminants in marin organisms, especially PCBs, HAPs and heavy metals, using seasonal biomarker responses: acetylcholinesterase (AChE) catalase (CAT) glutathion s-transferase (GST) and condition indexes. Using biomarkers data, an site classification index were developed to assess the potential toxic of coastal areas. Overall, on the six study sites, all follow the same gradient of contamination for PCBs and PAHs. Maximum concentrations were found in industrial harbour site (97.6 µg kg^{-1} d.w.; 2892.1 µg kg^{-1} d.w.) and the minimum in an wild site (3.7 µg kg^{-1} d.w.; 68.1 µg kg^{-1} d.w.) for PCBs and HAPs respectively. It notes a more scattered distribution ofheavy metals in different sites. High maximum concentrations of Plomb and Cadmium correspond to an agricultural and fishing site (9.7; 3.2 µg g^{-1} d.w.) respectively. Zinc and Copper were higher in estuarine and industrial sites (207.7; 5.28 µg g^{-1} d.w.) respectively. Biomarker index was an interesting tool to rank sites according to their risk potential, revealing that the sites exposed to anthropogenic pressure are the most dangerous to the health of organisms.

RS22 - Poster

ACUTE TOXICITY OF CADMIUM ON DONAX TRUNCULUS (MOLLUSCA, BIVALIVA): METALLOTHIONEIN LEVELS IN MANTLE, GONAD AND DIGESTIVE GLAND DURING THE REPRODUCTION

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The regional coastal environments have been subjected to various forms of degradation, including chemical contaminants associated with densely populated urban areas via harbors and other industrial complexes. Previous studies have reported a metal contamination with elevated levels of cadmium. This highly toxic pollutant, with cumulative and non-biodegradable properties has been detected in the tissues of *Donax trunculus* (Bivalvia, Donacidae) with a significant site and season effects. The aim of thecurrent study was to determine the concentration of metallothionein-like proteins (MTs) in mantle, gonad and digestive gland of male and female of *D. trunculus* during the reproduction period at spring (before spawning). The samples were collected at El Battah a relatively clean site andreared in the laboratory under controlled conditions. Cadmium was added to the rearing water at two sublethal concentrations (LC_{10} and LC_{25}- 96h) determined previously. The analysis of MTs was carried out at different exposure times (0, 48, and 96h). Our results show that digestive gland presented higher levels of MT especially in females, than gonad and mantle. Data subjected to a multivariate analysis of variance revealed effects of concentration, time and sex. These results are discussed according to physiology and reproductive cycle of this sentinel species.

RS22 - Oral

BENTHIC MICROBIAL COMMUNITY ADAPTATION TO PESTICIDE: A PROMISING BIOLOGICAL INDICATOR TO ASSESS ECOLOGICAL RECOVERY FOLLOWING A DECREASE IN PESTICIDE CONTAMINATION.

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In lotic ecosystems, benthic microbial assemblages are considered as useful potential indicators of ecological status because they integrate the effects of multiple disturbances and have a strong capacity to adapt to stressors. Chronic pesticides exposure can thus induce adaptation processes in benthic microbial communities, leading to an increase in their capacities to tolerate and/or degrade these toxicants. It suggests that the study of microbial adaptation can represent a powerful ecological indicator for monitoring pesticide contamination and assessing associated ecological effects. Accordingly we evaluated the use of i) freshwater sediment biodegradation potential and ii) periphytic biofilms tolerance capacities, as microbial indicators for monitoring ecological recovery following a decrease in pesticide exposure. For this purpose, a 3.5-year case study (2008–2011) was conducted in a French small stream long exposed to high concentrations of the herbicide diuron. Our results showed that the ban on diuron in December 2008 resulted in a progressive decrease in its concentrations in the river, leading to a fall in sediment diuron-mineralizing capacities. The PICT approach also revealed a decrease in the capacity of periphytic phototrophic communities to tolerate this herbicide. These results open prospects for developing a new class of ecological indicator based on microbial adaptation capacities.

RS22 - Oral

COPPER SULPHATE REDUCES THE METABOLIC ACTIVITY OF GAMMARUS FOSSARUM IN LABORATORY AND FIELD EXPERIMENTS

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The specialised fauna of springs is affected by contamination with xenobiotics from human activities in the surrounding landscape. We assessed the effects of exposure to toxins in laboratory and field experiments by using copper sulphate as a model substance and *Gammarus fossarum* Koch, 1836, as the model organism. This amphipod is a common representative of the European spring fauna and copper is a widespread contaminant. The experiments were conducted in test chambers in flow channels and directly in a spring. The gammarids were fed with leaf discs, which had been exposed to a copper solution for 96 hours. The feeding activity was quantified on the level of the organism; the respiratory electron transport system (ETS) assay was conducted in order to determine changes on the cellular level.

The results show that the feeding activity was not affected significantly by the copper. The ETS activity of the gammarids which had been feeding on the copper-contaminated leaf discs was significantly reduced. The results followed the same pattern for gammarids from the laboratory and the spring. By conducting the experiments in a laboratory and in the field, we took a crucial step towards a more realistic approach when examining environmental pollutants on organisms.

RS22 - Oral

FUNCTIONAL TRAITS IN ECOTOXICOLOGY: CORRELATIVE MODELLING OF WHOLE BODY METAL CONCENTRATIONS AND COMMUNITY ASSESSMENT IN FRESHWATER INVERTEBRATES

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Bio-ecological traits are used increasingly in bio-monitoring. In the present study, they allowed to adapt a multiple regression model for whole body metal concentrations to assemblages of freshwater invertebrates. Field data was collected to calibrate a model predicting metal accumulation in macroinvertebrates from concentrations in water and sediment. Selected functional traits of the taxa (i.e. feeding mode like gathering collectors) were used as parametric terms within the model. The taxonomic composition at the study sites was also studied. The models for Ni, Cu, Pb, Zn, Cd and Al were able to explain over 50% of the variance in bioaccumulation (adjusted R^2). The significant parameters conveyed information on different uptake mechanisms. Coefficients for trait categories could be used to identify sensitive traits and taxa. Links with the taxonomic and functional composition of the community are discussed. Overall, the study confirmed that the use of traits is a promising approach to enhance bioaccumulation modelling and to improve our understanding of the relationships between biogeochemistry (concentration and availability of metals in water and sediment), bioaccumulation and community composition.

RS22 - Oral

FLUCTUATIONS IN PERIPHYTON COMMUNITY COMPOSITION AND BIOMASS DUE TO PHARMACEUTICAL COMPOUNDS AND ENVIRONMENTAL FACTORS

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Hospital wastewaters (HWWs) contain more pharmaceuticals than urban wastewaters (UWWs) and they are generally discharged in sewers without pretreatment. Since traditional urban wastewater treatment plants (WWTPs) are not adapted to treat HWWs, effluents may contain pollutants that may impair receiving aquatic environments. Better comprehension of pharmaceuticals` toxicity and persistence is required in order to develop more accurate environmental risk assessment and management strategies. Due to their fast and varied structural changes in response to physical, chemical and biological fluctuations, biofilms are interesting 'sensors' to assess environmental impacts of pharmaceuticals. This study was carried out as part of the SIPIBEL field observatory on hospital's effluents and urban WWTPs. It evaluated the structure and diversity of biofilm communities i) exposed to urban and hospital WWTP effluents and ii) in the receiving river up- and downstream from the WWTP output, through six successive monthly colonizations of biofilms.

Results indicated that urban and hospital WWTP effluents affect differently biofilm communities. Higher pharmaceuticals` concentrations in the hospital effluent caused a decrease in biomass and bacterial richness and strong differences in community composition. River communities, which were very different from communities observed in the basins effluents, exhibit only small differences between up- and downstream locations.

RS22 - Oral

ECOTOXICOLOGICAL EVALUATION OF AN ALLELOPATHIC APPROACH TO PREVENT CYANOBACTERIA PROLIFERATION IN LENTIC FRESHWATER ECOSYSTEMS

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From the various anthropogenic pressures affecting lentic hydrosystems, increase in nutrient loadings is of particular concerns. This later may lead to phytomass proliferations including harmful microalgae blooms, which can disrupt the normal functioning and exploitation of freshwater ecosystems. Within this context, the use of naturally occurring chemicals, referred as allelopathy, has gained into great interest as an eco-friendly technology to prevent microalgae growth. The primary aim of this work was to evaluate the efficiency of two allelopathic substances: gallic acid (GA) and nonanoic acid (NA) usedeither alone or in combination to limit cyanobacteria proliferation. For this purpose, thirteen outdoor freshwater lentic mesocosms (unit volume: 3 m^3) were designed into which several phytoplankton enrichments were conducted (encompassing different cyanobacteria genera and other unrelated algae species). Various non-target organisms belonging to higher trophic levels (physa, lymnaea, amphipods, rudds) were also introduced into each artificial ponds. After an eight-week stabilization period, a full factorial design based on the presence/absence of allelopathic compounds was implemented: 4 control tanks, 3 GA tanks, 3 NA tanks and 3 [GA + NA] tanks. Following four-week exposure, results concerning phytoplankton community biomass evolution as well as a panel of cellular biomarkers in non-target species were specifically evaluated.

RS22 - Oral

ASSESSING THE EFFECTS OF SILVER NANOPARTICLES ON THE ECOPHYSIOLOGY AND ECOLOGY OF GAMMARUS ROESELI.

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With antibacterial properties, silver nanoparticles (nAg) are widely used in current consumer products. The risk associated to their potential release into freshwater ecosystems need to be addressed by using environmentally realistic exposure concentrations. Due to their role in ecosystem functioning and their sensitivity to numerous contaminants, Gammaridae are widely used in ecotoxicological studies. To our knowledge, the effects of nAg on gammarids have never been reported yet. In this context, we performed a study in order to evaluate the effects of low concentrations (0.5 to 5µg.L^{-1}) of 5 nAg (size from 10 to 100nm) on *Gammarus roeseli* exposed for 72h. Strong effects were observed on the respiration. The response intensity depended on the nanoparticle size: the highest oxygen consumption rate was observed in organisms exposed to 10nm nAg whereas the lowest was recorded in organisms exposed to 100nm. Effects on organism's respiration could reflect more subtle changes at the cellular bioenergetics level. In addition, other endpoints were investigated during this work (locomotion, FPOM production) and the first results tend to support that effects may be more pronounced for the smallest nanoparticle size. Realistic nAg concentrations, through direct effect at individual level, may cause indirect effects on the aquatic ecosystem functioning.

RS22 - Oral

FUNCTIONAL, BEHAVIORAL AND PHYSIOLOGICAL EFFECTS OF METAL CONTAMINATED LITTERS ON AQUATIC ECOSYSTEMS.

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Numerous polluted sites have been left unmanaged since the end of the industrial era in Europe, in the mid 20th century. Metals such as cadmium and zinc are accumulated in leaves, in quantity depending on tree species. At abscission, leaves still contain metals which can be transferred to adjacent ecosystems (terrestrial or aquatic) and are then susceptible to affect organisms and associated functional processes. In the present study, we aimed to assess the effects of contaminated litter entering small streams, highly dependent on allochthonous organic matter for their functioning. We first assessed the leaching of metals from contaminated litter, showing its fast and high release in water. Then, we tested the impact of leachates on the common freshwater shredder *Gammarus fossarum* following survival, metal bioconcentration, physiological (osmoregulation, digestive enzymes, lipid peroxidation, energy reserve) and behavioral responses (locomotion & ventilation). Finally, in an *in situ* experiment, we conjointly assessed the effects metal contaminated litters on their decomposition and on their consumption by *G. fossarum*. Despite behavioral modifications, litter decomposition and consumption did not differ between contaminated and un-contaminated litters suggesting that in spite of detrimental effects of contaminated litters, ecosystem functions can be maintained, at least in the short term.

RS22 - Oral

HIGH FOOD QUALITY INCREASE THE DETRIMENTAL EFFECTS OF CADMIUM ON THE DETRITIVORE, GAMMARUS FOSSARUM

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In ecosystems, organisms are often exposed to several stressors simultaneously (e.g., pollutants, low resource quality, parasitism…). Yet, interactive effects of stressors on species and ecosystems still remain poorly appreciated. In the present study, we hypothesized that higher food quality would reduce the resistance of molting organisms to metals by increasing the frequency of molt events, a highly sensitive stage. The phosphorus (P) content of two leaf litters representing contrasting carbon quality (*Alnus glutinosa*, *Acer pseudoplatanus*) were manipulated using aquatic hyphomycetes immobilization capacities. Then, the detritivorous crustacean, *Gammarus fossarum* were fed on each food quality, exposed or not to environmentally realistic cadmium concentrations (0.35 and 0.7 $\mu g.L^{-1}$).

Survival and growth of unexposed gammarids were driven by carbon quality and elemental content of litters, as predicted by ecological stoichiometry theory. Cadmium exposed-gammarids showed lower survival and growth rate but, in agreement with our hypothesis, this effect was magnified by a higher P level in resources.

Our results evidenced that despite positive effects of resource quality on organisms life history traits, a high resource quality might increase the detrimental effects of contaminants. This study suggests that species sensitivity to contaminants in nature might be underestimated in ecosystems facing both nutrient and contaminant stresses.

RS22 - Oral

APPLICATION OF CELL BIOSENSORS IN ECOTOXICOLOGY OF CYANOBACTERIA - NOVEL DETERMINANTS OF TOXICITY

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Toxic water blooms involving cyanobacteria are a problem on the global scale, therefore identification and understanding of any bioactive factors produced by various genera/species of cyanobacteria is crucial. We propose, for this action, the use of previously designed, genetically modified cell line-based biosensors sensitive to the activation of signal transduction pathways important from the toxicological point of view (NFkappaB, Nfr2, AhR or GR). Theresponse of biosensors, when exposed to cyanobacterial-derived samples (with genus as *Microcystis, Planktothrix, Cylindrospermopsis* or *Aphanizomenon*) has allowed us to identify novel determinants of toxicity in environmental samples as well as in laboratory cultures. We have shown that some cyanobacterial cell components eliciting a stress/danger response from biosensors are not linked to main known cyanotoxins (microcystin-LR, cylindrospermopsin or anatoxin-a). We have also shown a clear correlation between the type of elicited biosensor response and cyanobacterial genus/species, both in mixed-species blooms and in laboratory cultures. Moreover, by characterising the effect of main cyanotoxins (MC, CYN or ATX) on our biosensors, we were able to validate both their versatility and capability of distinguishing between known and novel toxicity determinants.

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RS22 - Oral

INTRASPECIFIC VARIABILITY OF NITZSCHIA PALEA (KÜTZING) W. SMITH TO TOXIC SUBSTANCES

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Aquatic environments are impacted by many pollutants, including pesticides and metals. It has been shown that diatoms are sensitive to such micropollutants.

In a previous study, Larras et al. (2014) have shown clades of diatoms with homogeneous herbicide tolerance, making the assumption that a given taxon’s sensitivity is homogeneous.

We tested this hypothesis with Nitzschia palea, known for growing in polluted environments, showing taxonomic and intraspecific phylogenetic diversity. Sixteen strains of N. palea from different regions were tested to assess their sensitivity to the herbicides atrazine, terbutryn, diuron and isoproturon, as well as to cadmium and copper. Single strain cultures were exposed to these substances for 96 hours, after which growth inhibition was assessed.

Tolerance differences (EC50) were observed among strains to the same pollutant (from 14x for isoproturon up to 316x for cadmium) and among pollutants to the same strain. Strains from the Portuguese rivers are often more sensitive and those from the UK are more tolerant. Results also show that tolerance is dependent on the biochemical response. There isn’t, however, a direct link between sensitivity and phylogeny.

RS22 - Oral

VARIOUS BACTERIAL GUILDS CONTRIBUTE TO METHYLMERCURY FORMATION IN SEDIMENTS CONTAMINATED BY SEWAGE TREATMENT PLANT DISCHARGES

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The methylation of inorganic-Hg (IHg) to methylmercury (MeHg) is a major concern in aquatic environment, because MeHg can affect human health. Hg methylation is mediated by sulfate-reducing bacteria (SRB), iron-reducing bacteria (FeRB), methanogens and/or firmicutes. Previous studies demonstrated a concomitant release of Hg, iron and organic matter by many sewage treatment plant (STP) discharges.

The aim of the present study was thus to assess the impact of the STP's discharges on Hg methylation in sediments by combining a physico-chemical and microbiological characterization of sediments.

The relationship between species and environmental factors was explained by CCA with 86.91% total contribution. Data suggests that the MeHg concentration was correlated to Organic Carbon, Sulfur, Iron and IHg concentrations in sediments. In all samples proteobacteria, notably g - and d -proteobacteria, wasthe dominant phylum, followed by *Bacteroidetes*, and *Chloroflexi*. Amongst the species carrying genes involved in Hg methylation, *Geobacte*r and *Syntrophus* were clearly more abundant than other genus. Besides, the genes of methanogens (mcrA), SRB (drsA), Hg demethylation (merB) and Hg methylation (hgcA) were the genes influencing the most the community structure. Globally data therefore suggest that FeRB, SRB and methanogens may significantly contribute to MeHg formation in sediments impacted by STP discharges.

RS22 - Oral

HIGHLIGHTING THE IMPACT OF MULTI-POLLUTION IN MEDITERRANEAN FRESHWATERS THROUGH ECOTOXICOLOGY

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Mediterranean climate is characterized by an alternation of long dry periods and short but intense seasonal rainfalls. These contrasts in climate influence river dynamics and therefore the concentration of micropollutants encountered in freshwaters. During dry periods, contaminants become concentrated in rivers watersheds while, during rainfalls, flood events remobilize particles from soils and sediments intensifying multi-pollution phenomena in freshwaters. Mediterranean rivers are therefore good natural models to study the impact of mixtures of pollutants on ecosystems. In this study, we aim atevaluating the ecological impact of recurrent multi-pollution through the ecotoxicological responses of three different model organisms: *Branchiostoma lanceolatum* (Cephalochordata, amphioxus), *Sphaerechinus granularis* (Echinodermata, sea urchin) and *Vibrio fisheri* (bacterium used in Microtox® test). Organisms' responses in terms of growth or activity following contact with waters collected from one of the main rivers of the French Mediterranean basin, the Têt River, revealed the impact of multi-pollution. Indeed, similar negative responses were observed from all organisms to peak contaminations during a flood event, as well as comparable resilience.

RS22 - Poster

IMPACTS OF AGNPS ON A LEAF-SHREDDING INVERTEBRATE VARY WITH EXPOSURE ROUTE

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Silver nanoparticles (AgNPs) have been increasingly used over the last decade, resulting in their heightened release into freshwater ecosystems. AgNPs and ionic Ag derived from NPs can have toxic effects on aquatic species such as invertebrate shredders, which play an important role in aquatic detrital food webs. The goal of this study was to assess the impacts of non-lethal AgNPs and Ag^+ concentrations on litter breakdown and fine particulateorganic matter (FPOM) production by shredders. We assessed both direct (medium) and indirect (food) mechanisms by exposing a common shredder, *Gammarus pulex* (Amphipoda, Gammaridae), to: (i) water contaminated with AgNPs (0, 1, 100 µg L^{-1}) and $AgNO_3$ (0, 0.1 µg L^{-1}), and (ii) leaves contaminated for 6 days with AgNPs and $AgNO_3$ at the same concentrations. Leaf consumption rate and FPOM production were assessed after 15 days. Leaf consumption only decreased when AgNP and $AgNO_3$ exposure occurred via contaminated leaves. However FPOM production by *Gammarus* was affected by bothexposure pathways, showing that exposure to AgNP and $AgNO_3$ via both food and water can cause stress to invertebrate shredder *Gammarus pulex*. This highlights the use of feeding behaviour of invertebrate shredders as an endpoint to assess NP toxicity in aquatic environment.

RS22 - Oral

PESTICIDES MIXTURES AND FISH: FROM CELLULAR RESPONSES TO BEHAVIORAL CHANGES

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France is the fourth largest consumer of pesticides, and chronic contamination of surface water is reported by water quality monitoring programs. The modes of action of most herbicides and fungicides found in rivers on non-target species – like fish – are little known. Moreover, their toxicity is generally considered as low or unproven at the environmental concentrations. But studies on the toxicity of complex mixtures of pesticides on fish are scarce. The current study explored the effects of environmental contaminations by pesticides on fish from the cellular response to the individual. For that, *Carassius auratus* – a fish model species in environmental toxicology - were exposed during 96 hours to mixtures of pesticides at environmental relevant concentrations. We analyzed the sediment reworking behavior, activity, exploratory behavior and feeding rates. At the organ level, we realized somatic indexes measures, histological analysis and protein concentrations dosages. Liver cellular response was assessed by 2D-Proteomic. Our findings indicate that (1) low environmental relevant concentrations of pesticides lead to cellular, physiological and behavioral perturbations in fish; (2) fish responses (adaptive stress response vs. toxic effects) depend on the intensity of stress and (3) fish may be unable to set up efficient adaptive responses when stress become too severe.

RS22 - Oral

COMMUNITY DYNAMICS IN BENTHIC BIOFILMS IN RESPONSE TO DIURON

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Benthic biofilms (periphyton) are taxonomically diverse and dynamic communities of heterotrophic and phototrophic microorganisms. Periphyton is an important component of stream ecosystems regarding biomass and oxygen production. Its complexity and dynamics pose a challenge to identifying appropriate descriptors of stress responses, useful level of detail, and linking observed changes to understand underlying mechanisms.

This study aimed at examining the response of periphyton to Diuron as model herbizide comparing community dynamics considering structural, genetic, and functional descriptors. Periphyton continuously exposed to 5 µg/L Diuron was assessed by flow cytometry, genetic fingerprinting (automated ribosomal intergenic spacer analysis), photosynthetic efficiency (pulse-amplitude modulated fluorometry, PAM), taxonomy, biomass, and the analysis of extracellular polymeric substances (EPS, by LC-OCD-OND).

Structural, genetic, and functional descriptors showed a specific time-dependent response to Diuron. Genetic analysis indicated restructuration of the communities within the first week with a decrease in green algae diversity. Flow cytometric analysis with ten fluorescent ranges supported these results. Furthermore, EPS analysis indicated a decrease in C/N ratio in the extracellular biopolymers. In contrast, changes in photosynthetic efficiency indicating structural and/or functional changes became manifest after two weeks. After three weeks, none of the descriptors showed major differences between control and Diuron-treated communities.

RS22 - Poster

LAKE GENEVA POLLUTION BY MICROPOLLUTANTS, LONG-TERM MONITORING IN LAKE WATER, SEDIMENT AND BIOTA

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Since 2004, the International Commission for Lake Geneva Protection (Commission Internationale pour la Protection des Eaux du Léman – CIPEL) has strengthened the monitoring of micropollutants thanks to the improvement of analytical techniques. Each year, more than four hundred pesticides and fifty drugs are analysed. The concentrations of 40 pesticides measured vary between 1 and 20 ng/L and those of seven pharmaceuticals between 1 ng/l and 1 µg/L. Mercury, dioxins, furans, polychlorinated biphenyl indicators, dioxin-like polychlorinated biphenyls, polybrominated ethers, organochlorine pesticides, perfluorinated substances and phthalates are investigated every four years from the flesh of six fish species (Arctic char, whitefish, lake trout, perch and burbot). PCBs contamination was revealed in 2008 for large fatty fish Arctic char (Salvelinus alpinus) which led authorities to prohibit commercialization of fish longer than 39 cm. In 2012, the analysis of PCBs and dioxins showed high concentrations in large lake trouts (Salmo trutta lacustris).Mussels (Dreissena polymorpha) and sediments are also monitored every 10-20 years. In 2015, a large survey on sediments is on the agenda with special attention to heavy metals, PCBs, pesticides, PFOS and some emerging pollutants.

RS22 - Poster

SPATIAL OCCURRENCE OF HEPATOTOXIC MICROCYSTINS IN DANUBE DELTA SHALLOW LAKES

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In the shallow lakes of the Danube Delta Biosphere Reserve (Romania) frequent cyanobacteria blooms occur as consequence of eutrophication. Genera such as Aphanizomenon, Microcystis, Oscillatoria, Anabaena, known to be able to release cyanotoxins, are often observed during these blooms, posing the risk of harmful algal blooms in the context of climate change. The water quality of these lakes is of particular importance for humans inhabiting the delta as for the wildlife. Therefore, we aimed to identify and quantify the presence of cyanotoxins in the water column.

Our study was carried out in October 2014 and focused on the identification of hepatotoxic microcystins in 8 shallow lakes, using HPLC – DAD method. The lakes were selected based on the high cyanobacterial abundance, estimated from a survey of cyanobacteria chlorophyll a content in the water column. Microcystins type RR, YR, LR, LF, LW were detected, the most frequent being microcystins LR, which ranged between 12.56 – 16.42 µg/l (LR content in the aqueous phase). The highest concentration of total microcystins was recorded in Rosu Lake, overcoming e.g. the Italian standards for maximum admissible concentrations (MAC) in bathing water. The relationship of microcystins presence with the biotic and abiotic environment will be further investigated.

RS22 - Poster

SPECIATION OF CD, PB AND ZN IN AQUATIC SYSTEMS BY ULTRAFILTRATION AND ICP OES

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The chemical forms of an element in aquatic environments are related to their mobility and toxicity. In this way, the total concentration of a metal in the water do not reveal its real level of contamination to organisms. Consequently, it is important to investigate specific fractions of metals and its interactions with dissolved organic carbon (DOC) to a better understanding of their role in the environment. Samples of surface water were collected in Itapanhaú and Sorocabinha rivers in the State of São Paulo, southeast of Brazil in order to understand the effects of NOM in the mobility and availability of Cd and Pb. The dissolved fraction was determined using 0.45 µm filter. It was used ultrafiltration systems to determine the fractions <1KDa, which was considered “free” fraction (or inorganic complexes). The DOC obtained was 52.50 and 16.20 $mg.L^{-1}$ for Sorocabinha and Itapanhaú Rivers respectively. Concerning the trace metals present in the samples, Cd is absent in both rivers. The Pb concentration in the Sorocabinha river is predominantly complexed in the particulated fraction (total-dissolved) and is below detection limit in the Itapanhaú. The Zn concentration is within the usual natural levels and is mostly complexed by dissolved and particulated.

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RS22 - Poster

BIOACCUMULATION OF MICROCYSTIN-LR AND INFLUENCE IN LEPTONEMA BEHAVIOR (TRICHOPTERA: HYDROPSYCHIDAE)

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The use of freshwater for human consumption, industrial and watering livestock has intensified in recent years, which requires more stringent policies for the management of water use. The generation of effluents and improper disposal in water bodies has contributed to the eutrophication of aquatic environments, resulting in extensive damage to public health. One such damage is related to blooms of producers cyanobacteria cyanotoxins potentially. In view of these aspects this study aimed to assess the effect of microcystin (MC-LR) produced by *Dolichospermum circinale* exposed to larvae of Trichopteras, as to behavior and bioaccumulation. Acute exposure of 96 hours was performed with 50.000 (R50) and 25.000 (R25) cell *D. circinale*. This study found that the higher the concentration of cells, greater disturbances in Trichopteras and greater production of MC-LR. The highest detected levels of MC-LR were 0.45 µg/L in water exposure samples made with R50, however, the highest concentration in Trichopteras was 5.98 ng/g. The concentration R50, showed over 50% mortality in Trichopteras. It is recommended greater attention to the amount of cells established by the Brazilian ordinance n° 2.914, even in low concentration of cells, *D. circinale* shown to be potentially toxic to Trichopteras.

RS22 - Oral

BIOMARKER RESPONSES TO NANOCUO-INDUCED OXIDATIVE AND NEURONAL STRESS IN FRESHWATER CADDISFLY LARVAE

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The release of nanometals into natural waters has raised concern about the risks of these emerging contaminants to aquatic biota. The caddisfly larva *Allogamus ligonifer* plays a key role in detrital foodwebs by transferring carbon and energy from plant litter to higher trophic levels in streams. To understand the role of released Cu ions in nanoCuO-induced stress, biomarker responses were assessed in *A. ligonifer* after 96h exposure to nanoCuO or Cu^{2+} (as $CuCl_2$) at concentrations $<LC_{30}$. Cu^{2+} released from nanoCuO under exposure conditions was quantified, and biomarker responses to Cu^{2+} at similar effective concentrations were compared. Superoxide dismutase, glutathione peroxidase and glutathione reductase (GR) had highest activities at lowest concentrations ($<LC_5$). Apart from GR, the activity of these enzymes decreased with increasing concentrations of nanoCuO or Cu^{2+} from LC_{10} to LC_{30}. The activity of glutathione S-transferase increased whereas that of catalase decreased from LC_{10} to LC_{30}. NanoCuO or released Cu^{2+} caused less impact on antioxidant enzymes at concentrations $<LC_{10}$, but had a dose-dependent negative effects between LC_{10} and LC_{30}. Cholinesteraseswere negatively affected by nanoCuO or released Cu^{2+} even at $<LC_{10}$, suggesting neuronal stress. Results suggest that Cu^{2+} plays a crucial role in nanoCuO-induced stress in *A. ligonifer*.

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SS01 - Oral

DEVELOPMENT AND ADVANCES IN ENVIRONMENTAL DNA (EDNA) TECHNOLOGIES FOR AQUATIC INVASIVE SPECIES SURVEILLANCE IN NORTH AMERICA

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Detection of invasive species in aquatic environments routinely relies upon the ability to detect and monitor low densities of organisms with patchy distributions. This can be particularly challenging in aquatic ecosystems, where even large organisms can be difficult to directly observe or capture. Traditional sampling methods are only effective in a narrow range of habitats, principally shallow water with slow water velocities, or moderate to high visibility. Genetic and genomic sampling methods have the potential to overcome many of the constraints posed by traditional aquatic monitoring and detection gear. However, despite the promise of DNA-based monitoring methods, the adoption of these tools in decision-making frameworks remains challenging. The current status of DNA-based tools for aquatic invasive species monitoring in North America and the impediments to their effective translation into management contexts will be discussed. Potential sources of uncertainty associated with molecular technologies, possibilities for limiting that uncertainty, and the future use of these tools for invasive species surveillance in North American waters will be presented.

SS01 - Oral

CAN DNA BASED MONITORING OF MACROZOOBENTHOS DELIVER ABUNDANCE DATA? TESTING PRIMER BIAS AND BIOMASS - SEQUENCE RELATIONSHIPS WITH A NOVEL METABARCODING PROTOCOL

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Metabarcoding combines DNA barcoding with next generation sequencing to reliably identify hundreds of specimens at once. However, detection rates in species-rich invertebrate samples as well as the capability to quantify biomass or species abundances have not been tested. We developed a novel Cytochrome c Oxidase 1 metabarcoding protocol and performed two controlled Illumina MiSeq experiments (each with 10 replicates). In the first experiment we used 31 specimens of a single stonefly species that differed across four orders of magnitude in biomass. We found a clear biomass - sequence abundance relationship but even smallest specimens were reliably detected. In the second experiment recovery of 52 different freshwater invertebrate taxa was tested using similar biomass as templates. With a single primer pair we could recover 83% of the taxa. However, sequence abundance varied by four orders magnitudes between taxa.Our experiments show that although biomass can be estimated if single species are present in a sample, reliable estimates from environmental samples are impossible due to primer bias. Thus, DNA-based ecosystem assessments should rely on presence-absence rather than abundance data.

SS01 - Oral

EDNA BARCODING IN FRESHWATER DIATOMS FOR WATER QUALITY ASSESSMENTS

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Diatoms are frequently used for water quality assessments; however identification to species level is difficult, time consuming and needs in-depth knowledge of the organisms under investigation, as non-homoplastic morphological characters that are species-specific are scarce. We here investigate how identification methods based on metabarcoding perform in comparison to morphological diatom identification. Our findings indicate that NGS technology almost always leads to a higher number of identified taxa, whose presence could subsequently be verified by LM. The sequence based approach allows for a much more graduated insight into the taxonomic diversity of the environmental samples. Taxa retrieval varies considerably throughout the river system, depending on species occurrences and the taxonomic depth of the reference databases. We also identified the quality of the reference library as a key aspect of valid biodiversity assessments. Standardisation efforts for the quality control of diatom taxonomic reference libraries are discussed. The results of the study provide evidence that metabarcoding of diatoms using the V4 region (18S) has a great potential for water quality assessments and could complement and maybe even improve the identification via light microscopy, if the challenge of quantifying abundances can be successfully mastered.

SS01 - Oral

NEXT-GENERATION MONITORING OF AQUATIC BIODIVERSITY USING ENVIRONMENTAL DNA METABARCODING

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Global biodiversity in freshwater and the oceans are declining at high rates. Reliable tools for assessing and monitoring aquatic biodiversity, especially for rare and cryptic species, are important for controlling this loss. Recent advances in DNA sequencing have provided a new reliable tool for species detection from environmental DNA (eDNA) present into aquatic or terrestrial environments. We present in this study a novel approach for monitoring aquatic biodiversity, based on eDNA metabarcoding. We demonstrate the reliability of this approach and its validation using two key aquatic vertebrate groups (amphibians and bony fish). The comparison of eDNA metabarcoding results with traditional survey data and historical data proves that this new eDNA metabarcoding approach represents a next-generation tool for biodiversity monitoring of a wide range of aquatic ecosystems.

SS01 - Oral

R-SYST::DIATOM: AN OPEN-ACCESS AND CURATED BARCODE DATABASE FOR DIATOMS

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Microalgae and diatoms in particular are excellent indicators of freshwater pollution. Actual standardized methodologies are based on microscopic determinations which is time consuming and prone to identification uncertainties. Use of DNA-barcoding is a way to avoid these flaws. Moreover, next-generation-sequencing (NGS) enables getting a large quantity of unidentified barcodes from natural samples. To name them, each of these barcodes are compared to a reference barcoding library, using algorithms. Proof of concept has been recently shown for synthetic and natural communities and underlined the importance of the quality of this reference barcoding library for quality identification.

Here, we present an open-access and curated reference barcoding database, called R-Syst::diatom. The data come from 1) a culture collection of algae maintained at INRA which is regularly barcoded for new strains and 2) NCBI. Two kinds of barcodes were chosen to feed the database: 18S and rbcL because of their identification efficiency. Data are curated using innovative (Declic) and classical (Blast and classical phylogenies) bioinformatic tools and up-to-date taxonomy (Algaebase, Catalogue of Diatom Names, peer reviewed papers). Every 6 month R-Syst::diatom is updated. The database is available through the R-Syst website (http://www.rsyst.inra.fr/) and through virtual_BiodiversityL@b, a galaxy platform dedicated to NGS data analysis (https://galaxy-pgtp.pierroton.inra.fr/).

SS01 - Oral

A PIPELINE FOR BUILDING MOLECULAR BASED INVENTORIES AND COMPUTING DIVERSITY INDICES OF COMMUNITIES.

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Exploring biodiversity patterns in space and time has been a challenge for over one century. It has evolved from phenotypic based inventories to molecular based ones, and benefitted recently from data avalanches with NGS. This is especially true for protists, which represent the highest 'deep' diversity. We present here a pipeline which enables to produce species based inventories of protist communities, from list of reads of a metagenome of an environmental sample. Beyond that, many diversity indices have been derived from inventories where each individual was recorded, named, and counted. However, data available from NGS experiments are no longer individual based annotations. In a second part, we present some preliminary results obtained from several diatom communities, which have been known simultaneously by individual based optical inventories and by lists of reads from NGS experiment at sample level. We compute diversity indices on both inventories, compare them, and discuss the role played by the weight of the tail distribution in unifying or distinguishing both ways of producing inventories. Our perspective is to propose sound diversity indices computation from set of reads as output of NGS experiments.

SS01 - Oral

THE POWER AND PROMISE OF ENVIRONMENTAL DNA FOR RIVER BIODIVERSITY MONITORING

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River channel restoration is used in water management to restore biodiversity and ecosystem functioning. Recovery, however, is often context dependent and intrinsically linked to whether or not species occur locally and can recolonize a restored area. Determining the local species pool from a rivers' catchment is therefore necessary in order to predict potential recovery. In river systems, the power of using environmental DNA (eDNA) to estimate biodiversity of animals is just starting to be explored. It is known that eDNA of individual species can be transported downstream. Thus, water samples may be an integrated measure of aquatic biodiversity for a river's catchment. In this study we used next generation sequencing of eDNA to describe metazoan eukaryotes across 24 catchments in Switzerland. We have found over 10,000 molecular operation taxonomic units (MOTUs) across the sites and the MOTUs can be attributed to nearly twenty animal phyla (e.g., Annelida, Arthropoda, Chordata, Heterokontophyta, and Mollusca). Additionally, terrestrial taxa such as birds, cows and spiders are detected. Together these results validate that eDNA can be used to biomonitor the animal kingdom living in or near freshwater resources and provides evidence that it does so on a scale relevant to the catchment of a watershed.

SS01 - Oral

TEMPORAL EVOLUTION OF BENTHIC DIATOM COMMUNITY IN LAKE GENEVA USING NEXT-GENERATION SEQUENCING APPROACH

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Diatoms are among the main bioindicators used to assess the ecological quality of waterbodies. However, the taxonomic determination of their communities with microscopy is difficult and time-consuming. As Next-Generation Sequencing (NGS) has been shown to be suitable for studying their communities (Kermarrec et al 2013), the reliability of this metabarcoding approach was tested on environmental samples. We followed the temporal evolution of the benthic diatom community in Lake Geneva during ten successive months at the same site. NGS sequencing was performed with PGM on rbcL barcode with replicates. Read libraries were analyzed with a special bioinformatics workflow and an expert reference database (R-Syst::diatom database) to obtain diatoms inventories.

Taxonomic name attribution to reads was verified by comparing NGS inventories to microscopy inventories. Some divergences were observed mainly due to the incomplete coverage of the reference database. However, when considering only species that were in the reference database, inventories were mostly consistent qualitatively and quantitativelyand rbcL marker appeared to be powerful for molecular identification at species level.. Moreover, diatom community composition reflected similar ecological status of the lake for both molecular and morphological approaches, encouraging the use of such a metabarcoding approach coupled to NGS in biomonitoring programs.

SS01 - Oral

FISH BIODIVERSITY SURVEY IN FRESHWATER ECOSYSTEMS: PERFORMANCE, ROBUSTNESS AND ECOLOGICAL RELIABILITY OF EDNA METABARCODING APPROACH

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In the past few years, environmental DNA (eDNA) has drawn attention for different reasons, including its potential use for conservation purposes. Most of the eDNA research has focused on the detection of single species using a species-specific marker. On the other hand, the eDNA metabarcoding approach, designed for group-specific detection at species level, has not been extensively tested in freshwater environments up to now. In this study, we investigated the performance, robustness and ecological reliability of this approach for assessing fish biodiversity in a stream outflowing from a lake . Three main aspects were tested: (1) the effect of water sampling strategies on the detection probability, (2) the comparison of complete field surveys with the eDNA metabarcoding approach and (3) the longitudinal pattern of the eDNA metabarcoding signal. Our eDNA metabarcoding results showed a low variability between different sampling strategies, and demonstrated the reliability of the eDNA approach when compared to traditional field methods. In addition, this study shows distance detections longer than the site range (150m) and no detection of lake dwelling species 3.6km away from the lake in the outflowing stream.

SS01 - Poster

USING META-BARCODE TECHNOLOGY TO SURVEILLANCE FISH COMMUNITY IN TAIHU LAKE

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Taihu lake, a very famous freshwater lake in eastern China, had more than one hundred bony - fish species in historical, belonging to 73 genus, 25 families, and 14 orders. In the past two decades, according to the survey of fish using traditional capture method, there were no less than fifty species in this lake, because of the dike built round the lake, severing the intercommunication between the Yangtze river and Taihu lake. Using lake water DNA is a new, promising method for tracing fish practices, and provides a new outlook for protecting bio-diversity in Taihu lake. First, we constructed a DNA barcode library of fish in Taihu lake, Then, water sample were collected in 108 sites around the Taihu basin to extract DNA, and after amplify target DNA region, NGS technology was cooperated to sequence enough reads to assign taxonomy using above DNA barcode library. meta- barcode technology, compared with traditional capture method, rapidly provided detailed fish community data to make fishery management policy. and also, it's the first practice using environmental DNA method in Taihu lake.

SS01 - Oral

MONITORING LAKE-ECOSYSTEM HEALTH USING METABARCODING OF ENVIRONMENTAL DNA: TEMPORAL PERSISTENCE AND ECOLOGICAL RELEVANCE.

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The use of environmental DNA (eDNA) has been advocated as a powerful tool for biodiversity identification in freshwater ecosystems. A related additional application lies with monitoring ecosystem health or biomonitoring. Traditionally, applications of biomonitoring have been based upon taxonomic identification of biota, such as macroinvertebrates.

We are testing the use of eDNA for the detection of chironomid midges (Diptera: Chironomidae), a sentinel group for lake monitoring. Water and chironomid exuviae (CPET) community samples have been collected every 3 weeks, from an annual series of water samples in a natural lake ecosystem in North Wales, and subjected to amplicon sequencing (MiSeq) of the Cytochrome Oxidase I (COI) gene. Parallel taxonomic identification of some community samples provides a real time comparison of molecular vs. traditional approaches. Additionally, we are investigating the temporal persistence of eDNA in the wild by recording taxon presence from aqueous eDNA and the community samples. Findings will contribute towards establishing a framework for direct application of eDNA in lake health assessment, ultimately aiming to fulfil international directives.

SS01 - Oral

REGIONAL-SCALE PATTERNS IN PLANKTONIC MICROBIAL COMMUNITIES FROM TEMPERATE OLIGOTROPHIC LAKES IN THE SOUTHERN HEMISPHERE.

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Relatively little is known about the diversity and community structure of freshwater plankton in lakes of the Southern Hemisphere and, in particular, if physical and chemical forcing results in congruent biotic structure as observed in Northern Hemisphere lakes or rather that microbial plankton bears a strong imprint of divergent biogeographical histories.

Here, we studied spring and summer microbial plankton communities in limnologically similar, oligotrophic lakes in Chile (36-39°S) and New-Zealand (41-45°S) along altitudinal gradients (20-2000 m). Prokaryotic and eukaryotic assemblages were taxonomically profiled with 16S and rbcl/18S rRNA marker genes, respectively, using paired-end Illumina MiSeq sequencing. As in similar Northern Hemisphere lakes, the eukaryote phyla, Dinophyta, Stramenopila, and Chlorophyta, and the prokaryote

Proteobacteria (α and β), Actinobacteria and Bacteroidetes, accounted for the majority of reads. We observed comparable macroecological patterns within both regions, with local OTU richness being negatively related with altitude for both prokaryotes and eukaryotes, and positively correlating with lake area for the latter only. Multivariate analysis further revealed that conductivity and underwater light climate were important structuring factors. Strikingly, different phylogenetic groups exhibited divergent levels of differentiation between both regions. This is at least partially in agreement with earlier studies showing significant bioregionalisation in Southern Hemisphere microbiota.

SS01 - Oral

FINE TUNING FOR THE TROPICS: APPLICATION OF EDNA TECHNOLOGY FOR INVASIVE FISH DETECTION IN TROPICAL FRESHWATER ECOSYSTEMS.

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The use of eDNA technology is gaining momentum as a tool in temperate regions, but its effectiveness remains to be fully explored in the tropics with their unique climatic conditions (higher average water temperatures, elevated UV exposure, high levels of suspended particulate matter (SPM), and large-flow wet seasons). In light of this, we have made modifications to the conventional eDNA protocols so that they are more suited for use in tropical environments using the invasive pest fish, Tilapia, *Oreochromis mossambicus*

as a model. This is the first study to successfully use 20-μm filters to detect species in environments where turbidity hampers conventional filtration methods. Our work is the first to demonstrate that fish shed more DNA into the environment when exposed to higher temperatures. This is a key finding if eDNA is going to be used for qPCR quantification. We confirm that there is no detectable effect of temperature on eDNA degradation rates (tested to 35°C). We were able to determine our minimum detection limits (1 fish/.4 Megalitres) and found that the application of water flow into ponds with high fish density did not affect eDNA detection rates.

SS01 - Poster

EVALUATION OF MICROBIAL COMMUNITIES TO DISTINGUISH ENVIRONMENTAL DIFFERENCES IN SPRING WATERSHEDS

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Groundwater flows through subsurface aquifers where numerous and complex geochemical interactions can result in a potential decrease of water quality. It is therefore important to understand the effects and impacts of these processes. Springs are ideal places to study such effects because they provide ready access to subsurface water. The concentration of chemical parameters in spring water can indicate the origin of the recharge and chemical processes happening in the spring´s watershed. Currently, only abiotic factors are considered when assessing groundwater quality, however, groundwater is also an ecosystem inhabited by a variety of organisms, which react to changes in their environments. As such, these organisms are potential models, or indicators, for water quality. The aim of this study was to investigate the spatial and temporal composition of bacterial communities and the environmental conditions of different springs to evaluate whether abiotic parameters shape the composition of microbial communities, and if shifts in abiotic conditions alter community composition. Bacterial 16S rDNA from water samples was isolated and sequenced to analyse community composition and we tested whether the identified species correlated with the abiotic parameters. Preliminary results indicate that environmental parameters (electrical conductivity and nitrate concentration) have a tendency to influence community composition.

SS01 - Poster

USE OF ENVIRONMENTAL DNA TO DETECT NON-NATIVE FRESHWATER FISHES.

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Effective management of non-native species depends on reliable knowledge of their distribution, and environmental DNA (eDNA) surveys can prove more effective for determining species presence than traditional survey techniques. This study used conventional PCR and species-specific primers to detect fourfreshwater fish species introduced to the UK: topmouth gudgeon *Pseudorasbora parva*, sunbleak *Leucaspius delineatus*, pumpkinseed *Lepomis gibbosus* and fathead minnow *Pimephales promelas*. Laboratory trials detected DNA of all four species within 24 h of introduction into 44-L aquaria, at three different fish densities (1, 5 and 10 fish). In experimental ponds, pumpkinseed DNA was detected within 6–12 hours of fish stocking. These methods were then applied to a field survey, with eDNA confirming topmouth gudgeon presence in three ponds where it was known to occur. Surveys were then conducted to test the effectiveness of a topmouth gudgeon eradication attempt in a 1.4-ha commercial fishing lake. Our sampling methodology involved water sampling at 24 points (12 littoral, 12 pelagic). Four replicate filtrations and DNA extractions were conducted at each point. Topmouth gudgeon DNA was detected only at three points in the lake. These results were confirmed by a second sampling in a more restricted area and sequencing.

SS01 - Oral

WHEN MORPHOLOGY MEETS GENETICS : THE CASE OF MACARONESIAN MAYFLIES

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Recent genetic studies using a general mixed Yule-coalescent (GMYC) model revealed the presence of 12 putative species of Baetidae (Ephemeroptera) in the Canary Islands and Madeira. Pronounced island endemism contradicts previous taxonomic work, which reported a depauperate fauna that included severalmainland species. With a set of morphological characters already applied to continental cryptic species within the genera *Baetis* and *Cloeon*, we wanted to test the extent to which morphology supports the genetic results. For most putative species, we were able to findmorphological characters to reinforce the validity of the species status. Each cryptic species seems to be endemic to a distinct island except *Baetis atlanticus*, which occurs both on Madeira and Continental Europe. These results have important conservation implications; because of their small population size and extensive habitat alteration, most species must be considered as highly endangered.

SS01 - Oral

INVESTIGATING LONG-TERM CYANOBACTERIAL RESPONSE TO EUTROPHICATION AND RE-OLIGOTROPHICATION USING EDNA PRESERVED IN LAKE SEDIMENTS

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Eutrophication promotes phytoplankton growth and increases the risk of harmful cyanobacterial bloom occurrence in freshwaters. However, the responses of cyanobacterial communities to long-term eutrophication and re-oligotrophication processes are poorly understood. We investigated the dynamics of cyanobacteria community structure in peri-alpine lakes located in Switzerland and Italy over the last century using environmental DNA (eDNA) recovered from sediments cores along with long-term monitoring data on physico-chemical parameters and species abundances. High-throughput sequencing of cyanobacterial 16S rRNA genes revealed that their diversity and richness changed through the periods of pre, mid, and post-eutrophication. Microscopic identification of cyanobacteria in the water column from the 1980s to present also showed a change in diversity and community composition along a phosphorus gradient. Furthermore, community richness and taxonomic composition in pre- and post- eutrophication periods appeared to be more similar to each other than to the community during the eutrophication phase. This study highlights the potential of combining eDNA and long term monitoring data to reconstruct long-term community changes in freshwater plankton and investigate species biogeography in time and space.

SS01 - Oral

POTENTIAL AND PITFALLS OF DNA-BASED BIODIVERSITY ASSESSMENTS IN THE CONTEXT OF THE EU WATER FRAMEWORK DIRECTIVE

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Detailed taxa lists are the basis for biodiversity assessments in the context of the European Water Framework Directive (WFD). These lists shall reflect the true biodiversity of the sampled ecosystem and are compared against taxa lists obtained from a reference ecosystem in order to assess the ecological status. Recent studies, however, have identified different sources of error that limit the quality of WFD ecosystem assessments, namely i) sampling errors, ii) overlooked specimens, and iii) species misidentifications. These problems can lead to incorrect assignments of the ecological status. Novel 'next-generation sequencing' techniques, such as DNA-metabarcoding of bulk samples or eDNA screens of water samples, have been proposed as a possible solution. Yet, analytical and conceptual challenges remain prior to a successful integration in standardized WFD-based assessments. In this talk I will outline the potential and pitfalls of novel DNA-based techniques when specifically considering their application in the context of the EU-WFD.

SS01 - Oral

IMPROVED ENVIRONMENTAL BIOMONITORING USING TARGETED GENE ENRICHMENT - A CASE STUDY USING FRESHWATER MACROINVERTEBRATES

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We investigated the applicability of using molecular methods to assess macroinvertebrate community composition in samples collected from 12 rivers across New Zealand. The samples were initially analysed using traditional morphological techniques. Two genetic methods were tested; (1) gene enrichment (using MYbaits), and (2) PCR amplification of the *Cytochrome Oxidase 1* mitochondrial gene. Sequencing was undertaken using the Illumina™ MiSeq platform. The highest Spearman rank correlations between abundance and biomass (determined microscopically), and the number of sequence reads were obtained using the gene enrichment technique for 90% of samples. We assessed the detectability of rare (<1% of the total abundance or biomass), moderately abundant (1–5%), and highly abundant (>5%) taxa with each genetic methods. The median detection rate was highest with the gene enrichment method, for both abundance and biomass for all classes. These data emphasise the challenges with using PCR amplification-based methods, and highlight the potential benefits of using more targeted approaches, such as gene enrichment, for biomonitoring.

SS01 - Oral

INFERRING BIOTIC INDICES FROM MOLECULAR DATA

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Environmental diversity surveys are crucial for the bioassessment and biomonitoring of anthropogenic impacts on aquatic ecosystems. Traditional monitoring is based on morphotaxonomic inventories of biological communities, which are time-consuming, expensive and require excellent taxonomic expertise. High-throughput sequencing of environmental DNA or RNA (metabarcoding) offers a powerful tool to describe the biodiversity. However, the capacity of the metabarcoding approach to meet the quality standards of bioindication is subject of controversy. Here, we present the comparison of biotic indices inferred from morphotaxonomic and molecular data for different groups of bioindicators (diatoms, oligochaetes, meiofauna). We found that the molecular data faithfully reflected the morphology-based indices and provides a similar assessment of ecosystem status. We advocate that future biomonitoring should integrate metabarcoding as a rapid and accurate tool for the evaluation of the quality of aquatic ecosystems.

SS01 - Poster

ENVIRONMENTAL MONITORING: INFERRING DIATOM INDEX FROM NEXT-GENERATION SEQUENCING DATA

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Diatoms are widely used as bio-indicators for the assessment of water quality in rivers and streams. Classically, the diatom biotic indices are based on the relative abundance of morphologically identified species weighted by their autoecological value. Obtaining such indices is time-consuming, costly and requires excellent taxonomic expertise, which is not always available. Here we tested the possibility to overcome these limitations by using a next-generation sequencing (NGS) approach to identify and quantify diatoms found in environmental DNA and RNA samples. We analysed 27 river sites in the Geneva area (Switzerland), in order to compare the values of the Swiss Diatom Index (DI-CH) computed either by microscopic quantification of diatom species or directly from NGS data. Despite gaps in the reference database and variations in relative abundance of analysed species, the diatom index shows a significant correlation between morphological and molecular data indicating similar biological quality status for the majority of sites. This proof-of-concept study demonstrates the potential of NGS approach for identification and quantification of diatoms in environmental samples, opening new avenues towards the routine application of genetic tools for bioassessment and biomonitoring of aquatic ecosystems.

SS01 - Poster

NEXT-GENERATION SEQUENCING OF AQUATIC OLIGOCHAETES: COMPARISON OF EXPERIMENTAL COMMUNITIES

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Aquatic oligochaetes are a common group of freshwater benthic invertebrates known to be very sensitive to environmental changes and currently used as bioindicators in some countries. Actually, more extensive application of oligochaetes for assessing the ecological quality of watercourses and lakes would require overcoming the difficulties related to morphology-based identification of oligochaetes species. Here, we are testing the possibility to use the Next-generation sequencing (NGS) of a standard cytochrome c oxydase I (COI) barcode as a tool for rapid assessment of oligochaetes diversity in mixed samples. To know the exact composition of each sample we Sanger sequenced every individual present in these samples. Our study shows that the majority of lineages can be detected in NGS analyses. We also observe that the NGS data reflect quite well the relative abundance of species present in the sequenced samples. Although the abundance of a few species or genetic types in NGS data is either over- or underestimated, the difference seems rather consistent across samples suggesting that it might be possible to overcome this limitation by using an empirically designed correction factor. We show that such factors reinforce the congruence between the values of oligochetes-based indices inferred from NGS and Sanger sequencing data. Their validation by further experimental studies will be needed in order to fully benefit from the potential of NGS technology in biomonitoring studies based on oligochaete communities.

SS01 - Poster

TOWARDS A COMPREHENSIVE DNA BARCODING DATABASE FOR SWISS STONEFLIES

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Stoneflies belong to the Plecoptera order, which together with the Ephemeroptera and Trichoptera (EPT) are commonly used as bioindicators of water quality. However, the morphological identification of species, especially of immature stages is often difficult. The DNA barcoding provides an alternative in species identification that complements the traditional morphological approach. Here, we present the results of the SwissBOL (Swiss Barcode of Life) project, which aims at completing the barcoding database for Plecoptera and other aquatic insects. We obtained COI sequences for 228 specimens belonging to 84 out of 112 Plecoptera species listed in Switzerland. A non-destructive DNA extraction, which does not affect the morphology of the sequenced specimens, was employed. Our study is the first step towards building the EPT database, which is essential for implementation of the eDNA metabarcoding for the biomonitoring of aquatic ecosystems in Switzerland.

SS03 - Poster

IMPACT OF ENVIRONMENTAL FACTORS ON ALLELOPATHIC INTERACTIONS IN FRESHWATER PHOTOTROPHIC BIOFILMS

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Allelopathy, the chemical inhibition of competitors, is known to influence phytoplanktonic community structure and dynamics. However, this process is poorly studied in benthic communities. The biofilm-forming filamentous green algae *Uronema confervicolum* is known to produce several allelochemicals: two polyunsatured fatty acids (linoleic and α-linolenic acid) that inhibit diatom growth, and unidentified compounds that inhibit diatom adhesion. The aim of the study is to understand how environmental factors could influence the production of allelochemicals by *U. conferviculum*. Antifouling compounds production was followed using an adhesion inhibition assay. Polyunsatured fatty acid concentrations in algal biomass and in culture medium were measured using gas chromatography. In a first experiment, allelochemicals production was followed during a 48-day period in standard conditions. In a second experiment, light and aeration conditions were modified in order to obtain three different growth rates, crossed with four different nutrient conditions (depleted in nitrogen and/or phosphorus). Each culture was sampled at the middle and at the end of the exponential growth phase. First results indicate a strong influence of culture age on allelochemicals production. The amount of both fatty acids per unit of biomass was higher in early exponential phase and then strongly decreased.

SS03 - Oral

DISENTANGLING THE RESPONSE OF FUNCTIONAL INDICATORS OF HEADWATER STREAM HEALTH ACROSS A CATCHMENT-LEVEL LAND-USE GRADIENT

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Headwaters are important components of the riverine landscape where intense biological activities, chemical as well as hydromorphological processes occur, influencing then downstream reaches. Disturbance to these systems as a result of modification of natural landscapes and land-use intensification has the potential to affect ecosystems situated downstream. Tools for assessing the ecological state of stream are needed, notably to measure the success of restoration efforts. In this regard, measuring ecosystem functions is increasingly recognised as a potent tool for assessing stream health. In this study, we measured the response of epilithic biofilm growth, benthic algal biomass, detritivore- and microbe-mediated leaf litter decomposition rates, leaf litter-associated eco-enzymatic activities and loss of cotton-strip tensile strength across a land-use gradient of thirty-one catchments. We specifically attempted to answer two questions: (1) were there consistent responses to the land-use gradient among contrasting functional indicators, (2) what were the links between water quality and functional indicators? First results showed clear relationships between land-use gradient and streamwater nutrient load. The responses of functional indicators were not always straightforward and suggest that the evaluation of stream ecological status should gain by combining several functional indicators and assessments of physico-chemical parameters at a higher frequency and more extended time-scale.

SS03 - Oral

INFLUENCE OF CHEMICAL SPECIATION AND PERIPHYTIC COMPOSITION ON MERCURY CONTENT IN PERIPHYTON

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Periphyton is a melting pot of microorganisms which lives in aquatic systems. The objectives of the present study were to better understand the role of the water quality characteristics on periphyton composition and its Hg accumulation. Mercury is a priority hazardous substance due to its toxicity, and biomagnification of methylmercury (CH3Hg) along the food chain. To that end, periphyton were grown along the Olt River (Romania), representing a gradient of Hg pollution. They were analyzed for their Hg content and composition (microscopic and genetic analyses). Physico-chemical parameters of ambient waters were also examined and Hg speciation calculated at each studied site. Bioaccumulation of inorganic Hg was found to be positively linked with Hg(OH)2 concentration in water in contrast with CH3Hg, which was rather influenced by the presence of gcs gene in the biofilms. Microscopy and pyrosequencing analyses showed that periphytic composition changes along the Olt River with the increase in polluted sites of bacterial phylum such as Verrucomicrobia, Firmicutes, Cyanobacteria and Bacteroidetes, which are known to be involved in Hg transformation. Overall our study demonstrates that Hg speciation and periphytic composition are important parameters to take into account to predict its uptake by periphyton and the impact on aquatic systems.

SS03 - Oral

SPATIAL DISTRIBUTION OF ZOOPLANKTON COMMUNITIES AND WATER CHEMISTRY IN THE UPSTREAM SCHELDT BASIN: COUPLING AND LINKAGE WITH WATER FRAMEWORK DIRECTIVE.

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The Scheldt estuary has its source in the north of France, crosses Belgium to flow into the North Sea at Vlissingen, The Netherlands. This study presents one of the first inventories of the zooplankton community in the poorly documented rivers of the upstream Scheldt basin, resulting from two spring campaigns covering 18 stations.

The zooplankton community is generally pauci-specific, strongly dominated by rotifers. The genus *Brachionus*, *Keratella*, and *Polyarthra* dominate strongly. Most stations are impacted by human activities such as urban, industrial and agricultural activities as well as past mining and industrial activities and hydromorphological pressures such as canalization. As a consequence of this, the Water Framework Directive classifies most stations as moderate to bad qualities. There is a tendency for higher zooplankton abundance at stations which are categorized as moderate.

An extensive quantification of pollutants (elements were quantified covering trace metals, phtalates, pesticides, PCB, PAH and methyl-PAH) carried out at the same stations/time as the zooplankton sampling showed that mainly pesticides structure the zooplankton spatial distribution. We also discuss difficulties encountered to combine the extensive chemical dataset with the zooplankton data as well as the comparison of this exercise with the Water Framework Directive classification of the stations.

SS03 - Oral

NEED OF PHYSIOCHEMICAL MONITORING IN MUSSELS HABITAT RESTORATION

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The once widespread *Unio crassus* in Luxembourg can be found nowadays only in the upper course of the rivers Our and Sauer. Habitat restoration will be the only possible way to save these local populations on the long run. The major part of this restoration is the improvement of water quality in the tributaries of Our and Sauer. *Unio crassus* is not an fast responding indicator for the water quality because of its life cycle and activity. Therefore a monitoring program with different physiochemical parameters such as phosphate, nitrate, turbidity, redox potential and sediment deposition was established. The aim of the monitoring is to give a detailed description of the in situ status and to evaluate the practical measures. Furthermore the results of the monitoring are an important tool to show the efficiency of the measures to the concerned parties and the administration.

This study shows the implementation of the monitoring program, the realization of different measures and their evaluation. The work is implemented in the LIFE+ Nature project LIFE11 NAT/LU/857 to restore rivers in the Luxemburgish Ardennes.

SS03 - Oral

HOW WELL CAN COMMONLY-USED METRICS DESCRIBE THE EFFECT OF WATERSHED-LEVEL LAND-USES ON AQUATIC NATURAL ORGANIC MATTER?

J. Cornut[1,2], M. Danger[1,2], S. Devin[1,2], V. Felten[1,2], M. Filella[1,3], M. Fouillet[1,2], F. Guérold[1,2], F. Manoury-Danger[1,2], V. Mba Ekomo[1,4], S. Mounier[5] , J. Rodríguez-Murillo[6], B. Pernet-Coudrier[7], M. Spitoni[1,8]
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Modification of natural landscapes and land-use intensification often influence the ecological functioning of aquatic ecosystems downstream. Tools for assessing the ecological state of streams are needed, notably to measure the success of restoration efforts. In this regard, riverine natural organic matter (NOM) may provide spatially integrated parameters useful for research and management. However, this requires the prior understanding of the relationship between land-use and aquatic NOM concentration and characteristics. So far, attempts in this direction have often been hindered by the vast diversity of confounding factors, except in a few cases with sharp and well-defined gradients. The problem is accentuated by the elusive nature of NOM itself and the limited information furnished by the myriad of commonly-used analytical methods. In the present study, we followed NOM total concentrations and characteristics in 31 headwater streams in a temperate zone (Lorraine, France) at two occasions with the objective of critically testing the usefulness of commonly-used NOM metrics. We benefited from (i) an unusually extensive set of perfectly characterised watersheds along a land-use gradient; (ii) a parallel study where a variety of functional indicators of stream health were measured; (iii) an extensive expertise on analytical methods for NOM characterisation and quantification.

SS03 - Oral

ECOLOGICAL AND CHEMICAL STATUS OF PERI-URBAN LAKES IN THE ILE-DE-FRANCE REGION: DATA COLLECTION AND INDICATOR DEFINITION

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Peri -urban lakes provide essential ecosystem services. They are subject to a large variety of local and global pressures that may interact, such as nutrient imbalance, organic micro-pollutants and trace metals from both agricultural and urban origins. In this context, one of the main objectives of the research project PULSE (Peri-Urban Lakes, Society, and Environment) was to investigate the impact of anthropogenic pressures on water quality of peri-urban lakes by monitoring a large variety of physical, biological and chemical parameters on a representative sample of 49 lakes in the Ile-de-France region. Thephysical-chemical parameters (water temperature, pH, conductivity and oxygen), the biological parameters (Chlorophyll *a*, Cyanobacteria biomass, *Escherichia coli* densities…), and the chemical parameters (Polycyclic Aromatic Hydrocarbons and trace metals) were measured simultaneously in the water column during summer campaigns, performed during 3 successive years (2011, 2012, 2013). Based on a comparative analysis of the values obtained during these 3 years, water quality indicators were defined and provided us with an interdisciplinary overview of the lake status in the Ile-de-France region. These indicators also allowed us to assess the links between the biological and chemical status of the lakes and the characteristics of their catchment, at the regional scale.

SS05 - Oral

ASSESSING THE EFFECTS OF SITE-SPECIFIC CHEMICAL MIXTURES ON BIOFILM COMMUNITIES USING THE CONCEPT OF POLLUTION-INDUCED COMMUNITY TOLERANCE (PICT)

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The PICT-concept was recently suggested to support site-specific risk assessment, because it provides a causal link between chemical exposure and community effects. However, the application of the concept at different field sites is restricted by a limited comparability of local communities stressed by complex mixtures of contaminants. To overcome these limitations, we used mobile aquatic mesocosms (MOBICOS) to cultivate biofilms within flow channels fed with unaltered surface water from the Holtemme River (Germany). This river exhibits a distinct land use gradient of pristine, urban and agricultural sites. Chemical extracts were derived from an agricultural site and a site impacted by a WWTP by Solid Phase Extraction from April to October 2014. The effects of these mixtures were evaluated on biofilms cultivated at a pristine site and a site close to the mouth of the stream, respectively. Additionally, chemicals identified in former monitoring programs were tested. Clear PICT-responses were identified for the extracts and the single compounds indicating that a limited number of modes-of-actions may drive the overall PICT-response. A strategy will be suggested how integrated community responses like PICT can be related to chemical profiles of contaminated sites to identify chemical groups potentially responsible for the impairment of aquatic communities.

SS05 - Oral

ESTABLISHING CAUSALITY IN ECOTOXICOLOGICAL RISK ASSESSMENT OF MICROPOLLUTANTS IN WASTEWATER EFFLUENTS

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The aim of this field study is to causally link real effects resulting from microbial community-level exposure to mixtures of micropollutants present in wastewater treatment plants (WWTPs) effluents. Therefore, we combined passive sampling technologies with the assessment of extract toxicity on in-situ periphyton. Periphyton were sampled up- and downstream of four WWTPs in Switzerland and exposed to various dilutions of extracts from passive samplers (PS) that were immersed at the effluent of each site. Tolerance to PS extracts was determined according to the pollution-induced community tolerance (PICT) concept by measuring the inhibition of various functional endpoints. Results showed that despite low concentrations of MPs downstream of the effluents, phototrophic and heterotrophic components of the periphyton displayed increased tolerance towards these MPs. Interestingly, increase of phototrophic and heterotrophic tolerance was variable among sites, which might give a first indication on the MPs composition in the effluents (dominance of herbicides or bactericides). Moreover, the observed effects were accompanied by changes in the microbial molecular diversity. Overall, our study highlights the sensitivity of the proposed approach to detect effects of low MPs concentrations occurring in the field and to establish a causal link between exposure and observed ecological effects on freshwater microbial communities.

SS05 - Oral

INFLUENCE OF TEMPERATURE ON THE PICT-RESPONSE OF PHOTOTROPHIC AND HETEROTROPHIC BIOFILM COMMUNITIES TO COPPER

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The concept of pollution-induced community tolerance (PICT) is a promising tool to establish in the field causal relationship between toxicant exposure and resulting effects. However, for a better application of the PICT-concept, it is important to take into account the influence of abiotic factors on the induction of community tolerance. Accordingly and given the increase in extreme climatic events due to climate change, it is necessary to assess how temperature can modulate the PICT-response following toxicant exposure by affecting the sensitivity of microbial communities. In this aim, we evaluated in microcosms the influence of temperature on the tolerance level of phototrophic and heterotrophic biofilm communities to Cu, according to previous exposure to this metal. Natural biofilms were subjected for 4 weeks to 3 thermal conditions (18°C, 23°C and 28°C) in presence or not of Cu (10 µg/L). Tolerance levels were evaluated using short-term toxicity tests targeting photosynthetic (yield) and heterotrophic enzymatic activities (β-glucosidase, leucine-aminopeptidase and phosphatase). Our results showed a significant influence of temperature on the tolerance levels. However, the magnitude and the direction of the effects of temperature varied according to the Cu exposure history, the kind of communities (phototrophs or heterotrophs), and the functional descriptor considered.

SS05 - Oral

LAKE GENEVA CONTAMINATION BY HERBICIDES: MONITORING RESTORATION USING POLLUTION-INDUCED COMMUNITY TOLERANCE (PICT)

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The PICT approach is currently used to highlight the degradation of ecosystems along pollution gradients. However, studies dealing with its accuracy to point out restoration and *in situ* ecological state are scarce. In this study, the PICT approach was tested as a tool to monitor the ecotoxic restoration of Lake Geneva from herbicides exposure before and after a 12 years period of pollution management (1999 and 2011). Chemical monitoring revealed an actual decrease in herbicide concentrations in the water column since last decades. The taxonomical composition of phytoplankton communities and their tolerance to atrazine and copper herbicides was assessed monthly in 1999 and in 2011 using same protocols. Changes of phytoplankton communities composition between these two years was found to be linked to herbicides decrease. Jointly, PICT monitoring indicated a significant tolerance decrease in the community to both herbicides. To a lesser extent, tolerance to atrazine and copper changed at the intra-annual level, due to community composition shifts linked to seasonal phosphorus and temperature changes. PICT appeared to be a powerful tool to reveal effect of toxic pressure on environmental communities and useful to monitor ecosystem restoration.

SS05 - Oral

EFFECT-ASSESSMENT OF WASTEWATER EFFLUENTS BY MOLECULAR BIOMARKERS IN BROWN TROUT (SALMO TRUTTA)

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Most of the tests developed for detection of chemical effects in organisms exposed in the environment are applicable to only a few model species. mRNA expression analysis of selected biomarker-genes is a promising approach for field monitoring of non-model organisms because it can capture a wide spectrum of responses of organisms to chemical exposure. We established a biomarker-gene-set for brown trout to assess the effects of micropollutants released by wastewater treatment plants (WWTP). The biomarker-set consisted of genes which reflect different cellular stress responses. Transcriptional regulation of these genes were measured in wild brown trout caught downstream and upstream of the WWTP. Results showed that mRNA levels are site dependent. Fish taken downstream generally express a different transcriptional regulation pattern than fish from upstream, indicating higher abundance of environmental stressors downstream. For example, the metal or endocrine disruption sensitive genes were found to be significantly up-regulated. Indeed, chemical analysis confirmed high concentrations of such compounds in the water from this site. Our data demonstrates that quantifying expression levels of selected biomarker-genes allows an assessment of exposure to and related effects of toxic chemicals. It appears that our method is a promising screening assay for assessing surface water quality.

SS05 - Oral

RIVER BIOFILMS: A GOOD TOOL FOR THE ENVIRONMENTAL RISK ASSESSMENT OF METALS IN URBAN FRESHWATER STREAMS?

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The key objective of the water framework directive is to achieve good ecological and chemical status for surface waters. In a previous study, we observed the influence of environmental parameters (organic carbon, temperature) on the metal accumulation in river biofilms and their metal tolerance.

The aim of the present study is to demonstrate the interest of the river biofilms as a tool for the monitoring of freshwater quality (especially a multi-metallic pollution) in numerous different conditions of exposure, integrating varying environmental parameters. Thus, natural river biofilms were grown during two weeks in October 2013, on immersed plastic membranes exposed at twenty sites monitored in the framework of the Seine river (North of France) basin management plan along an anthropic pollution gradient. Metal (Cu, Mn, Pb, Zn) accumulation within the biofilms (non-exchangeable and total accumulated metals) was measured. Total, dissolved, and DGT-labile (with Diffusive Gradient in Thin films) metallic concentrations were monitored as well as major physico-chemical parameters in the river water at all sampling sites.

In general, the results show that concentrations of metals accumulated within the biofilms reflected the pattern of the metallic contamination along the Seine river basin. Thus, Mn and Pb contents in biofilms are significantly correlated with water concentrations, especially with the dissolved fraction. Nevertheless, at some sites, metal concentrations measured in biofilms were significantly different from what the classification of streams according to chemical and ecological criteria let us expect. Data on biofilm composition could allow to better understand the link between metallic exposure and biofilms' responses in a context of varying environmental parameters. We will finally discuss the interest and the relevance of the river biofilm to assess the environmental risk of metallic urban pollution for freshwater streams.

SS05 - Oral

COMPLEX COMMUNITIES EXPOSED TO MULTIPLE POLLUTANTS: USING PASSIVE SAMPLER EXTRACTS IN PERIPHYTON ECOTOXICOLOGY

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In rivers, risk assessment requires taking into account both the complexity of contaminations (multiple substances at low concentrations), and the increasing demand for ecologically realistic biological endpoints used in toxicity testing. These issues can be tackled by coupling toxicity assessment using complex communities, such as periphyton, and complex contaminants like passive samplers extracts (PSE).

Here we propose to review some recent progresses in ecotoxicology allowed by the joint use of PSE from POCIS (Polar Organic Chemical Integrative Samplers) and river periphyton. More specifically, we will present diverse experimental approaches, aiming at:

-characterizing the 'toxic potential' of waters and applying the pollution community induced tolerance (PICT) approach to pesticide mixtures,

-increasing the environmental realism in microcosm experiments by performing chronic low dose exposure to mixtures from PSE.

We were able to detect PICT in periphyton collected in rivers showing a gradient of increasing pesticide concentrations or at sites with different contamination profiles using toxicity tests with PSE from the field. Then, we improved mixture toxicity assessment by implementing chronic exposure experiments with PSE as a complex contaminant, at low doses. The environmentally relevant concentrations tested drove community changes, in their structure (biomass, composition) as well as in their functions (enzymatic activities)

SS05 - Oral

MEDITERRANEAN RIVERS AND MICROBIAL COMMUNITY DIVERSITY CHANGES AS MODELS FOR RISK ASSESSMENT OF MULTI-POLLUTION EVENTS

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Micropollutants (MPs) environmental impact in freshwaters is influenced by many factors such as river dynamics, which regulate frequency and intensity of multi-pollution events (particularly, in Mediterranean coastal rivers during flood events typical of this climate), or aquatic microorganisms, which are involved in the degradation of MPs. Our project takes up the challenge of assessing the adverse impact of environmental mixtures of MPs (pesticides, trace metals and pharmaceuticals) in Mediterranean rivers by using microbial communities changes as markers of the ecosystem reactivity to these stressors. A high-frequency field sampling method combined with the use of new generation sequencing techniques, metagenomics and metatranscriptomics, will allow us to finely study microbial (bacteria and archaea) community diversities. Exploratory data analysis (ESA) will be used to reveal the link between river dynamics and the observed microbial functional and structural diversity changes with the final objective to discover biomarkers for risk assessment of multi-pollution events. Molecular analysis will be coupled to a pollution induced community tolerance (PICT) approach to assess if changes in the diversity of microbial communities exposed to multi-pollutions events would lead to an increase in their tolerance and to check whether the structural or functional changes are similar to those observed 'in vivo'.

SS05 - Oral

ENVIRONMENTAL CONTEXT INFLUENCES INVERTEBRATE COMMUNITY RESPONSES TO ANTHROPOGENIC PERTURBATIONS IN TEMPERATE STREAMS

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Human population growth and landuse change are causing increased environmental pollution, thus threatening aquatic biodiversity and ecosystem services.

Assessing impacts of anthropogenic disturbances on stream ecosystems often uses macroinvertebrate indicators, but there is little known about the environmental factors that influence community resistance to perturbations. We predicted that community changes would be strongly contingent upon environmental context (e.g., catchment landuses) mediated through proximate effects on upstream assemblages, as opposed to the magnitude of local disturbance (e.g., wastewater discharges). To test our hypotheses, we sampled macroinvertebrate communities in twelve Swiss streams, with sampling reaches located above and below wastewater discharges, and assessed environmental factors at the local and catchment scale. We found that consistent with previous studies, wastewater discharges were associated with decreased alpha diversity and altered composition of downstream macroinvertebrate communities. Catchments with intensive landuses (e.g., cropping) had more pollution-tolerant assemblages, meaning that upstream community composition was a stronger determinant of total community sensitivity than the magnitude of the disturbance (e.g., wastewater discharges). In contrast, trait-specific indices were more sensitive to the effects of wastewater. This shows how

anthropogenic influences across spatially heterogeneous landscapes shape macroinvertebrate community structure, and therefore determine the type of assemblages exposed to local disturbances.

SS05 - Oral

ECOIMPACT - EFFECTS OF MICROPOLLUTANTS FROM WASTEWATER TREATMENT PLANTS ON STREAM ECOSYSTEMS: ECOTOXICOLOGICAL AND CHEMICAL EVALUATIONS IN 24 SWISS RIVERS

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The aim of the project EcoImpact is to evaluate the effects of micropollutants originating from wastewater treatment plant (WWTP) effluents on stream ecosystems. The project combines chemical, microbiological, ecotoxicological and ecological evaluations in order to enable a comprehensive understanding of the processes in the river ecosystems. This contribution focuses on a part of the project: the ecotoxicological and chemical evaluations. To assess micropollutant effects, several measurement campaigns were conducted in 2013 and 2014: In 2013 a screening of 400 micropollutants as well as laboratory andfield bioassays were performed. At selected sites, feeding activity of amphipods (*Gammarus fossarum*) as well as the reproduction of water flea (*Ceriodaphnia dubia*) were assessed. Additionally, effects on the photosynthesis and growth of single-celled green algae (*Pseudokirchnerielle subcapitata*), estrogenic activity (Yeast Estrogen Screen), and neurotoxic effects (acetylcholinesterase inhibition assay) were evaluated in all samples. The 2014 assessment programme consisted of the chemical evaluation of 60 substances as well as an assessment of estrogenic activity, algal toxicity and neurotoxic effects. An overview on the obtained results will be given in the presentation. In general the applied methods proved to be well suitable for a chemical and ecotoxicological assessment of river water quality.

SS05 - Oral

TAKING INTO ACCOUNT OF ENVIRONMENTAL FACTORS TO IMPROVE TOXIC RISK ASSESSMENT BASED ON SPECIES SENSITIVITY DISTRIBUTION (SSD) MODELS (DIATOMS AND NATURAL BIOFILMS).

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Risk assessment approaches are essential tools for predicting toxic effects and helping ecosystems management. In particular (SSD) models are designed to predict risk's thresholds for natural communities, based on the knowledge of individual sensitivities obtained at the laboratory level. Our works have indicated the sensitivity of 11 diatom strains, representative of the environmental diversity and of natural biofilms in microcosms. Six herbicides, with 2 different modes of action, were tested.

Based on these data of species sensitivity and SSD modelization, we have been able to establish protective environmental thresholds that takes into account some ecological factors such as strains growth mode (benthic - planktonic), differences in interspecific sensitivity (related to phylogeny) and, for communities of natural biofilms, their biodiversity (depending on season).

Our results showed that these factors partially control the biological response to toxics and taking them into consideration helps to refine the predictions associated to SSD models. A given risk' threshold (i.e. HC 5, Hazardous Concentration 5%) will be associated to different toxic concentrations depending on the mode of growth (in connection with contaminant's hydrophobicity), on the sensitivity of diatoms (with likely a genetic component), and finally, the season also changes the sensitivity of natural communities to PSII inhibitors (via biofilms' biodiversity).

SS06 - Oral

METHANE OVERSATURATION IN WELL-OXYGENATED LAKE WATERS

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The widely reported paradox of methane oversaturation in well oxygenated lake water challenges the prevailing paradigm that methanogenesis only occurs under anoxic conditions. Using a combination of field sampling, incubation experiments and modeling, we demonstrate that the recurring mid-water methane peak in Lake Stechlin, NE Germany, was not the result of methane input from the littoral zone or bottom sediment, or the presence of known microanoxic zones. The measured methane peak overlapped with oxygen oversaturation in the seasonal thermocline. Incubation experiments and isotope analysis confirmed active methane production, which seem to be linked to photosynthesis and/or nitrogen fixation within the oxygenated water. Thereby, photoinhibition of methane oxidation result in accumulation of methane in the oxygen-rich upper layer. Methane efflux from this mid-water source was estimated at 12 g m-2 yr-1. Mid-water methane oversaturation was also observed in nine other lakes, and collectively they showed a strongly negative gradient of log methane concentration within 0-20% D.O. in the bottom water, and a positive gradient within ≥20% D.O. in the upper water column. According to our calculations, methane from oxic layers in lakes has the potential to raise the global freshwater emission by ca. 34%.

SS06 - Oral

HIGHER METHANE EMISSION FROM CENTRAL AND WESTERN THAN NORTHERN EUROPEAN LAKES: IMPLICATIONS FOR REGIONAL UPSCALING

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Temperate lakes contribute a large fraction to total methane emissions from freshwaters. Emissions per lake area in boreal and northern temperate regions are assumed to be lower than in temperate regions more heavily influenced by agricultural land use, like central and western Europe. However, methodologically consistent multi-lake studies confirming these regional differences are presently lacking. We measured diffusive and ebullitive flux from 30 small central and western European and 17 northern European lakes using standardized measurements during a single visit in late summer. Flux estimates between regions are compared and the relevance of differences for regional emission estimates is discussed based on the example of small lakes in Switzerland. Measured diffusive and ebullitive fluxes per area were on average one order of magnitude higher in central and western European than in northern European lakes. Based on the relationships between lake surface area and annual flux estimates inferred from our measurements in late summer, emissions from small Swiss lakes might be more than 90 % higher than based on relationships between these variables used in earlier studies. The study highlights the inter-regional variability in lacustrine methane emissions and the need for regionally developed calibration data for regional and global emission estimates.

SS06 - Oral

SPATIAL VARIABILITY OF LAKE BIOTA Δ13C VALUES IN THERMOKARST LAKES: ASSESSING THE COMPLEXITY OF LACUSTRINE METHANE CYCLING.

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Thermokarst lakes can release methane via ebullition (bubbling). Low $\delta^{13}C$ values of the hopanoid diploptene, which can be linked to levels of methane oxidising bacteria, may be a proxy for lake-atmosphere methane flux, but probably relate primarily to diffusive methane. If there were a positive correlation between methane ebullition flux and diffusive methane production, $\delta^{13}C$ values of diploptene may function as a proxy for methane flux. Surface sediment samples were analysed from within nearshore methane ebullition zones of two lakes and from one central area without ebullition. Diploptene had $\delta^{13}C$ values < -38.5‰ in all samples, suggesting widespread methane oxidation. The most ^{13} C-depleted diploptene was found in the ebullition zone of one lake (-50.1 to -68.2‰), although higher values were found in the ebullition zone of another lake; this may be related to different sedimentary sources of methane. Diploptene $\delta^{13}C$ values were also low in the central zone (-46.9 to -56.8‰). Furthermore, the diploptene $\delta^{13}C$ values feature high within-area variability. Thus a link between methane ebullition flux and diffusive methane production did not emerge from these data. Without further investigation, single-value, down-core records of hopanoid isotopic signatures may not be secure indicators of changing methane ebullition flux.

SS06 - Oral

THE CONTRASTING EFFECT OF SEDIMENT METHANE GAS VOIDS ON DIFFUSIVE FLUXES OF - SOLUBLE AND SPARINGLY-SOLUBLE - DISSOLVED SUBSTANCES

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Accumulation of free gas in sediments is a common phenomenon in aquatic sediments, where gas contents can reach up to 10% of the sediment volume. The presence of free gas in sediments and ebullition can influence the pore water exchange across the sediment water interface. It has been documented that, in some cases, ebullition can enhance the pore water flux by several factors in permeable and semi-permeable sediments and thus contribute to internal nutrient loading that in itself can exacerbate CH_4 production. Our experiments with Rhodamine WT and Bromide as tracers, however, indicate that apparent diffusivities of soluble substances in gas bearing and bubbling sediments were in fact not enhanced, but reduced by ca. 20%, despite active ebullition. We attribute these results to free, stationary gas voids in the pore water acting as additional 'obstacles' for soluble species, thus increasing tortuosity and decreasing their apparent diffusivities. Furthermore, we demonstrate with modeling exercises how a modest amount of free gas in sediments (2% V/V) will enhance diffusivities of sparingly-soluble substances such as methane by an order-of-magnitude. Finally we will discuss the implications of these effects for the understanding of internal nutrient loading and dissolved gas fluxes in aquatic water bodies.

SS06 - Oral

PRODUCTION OF CH4 AND CO2 IN COASTAL LAKES ON THE SOUTHERN BALTIC COAST: DRIVING FACTORS, INTENSITY AND TEMPORAL VARIABILITY

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Coastal lakes along the Polish Baltic coast are very productive freshwater/brackishwater ecosystems and potential sources of CH_4 and CO_2. Among many factors controlling production of microbial gases salinity seems to be of great importance and it is known to affect the mechanism of methanogenesis.

Salinity becomes more and more important ecological factor in coastal ecosystems due to increasing frequency of saltwater ingressions to coastal lakes. Nevertheless, it is not established whether in these environments the effect of salinity on microbial processes can be distinguished from the changes governed by temperature and bioproductivity.

To verify this we selected 7 coastal lakes located on the Polish Baltic coast: Resko, Jamno, Bukowo, Kopan, Wicko, Gardno and. Lebsko which display changes in salinity between 0.1 and 6.57‰. In these lakes we sampled sediment gas and water to analyze concentrations of CH_4, molecular composition of gas as well as stable C and H isotope signatures of CH_4 and CO_2.

It was found that: (i) the concentrations of CH_4 in lake waters are appreciably low, (ii) the lakes display different pathways of methanogenesis and that (iii) there is no clear relationship between salinity and the composition of gas.

SS06 - Oral

ENHANCED DIFFUSIVE METHANE EMISSIONS FROM OLIGOTROPHIC LAKE STECHLIN: EXPLORING THE MICROBUBBLE HYPOTHESIS

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We resolved surface CH_4 and CO_2 fluxes from an oligotrophic lake during the onset of fall turnover using the floating chamber method. Assuming Fickian transport, the normalized exchange rates, K600, should be equivalent for the individual gases. While true for wind speeds < 2 m s^{-1}, we found that K600-CH_4 increased faster with wind speed than K600-CO_2, and was 4 times higher at a wind speed of 7 m s^{-1}. The most probable explanation for the K600-CH_4 enhancement is the exchange of microbubbles in the lake's surface layer. An increase in K600 due to microbubbles is much more pronounced for the sparingly-soluble gases CH_4, N_2 and O_2 than for soluble gases, such as CO_2. While the source of the microbubbles is unclear (entrainment and/or O_2/N_2 supersaturation), we determined that an average of 145 L m^{-2} d^{-1} of microbubble gas exchange is required to produce the observed elevated K600-CH_4. As K600 parameterizations are used to estimate diffusive CH_4 emissions from aquatic systems, the presence of microbubbles could substantially increase CH_4 fluxes and therefore alter C balances.

SS06 - Oral

METHANE EBULLITION FROM SMALL STREAMS AFFECTED BY THE EFFLUENT OF MUNICIPAL WASTEWATER TREATMENT PLANTS

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Recent estimates have demonstrated the importance of streams to the global carbon cycle, indicating that a significant amount of terrestrial C is emitted as carbon dioxide (CO2) and methane (CH4) from the streams' surfaces. Only a limited amount of C flux data from streams is available, and it is mostly restricted to diffusive CO2 and CH4 fluxes and don't include ebullitive CH4 emissions. Furthermore, previous studies disregard streams with anthropogenic organic carbon loads. While managing measurements of diffusive fluxes to the atmosphere poses a significant challenge due to the variability in dissolved methane, mounting the magnitude of ebullition is even more challenging due to high temporal and spatial variability and lack of straight forward sampling techniques. Here we show the contribution of ebullitive CH4 emissions from small streams that affected by effluents of municipal wastewater treatment plants (WWTPs). Our measurements include ebullition rates of upstream and downstream from the outlet of WWTPs by using a simple low-cost tool designed for shallow water systems.

SS06 - Oral

THE STABLE CARBON ISOTOPIC COMPOSITION OF DAPHNIA EPHIPPIA IN SMALL, TEMPERATE LAKES REFLECTS IN-LAKE METHANE AVAILABILITY

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Daphnia

(Cladocera) can ingest methane-oxidizing bacteria and incorporate methanogenic carbon, leading to strongly negative

$\delta^{13}C$ values of *Daphnia* biomass. Therefore, $\delta^{13}C$ analysis of *Daphnia* resting eggs (ephippia) in lake sediments canpotentially be used to reconstruct past in-lake methane availability. However, studies demonstrating that $\delta^{13}C$ values of*Daphnia* ephippia are systematically related to methane concentrations ($[CH_4]$) are still missing. We measured ephippia $\delta^{13}C$ values in surface sediments of 15 small lakes, and compared these with late-summer $[CH_4]$. $\delta^{13}C$ values ranged from -51.6 to -25.9 ‰, and were correlated with $[CH_4]$ in both the surface and bottom water. This variability in ephippia $\delta^{13}C$ values between our study sites could not be explained by variables that are expected to influence orreflect the $\delta^{13}C$ values of algae at our study sites, such as concentration and $\delta^{13}C$ values of CO_2 and $\delta^{13}C$ values of sedimentary organic matter. We conclude that incorporation of methanogenic carbon by *Daphnia* must have been widespread in our study lakes, especially those with high $[CH_4]$. Our results suggest a systematic relationship between ephippia $\delta^{13}C$ values and $[CH_4]$ in small temperate lakes, and that $\delta^{13}C$ analysis of ephippia from sediment records may provide insights into past changes in $[CH_4]$.

SS06 - Poster

PALEOLIMNOLOGICAL APPROACH TO STUDY THE PAST TROPHIC RELIANCE OF METHANE IN BENTHIC FOOD WEB: COMBINED ANALYSES OF STABLE ISOTOPES (CARBON AND HYDROGEN) AND ANCIENT DNA.

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Biogenic methane contributes significantly to the benthic food web, and in particular to the chironomid biomass via methanotroph assimilation. In the last decade, the use of lake sediment as ecological archives in paleolimnological studies provides essential long-term reconstruction of methane availability in aquatic food web. We propose an innovative methodological approach based on the study of sediment core to assess the temporal evolution of methane production, oxidation and transfer into food web using sediment cores: (i) the past methanotroph dynamic can be reconstructed by specific and quantitative analysis (qPCR) of ancient methanotroph DNA preserved in lake sediment, (ii) the source of assimilated carbon, and in particular methanotroph assimilation can be highlighted using carbon isotope analysis of chironomid remains, and (iii) in case of the evidence of methane-derived carbon assimilation by chironomid, the type of methanogenesis (acetoclastic or hydrogenotrophic) can be highlighted using hydrogen isotope analysis of chironomid remains. The high potential of the combination of these descriptors was evidenced by the successful apply to Lake Remoray.

SS06 - Oral

THE TROPHIC RELIANCE OF METHANE IN THE BENTHIC FOOD WEB: NATURAL VERSUS ANTHROPOGENIC DRIVERS.

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It is now widely recognized that biogenic methane can contribute up to 80% of the chironomid biomass in case of hypoxic tropholytic zone. However, several studies have revealed that hypoxic deep conditions can appear more or less abruptly through time, suggesting that the biogenic methane contribution is not the 'reference' functioning in most lakes. This study aims at identifying the causes of the trophic reliance of methane ('TRM') activation, and to understand the environmental conditions that enable the activation of the TRM. Three different lakes (productivity, altitude, water depth, etc.) were investigated using paleolimnological approach. The methodological strategy is built in three steps: (i) the reconstruction of the temporal evolution of methanotroph availability (ancient DNA of methanotroph) and the chironomid paleo-diet (carbon stable isotopes), (ii) the comparison of these dynamics with the histories of climate variability and anthropogenic pressures (pollen analysis) (iii) and the assessment of the environmental conditions (trophic state, oxygen conditions and organic matter accumulation) that allowed this activation. Results reveal very contrasting evolutions suggesting (i) that this pathway is highly driven by human and climate pressures and (ii) that lakes seem to have a various 'sensibility' facing the activation and the modulation of the TRM.

SS06 - Poster

DEVELOPPEMENT OF FUNCTIONAL INDICATORS FOR LENTIC ECOSYSTEMS.

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The European Water Framework Directive (WFD) define 'Ecological status' as an expression of the quality of the structure and functioning of aquatic ecosystems. It aims to achieve the 'good ecological status' for all water bodies. Under this scheme, most of aquatic monitoring programs have currently only focused on the use of indicators of community structures. These evaluations generally do not include functional processes such as rates of organic matter degradation and ecosystem metabolism.

In this context, the ONEMA/IRSTEA consortium launched in 2014 the Functional Indicators Project for the French lakes with the aims of investigating new indicators based on fundamental ecosystem processes.

One approach of the project is to standardize inexpensive *in situ* measurements of methane (CH_4), oxygen (O2) and carbon dioxide (CO_2) flux, which are good indicators of ecosystem metabolism: production, respiration and methanogenesis.

in situ

measurements are realized with a prototype auto-sampler floating chamber for air-water interface and a benthic chamber for sediment-water interface. These measurements will be applied on different types of lakes with a range of chemical and physical stressors and in the case of restoration program survey in order to determine whether functional variables related to gas emission could be a useful functional indicator.

SS06 - Oral

IMPACTS OF IMPOUNDMENTS ON CH4 EMISSION IN A TEMPERATE RIVER

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Run-of-river reservoirs alter sediment transport and thereby also carbon transport, which has potential consequences on methane (CH_4) production and emission rates. We conducted a study to determine the fate of CH_4 with high spatio-temporal resolution on the dam-impacted lower Aare River in Switzerland. Results show that CH_4 concentrations were high and constant in the upper, more pristine part of the river. Along the heavilymodified downstream part, the concentrations gradually decreased by a factor of 2. The section showed average CH_4 emission rates of 7.3 mg m $^{-2}$ d^{-1} (0.42−55.5 mg m^{-2} d^{-1}). The CH_4 budget suggests that in the upstream reaches of the river relatively large amounts of CH_4 were derived from lateral exchange with riparian wetlands and groundwater. These inputs were missing in the channelized and dammed lower part, where the river showed significant CH_4 losses. Our analysis indicates that the cascade of run-of-the-river reservoirs in this river reach facilitated methane release to the atmosphere via turbines. The reservoirs did not act as an additional methane source because the hydropower schemes are situated downstream of a lake which minimizes reservoir sedimentation.

SS06 - Oral

SEDIMENT INCUBATION EXPERIMENTS SHOW NO INCREASE OF METHANE CONCENTRATIONS AT INCREASING TEMPERATURES

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Methane is the greenhouse gas with the second highest global warming potential and produced as the final product of the anaerobic decomposition of organicmatter. Numerous studies have shown that increasing temperatures trigger the microbial process of methanogenesis, but only few studies were performed *in situ* or using undisturbed sediment cores.

In our study, intact sediment cores from the meso-oligotrophic Lake Stechlin (Germany) and the mesotrophic Lake Geneva (France/Switzerland) were incubated each at 4°C, 8°C and 12°C for three weeks. Methane production rates, measured after 48 h, were highest at 12°C for both lakes, but final CH_4 concentrations in sediments, being the result of production, oxidation and emission, showed no increase after 3 weeks of incubation at higher temperatures. Sediments of Lake Stechlin even showed a significant decrease of methane concentrations with increasing temperatures. We assume that aerobic and anaerobic methane oxidation played a vital role for this decrease, but qPCR analyses showed no correlation of the copy numbers of pmoA genes (methanotrophs) or mcrA genes (methanogens) to measured methane concentrations.

Our results demonstrate that contrary processes can be triggered by increasing temperatures, and make it therefore unclear, if climate warming will lead to increasing methane emissions from freshwater lakes.

SS06 - Oral

EXCEPTIONAL VENTILATION OF DEEP MEROMICTIC LAKE LUGANO HAS LONG-TERM IMPACT ON THE LACUSTRINE REDOX AND METHANE BALANCES

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The North Basin of Lake Lugano (Switzerland) was meromictic for several decades, with a quasi-permanent chemocline at ~100 m water depth and stagnant, anoxic waters below the chemocline, laden with high concentrations of methane (CH_4) derived from benthic methanogenesis. Two consecutive cold winters in 2005 and 2006 destabilized the stratified water column to the point that exceptionally strong mixing was induced.

The mixing events during the winters of 2005 and 2006 were part of a longer water-column destabilization trend associated with the reduction of density stratification due to a gradual deep-water temperature increase by geothermal heating during the late 1990s. We investigated the short and mid-term impacts of the exceptional mixing events 2005/2006 on the lake's redox and CH_4 balance, and examined the temporal context regarding the re-establishment of steady state conditions thereafter.

The ventilation events represented a profound disturbance of the biogeochemical cycling and element budgets in the North Basin. For several decades, the redox balance in the lake was strongly negative, with a minimum of -15'000 t O_2 equivalents at the beginning of this millennium. Between 2004 and 2008, the redox balance of the North Basin turned positive, directly reflecting the disappearance of large amounts of reduced substances in the hypolimnion (i.e., mainly CH_4 and NH_4, but also HS_-, Mn^{2+}, and Fe^{2+}) in association with theventilation of the deep hypolimnion. With the ventilation event in March 2005, almost all hypolimnetic CH_4 was eliminated (~3000 t CH_4). Based on stoichiometric considerations, aerobic oxidation of CH_4 upon the exposure of the CH_4 pool to O_2 –replete waters during water column mixing can only partly explain the disappearance of the CH_4, and neither geochemical nor molecular evidence was found for anaerobic CH_4 oxidation. We argue that almost two thirds of the CH_4 evaded rapidly to the atmosphere, through storage flux upon exposure of anoxic CH_4-rich deep-water to the atmosphere. Hence, the normally very efficient water column CH_4 filter in Lake Lugano can be temporarily suspended during episodic destratification events, rendering the lake into a significant source of CH_4. Since 2006, the total annual mean CH_4 inventory increased from ~140 t CH_4 to ~600 t CH_4 in 2013, corresponding

to an average basin-wide net production of 66 t CH_4 per year. Whereas soon after the ventilation event, the hypolimnetic O_2 depletion in the North Basin was restored again, return to methane homeostasis is unlikely for the near future. The mixing events only provided temporary relief from whole-water column anoxia, yet they have strongly and sustainably reduced the overall hypolimnetic oxygen demand, potentially easing future measures to mitigate O_2 depletion in the lake basin.

SS06 - Oral

METHANE PRODUCTION, OXIDATION AND EMISSION IN A SMALL NORTH TEMPERATE LAKE

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Despite the ubiquitous, but variable methane (CH4) supersaturation in lakes, mechanistic understanding of this feature remains scanty. While lake size being a good predictor of CH4 supersaturation within many regions, growing evidence suggests that within-lake CH4 variability can be as large or larger than inter-lake variability warrants the need of a general, process-based explanation on CH4 cycling in lakes. Spatio-temporal data from Lake Croche (Quebec, Canada) were used to reconstruct the pathways leading to CH4 supersaturation in northern temperate lakes. Concentration-, and isotopic (δ13C-CH4) - based mass balance coupled with physical (horizontal and vertical) mixing were used to identify/estimate the key processes. While flux from hypolimnetic sediments was the largest source of water column CH4, strong and persistent CH4 oxidation zone separated the CH4-rich hypolimnion from surface layer. In spite of this, CH4 concentrations in the upper layers increased as the stratification progresses, indicating an independent regulation of upper layer processes. Seasonality in CH4 flux from the epilimnetic sediments and its subsequent horizontal mixing seems to be the mechanism behind this pattern. Air-water exchange was a relatively larger sink than the oxidative loss of CH4 in the upper water column. We discuss how the coupling/decoupling of processes within different layers of stratified water column could be important in explaining the overall CH4 emission from northern temperate lakes.

SS06 - Oral

METHANE EMISSION FROM RESERVOIRS: A GLOBAL ANALYSIS

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Methane emission from freshwater systems is the net balance of production and oxidation processes. Data compiled from the literature were used to develop models of surface methane flux from reservoirs with the particular objective of assessing the influence of ecosystem size, eutrophication, stratification regime, temperature and bathymetric shape. Our analysis shows that minimum and maximum emission rates are constrained by different factors. In general, the most important determinants of diffusive emissions are surface water temperature, mixing regime and reservoir age. The cross-system pattern of temperature dependence of CH_4 emissions corresponds to an ecosystem-level Q_{10} of about 3.5, similar to what has been recently reported in other freshwater systems. Dimictic and monomictic systems show the lowest and highest emission rates, respectively. The results of these findings are then applied to estimate the global emission of methane associated with large reservoirs.

SS07 - Oral

SCANNING ELECTRON MICROSCOPY (SEM): AN UNDERUSED TOOL FOR THE STUDY OF NATURAL ORGANIC MATTER IN FRESHWATERS

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Scanning electron microscopy (SEM) has been widely used to characterize the mineralogy, chemical composition and sometimes particle size distribution of colloidal particles in natural waters. Too often, however, SEM has been considered as ‘routine’ analysis, either providing just complementary information to other techniques or applications being limited to publish images merely for illustrative purposes. In particular, SEM has rarely been considered an important tool in natural organic matter (NOM) studies. This is unfortunate because, until recently, very few analytical techniques existed for the study of the fraction of freshwater NOM that can be ‘seen’ by SEM –the so-called particulate organic matter (POM). POM is very heterogeneous, consisting of living and dead organisms, fecal pellets, exopolymers, aggregates, leafs, organically coated mineral particles, etc. and has always remained the ‘poor relation’ in NOM studies. Even nowadays, when new techniques exist (i.e., STXM, nano-SIMS, FTICR mass spectrometry, etc.), they cannot be used routinely either because of their cost or of analytical limitations and SEM remains an irreplaceable tool. State-of-the-art examples of applications of SEM for the characterization of NOM in different freshwaters will be shown and discussed.

SS07 - Oral

CHARACTERIZATION OF ORGANIC MATTER IN TEMPORARY ENDORHEIC SALINE LAKES (LA MANCHA, CENTRAL SPAIN) AND STUDY OF ITS EVOLUTION

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La Mancha is rich in endorheic saline lakes. They are usually small (<200 Ha surface), shallow (<50 cm depth), of saline and hypersaline character ("playa lakes"). We have studied the hydrochemistry, dissolved organic matter (DOM) and particulated organic matter (POM) of 9 ponds in April and October 2014 and followed the variation of dissolved organic carbon (DOC), particulated organic carbon (POC) and other parameters by bi-weekly sampling of three ponds for several months starting November 2014. DOM quality has been followed by visible-UV spectroscopy and excitation-emission fluorescence (EEM). Sediment organic C and N have also been measured. DOM reaches high concentrations (10 to ca. 300 mg C/L), increasing with conductivity, which suggest evaporative concentration of groundwater and rainwater in the basin. DOM shows low $SUVA_{254}$, decreasing with pond salinity, which correspond to weak aromaticity. EEM spectra show no trace of protein-like fluorescence and either weakening or disappearance of one of the humic peaks in hypersaline ponds. C/N ratio of DOM is generally higher than POM's and tends to increase with salinity. Overall, data indicate that lake organic matter is mostly of autochthonous origin modified by photochemical and bacterial transformations.

SS07 - Oral

DRIVERS OF QUANTITATIVE AND QUALITATIVE DIVERSITY OF DISSOLVED ORGANIC MATTER IN AN INTERMITTENT MEDITERRANEAN STREAM

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Dissolved organic matter (DOM) plays a key role in many aquatic ecosystem processes. DOM qualitative properties, such as its origin or its bioavailability, can be evaluated using its optical properties. In the present study the temporal variability of absorbance and fluorescence were analysed in an intermittent Mediterranean stream draining a forested catchment (15 km^2) in Catalonia (Spain). Our aim was to reveal the drivers of the diversity of spectroscopic DOM properties under the largest spectra of hydrological conditions typical of Mediterranean fluvial systems.

Stream water was sampled intensively during two years to capture all extreme hydrological episodes, from summer drought to intense storms in autumn and spring. DOM variability was studied in quantitative — dissolved organic carbon (DOC) — and qualitative — specific ultraviolet absorbance ($SUVA_{254}$), spectral slopes ratio (S_R) , fluorescence index (FI), humification index (HIX), biological index (BIX) and emission-excitation matrices (EEMs) — terms. A partial least squares regression, including the hydro-biogeochemical characteristics of each hydrological episode, was used to determine which of these parameters are more relevant in the configuration of the variability of DOM properties.

SS07 - Oral

LONG-TERM TRENDS IN HYDROCHEMISTRY OF ACID-SENSITIVE RESERVOIR TRIBUTARIES IN THE ERZGEBIRGE (ORE MOUNTAINS, GERMANY): ABSOLUTE DIFFERENCES AND RELATIVE SIMILARITIES.

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Seasonal variability of dissolved chemical water quality parameters (CQP) of the three main tributaries of the drinking water Rauschenbach Reservoir (southeast Germany, Ore Mountains) was investigated between 2010 and 2013 and compared with long-term trends based on monthly measurements since 1993. Although the streams are situated in close vicinity, the absolute concentration ranges of most CQP differ. However, the long-term trends of the standard normalized data are very similar. This is confirmed if the Rauschenbach data are compared with observations at further 20 reservoir tributaries in the Ore Mountains along an east-west trajectory of about 150 km and an altitude range between 430 m and 910 m unless not influenced by settlements and/or intensive agriculture. Most critical in terms of drinking water supply is the continuous increase in DOC and orthophosphate. The latter fact raises concerns that eutrophication in future may become an issue in forested catchments that traditionally were considered unproblematic in this respect. The study shows that the absolute concentrations of the streams CQP depend on site-specific properties of the catchment (e.g. topography, vegetation). The similarity of the relative trends in different watersheds, however, results from regional changes caused by the recovery from acidification and global warming.

SS08 - Oral

CLIMATE CHANGE INDUCED DISTRIBUTION SHIFTS AND ALTERED BIOTIC INTERACTION: THE EXAMPLE OF THYMALLUS THYMALLUS AND ALLOGAMUS AURICOLLIS

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Climate change impacts force species to react by adaption, extirpation/extinction or migration. Predatory fish are opportunistic feeders and their future occurrence will also rely on adequate food sources. On the basis of a full dendritic river network we modelled the distribution of *Thymallus thymallus* and *Allogamus auricollis*. For model calibration a dataset from the period 2003 to 2010 was used. Gains (baseline absence – future presence) and losses (baseline presence – future absence) were evaluated between the baseline climate (1961-1990) and future climate conditions of the period 2041 to 2060 according to four representative concentration pathways (RCPs) and realised by three circulation models. Overall, the models showed good performance according to sensitivity and specificity. The distribution of *A. auricollis* was majorly driven bytemperature (July temperature and temperature range). Beside temperature river size expressed by length of upstream network was an important variable for *T. thymallus* distribution. The results indicate dramatic losses of potential habitat especially for *A. auricollis* (up to 70%) but also for *T. thymallus* (up to 50%). The results imply important findings for conservation and management. T. thymallus is already endangered. Accordingly, further impacts will deteriorate their status with according effects on assemblage composition.

SS08 - Oral

DO SIMULATED WATER TEMPERATURES GIVE MORE ACCURATE PREDICTIONS THAN AIR TEMPERATURE WHEN MODELLING STREAM FISH DISTRIBUTION?

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Water temperature is a key factor influencing freshwater fish. When modelling fish distribution at large scale, it has traditionally been approximated by coarse air temperature data. Our goal was to compare predictions of species distribution models including either a set of water or air temperature variables for 36 stream fish species in the Loire catchment (France). Stream water temperature were simulated using a spatially heat balance model. The current distribution of fish species was modelled using two statistical techniques (GLM and Random Forests) applied to a combination of geo-morphological, hydrological and air or water temperature variables. Overall, we found that water temperature did not explain better current fish distribution than air temperature. Predictive performances for both temperatures were high and close indicating that models were accurate. However, a finer visual inspection of predicted distributions displays quite different patterns for some species at the catchment scale depending on temperature. These findings suggest that the traditional rough approximation of water by air temperature used for aquatic species has probably not resulted in inaccurate predictions of distribution. However, finer projections of water temperature warming should be considered to enhance distribution shift forecasts for species whose current distribution is better predicted with water temperature.

SS08 - Oral

MODELLING OF PELAGIC TO BENTHIC PRIMARY PRODUCTION RATIOS IN HEMIBOREAL LAKES

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The distribution of whole-lake primary production between planktonic and benthic habitat, also called autotrophic structure, carries critical information about lake food web layout and organic matter fluxes. Although planktonic primary production has been intensively studied since the onset of limnology, the paucity of estimates for benthic production is still blatant, meaning that autotrophic structure of lakes remains poorly known to date. In this study we have modelled both planktonic and benthic production and autotrophic structure of Estonian lakes, representing the overwhelming majority of this country inland water volume. We employed an empirical model based on a limited set of variables easily available from basic limnological databases, with a high precision in time (10 min) and depth (every 10 cm). Our results showed that although the studied Estonian lakes ranged from periphyton- to phytoplankton-dominated, phytoplankton represented on average 90% of their primary production. Shallow and/or clear lakes with low chlorophyll a (chla) were generally more favourable to benthic production than deep and/or turbid lakes. An increase of chla and turbidity in hemi-boreal lakes caused by climate warming is expected to skew the pelagic to benthic production ratio even more towards dominance of phytoplankton, with dramatic consequences on lake carbon fluxes.

SS08 - Oral

NEW NEAR-GLOBAL 1 KM SPATIALLY CONTINUOUS FRESHWATER ENVIRONMENTAL VARIABLES FOR BIODIVERSITY ANALYSES AND SPECIES DISTRIBUTION MODELING

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The lack of spatially continuous freshwater-specific environmental variables hamper comparative biogeographical analyses across large spatial gradients and on a fine spatial grain. We developed a near-global 1 km spatially continuous data set for freshwater environmental variables based on the HydroSHEDS hydrography and by delineating the sub-catchment for each 1 km grid cell along the stream network. We then related continuous global data sets on climate, topography, river topology, land cover and surface geology to each sub-catchment, and summarized each environmental variable using several metrics (average, minimum, maximum, range, sum, inverse distance-weighted average and sum). Further, we extended the variables of the river network to lakes and reservoirs of the Global Lakes and Wetlands Database. Finally, we summarized the monthly climatic variables to 19 long-term hydro-climatic variables following the 'bioclim' framework to provide input data for species distribution models. This newly developed set of continuous river network variables provides an improved basis for analyzing and mapping freshwater biodiversity on a near-global extent yet on a fine spatial grain.

SS08 - Oral

INTER-ANNUAL RESPONSE OF FISH POPULATION TO TEMPORAL VARIABILITY OF FLOW REGIMES IN A RIVER, JAPAN

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Alteration of flow regimes is a critical factor responsible for the declining trend in freshwater fish population. We aimed to find important flow characteristics influencing population dynamics of freshwater fishes in the Sagami River, Japan (1,680 km^2) . The population of 30 freshwater fish species was modeled using random forest based on field surveys at 45 sites for 4 years (108-times in total). The analysis was conducted with a set of predictor variables concerning geo-morphological features, water quality, flow regimes, and survey conditions. As a result, median flow in August and maximum flow volume occurring in August–October in the previous year of each fish survey were selected as important predictors for population variability of 5 and 6 species, respectively. Interestingly, the season of these two variables was right after the peak season for spawning of many species. These results suggest that survival of eggs or/and juveniles, which should be critical for determining the abundance in the next year, may be affected by these flow regimes. Hence, environmental flow management prioritizing restoration of flow characteristics at recruitment timing may be effective for maintenance of the fish community in this river.

SS08 - Poster

A NEW 1-D COUPLED PHYSICAL-BIOLOGICAL MODEL TO SIMULATE PLANKTON DYNAMICS IN LAKE BOURGET

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In the deep peri-alpine Lake Bourget, a recent abrupt shift in the phytoplankton community composition sets ideal grounds for testing hypotheses with regard to seasonal succession and inter-annual variations in natural plankton communities. In this study, we present a novel coupled 1-D physical-biological model implemented to Lake Bourget. The biological model was developed as a set of modular components under the Framework for Aquatic Biogeochemical Models (FABM) while the General Ocean Turbulence Model (GOTM) was used as the hydrodynamical host. Functional plankton types comprise two zooplankton groups, one mixotroph group and three phytoplankton groups, the latter ones parameterized on the basis of the taxonomic family and average cell volume of the contributing species. The model shows high skill in estimating the spatio-temporal distribution of abiotic variables and, to a lesser extent, of biotic variables. Importantly, the inter-annual variations in the relative abundance of functional plankton types are in qualitative agreement withthose observed in the lake during the simulated years. Numerical experiments suggest that the absence of the cyanobacterium *Planktothrix rubescens* in 2010 is mostly related to its low winter concentration, implying that the dynamics of the previous year is the underlying reason for its disappearance.

SS08 - Oral

INSIGHTS FROM LONG-TERM MONITORING DATA IN FRESHWATER SPECIES DISTRIBUTION MODELS:PREDICTIONS FOR STREAM MACROINVERTEBRATES IN THE GERMAN LTER-SITE RHINE-MAIN-OBSERVATORY

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Species distribution models (SDMs) performance relies largely on the properties of the data used as input, particularly the occurrence data. Long term monitoring data can provide a good framework to better understand how input data affects SDM performance. Data from the German long-term ecological research (LTER) site Rhine-Main-Observatory was used to set up a species distribution model (SDM) in the Kinzig catchment. The thorough knowledge on the monitoring data allowed to shed some light on different sources of bias that plague SDMs: (a) level of taxonomic identification of the modeled organisms, (b) the spatial arrangement of sampling sites, and (c) the sampling intensity at each sampling site. The presented SDM is a high-resolution, catchment model for 175 taxa of stream macroinvertebrates and projected on the Kinzig River stream network using bioclimatic, topographical, hydrological, land use and geological predictors. Average model performance across all taxa was good, with a TSS of 0.83 (±0.09 SD) and a ROC of 0.95 (± 0.03). The most relevant predictor was mean annual discharge, explaining on average 51.5% (±25.18% SD) of the total variation. Predicted richness, as well as mapped ensemble model uncertainty for the Kinzig stream network are presented. The effects of taxonomical resolution on model performance are discussed, as well as bias stemming from the sampling procedure in terms of density (spatial bias) and frequency (temporal bias).

SS08 - Oral

MODELLING THE IMPACT OF A STORMWATER INFLOW ON ESCHERICHIA COLI DENSITIES IN AN URBAN SHALLOW LAKE

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Urban lakes provide many ecosystem services including recreational activities. These lakes can be contaminated by waterborne pathogens from various sources, such as storm sewers. As a consequence rain events can affect the lake microbial quality. However, little is known about t he factors that impact the fate of pathogens, and the duration of the contamination. In order to address this issue, *Escherichia coli*, a fecal indicator bacterium, was quantified in the stormwater inlet of Lake Créteil (France). During a 6-month period (June to December 2013), six storm events were monitored. *E. coli* concentrations were measured in integrated samples of the inflow and in samples collected 6 hours later in the lake along a spatial gradient. Water temperature, current velocities and *E. coli* concentrations were computed using the 3D hydrodynamic model Delft3D-Flow. The model was calibrated with one storm event and verified with the other events. Simulation results reproduced the plume extension and theobserved *E. coli* concentrations. The model provided useful outcomes on the extension of the plume, its motion, the time, location and duration of *E. coli* peaks. These results show that a 3D hydrodynamic model can be used to infer the space-time representativeness of discrete monitoring.

SS08 - Poster

USE OF SELF ORGANISING MAPS IN MODELLING THE DISTRIBUTION PATTERNS OF GAMMARID SPECIES

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Self Organizing Maps(SOM) are increasingly popular methods in processing high-dimensional ecological data; however, their potentials are not yet fully utilized. It was our ambition to prove evidence on an unknown advantage of the SOMs, which we aimed to test through data on the distributional patterns of Gammarid species. Quantitative samples and a wide spectrum of environmental data were obtained from the catchment area of two of the largest side tributaries of the Tisza River. Distributional patterns and habitat preference of three Gammarid species were described by Self Organizing Map methods and regression tree analysis (CART) on spatial and temporal scale. Using SOMs helped us to bring out distinctions in our data and enhance the differences, thus making them easier to recognize and also, with their help we were able to model the relations of the species to habitat types non-existent among our samples. SOMs improved the correlations which proved to be highly useful: besides their use to display complex data in a perspicuous way, they have other advantages in bringing out existing relationships in data otherwise difficult to detect.

SS08 - Oral

CATCHMENT ZONING FOR FRESHWATER CONSERVATION: USING MODELLING AND DECISION SUPPORT TOOLS TO ENHANCE ON-THE-GROUND ACTION

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Recent advances in freshwater conservation planning allow addressing some of the specific needs of these systems, such as spatial connectivity or propagation of threats along streams. However, conservation recommendations in freshwaters often require considering large areas that cannot be managed under traditional schemes (e.g., strict protection).

To address this issue, a multi-zoning approach with management zones subject to different management regimes is proposed. So far, this approach has only been used in ad-hoc exercises where zones were allocated using expert criteria. Here, we demonstrate how to create a catchment multi-zone plan by applying a decision support tool used in other realms. We also demonstrate how to address common conservation planning issues, such as accounting for threats or species-specific connectivity needs.

We found that by prioritizing the allocation of zones subject to different management regimes we could minimise the total area in need of strict conservation by a two-fold factor. This reduction can be further reduced (three-fold) when considering species' connectivity needs. The integration of threats helped reduce the average threats of areas selected by a two-fold factor. Catchment zoning can help refine conservation recommendations and enhance cost-effectiveness by prescribing different management regimes informed by ecological needs or distribution of threats.

SS08 - Oral

MORPHO-FUNCTIONAL GROUPS FOR LAKE GENEVA – A KEY FIRST STEP TO MODEL AND PREDICT THE SUCCESSION OF PHYTOPLANKTON

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Predicting the stochastic pattern of the phytoplankton community remains a challenging task when modelling lake ecosystems due to their extremely diverse behavior. This study represents a modelling approach of functional groups of the phytoplankton community in Lake Geneva using the water quality model DYRESM-CAEDYM. Lake Geneva plays an important environmental role as it is the largest lake in central Europe, representing an essential resource for drinking water supply. This region is particular sensitive to climate change and it is hypothesized that more episodes of harmful cyanobacteria outbreaks will occur under warmer climatic conditions, which may lead to negative impacts on its water quality and the public health. Our aim was to produce a predictive management tool and to assess the ecological state of the lake under present and under future climatic conditions, focusing on the phytoplankton community. For this purpose, morpho-functional groups of phytoplankton specific for Lake Geneva were identified. The simulations demonstrated the close relationship of successional sequences with mixing and stratification, which were strongly seasonally driven. Morpho-functional groups appear to be an appropriate level of state variable representation in this type of modelling approach to enable valuable insights into emerging environmental drivers such as climate change.

SS08 - Oral

LINKING HYDROMORPHOLOGY AND STREAM ECOSYSTEM FUNCTIONING

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The hydromorphological components of lotic ecosystems provide the template upon which biodiversity and ecological functions are built. In spite of this pivotal importance, the bio-physical linkages in stream ecosystems remain poorly understood. Indeed, most efforts were focused on the effects of water pollution, while chemical stressors often co-occur with physical ones. Besides, considering the growing number of stream restoration works, understanding hydromorphology/ecosystem functions relationships is necessary to predict the trajectories of these modified ecosystems and potential gains in terms of ecological services. This is the aim of the present study to elaborate such predictive models. Priority areas for restoration at the scale of the French hydrographic network are targeted based on the probabilities of ecosystem functioning impairment. To achieve this objective, 85 stations were selected and characterized, with a particular attention paid to hydromorphological and ecosystem functioning assessments, relying on two national protocols (water basin and reach scales) and leaf litter breakdown process as a proxy, respectively. First results, which point out strong relationships between hydromorphology and leaf litter breakdown at local and regional scales, suggest that leaf litter breakdown may be appropriate for evaluating and predicting physical impairment of streams as already demonstrated for chemical stressors.

SS08 - Oral

DIEL TRENDS OF DISSOLVED OXYGEN AND CARBON DIOXIDE: A STREAM ECOSYSTEM METABOLISM MODEL

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Stream metabolism describes the production and transformation of various pools of organic carbon (OC) at the level of the whole ecosystem. Consequently, the understanding of the factors, which govern stream metabolism dynamics, is crucial to assessment of ecosystem function. Typically, integrative variables like dissolved oxygen (O_2) are used to estimate gross primary production (GPP) and ecosystem respiration (ER). Here, we present a process-based model describing the diurnal dynamics of dissolved O_2 and carbon dioxide (CO_2) and two pools of OC in stream water. The underlyingdifferential equations are linked by the respiratory and photosynthetic quotients, which describe the mole of CO_2 produced per mole of O_2 consumed and vice versa. The model is then fitted to time series of CO_2 and O_2 collected in streams differing in adjacent land use across several seasons in 2013/2014. Results suggest a strong control of land use, which influences stream metabolism by input of OC, and of seasons, which control metabolism through temperature and irradiation. Our suggested modelling approach deepens our understanding of carbon turnover in stream ecosystems, leading towards an improved assessment of the role of streams in the regional and global carbon cycle.

SS08 - Oral

A STEP FORWARD TO MORE PREDICTIVE COMMUNITY ECOLOGY USING PROCESS-BASED MODELS AND BAYESIAN INFERENCE

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Community ecology has been for a long time a research area where descriptive approaches were the main tools that can be used because of the high complexity of the communities. However, recent approaches such as ecological stoichiometry, metabolic theory of ecology and trait ecology has allowed more mechanistic approaches to emerge such as the Streambugs model. This process-based model aims at predicting the composition and biomass dynamic of benthic invertebrate communities. One of the main issues in using such process-based ecological models is the large number of required but highly uncertain parameters. To compel with this, we employed a Bayesian inference approach to combine knowledge obtained from previous sources and from investigated data. The Metropolis Markov Chain Monte Carlo algorithm that we implemented allows us to improve the predictions and reduce their uncertainties for the case study of the Sihl river (Switzerland) by learning on some parameter values. We then illustrated how our model could be used to test ecological theories. We used the calibrated model to run simulations designed to test the predictions of two hypotheses related to disturbance for our system: the Intermediate Disturbance Hypothesis (IDH) and its generalization, the Dynamic Equilibrium Hypothesis (DEH).

SS08 - Oral

RAPID CHANGES IN PHYTOPLANKTON SIZE DISTRIBUTIONS ARE DRIVEN BY COMPETITION FOR NUTRIENTS AND STORMS

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Phytoplankton cell size distributions influence ecosystem functions such as carbon uptake and export, and are correlated with traits that determine nutrient competitive ability. Therefore, understanding how size distributions change with nutrient concentration can improve our ability to model ecosystem processes and test predictions of resource competition theory. To understand how cell size and macronutrients influence each other, we measured >50 million individual cells over 4 months in a eutrophic Swiss lake (Greifensee), sampling every 4 hours. Our findings are consistent with predictions from resource competition theory. Intervals between storms are characterized by decreases in community median cell length and dissolved phosphate concentration, as expected due to the greater efficiency of small cells at nutrient acquisition. Storms supply pulses of nutrients that lead to the proliferation of large cells, which benefit from high nutrient concentrations due to their capacity for rapid nutrient uptake and storage. These spikes in median cell size dissipate within days, as the phosphate concentrations decrease. Our findings highlight the predictive ability of resource competition theory in natural environments, and the importance of infrequent events in influencing community and ecosystem dynamics.

SS08 - Oral

A 3D HYDRODYNAMIC-ECOLOGICAL MODEL FOR ASSESSING THE VARIABILITY OF CYANOBACTERIAL ABUNDANCE IN A RECONSTRUCTED SHALLOW LAKE.

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Mediterranean freshwater ecosystems exhibit extensive eutrophication symptoms, including frequent occurrence of cyanobacterial blooms that are often toxic. The reconstructed Lake Karla in central Greece is an example of a shallow lake ecosystem characterized by eutrophic conditions and by cyanobacterial abundance. The three dimensional hydrodynamic - ecological model, ELCOM-CAEDYM, was applied in order to simulate Year 4 following lake reconstruction, during which, phytoplankton consists mainly of cyanobacteria. Specifically, the model was used to explore the physical, chemical and biological processes that determine the spatio-temporal variability of cyanobacterial biovolume throughout four seasons. Lake samples were collected throughout the year and physicochemical and biological data were obtained. Furthermore, meteorological observations were collected for the same period. ELCOM-CAEDYM was also coupled with the Weather Research and Forecasting (WRF) model designed to serve both atmospheric research and operational forecasting needs. Results indicate that temperature and total phosphorus are the primary factors controlling cyanobacterial abundance. This study demonstrates how numerical modeling has advanced to analyze, in a spatio-temporal fashion, the complex interactions between the physical and biochemical processes in shallow aquatic ecosystems. Ecological modeling is useful for understanding lake function and structure, testing hypothesis and make predictions and can be used by policy-makers to aid in decision making.

SS08 - Oral

ESTIMATING ECOSYSTEM METABOLISM FOR ENTIRE RIVER NETWORKS

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River ecosystem metabolism (REM) is a combination of the metabolic rates of all organisms within the aquatic food web. REM is a promising cost-effective measure of ecosystem functioning, as it integrates many different ecosystem processes and is affected by both rapid (primary productivity) and slow(organic matter decomposition) energy channels of the riverine food web. Within this study we estimated REM in up to 60 river reaches covering a 1200 km^2 catchment in northern Spain (Deva-Cares River) during the summer period (August-September 2014). We used oxygen mass-balance techniques in which primary production and ecosystem respiration were calculated from oxygen concentration daily curves. We then used recently developed spatial statistical methods for river networks based on covariance structures to model REM to all river reaches within the river network. We also used these models to analyze how REM spatial patterns are constrained by different catchment and river reach characteristics. Our preliminary results show that REM patterns of spatial correlation are highly influenced by valley width changes and river reach hydraulic characteristics, while we provide with one of the first estimates of spatially explicit REM estimate for an entire river network.

SS08 - Oral

VALIDATION OF MESOHABSIM METHOD USING CONDITIONAL AND MULTIVARIATE STATISTICAL HABITAT SUITABILITY CRITERIA FOR BULLHEAD COTTUS GOBIO

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Application of riverine instream habitat models such as MesoHABSIM is getting increasingly popular. Those models can predict changes in river ecosystem caused by hydropower operations or river training. They are a good tool for water management planning, especially in terms of Water Framework Directive demands. Important and essential steps in modelling process are validation studies which provides the user information about accuracy and reliability of generated results. For this purpose in September 2014 biological data was gathered during field survey on Stura Demonte River located in northwestern Italy; 116 individuals of bullheads – *Cottus gobio* (L.) were captured in 80 pre-exposed area electrofishing (PAE) grids. The samples were used to validate predictions of MesoHABSIM model created using 1) conditional preference criteria derived from expert knowledge and gathered literature and 2) logistic regression criteria based on observation of this species in many mountainous streams. The results show that predictions of MesoHABSIM model of bullhead feeding grounds habitat correlate well with fish presence for both types of habitat suitability criteria.

SS08 - Oral

FISH NATURAL HABITAT MAINTENANCE THROUGH RIPARIAN-ADDRESSED ENVIRONMENTAL FLOWS

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The physical habitat changes resulting from river damming are amongst the most relevant causes for the degradation of freshwater systems. Environmental flows aim to reduce such degradation but are still generally based on the requirements of aquatic species. Such an approach lacks the mid/long-term perspective of the riverine ecosystem, which may lead to inaccurate recommendations of environmental flows. This awareness is particularly important when we consider that biotic communities, like riparian vegetation, depend on flow regime in an inter-annual timescale. We used a dynamic floodplain vegetation model to forecast the riparian patch dynamics facing different flow regimes during a 10-year period in a Mediterranean river. The calibrated model was used to simulate environmental flow regimes addressing only fish species, and both fish and riparian vegetation requirements. The resulting riparian vegetation maps were benchmarked by the natural habitat. After a decade of flow regulation, the riparian habitat shaped by the fish-only addressed environmental flow regime changed significantly the physical and hydraulic characteristics of the river stretch, whereas the environmental flow regime accounting for riparian vegetation requirements proved to be able to maintain the naturalness of the riparian habitat, providing in a mid/long-term a nearest natural habitat availability for fish species.

SS08 - Oral

MODELLING THE EFFECTS OF PESTICIDES ON MACROINVERTEBRATE COMMUNITIES IN STREAM MESOCOSMS: A STREAMBUGS APPLICATION

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In pesticide risk assessment aquatic macroinvertebrates are used for risk characterization. However, the combined effects of contamination and biological interactions are often difficult to interpret and extrapolation to untested conditions remains challenging. In particular the recovery of populations and communities under realistic conditions is difficult to assess. Here, ecological modelling can improve the understanding of the involved processes and feedbacks. Therefore, we applied the mechanistic model Streambugs to data of a mesocosm experiment with pesticide contamination. Streambugs combines knowledge from theoretical food web modeling, the metabolic theory of ecology, ecological stoichiometry and functional trait data. For this case study, we additionally included time-varying toxic effects into the model based on species sensitivity towards the pesticide used in the experiment. Here, we present the results of a Bayesian parameter inference using Monte Carlo simulations and show how uncertainty of parameter values is propagated to the model output. Furthermore, we identify parameters and processes that drive community dynamics after contamination. In particular, we explore the role of community interactions including food competition and predation, going beyond the capacity of single population models.

SS08 - Poster

NOVEL MODELS TO PREDICT THE MACROINVERTEBRATE COMMUNITY, RICHNESS AND ABUNDANCE IN THE LOWER MEKONG BASIN

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Macroinvertebrates are frequently used to assess freshwater ecosystem quality. They inhabit diverse habitats depending on the environmental conditions. In this study, we predicted the macroinvertebrate community in the Lower Mekong Basin (LMB), their species richness and abundance using environmental variables. Six variables selected from Redundancy Analysis were used as predictors to develop habitat suitability models. Based on the Multivariate Regression Tree, macroinvertebrates were predicted into five different assemblages. Eight sites from the delta were predicted as one assemblage, and 24 sites from the upper LMB, Laos and Thailand, were structured into two assemblages depending on the Electrical Conductivity (EC) whilst 11 sites from Cambodia were predicted into two remaining assemblages based on the site disturbance. The species richness and abundance, based on the Regression Tree and Random Forest, were predicted to be higher in sites located in the delta, and lower for sites located further upstream. Sampling sites situated more inland reached a higher macroinvertebrate richness and abundance when the EC was higher than 6.33 and 19.68 mS/m, respectively. From our results, predictive models are useful tools in assessing the LMB ecosystem quality for conservation and management purposes, as this area is more vulnerable to habitat degradation.

SS09 - Oral

A COMPREHENSIVE TRAIT-BASED FRAMEWORK FOR STREAM ALGAL COMMUNITIES

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The use of comprehensive biological trait-based approaches to detect the effects of land use activities and global climate change on terrestrial plant and aquatic phytoplankton communities is increasing, but such a framework is still missing for stream algae. Here we present a conceptual framework of ten morphological, physiological, behavioural and life-history stream algal traits relating to resource acquisition and resistance to disturbance. We tested this approach by assessing the relationships between multiple agricultural stressors and algal traits at 43 stream sites. Our ‘natural experiment’ was conducted along gradients of agricultural land use (0 to 95% of the catchment in pasture) and hydrological alteration (0 to 92% stream flow reduction resulting from water abstraction for irrigation) as well as related in-stream physicochemical variables (nitrogen concentration and deposited fine sediment). Strategic choice of study sites resulted in uncorrelated gradients of agricultural land use and hydrological alteration. We studied the non-linear and non-additive response patterns of ten algal traits to the stressor gradients using general linear models and an information-theoretic model-selection approach. Cell shape, life form, pigment composition, nitrogen fixation and spore formation were key traits that showed the strongest relationships with environmental stressors. Overall, farming intensity exerted stronger effects on algal communities than hydrological alteration. The large-bodied, non-attached, filamentous algae that dominated under high farming intensities have limited dispersal abilities but may cope with unfavourable conditions through the formation of spores. Antagonistic interactions between farming intensity and stream flow reduction were observed for some traits, whereas no complex (non-additive) interactions occurred between nitrogen concentration and deposited fine sediment. Overall, the selected traits and our conceptual model were well suited to test stressor effects mediating resource supply and disturbance on algal communities. Our study also showed that investigating a comprehensive set of traits can help to shed light on the mechanisms shaping algal community composition where multiple stressors are operating. Further, to understand the non-linear and non-additive effects of such drivers, algal communities need to be studied along gradients of natural variation or multiple anthropogenic stressors.

SS09 - Oral

INDICATORS OF ECOLOGICAL FUNCTION TO DIAGNOSE AGRICULTURAL IMPACTS IN STREAM ASSEMBLAGES OF SOUTHERN MANITOBA, CANADA

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Agricultural activities in the Red River watershed of Manitoba, Canada, can be significant sources of excess nutrients, sediments and pesticides leading to ecological effects in watershed streams and downstream Lake Winnipeg. In such multiple stressor environments, it is difficult to identify, separate and diagnose the cause of environmental impacts from different agricultural activities using traditional methods (e.g., taxa assemblage). However, ecological function indicators (e.g., functional feeding groups) have potential as diagnostic indicators because they lead to the identification of ecological change pathways. This study evaluates the efficacy of three indicators of ecological function: benthic macroinvertebrate trait assemblages; trophic community indices; and nitrogen isotopic signatures of aquatic animals. Indicator sensitivity was evaluated by their association with human activity gradients that define the type and intensity of human activities (i.e., livestock, wastewater lagoon discharge, crop production). Study results identify indicators relevant for monitoring the effectiveness of existing regulations and best management practices in the Red River watershed, and point to the need for enhanced (or additional) measures to reduce agricultural impacts on these ecosystems.

SS09 - Oral

COMBINED ACTION OF COPPER AND LIGHT TO MICROALGAE

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Light is one of the most variable factor in natural environments, it is known to influece the speciation and bioavailability of chemical pollutants and itmight affect the physiological state and thus the sensitivity of organisms to the toxicant. However the combined action of light and pollutants on a quatic organisms were rarely investigated. In this work we studied the combined action of light and copper on microalgae. Low light and high light conditions as well as worse case scenarios of increased UVB irradiation were reproduced using a solar simulator. Tests were performed with single strain and multispecies cultures in order to highlight different species sensitivities and the possible influence of algal-algal interactions. Effects of the combined stressors were studied monitoring algal traits trough flow cytometry. High light conditions significantly increased the amount of uptaken copper while antagonistic effects were observed. On the other hand copper and UVB acted synergistically. Sensitivity of each strain to the pollutant changed depending on the light condition and in presence of other algal strain. The results obtained indicate that higher tier tests that take into account multiple stressors are needed in order to perform more reliable predictions of the impact of pollutants on natural ecosystem.

SS09 - Oral

LIFE IN TROUBLED WATERS: CLIMATE WARMING AND AGRICULTURAL STRESSORS INTERACT TO DETERMINE STREAM INVERTEBRATE COMMUNITY DYNAMICS

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Global climate change is likely to modify the ecological consequences of currently acting stressors, but the interactions between climate warming and land-use related stressors remain largely unknown. Agriculture affects streams and rivers worldwide, including via nutrient enrichment and increased fine sediment input. We manipulated nutrients (simulating surface runoff from agricultural catchments), deposited fine sediment (simulating catchment erosion) (2 levels each) and water temperature (8 levels, 0-6°C above ambient) simultaneously in 128 streamside mesocosms. Our aim was to determine the individual and combined effects of the three stressors on macroinvertebrate community dynamics (community composition and body size structure of benthic, drift and insect emergence assemblages). Changes in benthic community composition showed a complex interplay among habitat quality (with or without sediment), resource availability (with or without nutrient enrichment) and the behavioural/physiological tendency to drift or emerge as water temperature rose. One of our key findings is that community measures of stream health routinely used around the world (e.g. total invertebrate taxon richness, diversity and EPT taxon richness) all showed complex three-way interactions, with either a consistently stronger temperature response or a reversal of its direction when one or both agricultural stressors were also in operation.

SS09 - Oral

BENTHIC PRIMARY AND SECONDARY PRODUCERS: STRUCTURAL AND FUNCTIONAL RESPONSES UNDER MULTIPLE STRESS IN EXPERIMENTAL STREAM FLUMES

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European lowland stream ecosystems are subjected to multiple stressors, often including nutrient enrichment, sedimentation of fine organic and inorganic substrates and anthropogenically strengthened low flows in summer. We investigated the response of benthic primary (benthic algae species composition, chlorophyll a, ash-free dry mass and primary production) and secondary producers (benthic macroinvertebrate species composition) to different combinations of these stressors in twelve large stream flumes (12 m long) under realistic, yet controlled conditions. The experiment consisted of two phases: a normal flow phase and a low flow phase with 5 weeks each. We applied a nutrient enrichment scenario throughout the experimental period and under low flow we applied fine sediment scenario as a second factor. We took samples before the low flow period and every week during low-flow. Our main findings were that i) fine sedimentation had a stronger effect on both primary and secondary producers than nutrient enrichment, and ii) the effect of low flows were strongly enhanced by fine sedimentation for both primary and secondary producers and iii) the effect of fine sedimentation on the primary producers was reduced over time, likely due to adaptation to the new environment.

SS09 - Oral

MANAGING MULTIPLE STRESS FOR MULTIPLE BENEFITS: TOWARDS NEW SCIENTIFIC CONCEPTS, METHODS AND TOOLS IN RIVER BASIN MANAGEMENT

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Water resources globally are affected by a complex mixture of stressors resulting from a range of drivers, including urban and agricultural land use, hydropower generation and climate change. Understanding how stressors interfere and impact upon ecological status and ecosystem services is essential for developing effective River Basin Management Plans and shaping future environmental policy. This contribution details the nature of these problems for Europe's water resources and the need to find solutions at a range of spatial scales. In terms of the latter, we describe the aims and first results of the EU-funded project MARS (Managing Aquatic ecosystems and water Resources under multiple Stress), and the conceptual and analytical framework that it is adopting to provide this knowledge, understanding and tools needed to address multiple stressors. The project will support managers and policy makers in the practical implementation of the Water Framework Directive (WFD), of related legislation and of the Blueprint to Safeguard Europe's Water Resources by advising the 3rd River Basin Management Planning cycle, the revision of the WFD and by developing new tools for diagnosing and predicting multiple stressors.

SS09 - Poster

SPATIAL EARLY WARNING SIGNALS OF CATASTROPHIC TRANSITIONS IN SUBMERGED VEGETATION BEDS

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Catastrophic transitions in shallow lakes have been extensively studied along the temporal axis, showing that small increases in nutrient inputs can lead in the long run to a shift from a submerged vegetation-dominated state to a phytoplankton dominated state. Theoretical studies have suggested that such transitions are announced by a rise in temporal correlation in key variables such as chlorophyll *a*. Whereas the existence of such early warning signals have been demonstrated to occur also in space, at our knowledge such phenomenon has not been investigated with a spatial explicit perspective in the case of submerged vegetation in shallow lakes. Here, we analyzed the spatial signals characterizing the transition from a submerged vegetation state to a bare-sediment state along an upstream/downstream gradient in a shallow fluvial lake. Recent results from this system suggest that increases in agricultural runoff from the watershed could be associated with a catastrophic shift from dense submerged aquatic vegetation to bare sediments. We tested this hypothesis by measuring the increase in amplitude of early-warning signals of catastrophic transitions as suggested by current theoretical work. High-resolution aerial photography was used to estimate the spatial patterns of abundance of submerged aquatic vegetation along the plume of a nutrient-rich tributary.

SS09 - Oral

GREEN OR BROWN? STREAM ECOSYSTEM FUNCTIONING AFFECTED BY MULTIPLE AGRICULTURAL STRESSORS

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Agricultural land use generally results in multiple stressors acting simultaneously to affect the functioning of stream ecosystems. Multiple stressors can interact, causing non-additive effects (synergistic or antagonistic), in which case knowledge of single-stressor effects is insufficient for their management. We examined the single and interactive effects of four common agricultural stressors: nutrient enrichment, deposited fine sediment, flow velocity reduction, and a nitrification inhibitor (dicyandiamide, DCD) on the green (algae, grazers) and brown (leaf litter decomposition, fungi, shredders) compartments of the benthic food web of a New Zealand stream. Our experimental setup comprised 128 stream-fed outdoor mesocosms, which allowed natural colonisation by benthic organisms and independent stressor manipulation in a full-factorial design. Additive stressor effects dominated ecosystem responses. Slower flow reduced algal biomass and deciduous litter decomposition, whereas deposited sediment reduced algal and invertebrate biomass but accelerated evergreen litter decomposition. Nutrient enrichment increased algal biomass and shifted the invertebrate community to taxa with lower sensitivity to pollution. DCD slightly increased deciduous litter decomposition. Fine sediment and flow velocity reduction showed strongest effects, which warrants their consideration for the management of agricultural streams, which often focuses on eutrophication. Because interactions at the chosen stressor levels were rare, managers might mitigate them independently.

SS09 - Oral

NUTRIENTS AND SEDIMENTS – TWO OF THE MAJOR POLLUTANTS OF FRESHWATER STREAM ECOSYSTEMS – IMPACT UPON EPILITHIC

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Anthropogenic impacts on the natural aquatic ecosystem are significant and growing; intensification of agriculture is a threat to the stream ecosystems. Sediments and nutrients are the two major agricultural stressors and can have a major effect on aquatic natural ecosystems.

In this study, species and diversity of algae growth on stones and artificial tiles along the gradients of nutrients and sediment was investigated after 28 days of exposure at five different current speeds at each studied sites in order to [1] quantify the difference between epilithic communities on a phosphorus gradient, [2] quantify the difference between epilithic communities on a sediment gradient.

Results validated tiles as artificial substrates for algal growth, and showed no significant difference between tiles and stones at the same current speed. Nutrients were not limiting, and there was no difference in algal community at different gradients, meaning that concentration of nutrient was already sufficient enough to saturate cellular growth-rates. Species richness and diversity were unaffected by fine sediment.

Few experiments investigated the responses of epilithic across broad gradients of multiple stressors. My final year will thus design an experimental approach to examining the effects of phosphorus and sediment in isolation and together, in an effective way.

SS09 - Oral

EFFECTS OF SECONDARY SALINIZATION ON AQUATIC FUNGI AND LEAF DECOMPOSITION

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The ecological status of woodland streams is continuously threatened by human activities. Salinization is of major global concern due to its effect on stream biota and/or processes it maintains. Litter decomposition is a key ecosystem-level process driven by decomposers, mainly fungi (aquatic hyphomycetes), that link litter and invertebrates. Here, we gauged the effects of an ecological relevant gradient of salt dilutions (0 – 8 g/L NaCl) on (1) fungal growth and species reproductive output and (2) fungal mediated-decomposition of *Quercus robur* leaves. Sporulation occurred in five out of nine of the grown species at 2g/L, and only one at 8g/L. Based on these results, we evaluated if distinct fungal assemblages, with increasingly fewer species (9, 5, 1), were able to maintain similar functional properties and processes

under the different contamination levels – 0, 2, 4, 8 g/L NaCl. Oak mass loss and associated microbial parameters (respiration, sporulation) were evaluated across the salinity gradient. No significant differences were found in mass loss or sporulation promoted at 0 or 2 g/L NaCl. Respiration was almost 2-times higher in assemblages with no added salt. Results suggest that stream salinization may induce a decrease of fungal diversity with deleterious consequences on streams ecosystem function.

SS09 - Oral

PREDICTING FRESHWATER ECOSYSTEM RESPONSES TO MULTIPLE STRESSORS

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In only a short time, human activity has substantially altered the conditions for life over a large proportion of the Earth's fresh waters, where rates of extinction rates and impairment are now among the greatest of all ecosystems. There is an urgent need to improve techniques to predict the effects, but this is complex because i) organisms respond differently to anthropogenic stressors; ii) detrimental effects depend on how stressors interact; iii) some organisms can tolerate a wide range of stressor effects due to constitutive traits or through short-term genetic shifts. Key needs are to anticipate further ecosystem changes, to improve and develop assessment tools, and to guide environmental management with improved science. Here, we use river organisms to demonstrate that organismal and ecosystem responses to multiple stressors are non-random. We use different biodiversity measures (taxonomy, traits, food webs) to identify the effects of stressors acting in isolation and in combination, and to predict which organisms might be most sensitive to anthropogenic changes.

SS10 - Oral

LIMNOLOGY CENTER: MULTIDISCIPLINARY RESEARCH AND NEW TECHNOLOGIES TO STUDY LAKES

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The mission of the Limnology Center is to develop multidisciplinary and innovative projects on lakes, in order to ensure their sustainable use and conservation of natural resources. The goal is also to promote collaborations between international and national research institutions in freshwater sciences. Using the engineering experience of Ecole Polytechnique Fédérale de Lausanne, we expect to develop new technologies to study lakes. To test these technologies, Lake Geneva will provide an excellent model system. Currently, the Limnology Center has two main projects on Lake Geneva. Within the project Leman-Baikal, we developed a novel remote sensing platform to assess the 2-D heterogeneity of chlorophyll-a and particle content. Using ultralight aircrafts, we collected hyperspectral images of Lakes Leman and Baikal with an extremely high spatial resolution. Given the necessary authorization, our second project is to install a research platform on Lake Leman, in collaboration with University of Geneva. Instrumentation on this platform will collect biological and physical parameters at a high-temporal resolution. It will also function as a calibration point for remote sensing applications and provide a working space for external scientists. We hope you will be interested to collaborate with the Limnology Center!

SS10 - Oral

PCB FATE IN ALPINE LAKES: HOW DO THEY GET OUT?

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Long-range atmospheric transport of semivolatile organic compounds (SVOCs) like polychlorinated biphenyls (PCB) is responsible for the contamination of remote area such as alpine lakes. In high altitude lakes, cold temperature decrease volatilization of deposited PCB that could promotes their accumulation and therefore might increase their contamination in next decades. Although the presence of PCB in high altitude lakes has been acknowledged, there is still a crucial knowledge gap about their fate in such ecosystems. A mass budget of PCB was constructed for two alpine lakes revealing that PCB inputs exceeded outputs for both studied lakes and that the lakes acted as atmospheric PCB sinks for mountain environments. The annual inputs were primarily introduced by snow deposition. While the dominant deposition pathways were similar, with- and within-lake differences of PCB distribution or concentration between lake compartments (particulate matter, fish) were recorded. Results led to the conclusion that PCB fate depends on their sorption abilities with suspended particulate matter straight after spring thaw. Thus, fish with greater access to pelagic food have higher concentrations of PCB than those that are more restricted to benthic food.

SS10 - Oral

DIVERSITY AND DISTRIBUTION OF AMPHIPOD SPECIES IN SWITZERLAND: STUDIES FROM AN ALPINE PERSPECTIVE

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Amphipods are key organisms in many freshwater systems and contribute substantially to the diversity and functioning of macroinvertebrate communities. For many areas, however, diversity and distribution of amphipods is inadequately known, which limits their use in ecological and ecotoxicological studies and handicaps conservation initiatives. We studied the diversity and distribution of all 29 amphipod species in Switzerland. Switzerland has a central position within the Alps, including four major alpine catchments, and thus offers a unique system to study post-glaciation re-colonization and invasion dynamics. We specifically focused on the lacustrine species *Gammarus lacustris*, the single most widespread freshwater amphipod worldwide, with a nearlycircum-boreal distribution. We investigated its distribution along the alpine reach, both by own sampling campaigns and an extensive literature research. *Gammarus lacustris* turned out to be the most common amphipod species in high alpine lakes. Surprisingly, we discovered a distribution gap in Central Switzerland, resulting in a population in the Western Alps and a population in the Eastern Alps. Sampled individuals were analyzed using molecular and morphometric methods to investigate the intraspecific diversity and taxonomic status within the genus. Genetic data indicate that the alpine populations are distinctive from all other populations of this species known so far.

SS10 - Poster

A COMPARISON OF PERI-ALPINE LAKES ALONG AN ELEVATION GRADIENT BETWEEN 400-1400M

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This study investigates 35 alpine lakes of small to medium size from low land to subalpine elevation for abundance of zooplankton and phytoplankton, water chemistry and limnological characteristics.

Zooplankton biomass was determined as dry mass. Phytoplankton abundance was measured as Chlorophyll a extracted from the water sample from the epilimnion. A vertical profile was recorded for temperature, oxygen, pH and conductivity. Water chemistry (phosphorus, nitrogen, carbon/nitrogen ratio, alkalinity) was analysed from a depth-integrated sample collected from the epilimnion with a tube sampler.

Surface temperature (0-3m) was largely dictated by altitude, ranging from 21,5 to 8,7°C. Both, zooplankton and phytoplankton abundance were found to decrease with elevation. However, some lakes did not follow the general trend by showing exceptionally high phytoplankton densities at elevated altitudes. They were characterized by high Chl:TP and low zooplankton biomass. The data indicates that lakes at higher altitudes are particular susceptible for anthropogenic disturbance.

SS10 - Oral

EVIDENCE FOR CONTINUOUS CHANGES IN ALPINE LAKES – THE CASE OF ABRUPT EFFECTS IN PRE-ALPINE LAKE LUNZ, AUSTRIA

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As the case for many lakes in the Alps, the pre-alpine Lake Lunz (600 m.a.s.l., Austria) undergoes continuous change since the beginning of data collection in the late 19th century. Since 1921, the duration of annual ice-cover (~100 days until 1950s) decreases with increasing inter-annual variability since 1960s. In recent years (2007, 2014) the lake had no ice-cover at all. Days with surface water temperature >17C increased from 14 (1951-1980) to currently 64 days (1998-2013). Such increasing surface water temperature occurs particularly earlier in spring and favor spawning success of Northern pike (*Esox lucius*). Lake Lunz, known for its native Arctic charr (*Salvelinus alpinus*) population, shifted its fish population dramatically from a typically salmonid to a percid and now clearly pike dominated lake within only a few years. Preliminary stable isotope results show that pike share the same trophic niche as perch, while the formerly dominating *S. alpinus* population is almost wiped out. However, roach and chub populations increase considerably. Fatty acids in fish indicate that the shift from a salmonid to pike-dominated lake clearly leads to less fatty fish with also less highly valuable omega-3 fatty acids at the top of the lake food chain.

SS10 - Oral

EFFECT OF INCREASING TEMPERATURE AND HEAT WAVES ON PLANKTON COMMUNITIES IN EXPERIMENTAL ECOSYSTEMS

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It is expected that lake water temperatures will increase up to 4°C and extreme weather events will become much more common, including temperature fluctuations and heat waves. Changes in temperature regimes as warmer falls and winters have been reported to promote phytoplankton growth notably in alpine and Nordic ecosystems.

In an effort to better understand how higher water temperature and induced heat waves relative to a constant increase in mean temperature will affect plankton community composition, phenology, and functioning in alpine lakes we conduct a long-term, multi-seasonal mesocosm experiment using water and natural plankton communities from oligotrophic alpine Lake Lunz, Austria. Preliminary results show that increasing temperature promoted the growth of small sized green algae (Chlorophyta) while heat waves caused increasing cyanobacteria dominance. Ongoing analyses aim at investigating plankton biomass, biodiversity and productivity, as well as biochemical quality (stoichiometry and fatty acids) of both phyto- and zooplankton.

SS10 - Oral

COMPOSITIONAL PATTERN OF LAKE PHYTOPLANKTON IN THE ALPINE REGION

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There is increasing interest in the role of spatial process for the assembly of plankton communities. We sampled 60 lakes across Austria, Bavaria and Switzerland, spanning a longitudinal gradient of 800 km. The lakes ranged from 400 and 1400m above sea-level, and spanned from oligo- to eutrophic conditions. In spite of considerable variation in productivity and altitude, geographic location turned out to be a strong predictor for community composition. Notably, community composition correlated much more with longitude than with altitude, though the latter should be a much better predictor for climatic conditions. The data suggest that the topography of the Alps affects dispersal of plankton organisms.

SS10 - Poster

DIGGING NEW ALPINE PONDS FOR PROMOTING BIODIVERSITY THREATENED BY CLIMATE WARMING

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Freshwater biodiversity is highly vulnerable to climate warming. Boreo-alpine species are especially at risk and may have to colonize higher areas to avoid local extinction. Creation or restoration of small waterbodies in alpine areas could facilitate the species' upward dispersal and provide new habitats. The present study aimed therefore at i) assessing in alpine areas the capability of new man-made ponds to support boreo-alpine plants, aquatic beetles and dragonflies species, and ii) identifying the environmental parameters favoring the colonisation of these species in the new ponds. Among 37 recently created or restored ponds located in the Swiss Western Alps; 18 sheltered the targeted plant and 20 the targeted macroinvertebrate species. Relating the occurrence of these species to pond morphology, water physico-chemistry and landscape structure in the catchment allowed identifying the main drivers of successful conservation of these plants and macroinvertebrates potentially threatened by climate warming.

SS11 - Oral

RECENT TRENDS IN PLANKTONIC COMMUNITY OF LAKE BAIKAL AND THEIR POSSIBLE REASONS

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Lake Baikal now suffers from several types of human pressure: the physical impact as the result of the influence of Hydro-Power Dam, influencing the level of lake, and creation of several huge water reservoirs, causing regional climate shift; some biological pollution – invasion of alien viruses, bacteria, algae, plants, fishes; chemical pollutants input according to the share in the total: coming with tributaries from watershed basin (83%), atmospheric precipitation (16%), Baikalsk Pulp and Paper Combine (1%), other settlements and enterprises wastes, tourism, navigation (0.5% and less), nutrients (mineral forms of nitrogen and phosphorus) and toxic substances (oil products, sulfur containing organic matter, heavy metals and surfactants) together are less than 0.36% of total allochtonous compounds coming to Baikal. In the end of XX century we have created mathematical model of Lake Baikal ecosystem deviations and predicted the following changes in the ecosystem due to chemical pollution at the level of 1980th – 1990th: decrease of biomass of under-ice phytoplankton, increase of biomass of Summer-Autumn phytoplankton, some changes in zooplankton. Recently we observe the following trends in the plankton community: increase of widely distributed small-celled Summer-Autumn phytoplankton species biomass, decrease of endemic large-cell under-ice phytoplankton species biomass, changes in zooplankton.

SS11 - Poster

ESTIMATION OF CURRENT HYDROCHEMICAL STATE OF LAKE BAIKAL FROM OBSERVATION DATA IN THE 21ST CENTURY

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Lake Baikal is one of the unique natural ecosystems. To date, the conservation of its water purity is topical. The content of major components in the water column of Lake Baikal is constant. The stability of ionic composition of water is attributed to a huge volume of lacustrine water masses compared to the annual inflow of tributary waters, as well as to intense water exchange occurring in Lake Baikal.

Spatial and seasonal variability of concentrations of nutrients and oxygen is determined from biological processes and dynamics of the lake water masses. The content of nutrients in the pelagic area of the lake is low. It increases from the surface to the bottom. The concentrations of ammonium and nitrite nitrogen in the upper water layer of the pelagic area are insignificant at the end of mass development of algae. The constant record of oxygen at all depths is attributed to the lake unique mechanisms of renewal of deep waters. According to the results of our studies, the content of nutrients in the water of the pelagic part of the lake has not changed compared to that registered in the 1950s.

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SS11 - Poster

HYDROCHEMICAL CHARACTERISTICS OF THE LITTORAL AREA OF SOUTHERN BAIKAL

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The littoral area of Lake Baikal plays a key role in the ecosystem functioning. Due to the increase of interest to Lake Baikal and intense development of tourism in this area the lake is greatly subject to anthropogenic impact. We studied dynamics of nutrients, oxygen, carbon dioxide and methane in the coastal area of Southern Baikal where a great number of settlements are located. The content of dissolved gases and nutrients is uneven: concentration of nutrients and carbon dioxide increases with depth, whereas oxygen concentration decreases. Development of phytobenthos and macrophytes in summer affects significantly the content of these components and even alters the pattern of vertical distribution in certain areas of the southern basin: concentration of nutrients and carbon dioxide decreases to the bottom layer, whereas that of oxygen increases. Partial pressure of methane in the water of coastal area of Southern Baikal was 50 mkatm. Maximal content of methane, carbon dioxide and ammonium nitrogen was recorded in closed bays for mooring vessels, which are heavily polluted with oil and domestic wastes.

This work was supported by RFBR grant 14-05-00277a, Program of Department of Earth Sciences RAS № 10.

SS11 - Poster

HOLOCENE SEDIMENT DISTRIBUTION IN DIFFERENT BASINS OF LAKE BAIKAL

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Lake Baikal contains three basins: Southern, Central and Northern. Sedimentation within the basins is largely determined by basin relief /bottom morphology, by high seismic activity and by large tributaries.

1. Deep-water zones

are characterized by periodical occurring turbidites, which are intercalated to pelagic mud. The formation of the youngest turbidites in water depths >1300 m have taken place in the Southern basin in 1912 (near Sharyzhalgay), 1670, 1310 and 1030 (near Cape Ivanovskii).

2. Near-coast areas

with water depths <500 m and approximately 700 m off the N-shore of Southern Baikal show pelagic muds without turbidite layers. Diatom analyses testify that thin Holocene deposits overlay directly Late Pleistocene sediments.

3. Littoral zones

along the E-shore in Northern Baikal and along the S-shore of Southern Baikal are characterized by biogenic-terrigenous mud, formed under mainly calm conditions of sedimentation without any turbidites.

4. Deltas and delta-fan sites near the mouths of large rivers

consist mainly of terrigenous material. Sediments of the northern part of the Selenga Delta (Proval Bay), have excellently recorded the catastrophic earthquake of 1862, when large parts of the former Tsagan Steppe disappeared under water.

SS11 - Poster

THE SPATIAL DISTRIBUTION OF THE CONCENTRATION OF CARBON-CONTAINING GASES IN THE ATMOSPHERE AND IN THE SURFACE LAYER OF THE WATER OF LAKE BAIKAL

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The article analyzes the results obtained during the spring 2013 expedition through the pelagic zone of Lake Baikal and the southern littoral of the lake in August 2014. For a continuous map the spatial distribution of the partial pressure of CO_2 and CH_4 in the atmosphere and surface waters during the voyage of the research vessel used by the gas analyzer «Picarro» and equilibrator.

To study the vertical distribution of methane at different depths were taken of water samples using bathometers. It was found that during the all observation period partial pressure of carbon dioxide in the water was less than atmospheric. Therefore, CO_2 flux is usually comes from the atmosphere at the water surface. Reverse pattern is observed for methane - the partial pressure of methane in water was greater than atmospheric. Pressure CH_4 in water varied from 2.3 to 150 mkatm. Estimation of the difference fluxes, it was concluded that during the warmer months the total CO_2 flux exceeds the yield of CH_4, and therefore there is a flow of carbon from the atmosphere to the surface of the water.

This work was supported by the RFBR 14-05-00277a; Program of Department of Earth Sciences RAS № 10.

SS11 - Poster

THE TRANSFORMATION OF THE COMPONENTS AND PARAMETERS OF RIVER WATERS FLOWING INTO THE MIXING ZONE OF LAKE BAIKAL

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Comprehensive studies on the transformation of substances supplied with the river flow in the mixing 'river-lake' zone have been performed for the last 10 years. This area of research included the mouths of the three largest tributaries of Lake Baikal - the Selenga, Barguzin and Upper Angara Rivers. We measured total ion concentrations, concentrations of organic matters and nutrients in the water and studied species diversity of phytoplankton. It was established that processes occurring in the mixing zone of freshwater ecosystems are mainly caused by temperature contrasts of different water masses in spring-autumn and by differences in the salinity level during winter. Seasonal changes of nutrient concentrations varied in the river mouths depending on dynamics of the river flow and activity of production-destruction processes. About 65% of nitrate-nitrogen and up to 85% of mineral phosphorus were involved in the biological cycle during summer. The main changes in the river components were recorded in the narrow coastal zone within 3-4 km of the river mouths, whereas chemical composition of water and species diversity of phytoplankton remained the same in the open pelagic area of Lake Baikal.

SS11 - Oral

CAN SILICON ISOTOPES BE USED TO ASSESS ANTHROPOGENIC IMPACTS AND NUTRIENT UTILISATION IN LAKE BAIKAL, SIBERIA?

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Silicon isotope ($\delta\ ^{30}Si$) geochemistry provides information to constrain and understand biogeochemical cycling on land and in oceans. Here we present records of $\delta\ ^{30}Si$ from the vast drainage basin of ancient Lake Baikal, a World Heritage Site, to understand silicon cycling from the dominant river tributaries through into the lake itself.

Waters samples were collected along major rivers and deltas that flow into Lake Baikal, accounting for over 90% of all riverine inputs into the lake. Fluvial silicon concentrations in these systems range from c. 2.50-6.30 ppm, which contrasts with concentrations of < 1ppm from the An gara River, the lake's only outflow. Combined with river $\delta^{30}Si_{DSi}$ values of c. + 0.94 to +1.76‰ and deep-water lake values of c. +2.39‰, our data suggests significant (up to 60%) biological utilisation of silicon entering the lake. Comparison of these results to sediment core samples provides an insight into the fate of silicon in the basin and an assessment of how climate change and expanding anthropogenic activities in the catchment have impacted biogeochemical cycling during the 20th and 21st Century.

SS11 - Oral

WATER QUALITY CHALLENGES ALONG LAKE BAIKAL'S MAIN ARTERY: A META STUDY INTEGRATING RECENT RESEARCH FINDINGS FROM THE SELENGA RIVER BASIN

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Lake Baikal's important tributary is the Selenga River, which covers a catchment of about 450.000 km² in Mongolia and Russia. Until recently, data on water quality and contaminant transport were very scarce in this region. However, in the past 10 years, several research projects have investigated water quality impairments along the Selenga and its most important tributaries, including the Orkhon, Tuul and Kharaa Rivers.

This meta-study provides a synopsis of the current state of knowledge by summarizing key findings of recent investigations, particularly on the emission and transport of toxic or ecologically problematic substances. Moreover, key stressors are identified and future emission scenarios as well as management approaches discussed.

SS11 - Oral

BAIKAL NEUTRINO OBSERVATORY AS A DEEP-WATER LABORATORY FOR INTERDISCIPLINARY RESEARCHES

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For the Baikal neutrino telescope project a number of methods and instruments were designed to study different processes in the Baikal ecosystem. Now the hundreds of optical, acoustic and other sensors allow one to realize a long-term 3D monitoring of the various water parameters like water temperature, water currents, Earth electric field, inherent optical properties, intensity of water luminescence etc., Series of new phenomena were discovered and studied, like luminescence of Baikal water, coastal downwelling along the steep lake shores, appearance of 'foreshocks' in electric Earth fields before big magnitude Earthquakes in the Baikal rift zone.

We review the present status of the Baikal Neutrino Telescope infrastructure facilities for interdisciplinary environmental studies and the most interesting limnology results, which were obtained in the framework of the project. We will underline our interest to broaden the scientific objectives with new collaborators, by e.g. using the potential to include new measurement subsystems, distributed over km-scales with full online environmental monitoring capability.

SS11 - Poster

INFLOW OF NUTRIENTS AND ORGANIC SUBSTANCES WITH ATMOSPHERIC PRECIPITATION ONTO THE WATER AREA OF SOUTHERN LAKE BAIKAL

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In 2012-2014, we performed investigations of chemical composition of atmospheric precipitation and snow cover on the coast and in water area of Lake Baikal. The inflow of organic substances and nutrients from the atmosphere onto the water area of the lake was quantitatively estimated. Seasonal and annual variability of organic carbon, nitrogen, mineral nitrogen and phosphorus was analysed in atmospheric precipitation. Concentrations of mineral nitrogen and phosphorus depended on annual dynamics of precipitation and their sources of supply into atmosphere. The rise of nitrogen content in atmospheric precipitation was recorded in cold season and phosphorus in warm period. No seasonal trend of organic carbon concentration was clearly expressed because of its numerous sources of natural and anthropogenic origin.

Maximal concentrations of organic substances were recorded in the snow collected from the ice in Baikal near the settlements of Baikalsk and Slyudyanka (10.4-14.3 mg/l) because of the effect of industrial sources, stoves and transport on this area. Maximal content of organic (1-1.4 mg/l) and mineral (1.5-1.8 mg/l) nitrogen was registered in the snow cover at sites located on the way of transfer of air masses from large industrial sources of Pribaikalye towards the lake.

This work was supported by SRP 76.1.5.

SS11 - Poster

PETROLEUM PRODUCTS IN WATER AND SNOW COVER OF PRE-BAIKAL REGION

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Petroleum products are dangerous organic compounds polluting natural ecosystems. We present the results of determination of petroleum products in the Pre-Baikal Region snow cover, in Lake Baikal water and in its tributaries (Selenga, Barguzin, Upper Angara, Kichera, Tyya, Tompuda, Kholodnaya, Rel', Turka, Bugul'deyka, Sukhaya, Anga) obtained in 2011-2013.

Up to 3,000 tons of hydrocarbon income into the atmosphere in Irkutsk Region from industrial and transport emissions. In winter, the snow cover is a deposit environment of petroleum products accumulation. High content of petroleum products is determined in such cities as Shelekhov, Cheremkhovo, Zima, Angarsk, Irkutsk (23-38 mg/m^2). Accumulation of petroleum products in the snow sampled from the ice of South Baikal basin was 30 times lower than in the cities.

In the water of large tributaries of Lake Baikal, petroleum products concentrations varied from 0.005 to 0.095 mg/dm^3, with increase in spring, due to snow melting. Petroleum products content in small tributaries of Lake Baikal is low (0.006 — 0.010 mg/dm^3).

Petroleum products concentrations in water of South Baikal (0.005-0.008 mg/dm^3), Central Baikal (0.005-0.007 mg/dm^3) and NorthBaikal (0.004-0.008 mg/dm^3) and do not exceed maximal allowed concentrations (MAC) for water bodies with fishery functions (0.05 mg/dm ^{3}). High concentrations (up to 1 mg/dm^3) are found in the water of Central Baikal in the area of natural oil ingress, where the flow of oil-bearing hydrocarbons from the lake bottom reaches 2 tons/year.

SS11 - Oral

WHAT CAN WE LEARN FROM 13 YEARS OF TEMPERATURE OBSERVATIONS IN THE SOUTH BASIN OF LAKE BAIKAL?

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We summarize the results of 13 years of temperature measurements acquired in the framework of several research projects with moorings installed in the South Basin of Lake Baikal. An important result of the study was the characterization of regular downwelling events where cool surface water is plunging down to the deepest reaches of the basin. These events supply cold and oxygen rich water to the depth and thus maintain the negative temperature gradient in the permanently stratified deep water. A total of 13 downwelling events were observed, which could be classified into three different types: early winter events induced by coastal downwelling due to strong along-shore winds, under-ice events and spring events. Furthermore, the temperature time series were used to characterize seasonal mixing events and their interannual variability, to assess temperature trends in relation to previously estimated long-term trends, and to study the spectra and energetics of internal waves.

SS11 - Poster

OIL PRODUCTS IN WATER AND SNOWPACK OF PRE-BAIKALIA

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Oil products are organic compounds harmful to human and ecosystem health. We present the results of determination of oil products in the snowpack and surface water obtained in 2011-2013. In winter, snowpack is storage of oil products. High concentration of oil products (23-38 mg/m^2) in snowpack was observed for Shelekhov city, Cheremkhovo, Zima, Angarsk, and Irkutsk. Accumulation of oil products in the snow sampled from the ice of South Baikal basin was 30 times lower than in the cities. In the water of large tributaries of Lake Baikal, oil products concentrations varied from 0.005 to 0.095 mg/dm^3, with increase in spring, due to snow melting. Concentrations of oil products in small tributaries of Lake Baikal are low (0.006 — 0.010 mg/dm^3). Oil products concentrations in water of South Baikal varied from 0.005 to 0.008 mg/dm^3, in Central Baikal – from 0.005 to 0.007 mg/dm^3, and in North Baikal – from 0.004 to 0.008 mg/dm^3. These concentrations do not exceedmaximum allowable values in water bodies used for fishing (0.05 mg/dm^3). High concentrations (up to 1 mg/dm ^{3}) of oil products were observed in the water of Central Baikal near natural oil seeps.

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SS11 - Oral

INTERNAL WAVES IN LAKE BAIKAL'S SOUTH BASIN

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We study the internal wave spectrum in Lake Baikal by using temperature measurements taken over a time span of 13 years at the South Basin of the lake. Lake Baikal with a maximum depth of ~1.6 Km is the most voluminous fresh water body on earth. The top 250 m are seasonally stratified while the deeper part of the lake has a constant temperature of about 3.4 °C with a slight gradient of 2×10^{-4} °C m^{-1}. The densitystratification depends almost exclusively on temperature while salinity is nearly constant with depth. Typical values of the squared buoyancy frequency, N^2, vary between 10^{-8} s^{-2} in the deep water to over 10^{-6} s^{-2} at the thermocline. The local inertial frequency, f_i, 1.8×10^{-5} s^{-1} corresponds to an inertial period of 15.23 h. At this frequency, a distinct peak is observed in the temperature spectrum at all depths. We use the wavelet transform to study its spatial and temporal evolution and to investigate other possible internal waves frequencies (Kelvin, tidal). We evaluate the importance of the different internal waves, calculate the total integrated potential energy and evaluate the contribution of the internal waves to the high diffusivity values (up to 10^{-2} m^2 s^{-1}) observed in the lake's permanently stratified deep water.

SS11 - Poster

ICE-THERMAL AND WATER REGIME OF LAKE BAIKAL DURING 1950-2014

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The study shows the relationship of long-period (century) oscillations of Baikal surface water temperature in summer with NAO activity in winter since the middle of the XXth century. This relationship affects the winter air temperature and ice thickness, which in turn determines the ice breakup of the lake and beginning of the active warming of water column in spring. This influence is especially obvious since the early 1970s due to the increase in NAO activity accompanied by decrease in the Siberian high (SH). Such combination of circulation processes resulted in the significant warming in winter and reduced the ice period. In summer, the surface water temperature increased and by the mid 1990s reached the maximum values of the XXth century. The subsequent 1996–2011-2012 period showed the phase of reduced NAO activity followed by more severe winter temperatures and delayed warming of water column in the lake. However, temperature values during this period were rather higher in comparison to the previous phases of reduced NAO. For most part of the Baikal water area, summer water temperatures began to increase after 2011-2012. The cycles of the 10-35-year duration clearly represent the changes in the Baikal total surface inflow. These cycles and those of NAO indices as well as the Siberian high have complex relationship, but since 1996, the inflow was mainly below normal.

SS11 - Oral

DETERMINATION OF LAKE BAIKAL ENDEMIC AND PALEARCTIC AMPHIPODS THERMAL OPTIMA LIMITS BY CHANGES IN ITS STRESS MARKERS

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In the present study metabolic stress markers were comparatively monitored in endemic amphipods *Eulimnogammarus verrucosus* and *Ommatogammarus flavus* from Lake Baikal and in the Palearctic amphipod *Gammarus lacustri*s exposed to a wide range of ambient temperatures. The metabolic data were compared with thermal preferendum data obtained for the same species in behavioral experiments. It was found that exposure of amphipods under increased temperatures resulted in increase of HSP70 content and lactate, activating of antioxidant enzymes, as well as reduction of lactate dehydrogenase and glutathione S-transferase activities. Exposure of amphipods at low temperatures resulted in decrease of HSP70 content, increase of lactate level, peroxidase and lactate dehydrogenase activation and reduction of glutathione S-transferase activity. It was noted that the most expressed changes of metabolism markers and the area of stability of cellular metabolic markers in all amphipods correlated with a preferred temperature limits obtained in behavioral experiments. Thus, for a first time with baikalian endemic amphipods we showed that the zone of stability of cellular metabolism closely related to their behavioral thermal preference zones and is likely to reflect thermal optima limits of each species.

SS11 - Oral

DISTRIBUTION OF DISSOLVED AND SUSPENDED HEAVY METALS IN THE SELENGA RIVER DELTA

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The Selenga River flows from mountainous part of Mongolia into the Baikal Lake in Russia. The Selenga River Delta covers about 540 sq km and accumulates more than a half of suspended matter and pollutants that comes from the basin. The main sources of pollution in the basin are associated with urban and mining areas. In Mongolia there are Ulaanbaatar city, industrial towns of Erdenet and Darkhan, while in Russia Ulan-Ude town and W-Mo processing factory in Zakamensk. Boroo and Zaamar gold mining areas are the main mining activities and situated in Mongolian part of the basin.

Among 71 elements 10 main pollutants was chosen. Within 10 heavy metals it was revealed that average content in water of V, Mn, Fe, Cu, Zn, Mo is above Maximum Permissible Concentrations for fishery waters. And content of Mn, Ni, As and U in the suspended matter is higher than average composition of upper continental crust according to K.H.Wedepohl.

The aim of this study was to detect the levels of pollutants and their spatial distribution within the Selenga Delta area. Thus zones of different pollution levels was defined: maximum concentrations were found in eastern and western parts in channels with big discharges.

SS11 - Oral

PROTEOMIC RESPONSES IN AMPHIPODS ENDEMIC TO LAKE BAIKAL AND A NON-BAIKAL SPECIES TO THERMAL STRESS

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Proteomics is the complex analysis of all proteins in organisms ('proteome'), enabling insights into protein regulation and modifications. The recent availability of genomic sequence information for different taxa enables application of proteomics also for non-model species. We aimed to obtain insights how the proteomes of two endemic species from Lake Baikal, *Eulimnogammarus cyaneus* and *E. verrucosus*, and of *Gammarus lacustris*, common in freshwaters across the Paleartic respond to thermal stress. Using 1D, 2D PAAG-electrophoresis with [35S]- methionine labeled proteins, followed by MALDI-TOF-TOF MS/MS analysis, the thermal stress-proteomes were characterized. In comparison to the more thermosensitive *E. verrucosus* high levels of thermal lability of the proteomes from *E. cyaneus* and *G. lacustris* were observed. All identified thermal stress - responsive proteins could be assigned to four groups according to their functions: proteins of the cytoskeleton, proteins of energy turnover, molecular chaperones and antioxidative stress enzymes. The identified proteins may be useful as candidates for biomarker studies on the thermal stress condition of the studied amphipod species under different temperature regimes.

This study was supported by the Russian Foundation for Basic Research (projects 14-04-00501, 15-04-06685), Russian Science Foundation (project 14-14-00400) and by the 'Goszadanie' from Ministry of Education and Science of Russia.

SS11 - Oral

RING STRUCTURES ON THE ICE OF LAKE BAIKAL

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Satellite information gave possibility to find the ring structures on the ice cover of Lake Baikal. In recent years (2003 - 2014) they appeared in six regions of the lake. The diameter of the ring varies from 3 to 4.5 km are close to the baroclinic Rossby scale. Field studies of ring structures have shown that they are formed by the ring-geostrophic currents generated by the local penetration of deep waters in the near surface layer.

The simulation results 'large-scale' three-dimensional non-hydrostatic model using field temperature and current data in the vicinity of the ring structures indicate the presence of a local anticyclonic circulation. The currents increased to a maximum value (5-7 cm / s) at a distance of about 3 km from the center. The results of these calculations were used to simulate the changes in thickness of the ice of the ring structure. The thickness of the ice, were defined in the framework of the Stefan problem for a two-dimensional axisymmetric model. According to the model, the time required for the observed decrease of the ice thickness and formation of ring structure is 25 - 35 days.

SS11 - Oral

RESULTS OF 20 YEARS OF SEDIMENT TRAP MONITORING.PARTICLE DYNAMICS IN OCEAN-LIKE LAKE BAIKAL.

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Vertical particle fluxes have been monitored at several sites along Lake Baikal since December 1995. Sequencing and integrating sediment traps were deployed in moorings at different water depths down to 1360 m. Calculation of mass flux rates revealed distinct spatial and vertical differences. Total annual mass flux rates may fluctuate considerably, but show decreasing flux rates within a decade.

Exceptionally high mass flux rates appeared occasionally during the last two decades. They were identified as diatom-peaks, appeared periodically at a frequency of 2 - 4 years and were related to '*Melosira*'-years. Such maximal spring-blooms of diatoms provoke bulk settling velocities from the productive zone of the epilimnion to the deep lake floor of up to 76 m d^{-1}. Scavenging algal particles at such high rates prevents the otherwise very high dissolution rates of organic material, which amounts to be typically 90 %.

The deepest traps of the moorings, deployed generally 1.5 m above the lake floor, commonly acquire just slightly higher flux rates, caused by the turbid benthic boundary layer above the sediment. Only once an episode was documented, when severe re-suspension of already deposited material took place at the lake floor.

SS11 - Oral

IMPLICATIONS OF SHIFTING PLANKTON DEPTH DISTRIBUTION OVER 45 YEARS IN LAKE BAIKAL, SIBERIA

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Vertical stratification of aquatic ecosystems can be reinforced by long-term warming, altering spatial patterns differentially across plankton taxa. Examination of 45 years of Lake Baikal data from Irkutsk State University reveals that surface waters in the world's most voluminous freshwater lake are warming at an average rate of 2.01^{o}C century^{-1}, with more dramatic warming in the summer (3.78^{o}C century^{-1}) and significantly increasing relative thermal resistance to mixing during its brief summer stratification. Shorter term climate dynamics, such as those associated with the Pacific Decadal Oscillation and Arctic Oscillation, can further alter Siberian weather patterns that affect timing of seasonal changes (e.g., stratification) at the lake. Observed vertical patterns of algal distribution are consistent with studies in marine systems that have undergone warming and intensified stratification, with heavier taxa increasingly sinking beyond the photic zone while smaller, motile algae have maintained or increased their summer (JAS) presence in the photic zone. Concurrently, juveniles of the most abundant zooplankton taxon (Epischura baikalensis) occupy more shallow depths in summer, as do rotifers and cladocerans. Overall grazer overlap with edible phytoplankton has modestly increased over time, and shifting distributions into warmer waters have implications for growth, metabolism and exposure to pathogens and parasites.

SS11 - Oral

ANAEROBIC METHANE AND AMMONIUM OXIDATION OCCURS IN STACKED REDOX ZONES LINKED TO IRON- AND MANGANESE OXIDE LAYERS IN LAKE BAIKAL SEDIMENT

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Lake Baikal sediments feature unusual sequences of buried Fe-Mn oxide layers, that introduce considerable complexity and steep gradients in the vertical redox sequence. Geochemical evidence indicated that anaerobic methane oxidation occurs that may be coupled directly or indirectly to reduction of Fe-Mn oxides. In addition, evidence for anaerobic nitrification of ammonium was observed at sites with Mn (IV). 16S rRNA gene amplicon pyrosequencing revealed a number of unusual features in the depth profile of the microbial communities. Many OTUs showed multiple peaks in relative abundance with depth, confirming that multiple layers of active redox zones exist in this highly energy-limited sediment environment. Among the most abundant OTUs we observed Nitrospira and Nitrosomonadales which were present down to 8.75 cm and 13.25 cm depth, respectively. As oxygen did not penetrate below 1 cm depth, both of these typically oxic nitrification organisms were thus abundant far into apparently anaerobic depths, where Nitrate, Sulfate and reduced and oxidized metal species co-occur at very low concentrations. Typical aerobic methanotrophs were absent, but Crenothrix, a filamentous freshwater methane oxidizer and cand. Methylomirabilis, known for its ability to oxidize methane with nitrite, were present. The deepest zones were dominated by methanogenic and other hydrogenotrophic organisms.

SS11 - Oral

WATER QUALITY RETRIEVAL USING HYPERSPECTRAL OBSERVATIONS BY ULTRALIGHT AIRCRAFTS OVER THE SELENGA DELTA IN LAKE BAIKAL

V. Nouchi, D. Odermatt, D. Bouffard, J. Wüest

Hyperspectral systems on-board Unmanned Aerial Vehicles', drones, and ultra-light aircraft are raising the interest of the remote sensing community to investigate processes at a finer spatial, temporal and spectral resolution than available from traditional spaceborne instruments. Equipped with hyperspectral spectrometers, these systems enable a spatial resolution close to 1 m and revisit times in order of minutes. Our objective is to assess the suitability of such systems to accurately retrieve the inherent optical properties and constituents of optically complex waters, and their potential for the investigation of stratification processes in river estuaries. We present a processing scheme that facilitates calibration, atmospheric correction, georectification, and parameter retrieval for ULM based observations acquired with new ultralight hyperspectral cameras. Ground truth references acquired in the Selenga Delta in Lake Baikal (Russia) are used to validate the retrieval of surface reflectances and constituent concentrations using empirical and semi-analytical algorithms.

SS11 - Poster

BIODIVERSITY OF SUB-ICE MICROBIAL COMMUNITIES IN SOUTHERN BAIKAL

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Sub-ice environment is a complex dynamic ecosystem, in which the formation of the diverse communities is affected by low temperature, sub-ice currents, changes in nutrients concentration and variation of snow cover thickness. We analysed sub-ice communities in Southern Baikal from 4 sites at different distances from the shore. We collected 15 water samples at the 'water-ice' interface from February to April of 2013. Light and scanning electron microscopy showed that dinoflagellate *Gymnodinium baicalense* dominated (maximal abundance 919×10^3 cell/L). As a result of pyrosequencing of the 16S rRNA gene fragment and metagenomic analysis, we obtained 56,345 sequences and revealed 517 $OTU_{0.03}$ with the indices of Chao (from 105 to304) and Shannon (from 1.7 to 3.3). The sequences were grouped in 14 phyla, the highest number of sequences belonging to the phyla *Actinobacteria, Bacteroidetes* and *Proteobacteria*. The NMDS and cluster analyses demonstrated that taxonomic composition of the communities depended on time of their development. The contribution of the phylum *Bacteroidetes* decreased, whereas that of *Proteobacteria* increased. Thus, we characterised the structure of sub-ice communities, which were dominated by *Gymnodinium baicalense*. Bacterial composition was diverse and depended on time.

The work was supported by the project VI.61.1.4 (0345-2014-0006).

SS11 - Oral

PHYSICAL, CHEMICAL AND BIOLOGICAL DRIVERS OF PHYTO- AND BACTERIOPLANKTON DIVERSITY IN LAKE BAIKAL: SOME RESULTS FROM THE DIMENSIONS OF BIODIVERSITY PROJECT

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We present results from the 2013 spatial survey of Lake Baikal, nutrient enrichment experiments, metagenomic analyses and temperature experiments that were conducted to characterize bacterio- and phytoplankton taxonomic, genetic and functional diversity and identify major drivers of diversity. We found that phytoplankton in Lake Baikal are co-limited by nitrogen and phosphorus, at least in the summer. Major drivers of bacterio- and phytoplankton diversity were sample depth, station depth, temperature (separating open Baikal and bays), dissolved nutrients and chlorophyll. Interestingly, bacterial diversity increased with depth and different taxonomic groups were dominant at different locations. There was a considerable difference in functional traits (e.g., temperature responses) between endemic and cosmopolitan species within taxonomic groups. Also, strains and species isolated from highly thermally variable and warmer bays had higher temperature optima and wider thermal niches than strains isolated from open Baikal. The results show that potential changes in temperature and nutrient regimes in Lake Baikal may cause shifts in the composition and functional diversity of bacterio- and phytoplankton communities.

SS12 - Poster

IMPACTS OF WATER INTAKES ON ECOSYSTEMS: COMPARISON WITH DAMS AND THE KEY ISSUE OF THE SEDIMENT WAVE

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The interruption of natural flow for hydropower in Alpine regions causes impacts on both river flow and on sediment transfer systems, which may impact ecosystems downstream. The ecological impacts of rivers regulated by barrages, with sediments retained behind walls, are well studied. By contrast, there has been much less focus on water intakes where regular purges of sediment traps feed the river with solid material, whilst the transport capacity is drastically diminished. Whilst the effects of flow abstraction on ecology may be reduced through a compensation release, this does not deal with the problem of sediment which may only be transported at higher flows. The result may be aggradation of material downstream from the water intake. Subsequent purges may remobilise this material but the duration of remobilisation is commonly much shorter than the duration under natural flows. Hence, the aggrading zone migrates downstream, as a wave of sediment propagating through time. It induces a continuous channel morphological response, modifying refugia, spatial structure and habitats, resulting in a diversity and productivity decline. Thus, the sustainability of a fixed minimum residual flow may not be clear in rivers with high sediment delivery rates and alternative management strategies will be needed.

SS12 - Oral

AN ECOSYSTEM SERVICE APPROACH TO LICENSE NEW RUN OF THE RIVER HYDROPOWER PLANTS

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Freshwater ecosystems provide several services (ES) to society. Hydropower production is one of the most relevant ES supported by Alpine rivers, and it is often in conflict with other river uses and services. Recently, the demand by local authorities, public or private agencies for new small hydropower plants have been increasing, and new conflicts have been arousing. We propose an approach to model the alterations of selected ES which integrates hydrological and habitat models and evaluates possible variations of the selected ES under different withdrawal scenarios. The case-study is the Noce River, a gravel-bed river in the Italian Alps (Trentino, North East Italy) which is subject to hydropeaking. We selected four ES: habitat for juvenile and adult marble trout as biodiversity proxy, rafting as recreational services, and small hydropower production as provisioning service. We evaluated the variations of these services for maximum and no hydropower production, chosen as different boundary conditions. Moreover, we simulated the presence of four new different small hydropower plants with increasing withdrawals. Large hydropower is the key driver, affecting all the selected ES. Small hydropower decreases the potential for rafting up to 64%, while it is often negligible for other services.

SS12 - Oral

THE FUTURE OF SWISS HYDROPOWER: AN INTEGRATED ECONOMIC ASSESSMENT OF CHANCES, THREATS AND SOLUTIONS

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Hydropower (HP) represents a central pillar of Switzerland`s energy system and a crucial element of the Energy Strategy 2050 targets: HP is envisioned to increase production, is supposed to provide the needed flexibility to accommodate large shares of renewable generation, and plays an important role in regional economies and development. At the same time several uncertainties and external factors will have an impact on the current operation and future development of hydropower.

The joined project ***'The Future of Swiss Hydropower: An Integrated Economic Assessment of Chances, Threats and Solutions'*** tackles those challenges and aims at providing a comprehensive framework for the evaluation of and its application to assess hydropower operation, hydropower investments and the sustainability perspective on a regional level. Following a comprehensive stakeholder process to identify the main drivers and uncertainties for HP in the short and long run we will provide a holistic framework addressing the three respective main research questions:

1. What are the short-term operational options for Swiss HP to cope with the volatile market environment?
2. What are the long-term investment options for Swiss HP and how can uncertainty be accounted?
3. What are the regional impacts of these developments from a comprehensive sustainability perspective?

SS12 - Oral

ECOLOGICAL ASSESSMENT OF SEDIMENT MANAGEMENT STRATEGIES IN TWO ALPINE RIVERS

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Hydropower reservoirs have altered river ecosystems through habitat fragmentation, loss in hydrologic connectivity, and changes in eco-morphology. Recent regulatory changes have obligated river managers to mitigate these ecological impacts while still providing services for humans. This study focused on the loss in hydrologic connectivity and the effects of two different approaches used to restore flow and sediment dynamics in impounded alpine rivers: environmental flows (EFS) to simulate the natural flow regime and sediment by-pass tunnels (SBT) to replenish sediment levels below reservoirs. We examined the ecosystem response of each system using the ecological indicators of sediment respiration, primary production and macroinvertebrates above and below natural sediment input zones. Both approaches decreased sediment respiration (EFS = 27%; SBT = 47%), biofilm biomass (EFS = 18%, SBT = 83%), and macroinvertebrates richness (SBT = 70%) and density (SBT = 98%) after an event. In all cases, indicators rapidly recovered to pre-event values within two months. Our data suggest that sediment management actions can affect ecosystem processes and biota, probably acting as a pulse disturbance event. Further studies are necessary to assess the long-term effects of sediment management strategies on stream ecosystems.

SS12 - Oral

HYDROPOWER INFLUENCE ON RIVER THERMAL REGIMES: FROM THERMOPEAKING ALTERATION TO MITIGATION OF CLIMATIC EXTREMES?

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Water temperature is a fundamentally important factor in aquatic ecosystems, which strongly influences biological communities and ecological processes. However it is sensitively influenced by climate changes and human activities. Hydropower operation influences aquatic ecosystems in the most immediate reaction through modification of flow and water temperature regimes. In the case of high-head storage hydropower plants, their intermittent operation causes rapid artificial flow fluctuations downstream, known as 'hydropeaking', which may cause strong 'thermopeaking', i.e. artificial sudden fluctuation of the stream temperature, occurring at sub-daily time scales. When occurring, thermopeaking typically cools down the stream temperature in summer months, which also correspond to the timing of climatic extremes known as 'heat waves' that occur with increasing frequency. This work analyzes the responses of river water temperature (RWT) to air temperature modifications especially under heat waves for 22 river gauging stations across Switzerland, using a 30 years discharge and RWT dataset at 10-mins resolution. Results suggest that streams with thermopeaking may be much less sensitive to heat waves compared with stream reaches without sub-daily thermal alterations. The seemingly adverse ecological effects that have been associated so far with thermopeaking might therefore be partially counterbalanced by such protective effect of thermal peaking from heat waves. This research may help improve the understanding of multiple consequences of hydropower production on riverine ecosystems.

SS12 - Oral

A NEW MODE OF FINE SEDIMENTS MANAGEMENT FOR THE VERBOIS HYDROELECTRIC DAM ON THE RHÔNE RIVER IN THE CANTON OF GENEVA, SWITZERLAND

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Since the construction of Verbois hydroelectric dam in 1943, Geneva Public Utilities has effectuated, every three years, a washout of the accumulated sediment in order to maintain the adequate river bed gradient for sediment and gravel transit. The

deposited amount of fine sediment arriving principally from the Arve River leading into the hydroelectric dam is approximately 360’000 m^3 yearly. This method reduces the accumulation of sediment and assures the protection of Geneva residents against flooding but unfortunately results in significant environmental damage.

Detailed engineering studies, launched in 2003, have been conducted to find a more sustainable operating model to evacuate these huge quantities of sediment. Various options were evaluated based on the environmental impact, security aspects, economical factors, technical characteristics as well as the social focus.

The goal of the new scenario is to apply the downstream TSS regulatory limits used by Compagnie Nationale du Rhône. In order to achieve this goal, water dilution and partial lowering of the river level will be completed during the future washout process.

Therefore the TSS concentration will be lowered by one third and the impact on fish will be reduced. The next operation is planned for 2016.

SS12 - Oral

CHANNEL CONTRACTION DRIVES THE IMPACTS OF WATER ABSTRACTION ON STREAM ECOSYSTEM MULTIFUNCTION

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Water abstraction for hydropower is a prevalent impact in streams and rivers under humid climate, which is expected to increase in the future. This study was conducted in Artikutza (Navarre), aiming to assess the effects of water abstraction on stream ecosystem functioning. In a BACI experiment, we put in operation a long-unused abstraction scheme and reduced discharge in the experimental reach below 10% of the discharge in the control reach, mimicking the effect of hydropower schemes. We assessed the effects of water abstraction on stream width and depth, hydraulics, biofilm, extracellular enzyme activities, nutrient retention, benthic metabolism and retention and breakdown of organic matter, analysing both the patch and the reach scale. Water abstraction reduced width and depth of the wetted channel and slowed down the movement of water along the experimental reach. Biofilm biomass, exoenzyme activities and nutrient uptake decreased at the patch scale, whereas abstraction did not significantly affect the rest of the variables. However, as a consequence of the strong ecosystem contraction, impacts on all the variables were significantly intensified at the reach scale, which is more meaningful for the global accounting. Our results showed water abstraction can severely impact streams, especially due to channel contraction.

SS12 - Oral

HOW DID FISH WITHSTAND THE IMPACTS OF A COMPLETE RESERVOIR SLUICING (2012 VERBOIS RESERVOIR, RHÔNE RIVER)? IMPLICATIONS FOR THE MANAGEMENT OF LARGE DAMS

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Sediment sluicing operations of large hydroelectric reservoirs are commonly performed to maintain power production and to ensure safety concerns, but may have strong impacts on fish assemblages present both in the reservoir and downstream. Very few studies report quantitative in situ evaluations of impacts due to common practices of fine sediment management in a large river system. By June 2012, the emptying of the Verbois reservoir (Rhône River, Switzerland) was performed, and subsequent impacts of sediment release on fish assemblages present both in the reservoir (18-months hydroacoustic survey) and downstream (short-term movement and survival using radiotelemetry) were assessed. Overall, the study showed that such sediment management operations severely impacted the fish community of the Rhône River. Major loss of fish density with slow recolonization process was detected in the reservoir, as the total density declined by 57 %. Downstream to the dam, the overall mean survival of marked fish after the flushing was estimated to 74%, but differed between species (from 40 % for *Salmo trutta fario* to 80 % for *Squalius cephalus*). The flushing delay and strength seem by far too constraining for such a low-resilience fish community, claiming an alternative, less harmful way of releasing accumulated fine sediments.

SS12 - Oral

FISH LIKE 'THE ROLLING STONES'

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River systems are organized largely by physical processes, in particular the movement of water and sediments. Riverine organisms have developed a myriad of adaptations to cope with these environmental variations.

Anthropogenic pressures such as sediment traps, dams, and river channelization have fundamentally modified the sediment regime in many rivers worldwide, resulting in sediment depletion and subsequent channel incision and/or potentially an increased input of fine particles from assorted sediment behind dams.

Here we tested, using a gradient of anthropogenic impact across 33 alpine streams, whether sediment depletion resulted in structural and functional changes in riverine fish assemblages, with a special focus on trophic interactions. We compared reach scale channel conditions (e.g. channel stability, grain size distribution, degree of clogging, organic matter content of hyporheic sediment) with metrics of fish population structure (density and biomass of size classes) and variables on individual level (body condition, stomach content, morphometry).

Our findings provide basics for management and rehabilitation of sediment regimes in alpine streams.

SS12 - Poster

OPTIMIZING ENVIRONMENTAL FLOW RELEASES UNDER FUTURE HYDROPOWER OPERATION

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River impoundment for hydropower production has been shown to often result in a downstream reduction of ecological state worldwide. However, under the current prediction for a future increase in hydropower production in Switzerland and general concerns around the sustainability of hydropower operations with regard to environmental health, a need for further investigations has emerged. While the deterioration of ecosystems downstream of dams has been extensively reported, predictions for optimized flow management strategies require a further understanding of the hydrological, hydromorphological and ecological processes involved.

With this study, we propose to investigate how the impaired sediment fluxes resulting from regulated flow affect floodplain ecosystem structure and function.

State of the art drone technology will be used to monitor sediment fluxes and map changes in aquatic habitat under different flow management strategies. Sediment respiration will be measured as an indicator of stream metabolism and macroinvertebrates, biofilm and fish will be collected for analysis of community structure and function.

Analyses of biological traits, food web structure and trophic niche variation will further our mechanistic understanding of the biotic and abiotic processes linking sediment flux and ecosystem structure, resistance and resilience under current and forecasted flow management strategies.

SS12 - Oral

SUSTAINABLE ADAPTATION OF SWISS HYDROPOWER INFRASTRUCTURE TO MEET FUTURE ELECTRICITY NEEDS UNDER STRONG ENVIRONMENTAL CONSTRAINTS

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Switzerland's Energy Strategy 2050 focus on nuclear power phase out and on electricity generation from renewable sources, in particular from hydropower. Seven competence centers for research on energy (SCCERs) have recently been created, including one on the Supply of Electricity (SoE), aiming at developing fundamental research and innovative solutions in the fields of geo-energies and hydropower.

Hydropower is the major source of electricity in Switzerland with approximately 55% of the total electricity production (69 TWh in 2013). A total increase of annual production by 1.53 TWh to 3.16 TWh in average hydrological conditions until 2050 is targeted at, in a highly challenging context where almost all major river systems are already exploited. Moreover, where compliance with environmental laws after concession renewal and the increase in pumping consumption required for grid regulation are both reducing the net hydropower production.

The paper presents a comparison between the sustainability of hydropower and of other sources of electricity generation and the innovation roadmap of the SCCER-SoE. The roadmap aims at harnessing currently non-exploited hydropower potential, whilst maintaining present production levels, increasing the efficiency of existing systems and improving the ecological conditions of river catchments that are already used for hydropower production. This is paramount to justify upcoming adaptations of the existing hydropower infrastructure under challenging ecosystem protection requirements and electricity market conditions.

SS13 - Oral

THE TUM SHAFT HYDROPOWER – AN ECOLOGIC AND SUSTAINABLE HYDROPOWER CONCEPT

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Hydropower is a renewable and costly energy source and therefore high growth rates are expected in the coming decades. A comparison with the world’s biodiversity hotspots shows that the future hydropower developments actually often conflict with these sensitive areas. Classical hydropower concepts cannot offer a secure downstream migration path for aquatic organisms but also the upstream migration is often hindered due to bad design or inadequate dotation. Even more important are probably the effects of large and not ecology friendly hydropower plants on the reproduction of aquatic populations. High impounding, therefore low velocities and a completely changed grain size distributions of the reservoir bed minimize the reproduction spots of indigenous populations.

The multi-shaft hydropower concept has been invented and investigated at Technische Universität München, Germany. In an effort we tried to adapt this concept to the Mekong River as an alternative to the Xayaburi Hydropower Plant currently under construction despite vigorous opposition from the local population, neighboring countries and NGOs. The planning shows that an ecologic alternative is feasible and that even pure economic judgment (considering only construction costs and energy income) does not in any case clearly support 'the economy of scale'.

SS13 - Oral

PASSAGE PERFORMANCE OF A POTAMODROMOUS CYPRINID THROUGH A SMALL WEIR

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Unlike the numerous studies of the impacts of dams on fish populations, much less is known about the effects of small weirs. Nonetheless, these barriers may lead to fragmentation of river networks with negative consequences for fish migrations. To evaluate the passage performance of a potamodromous cyprinid, the Iberian barbel (*Luciobarbus bocagei*) when encountering small weirs, a total of 16 combinations of plunge pool depths (z=10, 20, 30, and 50 cm) and heights of the jump (h=5, 10, 15, and 25 cm; distance from the plunge pool surface to the top of the weir crest) were tested in an experimental flume. Results showed that both variables and their interaction term (z x h) were significant correlated withthe number of successful fish passages (PerMANOVA, $p< 0.01$). The highest number of passages (n=50) occurred for a combination of z=20 cm h=10 cm, and the lowest (n=1) for a combination of z=10 cm h=25 cm. Contrary to what was expected, increased passage did not occur at higher plunge pool depths in association with lower height of jump, demonstrating that passage success is a complex phenomenon where both variables interact to set the most effective hydraulic conditions for fish.

SS13 - Oral

EXPERIENCES OF THE EEL-PROTECTIVE POWER PLANT MANAGEMENT IN THE WESER RIVER SYSTEM

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Legal and political requirements expect all sectors in society to take river ecosystem health and biodiversity into consideration. Statkraft, international leader in hydropower and Europe's largest generator of renewable energy has implemented an early-warning system in combination with a fish-friendly turbine management for all its run-of-river hydropower plants located along the Weser river system. The European eel (*A. anguilla*) stock is highly endangered and faces multiple stressors such as pollution, overfishing, lack of habitat as well ecological discontinuity through run-of-river hydropower stations and weirs, especially during migrating season (Aug-Feb). When migrating, there is a risk for silver eel getting injured by intake rakes and turbine blades. The eel-friendly turbine passage is currently considered to be the best practice in protecting migrating silver eel by reducing injuries during turbine passage and by significantly increasing the total survival rate. The eel-protective power plant management addresses one critical life phase for the endangered silver eel and is a sustainable, economic as well ecologic long term solution significantly increasing the number of eel leaving European freshwaters, which is, from a management perspective, likely to be the most effective route to improving eel stock. Experiences and results of 3 years operation mode will be presented.

SS13 - Oral

IMPROVING FISH MOVEMENTS IN RIVER NETWORKS – AN OVERARCHING APPROACH

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Rivers are severely impacted by barriers that hamper the longitudinal connectivity of the systems, promoting species isolation and affecting the movements of freshwater fish species, which leads to genetic impoverishment and disappearance of populations. This work is focused on defining the problems of connectivity infringement as well as on finding solutions to enhance connectivity in barrier fragmented systems. During the studies conducing to this work, the impact of barriers on the distribution of freshwater fish species and the reduction of structural and functional connectivity of river basins were accessed. A technique to prioritize barriers to intervene in order to enhance connectivity is also presented. Barrier removal is often impractical so incorporating fish passage devices or improving existing facilities are possible options for restoring river connectivity. Strategies to retrofit existing fishways and guidelines for new fishway projects were determined and are present in this work, demonstrating how flow regime alterations can have an impact on fish negotiation success. This work is a multi-scale and multi-purpose approach to fish movement problems in river networks that progresses scientific knowledge and moves a step forward towards a holistic approach to river network studies, improving both problem and solution definition.

SS13 - Oral

CHANGES IN LONGITUDINAL CONNECTIVITY FOR FISH UNDER FUTURE CLIMATIC SCENARIOS IN THE TÂMEGA RIVER BASIN

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Climate change will predictably change hydrological patterns and processes at the catchment scale, with impacts on habitat conditions for fish. A general decrease in precipitation, especially in the dry season, is expected according to most scenarios available (e.g. IPPC for 2046-65). One of such effects will be to strengthen connectivity losses caused by the presence of artificial obstacles such as dams and weirs, which is expected to be more marked during summer. The main goal of this study is to predict how the longitudinal connectivity for fish will be affected under future scenarios of reduced flow and water depth in the Tâmega River basin (NW Portugal). The interplay of these changes with predicted alterations of habitat suitability is also assessed. This study focuses on three species: brown trout, barbel and nase. Hydrological, climatic, and hydrogeomorphological variables are modelled using a water modelling system (MOHID) both for the present and considering future climate change scenarios. Changes in obstacle passability under climate change were modelled separately for the wettest and the driest months and will be based on a graph-based metrics (Probability of Connectivity). The results will contribute to river management and impact mitigation actions under climate change.

SS13 - Oral

WEIR-INDUCED SERIAL DISCONTINUITY AND MITIGATION STRATEGIES

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Most of the world’s rivers are affected by dams and weirs, which results in modifications of serial continuity and a decline of riverine fish species diversity. Information on the quantitative and qualitative effects of weirs as well as on the efficiency of restoration measures is crucial for successful management of stream ecosystems. We developed and tested an evaluation system for the quantification of weir-introduced serial discontinuity, the effects of instream habitat restoration and the assessment of the ecological functionality of fish passes. Weir-induced effects exceeded the effects from variation of geographic location, geology, and drainage system. The effects were quantified concerning abiotic habitat properties as well as in the community structures of fishes, macroinvertebrates, macrophytes and periphyton. Instream habitat restoration revealed little effect on the fish community. In addition to their roles as migration corridors, fish passes provided important key habitats for juvenile and small rheophilic fishes. Consequently, fish passes can play an important role as compensatory habitats and this function should be better considered in river restoration. The evaluation system presented herein, by including several taxonomic groups and physicochemical habitat variables, provides a universally applicable tool for the ecological assessment of serial discontinuity and its mitigation.

SS13 - Poster

IDENTIFYING POTENTIAL IMPACTS OF HYDROPOWER REGULATION ON SALMONID HABITATS IN SCOTTISH RIVERS USING CONNECTIVITY METRICS

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Hydropower generation is an increasingly important source of renewable energy worldwide. However, there are potential conflicts between energy demands fromhydropower schemes and ecological flow requirements in regulated rivers. Scottish rivers support significant populations of Atlantic salmon (*Salmo salar* L.). The flow requirements for Atlantic salmon vary with life stage and consequently habitat, therefore the impacts of hydroschemes are spatially variable. An important element in maintaining a good ecological status or potential of riverine systems is the connectivity in river networks and fish access to different habitats. The impact of hydroschemes on the spatial and temporal connectivity is not well understood and currently there is no clear overview of where possible issues of connectivity might occur and adversely affect salmonid habitats. We aim to provide an overview of where possible issues of connectivity might occur by mapping the connectivity in Scottish river networks. We have used a set of simple connectivity measures to study how changes in the river network affect the connectivity of the catchment at different spatial scales and how this affects fish habitat use. These results can only be considered as preliminary, but form the basis for hydrological and biological data collection in an explicit context.

SS13 - Oral

RIVER CONTINUITY AT EXISTING WEIRS – DESIGN OF FISH WAYS UNDER DIFFICULT BOUNDARY CONDITIONS

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In Germany a lot of weirs exist in many rivers preventing the fish from migration. Especially the River Ruhr is disrupted by many more or less big weirs, sometimes additionally used by hydropower plants. Two of the biggest facilities, the weirs of Lake Kettwig and Lake Baldeney, are obstacles still impassable for fish. Since many years the Ruhrverband is looking for a fish pass solution at both locations being closely embedded in urban surroundings. Thus a step by step procedure was installed regarding and investigating different essential aspects in deep detail; the flow conditions downstream the turbines, different entry sceneries of a fish pass as well as diverse fish pass types.

These examinations results in the decision to install a new elevator system instead of a conventional fish pass. However, this solution has to be tested whether it will work under the given conditions or not. These task consists of a computational simulation of the hydraulic conditions, of flow experiments on a 1:4 model and finally of different tests in the real scale with living fish. As all the investigation done comes up with positive results preparations for starting the real construction of such a fish elevator will start soon.

SS13 - Poster

THE DISTRIBUTION OF THE NON-NATIVE GOBY PADOGOBIUS BONELLI IN THE TIBER RIVER (CENTRAL ITALY): COULD THE WEIRS PREVENT THE INVASION?

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The abundance and distribution of the non-native *Padogobius bonelli* in the Tiber River (Central Italy) were investigated twenty years after its introduction in order to assess the possible impact on the native goby *P. nigricans*, a threatened species endemic to Central Italy. Data from 77 sampling stations located in 36 watercourses within the Tiber River Basin were analysed. The results revealed that *P. bonelli* has spread furtherin recent years and several local extinctions of *P. nigricans* were reported. Moreover where *P. bonelli* has become more abundant, no *P. nigricans* juveniles were collected. The only undisturbed population of *P. nigricans* were found in the upper sector of the rivers, where the presence of weirs prevented the exotic species introduced into the Tiber River to migrate upstream. River damming is a human activity that negatively affects freshwater environments. However, in this case, the small weirs play and important role for the integrity of the native fish community because they could prevent the spread of exotic species from the downstream rivers to upstream contributing to the conservation of endangered species. Therefore secondary small streams represent a reservoir of native species, allowing the recolonization from neighbouring sites, which prevents long-term interspecific exclusion.

SS13 - Poster

DO RESERVOIR DAMS ACT AS ARTIFICIAL REEFS FOR FISH?

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Dam lakes constructed on the streams led to habitat losses for native organisms whereas they provide sheltering for protection, reproduction and feeding of fish species by holding water through damming. Rocky-structured dams leave some gaps for the species to use them as shelter. Through monthly fish samplingby electrofishing between March 2012-April 2013 in Kocadere Dam Lake, Keşan, individuals of *Perca fluviatilis*, *Cyprinus carpio*, *Carassius gibelio*, *Squalius orpheus*, and *Pseudorasbora parva*, were collected. Abundances of fish species were found to vary seasonally, increasing in spring, peaking at summer but decreasing in fall and winter. Fishes were observed to aggregate in deeper parts of the reservoir in winter. Length distribution of collected fishes showed that young individuals (0-10 cm) in spring and summer were more abundant than adults (> 10 cm) around the dam indicating successful recruitment whereas adults were represented by higher numbers in fall and winter. This fact was further confirmed by anglers who preferred to fish nearby the dam in spring and summer but other parts of the reservoirs in winter. This could indicate that young individuals use the dam area to avoid from predators while adults favour it for spawning and food.

SS13 - Poster

ESPACE ARVE & RHÔNE PROJECT: RESTORING ECOLOGICAL CONNECTIVITY IN A HIGHLY-FRAGMENTED WATERSHED

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Arve and Rhône Rivers catchment areas face to multiple anthropic pressures, from massive extraction of aggregates in Arve River, inducing strong incision of waterbed and tributaries disconnection, to weirs and dams building in the main stem of Arve and Rhône rivers and tributaries for hydropower production and riverbed stabilization. These numerous environmental infringements led to a strong fragmentation of fluvial continuum, with many barriers to the mobility of fish populations and interruption of solid material flow. Initiated in June 2013, the Interreg IV 'ESPACE Arve & Rhône' project (french acronyme for “Functional Spatial Scales of Processes Associated to Ecological Connectivity”) is a French-Swiss crossborder initiative that aims to estimate the area that different fish species need to complete their respective life cycle (home range), and to quantify crossing efficiency of main dams and associated fishways. Preliminary results indicated that ecological connectivity is strongly fragmented, with low efficiency of fishways and bypasses. Fish populations are highly constrained in their movements and migrations on the Arve and Rhône Rivers. The project will allow elaborating a prioritization model for managers in order to hierarchize barriers to restore ecological connectivity.

SS13 - Oral

POST-STOCKING SURVIVAL AND DISPERSAL OF WILD AND HATCHERY-REARED JUVENILE BROWN TROUT IN THREE RIVERS: EFFECTS OF STOCKING DENSITY

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Stocking with 0+ brown trout (*Salmo trutta*) reared in hatcheries still remains a common management practice in Swiss rivers, even though there are doubts as to the efficiency of these actions on population dynamics. A higher mortality of farmed versus wild fish is acknowledged, but other phenomena,such as reduced growth or enhanced migration of fish from both origins, are much more insidious and poorly documented for natural streams. An experimental *in situ* survey was conducted on three contrasted rivers to analyze the effects of 0+ stocking on wild 0+ fish. On each river, three reaches were restocked with different densities of hatchery-raised 0+ trout, corresponding to one to five times the natural population density. All stocked and wild fish were marked using PIT tags. Fish position was recorded weekly during three months with portable antennas, while downstream migration was monitored by means of fixed devices. Survival and migration rates were then evaluated. Preliminary results indicated distinct movement patterns between rivers. Stocked fish moved more than wild fish, both up- and downstream, and their mortality rate was higher. Survival of wild fish was not affected by stocking densities. Implications of our results are discussed with a highlight on management purposes.

SS14 - Oral

METACOMMUNITIES IN INTERMITTENT RIVERS: TOWARDS UNDERSTANDING EXTREME ALTERNATIVE STATES AND UNDERLYING ECOLOGICAL PROCESSES IN HIGHLY DYNAMIC SYSTEMS

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Community ecology progresses rapidly owing to the recognition that local communities are shaped by both local (biotic interactions, responses to abiotic environmental conditions) and regional (dispersal of species in a region) processes. Recent research on freshwater metacommunities offered ambiguous explanations for the relative importance of local vs regional processes. Moreover, most developments on metacommunities have considered both biological communities and their habitats as relatively stable, limiting our understanding of the temporal dynamics. Intermittent rivers (IRs) provide especially suitable arenas for examining metacommunity organisation in an extremely dynamic setting, where aquatic and terrestrial communities alternate periodically locally and coexist in a drainage network. We review metacommunity organisation in IRs to address the temporal dynamics of metacommunities in highly dynamic systems. We first compare metacommunities in perennial river systems (PRs) to those in IRs to explore how dynamic systems can lead to extreme alternate states in local community organisation. We also develop the idea that metacommunity organisation in the wet and dry phases of IRs are closely intertwined and affect the succession of each other. Last, we provide a roadmap to stimulate further developments of metacommunity research in IRs and other highly dynamic ecosystems.

SS14 - Oral

PERSISTENCE OF THE MACROINVERTEBRATE 'SEEDBANK' DURING REPEATED WETTING AND DRYING EVENTS IN A TEMPORARY STREAM

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The macroinvertebrate 'seedbank' comprises aquatic life stages that persist in dry sediments in temporary freshwaters. We rehydrated sediment samples collected from the dry bed of a temperate-zone river during a drought. Samples were collected: in November, following a 9-month dry period; in March, during the first dry phase after winter flows; and in May and August, during dry phases interrupted by short-duration periods of flow resumption. Our first hypothesis was that samples collected after the long dry period would contain a depauperate assemblage due to conditions exceeding the desiccation tolerance of many taxa. Our second hypothesis was that repeated wet-dry cycles would deplete the seedbank, reducing richness and abundance between March and August. Three aquatic taxa were recorded after the 9-month dry period, supporting our first hypothesis. Seasonal changes in insect abundance caused richness and abundance to increase between March and May before declining in August, indicating that, contrary to our second hypothesis, the assemblage was adapted to persist during repeated wet-dry cycles. In total, 33 taxa persisted in the seedbank, some probably comprising many species. With climate change predictions of increasing drought frequency, dry sediments should be recognized as biologically active and their refuge potential maximized through careful management.

SS14 - Oral

PARTICLE SIZE AND HETEROGENEITY AFFECTS THE VERTICAL MOVEMENT OF BENTHIC INVERTEBRATES DURING DEWATERING: AN EXPERIMENTAL APPROACH

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Riverbed sediments have been identified as a key refuge for benthic invertebrates in lotic ecosystems associated with flow regime variability and drying. Sediment size, heterogeneity and the availability of interstitial pore space may significantly influence the ability of macroinvertebrates to move vertically into subsurface sediments during drying, although this has been poorly quantified to date. In this ex-situ experimental study we created artificial transparent microcosms containing different sediment sizes and heterogeneity, and so contrasting interstitial pore space volumes. These enabled us to directly observe the vertical migration of three taxa (*Gammarus pulex*, *Asellus aquaticus* and *Hydropsyche siltalai*) through sediment during dewatering. Sediment size and heterogeneity significantly influenced the vertical movement of *G. pulex* and *A. aquaticus,*with more individuals becoming stranded above the waterline when particles were smaller (lower interstitial volume). In contrast, the response of *H. siltalai* to dewatering was not consistent between sediment treatments. These results demonstrate the need to consider individual taxa responses to streambed drying and how sediment characteristics may influence the responses recorded in the field. These results suggest sediment manipulation (addition of coarse gravel / removal of fines) in restoration schemes will promote community recovery as global climate predictions suggest frequent drying events.

SS14 - Oral

FROM HUMBLE BEGINNINGS TO BOOMING FUTURE: THE ECOLOGY AND MANAGEMENT OF INTERMITTENT RIVERS

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Research on the ecology and management of intermittent rivers (IRs) is in a ‘boom’ phase. We trace the development of ecological research on IRs, from its early focus on natural history through to the study of disturbance and the emerging application of metacommunity concepts. We find that IR research has contributed substantially to ecologists’ understanding of ecosystem responses and community resistance and resilience to both flooding and drying. Research is increasingly making use of existing data to synthesize knowledge and study IRs across continents and climate zones. Such research is elucidating the generality and individuality of biotic responses to drying; we give examples of some of our recent studies and analyses. 'Hot topics' that are likely to receive increasing research attention in the near future include IR mapping and predictive modelling of drying, multiple stressors research, metapopulation and metacommunity concepts, wet-dry (aquatic-terrestrial) phase transitions, and the study of temporal dynamics in IR communities. By building on the existing knowledge base, continuing to develop quantitative models and distribution maps of IRs, and using experimental studies to test hypotheses and strengthen concepts, we can better implement effective management and enhance our ecological understanding of these ubiquitous ecosystems.

SS14 - Oral

THE HYPORHEIC ZONE AS A PRIMARY SOURCE OF RESILIENCE FOR INVERTEBRATE COMMUNITIES IN INTERMITTENT ALLUVIAL RIVERS: EVIDENCE FROM FIELD AND LABORATORY EXPERIMENTS.

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Intermittent rivers, whose flow ceases periodically, represent half of the World's rivers and are expanding in many areas. Understanding community resilience in such systems is essential to predict the effects of climate change on biodiversity. We hypothesized that the hyporheic zone is the primary source of resilience in alluvial rivers and tested this using i. a natural experiment where community resilience to drying was addressed in 8 rivers, ii. a field experiment where flow and sources of resilience were manipulated, and iii. hyporheic mesocosm experiments that manipulated factors (water temperature and competition) associated with drying events. Our results indicate that communities in alluvial rivers are highly resilient to drying; recovery within 3 weeks of rewetting was observed in all rivers after drying events lasting 14-105 days. Preventing recolonization by drift did not alter recovery and circumstantial evidence indicates the hyporheic zone is the main source of resilience in alluvial rivers. Both intraspecific competition and increased temperature triggered the active vertical migration of invertebrates into the hyporheic zone. Altogether, these results indicate the hyporheic zone is essential to maintaining biodiversity in intermittent alluvial rivers.

SS14 - Oral

BIOINDICATION OF STREAM INTERMITTENCY BY MACROINVERTEBRATES IN TEMPERATE STREAMS – RESULTS OF THE BIODROUGHT PROJECT

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The effect of stream intermittency is frequently studied in Mediterranean countries but studies considering 'drought filter' impact on macroinvertebrate community in Central Europe are scarce. Regardless of the causes of dry episodes, which may originate from climate change or human activities, we hypothesise that drought induces structural changes in the macroinvertebrate community that last for a specific period. This 'drought footprint' is detectable by macroinvertebrate analysis during the recolonisation and its readability depends on both the duration and the spatial extent of the drought. In the BIODROUGHT project (www.biodrought.eu , grant TA02020395) we are developing a map of drought risk and a bioindication method for practical use in water management. We employed Linear Discriminant Analysis to find a combination of metrics that best discriminates among three stream classes (permanent, irregular drought, annual drought). The recent season specific method (for spring/autumn) combines metrics of three types: (i) representation of taxonomic groups (important are EPT taxa or Oligochaeta), (ii) species traits (rheophily, reproduction) and (iii) the presence of indicator taxa characteristic for permanent or intermittent streams (expressed by developed BIODROUGHT index). This approach was successfully tested for its discrimination accuracy on the Czech national database, which contains data from streams with known history.

SS14 - Poster

DIATOM BIOINDICATION ON DRY RIVERBEDS: IMPLICATIONS FOR PROTOCOLS AND INDEX VALUES (BDI/SPI) USED IN FRANCE.

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Non-permanent streams are an important part of hydrographic network in the world in a context of global warming . While the Water Framework Directive requires to member states the monitoring of their water bodies, non-permanent streams are outside the scope of standardized protocols in France when riverbeds are dried, notably those based on benthic diatoms . To improve management policies, it is essential to enlarge knowledge on the dynamics and recolonization processes of phototrophic biofilms, including benthic diatoms, subjected to variable drought intensities. We tested the reliability of diatom index values (BDI/ SPI) associated with different counting methods thanks to 3 experiments conducted at different complexity scales: from laboratory with simple biofilm and artificial drought to natural environment with complex biofilm and natural drought . Our results are discussed and suggested that only a slight modification of protocols is necessary to adapt BDI/ SPI to sampling and analyses on dry riverbeds. This allows great perspectives for this application at higher scale.

SS14 - Poster

WATER QUALITY AND BIODIVERSITY PATTERNS AT THE SEASONALLY INTERMITTENT EVROTAS RIVER (GREECE) IMPACTED BY DROUGHT AND POLLUTION

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The effects of drought and pollution on water quality and biodiversity patterns of the intermittent Evrotas River (Southern Greece), were assessed. Four reaches along the main course of the river were sampled in June 2014 when discharges were still relatively high; two minimally-impacted reaches and two reaches affected by drought and pollution, respectively. Sampling included composite water and sediment samples for priority and emerging pollutants detection, as well as biota samples, i.e. diatoms, macrophytes, macroinvertebrates and fish, to analyze biodiversity patterns and possible changes due to environmental stress. Analysis of water and sediment samples revealed the presence in all reaches of three pesticides listed as priority substances in the WFD, however their concentrations were below maximum allowable levels. Based on nutrients and macroinvertebrate indices, the two minimally-impacted reaches and the drought impacted reach varied from high to good quality. In contrast, the pollution impacted reach had higher nutrients load, a poorer macroinvertebrate fauna and lower percentage of taxa sensitive to pollution and was thus classified as moderate quality. Trophic status assessment based on macrophytes confirmed the poorer status of the pollution impacted reach, whereas a fish index especially designed for Evrotas River classified all reaches between high and good status.

SS14 - Oral

DOES CONNECTIVITY MITIGATE THE EFFECTS OF DRYING ON COMMUNITIES? INSIGHTS FROM A CROSS-SYSTEM ANALYSIS

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Disturbance plays an important role in determining community composition and dynamics. High connectivity among habitat patches may increase colonization rates and thus increase community resilience to disturbance. Temporary waterbodies experience regular disturbance (i.e. drying) and exhibit varying levels of connectivity. Intermittent streams are often connected by flow to perennial refuges during wet periods, while temporary ponds are isolated in a matrix of terrestrial habitat. We tested whether the community responses to drying differ among lotic and lentic habitats by using ten published case studies of temporary and permanent water bodies from different climates. We investigated the effects of drying on invertebrate (i) taxonomic richness, (ii) beta diversity, and (iii) taxonomic relatedness. Because drying is a severe disturbance, we expected and found striking similarities across systems, with local taxonomic richness being lower in intermittent systems. However, we also found contrasts between systems. For example, the magnitude of drying effect on taxonomic richness was smaller for streams than for ponds, suggesting that flow events, and subsequent connectivity, may moderate the impacts of drying. In contrast, drying clustered stream communities, indicating that flow connectivity did not necessarily constrain their taxonomic relatedness. Overall, our results suggest that connectivity mitigates some community responses to disturbance.

SS14 - Oral

STREAM BIOFILM RESPONSES TO FLOW INTERMITTENCY: FROM CELLS TO ECOSYSTEMS

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Microorganisms in stream biofilms require of specific structural and physiological adaptations to withstand the non-flow phase in intermittent streams. The biofilm responses to flow intermittency were first analysed in a Mediterranean headwater stream along a complete wet-dry-wet hydrological period. The biofilms experiencing the most obvious changes were the most affected by desiccation, while effects were less obvious in those inhabiting the streambed subsurface sediments. Both autotrophic and heterotrophic processes sharply decreased in the most exposed biofilms. Concentrations of chlorophyll-*a* became extremely low, and the degradation capacity of organic molecules (extracellular enzyme activities) also decreased. In the less exposed biofilms, the heterotrophic processes were less affected during non flow conditions. Flow return allowed a faster recovery of the autotrophic activity despite the extremely low chlorophyll-*a* values after the non-flow phase (just 10 % of the original). Analogous patterns have been observed in artificial streams submitted to desiccation. While the autotrophic processes (net primary production) were less resistant but more resilient, the situation was the reverse for the heterotrophic processes (respiration). These differences involved a shift towards heterotrophy at longer durations of the non-flow period, though limited to the non-flow period and to the first weeks after flow return.

SS14 - Oral

WHICH BIOLOGICAL TRAITS FAVOUR OR DISQUALIFY MACROINVERTEBRATES DURING A STREAM DROUGHT?

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Due to the ongoing climate change and a lack of summer precipitations, there is an increasing threat of stream intermittency in the temperate zone of Central Europe. In order to develop a retrospective method of indication of stream drought we focused our attention on the comparison of benthic macroinvertebrate assemblages living in permanent and intermittent streams.

We sampled macroinvertebrate assemblages in autumn and spring from a set of intermittent and permanent streams. Then we analyzed the taxonomic composition of the assemblages and calculated the proportional representation of 34 species traits related to species resistance and resilience to drought. The selection of these traits was based on an extensive literature review. Similarly, we used literature review to identify species with a potential to indicate permanency or intermittency of streams.

Finally, we compared the representation of indicator species and species traits between the assemblages of permanent and intermittent streams to identify (dis)advantageous traits that may prevent from or assist in coping with drought.

The BIODROUGHT project (www.biodrought.eu) is supported by a grant TA02020395.

SS14 - Oral

DRY RIVER BEDS AS DISPERSAL CORRIDORS FOR TERRESTRIAL VERTEBRATES: RESULTS FROM TWO MEDITERRANEAN STREAMS.

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Riparian and upland areas along rivers are known to be essential corridors for terrestrial animals. However, the potential role of dry beds of intermittent rivers as dispersal corridors for vertebrates has been largely ignored. In this study, we compared the use of four habitat types (dry river bed, riparian and upland areas, unpaved road) along two intermittent streams in Spain by terrestrial vertebrates (mammals, reptiles and birds). 72 marble dust stations were established to record the abundance and direction of vertebrate tracks. We performed GLMMs to identify the environmental factors affecting the frequency of occurrence (tracks per station and visit) of vertebrates. The mean frequency of occurrence was 1.7 in Parra and 1.8 in Rogativa. Dry beds were widely used by vertebrates, especially along the heavily vegetated Rogativa stream. The use of the different habitat types was consistent among vertebrate groups. In dry beds, directional tracks were more frequent, with a prevalence of tracks running parallel to the river line, particularly in summer. Our results highlight that dry river beds form important dispersal corridors for a wide range of terrestrial vertebrates, partly controlled by the degree of permeability of the surrounding landscape. Study funded by CLITEMP.

SS14 - Poster

NITROGEN DYNAMICS IN DRY RIVERBEDS: THE IMPORTANCE OF THE DURATION AND SEVERITY OF THE DRY PHASE

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Intermittent rivers, watercourses that experience a recurrent dry phase, expand worldwide due to global change. Water scarcity represents a master driver for biogeochemical processes by affecting microbial communities through desiccation and changes in sediment redox potential. Stream drying tends to promote organic matter mineralization and aerobic nitrogen (N)-processing pathways such as nitrification, which contributes to inorganic N-accumulation within drying riverbeds. In contrast, removal of N via denitrification, an anaerobic pathway, is reduced and limited to anoxic microsites in deeper, non-drying areas. We hypothesized that the relative importance of both processes and their consequences in terms of stream N fluxes (longitudinal and vertical) would be strongly associated to the duration and severity of dry period. We experimentally dried sediment cores from an intermittent river and then thoroughly studied how N processing varied associated to water fluctuations. The dry phase was shaped by controlling its duration and severity, the latter by simulating different intensities of rain pulses. Our results provide insights on N-processing and resulting N-budgets in dry riverbeds, and on the importance of intermittent watercourses for controlling N-fluxes at fluvial network scale.

SS14 - Poster

THE EFFECT OF DIFFERENT NUTRIENT SOURCES AND FLOOD EVENTS IN A TEMPORAY RIVER CATCHMENT (SE PORTUGAL)

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Agriculture is the major contributor for surface water eutrophication, leading to the need of mitigating soil nutrient losses from agricultural fields. This is of special concern in temporary river basins such as the Enxoé catchment (Guadiana basin, Portugal), where agriculture and extensive production of cattle are the main driving pressures.

The Enxoé River is a typical temporary water course, exhibiting no flow or ephemeral conditions from June to October. River monitoring was carried out from September, 2010 to August, 2013, comprising parameters as water stream level, turbidity and water quality during floods (i.e. SSC, TP, PP, and POC).

The SWAT model (including physico-chemical parameters, precipitation and fertilization pressures) was used to characterize the long-term fluxes of sediment and nutrients and MOHID Land was used to characterize flood dynamics.

Loads were mostly associated to non-point source pollution, incoming at the river along the margins by surface or subsurface flow. The modeling approach (integrated with field data) allowed the characterization of the current watershed dynamics, and establishment of protection measures, especially concerning erosion, one the key sources of nutrients loads to the catchment.

SS14 - Oral

A BIOLOGICAL TOOL TO PREDICT FLOW CONNECTIVITY IN REFERENCE TEMPORARY RIVERS FROM THE MEDITERRANEAN BASIN

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The high hydrological variability and associated ecological responses challenges the ecological status assessment of intermittent streams, particularly when setting reference conditions. This study examined the effects of flow connectivity in aquatic macroinvertebrates from seven reference streams across the Mediterranean Basin. We tested for the åeffect of flow cessation on biodiversity and biological quality indices, and, by performing random forest and classification tree analyses we identified important biological predictors for classifying the aquatic state either as flow or disconnected pools. Flow cessation was not critical for taxonomic and trait richness, Simpson's and Rao's taxonomic and trait diversity, but it was for biological quality indices and community composition. Several biological indices currently used for biological quality assessments presented lower values in disconnected pools. Macroinvertebrate families found to be important for classifying the aquatic state were Hydrophilidae, Simuliidae, Hydropsychidae, Planorbiidae, and Heptageniidae. For biological traits, trait categories associated to feeding habits, food, locomotion and substrate relation, and maximal body size were the most important and provided more accurate predictions compared to taxonomy. A combination of selected metrics and associated thresholds were proposed in order to assess the aquatic state in reference intermittent streams in the absence of hydrological data.

SS14 - Poster

TRIVERS: IMPLEMENTING THE WATER FRAMEWORK DIRECTIVE TO TEMPORARY RIVERS

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Temporary streams are those that undergo the recurrent cessation of flow or the complete drying of the streambed. Although they may represent the main part of the elementary drainage network, or even most of the total network in some areas due to climatic or lithological reasons, temporary streams are rarely included in stream monitoring networks. As a result, hydrological data for assessing the regime of temporary streams are often scarce. The LIFE TRivers project is developing a software (TREHS, Temporary Rivers' Ecological and Hydrological Status), which is designed to help the managers for adequately implement the Water Framework Directive in this type of water bodies. The first need for managing a temporary stream is the characterization of its hydrological regime, in order to help managers selecting appropriate sampling dates and using the right methods to determine its ecological status. Yet, the deviation of the actual regime from the natural one should be determined in order to assess the potential hydrological alteration due to the human activity and thereby determine the 'hydrological status'. LIFE TRivers will contribute to the conservation and restoration of one of the most common river typologies in the Mediterranean Basin, which contains most of Europe´s threatened freshwater biodiversity.

SS14 - Oral

RIVER RESTORATION EXPERIENCES IN GREECE AND CYPRUS: SPECIAL CONSIDERATIONS FOR EASTERN MEDITERRANEAN RIVERS

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Experiences of policy-relevant river restoration in two Eastern Mediterranean EU states show that there is a lack of serious effort in design and applications within river corridors. Applications promoted through EU-funded LIFE projects dominate initiatives. Ecological restoration of small rivers, especially naturally or artificially intermittent lotic systems, has lagged behind. Past efforts have focused on lentic waters and wetlands located in protected areas; most successful works centering on bird habitat conservation. Unfortunately, the EU WFD measures for river ecosystem recovery are usually poorly defined, poorly funded and not backed by integrative adaptive management strategies. There is usually a lack of biodiversity conservation synergy in the EU WFD water body restoration proposals despite the integrative and ecosystemic premises in the spirit of the WFD. Since ecological conditions are uniquely modified by centuries of human influence in most Mediterranean rivers, we urge in-depth restoration ecology research. Important unmet needs exist in designing more synergistic approaches that combine and better integrate more than mechanistic WFD measures. Research of type-specific reference conditions is important, especially for stream cartography of the 'natural state' baselines (e.g. perennial vs. intermittent states) and incorporating natural history knowledge during the planning and monitoring of restoration initiatives.

SS14 - Oral

VARIABLE RESPONSE OF INTERMITTENT STREAM BENTHOS TO SUMMER DRAWDOWN WITHIN THE SOUTHEASTERN PIEDMONT, USA

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In small streams of the SE Piedmont (US), predictable summer drawdown reduces wetted channel habitat and concentrates benthic communities, yet drawdown varies spatially and temporally depending on groundwater connection. In a previous study, we documented that benthic assemblages of 6 headwater Alabama streams varied with hydrologic permanence, with assemblage similarity being, at least partially, explained by permanence. However, in that study we used crude, discrete measures of bed-surface conditions to characterize hydroperiod. In the present study, we instrumented these same streams with continuous pressure transducers to quantify presence of subsurface water and estimate hydrologic harshness (as dryness duration) and, in turn, within-season assemblage response to drawdown. In early summer and prior to drawdown, richness, EPT richness, *H'* and several benthic populations varied predictably with harshness, which corresponded to a severe drought the previous summer. In contrast, during post-drawdown, most of the significant relationships disappeared as all but the most permanent streams showed substantial declines in species. Our results suggest that short-duration drying events (<1 mo) can dramatically reduce subsurface refugia and alter benthic assemblages, even in these highly forested, thermal-buffered systems where drying disturbance often is minimal.

SS14 - Oral

LINKING TERRESTRIAL AND AQUATIC DECOMPOSITION. FLOODPLAIN EXPOSURE OF LITTER CONTROLS ITS DECOMPOSITION IN STREAMS

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In rivers with high hydrological fluctuations, like temporary streams, the floodplains have a great influence on aquatic biogeochemical processes, such as litter decomposition. Litter can remain for long time in floodplains before reaching to the stream channel. During this period, litter is exposed to biotic and abiotic factors that alter its chemical quality, and subsequently, affecting its decomposition by aquatic organisms that can use these inputs of terrestrial organic matter.

In this work we compare the leaching and decomposition rates of *Phragmites australis* leaf litter exposed in a previous work in three floodplains of three geographic locations (Murcia -SE of Spain-, Gerona -NE of Spain- and Berlin –Germany-) with leaf litter without any previous exposure, with the aim of studying the effects of the floodplain exposure in the subsequently aquatic decomposition of litter.

Leaching of soluble compounds of litter and fungi colonization occurred during floodplain exposure have great influence on aquatic decomposition due to important changes in chemical quality. This work show how the exposure of litter in terrestrial environments can affect the availability of nutritive resources of litter and likely, changing its role into decomposer trophic webs in streams. (Study funded by the project CGL2010-21458 and FEDER funds)

SS14 - Oral

BIOGEOCHEMISTRY OF INTERMITTENT RIVERS AT THE INITIATION OF FLOW AFTER DRYING

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Intermittent rivers are a prevalent component of the landscape that is receiving greater research attention worldwide. Periods of zero flow define these ecosystems. The initiation of flow after a drying event is a period of dynamic change for intermittent rivers. The role of intermittent rivers in global and regional carbon, nitrogen, and phosphorus cycles is largely unknown. Intermittent rivers are rarely gauged, biogeochemical cycles are likely to be strongly pulsed, and severe sampling challenges exist for dissolved and particulate organic matter and nutrients as flow begins after drying. The transport of organic matter and nutrients in advancing wetting fronts at the initiation of flow following periods after zero flow deserve special attention. Concentrations of particulate organic carbon (POC), dissolved organic carbon (DOC), pH, alkalinity, dissolved oxygen (DO), turbidity, suspended sediments, nitrate (NO_3), and phosphate (PO_4) would be particularly useful to obtain during flow pulses after zero flow periods. Continuous real-time measurements would be especially valuable in discerning the pulsed and rapidly changing dynamics of intermittent rivers at times of flow initiation. Examples of the biogeochemical dynamics of some of these biogeochemical variables will be shown for intermittent rivers in different parts of the world.

SS14 - Oral

HYDROLOGIC VARIABILITY, LANDSCAPE-SCALE HABITAT DYNAMICS, AND POPULATION PERSISTENCE IN INTERMITTENT STREAMS.

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Low and cease-to-flow periods can play a major role in structuring stream ecosystems. During such times aquatic habitats fragment and contract to isolated pools as surface water is lost. These remaining habitats can serve as critical refuges for biota and become an important source of colonists once flows resume. However, while there is a growing number of studies demonstrating the importance of aquatic refuges at the local scale, there are still relatively few studies examining the role of landscape context in determining how local populations respond to drying cycles, and how drying affects populations at the streamscape scale. Here we present the findings from a multi-year landscape scale study of population dynamics across an intermittent streamscape to explore two key questions. First, how does proximity to permanent refuges affect patterns of population recovery at sites affected by drought, and secondly, how does focusing on the biota of remaining refuges explain the stream-scale effects of drying. As well as presenting findings from our own research, we identify a number of challenges and opportunities in gaining a greater insight into the role of landscape context in driving local and regional population dynamics, and how such insights can inform stream management and restoration.

SS15 - Oral

SMALL WATER BODIES OFFER IMMENSE OPPORTUNITIES FOR CONSERVATION AND DISCOVERY OF RARE SPECIES

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Since antiquity, man has settled around rivers, natural lakes and also, settled human populations have had dug ponds and lakes. Today, rise in human populations is inversely proportional to depleting water resources. While large lakes and wetlands have attracted enormous attention world over, biological significance of small water bodies in rural, remote and forest areas have not been appreciated. Waterbodies are open but safe treasures for survival of plant species,mollusks, fish, rodents etc. Local arboreal animals and birds feed on water. Small ponds/lakes within the forest ecosystem and within a rural village area offer a natural balance for survival of land as well as arboreal animals including rare, native and migratory birds. Three decades' field workhas identified that rare species of plants and animals are conserved in remote water bodies. We have observed 07 rare species of algae, *Gleotrichia, Nitellopsis,* and aquatic weeds *Isoetes, Ceratopteris etc;* a few of them are of great evolutionary significance. We haveutilized catchment area for conservation of rare and native medicinally very important plant species particularly, *Bacopa monnieri, Rauwolfia serpentina Adina cordifolia, Centella* sp etc. Waterbodies within forests are lifeline for animals, birds and offer excellent ponds for future conservation without interference.

SS15 - Poster

METAL DISTRIBUTION IN REMOTE MOUNTAIN LAKES IN SCOTLAND, USING PORTMORE LOCH AS AN EXAMPLE

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Remote mountain lakes are the most sensitive aquatic ecosystems in Europe. Despite being inaccessible and rarely disturbed by management practices, they contain increased amounts of potentially toxic trace metals derived from anthropogenic emissions brought by long-range atmospheric transport. Therefore, mountain lakes and their catchments are valuable indicators of past and present diffuse pollution and can serve as excellent models of global environmental change. Trace metals (Mn, Fe, Cu, Pb, Sb, and As) in a remote upland Scottish catchment at Portmore Loch were investigated in terms of their total concentration, fractionation, speciation, and biogeochemical behaviour, to gain insight in the main pathways of metal transfer, e.g. atmospheric deposition, geochemical weathering, and land use. Metal concentrations were comparable to the range of natural pristine waters, well within the standards established by the EU Drinking Water Directive. The largest concentration differences were observed between inlet and outlet, suggesting an importance of within-lake processes. The presence of tree canopies and forest floor caused retention of Mn, Cu and Pb, but enhanced mobilization of Fe. It is hypothesized that climate change may affect geochemical mobility of trace metals at Portmore Loch and increase their concentrations in overland flow from the catchment to receiving waters.

SS15 - Oral

AQUATIC MACROINVERTEBRATE BIODIVERSITY AND CONSERVATION VALUE OF URBAN AND RURAL PONDS

M. Hill

International interest in pond biodiversity and conservation value has increased significantly in recent years. At the landscape (pondscape) scale pond habitats often support a greater floral and faunal biodiversity than other freshwater bodies. However, there have been few regional scale studies examining pond biodiversity across a range of different landuses. This paper examines the regional macroinvertebrate biodiversity of 95 ponds across a range of temperate landuse types including: floodplain meadow, agricultural, forest and urban areas. The results demonstrate that at a landscape (gamma) scale, ponds support diverse (228 taxa) and valuable macroinvertebrate communities. At an alpha scale semi-natural meadow ponds supported significantly greater macroinvertebrate biodiversity and had higher conservation values than ponds in urban areas. However, total urban pond diversity (170) was comparable to total meadow pond diversity (175). High beta diversity was recorded between the pond types even though many were in close geographical proximity. The results highlight the need to develop a greater understanding of the regional distribution of freshwater biota associated with ponds. This is also essential to ensure that appropriate conservation measures and funds are directed to where they are most urgently required and/or may be most beneficial.

SS15 - Poster

SPATIOTEMPORAL VARIATION IN MACROINVERTEBRATE ASSEMBLAGES OF MEDITERRANEAN TEMPORARY PONDS OF CRETE ISLAND, GREECE

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Mediterranean Temporary Ponds of Greece have been neglected and only until recently their ecological value has been recognised. The seasonal and spatial patterns of macroinvertebrate assemblages and environmental parameters were assessed for the first time in Mediterranean temporary ponds of Western Crete. Macroinvertebrate fauna and environmental parameters (physicochemical, hydroperiod) were monitored for 3 years (2006-2008). A total of 63 macroinvertebrate taxa belonging to 33 families were recorded with *Plea minutissima*, *Berosus affinis*, *Pericoma* sp., *Culex* sp., Chironomidae and Cyprididae being the predominant taxa. Nutrient pollution was evident in ponds near agricultural areas and could be the reason for poor species richness. Inter-annual and seasonal variation of the macroinvertebrate fauna was highly significant, and macroinvertebrate community varied markedly between seasons among and within ponds (ANOSIM R= 0.965, p= 0.001). Statistical analysis showed a clear spatial and temporal distinction between lowland and upland sites. Heteroptera species were exclusively encountered on spring, while Coleoptera larvae and adults were present in all seasons, with adults being more abundant during winter. Species richness was relatively lower compared to temporary ponds from other regions due to their isolated character, unpredictable hydroperiod, man-made hydromorphological alterations and degraded water quality.

SS15 - Oral

EFFECTS OF NUTRIENT LOADING ON THE IN-STREAM PHOSPHOROUS RETENTION AND BENTHIC PROCESSES IN LOW-ORDER STREAMS (PROJECT POWERSTREAMS)

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We investigated the effects of nutrient loading on the in-stream phosphorous uptake, the stream metabolism, and biogeochemical processes at the sediment-water-interface in forested low-order streams. The catchments ranged from forests to extensively cultivated meadows and cropland. Reach-scale phosphorous uptake was estimated via short term nutrient additions with increasing phosphorous concentrations. Transient storage parameters were calculated on the base of conductivity break-through curves from salt injections. In addition, we analyzed the abundance of benthic algae and microorganims, the activity of extracellular enzymes, and the water and sediment quality. Sedimentary phosphorous uptake and release rates were studied via adsorption/desorption experiments. In-stream phosphorous uptake decreased with increasing nutrient loading. Average transport distances ranged from a few hundred meters in forest streams to several kilometers in agricultural streams. At elevated nutrient levels, light was the only limiting factor for primary production, leading to a high seasonal variability in the phosphate uptake and the activity of the benthic community. Sediments played a key role for the phosphorous retention in these small streams. Organic-rich sediments showed high phosphate release rates, which often exceeded nutrient uptake rates and functioned as a relevant internal phosphorous source for the benthic community.

SS15 - Oral

FAUNISTIC ASSEMBLAGES OF NATURAL SPRINGS ALONG AN ALTITUDINAL GRADIENT IN THE BERNESE ALPS, SWITZERLAND

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Alpine springs are sensitive ecotones, which are inhabited by highly adapted organisms. Studies on how the species assemblages change vertically have not been conducted until now. In this study alpine springs in the Bernese Alps were investigated along an altitudinal gradient over two years. The aim of this study was to analyse how macroinvertebrate assemblages of natural springs change along this gradient and which environmental factors determine these changes. The spring fauna was sampled quantitatively three times and a wide range of environmental parameters were measured. The species richness significantly decreased with increasing altitude. The composition of the species assemblages distinctively changed along the altitudinal gradient. The water temperature was an important factor for the species richness and the composition of the macroinvertebrate assemblages of the springs at different altitudes. Moss, stones and the degree of forestation also have a significant influence on the macroinvertebrate assemblages. The electrical conductivity and the species richness were very low in the high alpine springs. This is and indicator for the harsh environmental conditions. Understanding the current distribution of the spring fauna along altitudinal gradients is an important prerequisite to predict potential changes of the species distribution in the future.

SS15 - Oral

FAUNISTIC CHARACTERISATION OF SPRINGS IN DIFFERENT VALLEYS IN THE SWIS NATIONAL PARK

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Springs are unique freshwater habitats containing outstanding biocoenosis and have relatively stable physicochemical conditions. Combined with high habitat diversity this leads to an increased species richness. Especially in alpine environments springs may serve as refugia for relict species. The objective of this study was to examine the macroinvertebrate assemblages of springs on a broad spatial scale in five adjacent valleys in the Swiss National Park. The faunistic composition of the springs was analysed quantitatively using a small surber sampler and qualitatively by hand picking. Furthermore, we investigated environmental conditions and measured physicochemical variables. The results show that Diptera, Plecoptera, Trichoptera and Acari were the taxa most diverse and rich in individuals. In each taxon crenobiontic and crenophilous organisms with an alpine distribution were dominant. The speciescomposition changes significantly between different valleys and some species show a very limited distribution within a specific area. For example *Helophorus fauveli* appeared only in Val dal Botsch and *Panisopsis curvifrons* only in Val da Stabelchod. Nonetheless, the individuality of each spring within these broad spatial structures was still given. It can be concluded that according to this study alpine springs show a high α-and β-diversity.

SS15 - Oral

DOES GROUNDWATER STABILITY SUPPORT SPRING BIODIVERSITY?

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Boreal springs are recognised as hotspots of aquatic and terrestrial biodiversity. Their value in harbouring endemic, rare and cold-water spring specialist plant and invertebrate species is frequently linked to their unique intra- and inter-annual environmental stability. The stability of springs is largely determined by groundwater hydrology, and identification of main factors determining groundwater stability is essential for understanding among-site variation of spring biodiversity. Here we assess qualitative, quantitative and thermal stability of three intensively monitored Finnish aquifers. Both intra- and inter-annual variation of groundwater levels, temperature and water chemistry was highest in the smallest (~1 km^2) aquifer, whereas the largest aquifer (~10 km^2) showed substantial stability for all examined variables. Macroinvertebrate and bryophyte species data from 40 Finnish springs showed a positive relationship between crenophilic species richness and parent aquifer size, whereas species composition of these groups varied irrespective of aquifer size. Our results suggest that qualitative, quantitative and thermal groundwater stability provided by large aquifers facilitates a high floral and faunal spring biodiversity. Therefore, integrated hydrological and ecological research is needed to support the conservation and management of groundwater dependent ecosystems.

SS15 - Oral

DISENTANGLING THE INFLUENCE OF REGIONAL CHARACTERISTICS AND AGRICULTURAL INTENSITY ON THE BIODIVERSITY OF AQUATIC MACROINVERTEBRATES IN SMALL STREAMS

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As the global requirements for food increase, agricultural practices and land management must intensify to improve productivity and meet this ever-growing demand. However, the pollution from agricultural practices and negative impact on water quality and aquatic biota are now well illustrated. Therefore, agricultural intensification is potentially one of the greatest threats to aquatic biodiversity, healthy ecological function, ecosystem service provision and their long-term sustainability. Small waterbodies, especially streams, dominate the landscape and more importantly make an important contribution to regional aquatic biodiversity, and in turn, ecosystem function and service resilience. If agricultural intensification across Europe continues, as predicted, then these small waterbodies will be at the forefront of change. Therefore, the overall aim of this study is to appraise the sensitivity of small waterbodies to agricultural intensification by assessing whether the biodiversity of aquatic macroinvertebrates is influenced by increasing agricultural land-use intensity or dependent on the intrinsic physical characteristics of the associated region (e.g. geology). Stream sites in catchments with varying agricultural intensity (low, medium and high - each category in a separate region) were evaluated in spring and autumn. Such information is vital for establishing whether management practices and policies for biodiversity protection should be based at national or regional levels.

SS15 - Oral

DO TAXONOMIC STRUCTURE AND ECOSYSTEM FUNCTIONS RECOVER AFTER SPRING RESTORATION?

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Restoration of springs and other groundwater-dependent ecosystems has become increasingly popular, yet little is known about ecological responses to restoration. We assessed the taxonomic structure (bryophytes and benthic invertebrates) and ecosystem functions (leaf litter breakdown) in eastern Finnish restored springs (n=10) using a space-time substitution design. Thus, restored springs were compared with minimally disturbed (n=11) and impacted springs (n=13). The human impact was mainly in the form of land drainage for forestry purposes. Benthic invertebrate assemblages were similar in the natural and restored sites, whereas the impacted sites differed from the other two groups. Bryophyte abundance and species richness did not differ between near-natural and restored sites but were significantly lower in the impacted sites. Leaf litter decomposition rates did not differ among the spring types. Our results suggest that restoration actions may improve spring biodiversity but the weak differences between the impacted and near-natural springs indicate that unless groundwater quality and quantity are seriously impaired, the degradation of the spring habitat and the surrounding catchment by forestry activities will have little effect on spring ecosystems.

SS15 - Oral

ZOOPLANKTON STRUCTURE IN ICE-FREE VS. ICE-COVERED SHALLOW WATER BODIES

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The diversity of zooplankton in shallow water bodies can be very high (almost 200 taxa), even during the unvegetated period, which is confirmed by this study. The aims of this study were to determine: (i) the main triggers of zooplankton structuring during the cold period; (ii) zooplankton assemblages in pre- and post-vegetated periods within 10 shallow water bodies located in two parts of Europe differring by the presence (Poland) or absence (Croatia) of ice cover.

We observed significant differences between both investigated research areas; e.g. higher transparency and oxygen concentration in the ice-free compared to the ice-covered water bodies. The diversity and abundance of a particular zooplankton group were higher during the post-vegetated period, which was associated with higher chlorophyll *a* concentration. In the pre-vegetated period algal biomass was significantly reduced by the domination of algivorous copepod larvae, which were markedly more abundant in ice-covered water bodies. Our results suggest that the presence or absence of a freezing period could induce differences in the production triggers in the following season. However, other environmental parameters should also be considered as having an important impact on the structuring of the plankton community during the cold period.

SS15 - Poster

DO MICROORGANISM PRODUCTS PROVIDE AN EFFICIENT MEANS TO FIGHT AGAINST FILAMENTOUS ALGAES IN EUTROPHIC PONDS ?

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Many miracle products are currently proposed on the market to fight against filamentous algaes in private eutrophic ponds.

Effective Microorganism (EM) products differenciate from the other chemical based products because they are composed of photosynthetic and lactic microorganisms that are naturally present in the environment. These products have recently been successfully scientifically tested in an agricultural landscape as an alternative to chemical fertilisers with the purpose of, amongst other benefits, facilitating the process of degradation of organic matter.

In this study, the efficiency of this product will be tested in an aquatic environment (a pond with a surface area of 800m2, in the proximity of Lausanne, Switzerland). The pond was first monitored in 2012, before the beginning of the treatment and then again in 2014, one year after the treatment. The monitoring comprised chemical water analyses, visual observations of the algal development, as well as the use of an ecological indicator based on macroinvertebrates (CIEPT).

The results seem promising, but there may be other environmental parameters responsible for the complete disparition of the filamentous algaes and the amelioration of the ecological status of the pond observed in 2014.

SS15 - Oral

BENTHIC ALGAE ENSURE THE SURVIVAL AND GROWTH OF A DETRITIVOROUS INVERTEBRATE IN DETRITUS-BASED HEADWATER STREAMS

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Forested headwater streams have long been described as detritus-based ecosystems, relying on allochthonous detritus colonized by microbial decomposers (e.g. aquatic hyphomycetes) as main food resource. Autochthonous primary production is often strongly limited in these ecosystems (low light, nutrient limitations). Despite their low biomass and a quantitatively low contribution to consumers' diet, we hypothesized that benthic algae promote metazoan development as they constitute an essential food resource providing highly unsaturated fatty acids (HUFAs) to invertebrate consumers.

In this study, we coated, in an agarose (A) matrix, alone or combined, three types of resources: alder leaves (L), aquatic hyphomycetes mycelium (H) and benthic diatoms (D). We produced six different resources (A, AL, AH, AD, ALH, ALHD) which were used to feed individually invertebrate detritivore juveniles (*Gammarus fossarum*, Amphipoda). Fatty Acid (FA) analyses were performed on resource and gammarids. Survival and growth were followed during five weeks.

Survival and growth rates significantly increased with diatomic resources (AD-ALHD), but decreased with fungi (AH-ALH). Only organisms fed diatoms were able to maintain high HUFA levels, suggesting that gammarids are necessarily dependent on algae for HUFA acquisition. This study sheds new light on the importance of primary producers for sustaining headwater streams biodiversity and functioning.

SS15 - Oral

MORAINE PLATEAU SMALL WATER BODIES: THE "HYDROLOGICAL GATES" OF THE MORAINE PLATEAUS OF NORTHERN POLAND

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Small water bodies (SWBs) are postglacial bodies of water that have been a constant feature of the landscape of Northern Poland for thousands of years are particularly abundant on moraine plateaus. SWBs are traditionally considered to be retentive and evaporative bodies of water, as their water budget equation customarily includes to determinants only: precipitation (inflow) and evaporation (outflow). It is commonly believed that SWBs do not communicate with groundwater and that they are not involved in river runoff.

I have investigated a fragment of a catchment in Northern Poland and found that SWBs rarely play a retentive and evaporative function only, as all the SWBs I studied in the catchment were feeding water into the river system for at least some of the year, a finding that is in contrast to what the researchers have believed so far.

My calculations have also revealed that the SWBs I examined communicate with groundwater and that, depending on the season of the year (and, obviously, in accordance with the laws of hydrodynamics), water moves from the groundwater reservoirs to the ponds or *vice versa*.

SWBs may therefore be referred to as 'hydrological gates' that connect groundwater with the surface system.

SS15 - Oral

EFFECT OF A COMMON ALGICIDE ON PHYTOPLANKTON ASSEMBLAGES AND WATER QUALITY FOR IRRIGATION IN FARM PONDS

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Copper sulfate is one of the most common algicides in freshwater ecosystems and is widely used in irrigation ponds to prevent and remove microalgae and filamentous macroalgae. However, the use of copper sulfate does not warranty water quality parameters desirable for farming purpose, and can also decrease ecological parameters related to biodiversity. Here we test the effect of copper sulfate on irrigation ponds from an intensive agricultural area in southern Spain. We analyzed changes in phytoplankton species richness, diversity and community composition, as well as changes in water quality variables (chl a, TSS, phytoplankton biomass) during one crop year (2008-2009).Treated ponds showed lower phytoplankton richness than non-treated ponds. Also, the development of submerged macrophytes was impeded in treated ponds, whilst non-treated ponds showed dense meadows of macrophytes and filamentous green algae at the end of the experiment, with important improvement in water quality variables. Our results have important implications for farmers, since an alternative management avoiding the use of biocides can enhance water quality parameters and reconcile ecosystem services with biodiversity conservation.

SS15 - Oral

EFFECT OF BEAVER DAMS IN MERCURY METHYLATION AND THE ROLE OF DISSOLVED ORGANIC MATTER QUALITY

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Methylmercury (MeHg) is a neurotoxin that bioaccumulates in the aquatic food web. Its formation is a biotic process that occurs mainly in sediments. An increase in MeHg and dissolved organic carbon (DOC) concentrations in reservoirs have been reported during the early stage of its flooding. Although DOC controls mercury (Hg) availability for Hg methylating bacteria, the impact of DOC quantity and quality on Hg methylation in aquatic systems is still unclear. Here, we studied DOC quality and MeHg formation in 9 beaver ponds of different ages from across Sweden. We found a decrease in MeHg production with increasing age of the ponds, ponds older than 18 years featuring on average 65% lower methylation compared to those younger than 7 years. For the latter, an increase of DOC in the pond in comparison with the upstream part of the river was observed. Elevated chlorophyll a in these young ponds imply internally produced organic matter as an important driver of Hg methylation. Qualitative analysis of the dissolved organic matter with excitation-emission-matrix fluorescence spectroscopy, further suggests that unprocessed terrestrial organic matter also enhances Hg methylation in young pounds.

SS15 - Oral

ARE AQUATIC INSECTS IN ALPINE SPRINGS ESPECIALLY SENSITIVE TO CLIMATE CHANGE?

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Alpine springs are ecotones with usually very small annual variations of water temperature, which corresponds to the mean annual temperature of the air. Crenobiontic species seem to be well adapted to these stable conditions. Only little is known about the specific reaction of aquatic insects to climate change. We expect that in the next decades water temperature in springs will rise according to the air temperature. We have investigated more than 50 alpine springs in Switzerland. Most of them were structurally intact and mean temperatures between 1.7 and 6.5°C. Springs were colonized by several Plecoptera, Trichoptera, but only a few Ephemeroptera species. Based on specific traits in literature and databases of freshwater organisms we try to discover species that are restricted to cold-stenothermous conditions. Correlations of the presence or density of crenobiontic and crenophilous species and temperature will help to create a method to assess their sensitivity. This will allow to estimate the threat of alpine spring communities not only by habitat disturbance but also by climate change.

SS15 - Oral

THE IMPORTANCE OF SMALL WATERBODIES: IMPLICATIONS FOR FRESHWATER POLICY MAKERS

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There is growing world-wide recognition of the abundance, importance and vulnerability of small water bodies (ponds, small lakes, small streams and headwaters, ditches, springs, flushes). This presentation will review the current European knowledge of the habitats on their importance for freshwater biodiversity and ecosystem services, review the basic principles that influence their ecology and evaluate the main fundamental and practical knowledge gaps. The paper will make recommendations for policy makers to increase the effectiveness of management of these habitats, particularly in the context of the Water Framework Directive and the Habitats Directive.

SS15 - Oral

CARBON UPTAKE IN HEADWATER STREAMS: INSIGHTS FROM A COLLABORATIVE EXPERIMENT

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Flow variations are characteristic of non-regulated headwater streams, with a drought/low flow periods and a posterior flooding events, which have major impacts on streamwater biogeochemistry. Dissolved organic carbon (DOC) determines the energy budget and influences bacterial production and aquatic food webs in aquatic ecosystems. However, there is still little information about the influence of the flow variability on in-stream carbon uptake. Here, we present the results from the collaborative experiment DOMIPEX, whose main objective is to examine changes in DOC uptake patterns due to flow variation: low flow (summer) vs. flow expansion phase (autumn). For these two periods, we conducted experimental pulse additions of acetate (CH_3COOH) in eleven headwater streams across Europe. Selected streams presented similar characteristics (calcareous lithology, low discharge and non-impacted by human activities), but differed in their canopy cover (and thus in the potential autotrophic activity), DOC and total nitrogen concentrations. Heterotrophic uptake varied between both periods, as indicated by the retention rates and the assimilatory distance metrics. Results from the carbon quality and uptake parameters across streams, differing in their nutrient concentrations and canopy cover, provides valuable information into what are the main controls of in-stream carbon uptake and have implications for the whole ecosystem.

SS15 - Oral

HIGHLY EUTROPHICATED FISHPONDS - EFFECT OF THE PAST NUTRIENT INPUT AND CURRENT HIGH FISHSTOCK - RESULTS OF 20 YEARS MONITORING.

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For centuries, more than 20 000 fishponds (man –made shallow lakes) of size <1ha to 490ha form important hydrological system of the inland country - Czech Republic. During the 20th century, most of fishponds became eu- to hypertrophic both due to external nutrient loading (agriculture run off, municipal waste water) and fishery management (fertilizing, additional feeding). Fish stock and production rose and fish yield reached 1000kg/ha and even more. Mean concentrations of total nitrogen and phosphorus increased form less than 1 to 3mg/l and from 0.05 to 0.3 mg/l,respectively. Fertilizing of fishpons was reduced from 1990th. Fertilizing of agriculture fields declined in 1990 th and waste water treatment plants are being constructed. In spite of that fishponds remain heavily eutrophic. High phytoplankton biomass results in reduction of water transparency to less than 0.5m. Size of zooplankton is decreasing although total biomass of zooplankton is still high. High fish stocks combined with weed fish affect negatively structure of plankton. Internal nutrient loading keeps high trophic level. Regular development of cyanobacteria results in low food chain efficiency which is sometimes compensated for by additional feeding. Data collected during last 20 years from c. 40 fishponds in Třeboň Basin Biosphere reserve are presented.

SS15 - Poster

HABITAT BIODIVERSITY AND LANDSCAPE STRUCTURE: APPROACH IN A LOWLAND AREA OF CENTRAL EUROPE

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Information relating to species distribution has become an important tool in ecological research. The kind of catchment area and the way the land is used within the catchment area has a great impact on the hydrochemistry of small water bodies, and for hydrobionts, it is the principle parameter responsible for their structure and functioning. Prediction of suitable habitats for species is essential for the conservation and management of their native habitats. The approach to the agricultural landscape, dominant in Central Europe, is relevant for biodiversity conservation since landscape planning and management are generally conducted on wide spatial scales. The aim of the study was to test the distribution of aquatic organisms in relation to landscape structure and limnological indicators of small water bodies. The obtained results showed a positive predictive power for some target groups of plankton taxa and macrophytes and highlighted the importance of abiotic parameters for the detection of habitat suitability. Moreover, it was noted that combining physical environmental data with limnological features in analysing a water habitat suitability may be used to guide conservation efforts and landscape management practices.

SS15 - Oral

CHANGES IN INVERTEBRATE ASSEMBLAGES IN PONDS DURING GLACIER RECESSION IN SE ICELAND

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A clear indication of warming climate is apparent in retreating of the world’s glaciers. In many cases, glacier moraines harvest freshwater ecosystems such as kettle-hole ponds or appear as water-filled old streambeds. The development of these aquatic habitats offers a unique opportunity to study evolutionary processes as well as metacommunity dynamics of freshwater ecosystems. A rapid retreat of glaciers causes in many cases floods, which consequently leads to kettle hole formations. Some of these features are water filled, creating kettle hole ponds. In Iceland, glaciers are retreating at an unprecedented rate. This is reflected in formation of new freshwater habitats, which have evolved for last century. At the moraine of Skaftafellsjökull glacier, South East Iceland, there are numerous kettle hole ponds, which harbour exceptional aquatic habitats. A study within a transect, covering an area of last century’s glacier retreat; demonstrate how rapid colonization is and how rapidly both flora and fauna establish these empty niches.

SS15 - Oral

CAN AMPHIBIANS BE USED AS UMBRELLAS FOR BIODIVERSITY CONSERVATION IN PONDS?

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Amphibian decline led to worldwide conservation efforts, including the prioritization of sites for their protection. These sites could also contribute to the conservation of other freshwater taxa. Our study aimed to test whether amphibians could act as a potential umbrella for biodiversity in ponds, a particular type of freshwater ecosystem often characterized by a rich and diverse fauna and flora. We assessed the role of amphibians as surrogate for dragonflies, aquatic beetles, gastropods and aquatic plants in 89 ponds belonging to the Swiss amphibian breeding sites of national importance. Cross-taxon correlations in species richness and conservation values between the amphibians and the four other taxonomic groups were low in the studied ponds. Significant but weak congruence in community composition were found between the amphibians and the dragonflies, aquatic beetles and plants. The use of Amphibians as surrogate for pond biodiversity is therefore questionable. Further, some ponds of low interest for Amphibian conservation were important for the other freshwater taxa. A global pond biodiversity conservation strategy should therefore also consider ponds poor in Amphibians. Furthermore, we suggest considering several taxonomic groups both for pond biodiversity evaluation and selection of sites for biodiversity conservation.

SS15 - Oral

THE CONSERVATION BIOLOGY OF A TYPICAL EUROPEAN POND FISH, THE CRUCIAN CARP CARASSIUS CARASSIUS: DECLINE, LIFE-HISTORY TRAITS AND RE-INTRODUCTIONS

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[5]*AECOM*

The crucian carp Carassius carassius, a cryptic benthic fish characteristic of ponds, has been in decline in England and several other European countries due to habitat loss and hybridisation with feral brown goldfish C. auratus and common carp Cyprinus carpio. The extent and causes of crucian carp decline in the county of Norfolk (eastern England) over the last 35 years were assessed through comparisons of current distributions with those during the 1970s–80s and found to have declined by 71%. However, growth and life-history traits of crucian populations in Norfolk, Essex and Hertfordshire revealed amongst the highest growth rates and earliest ages at maturity of all European populations for which data exist. Conservation measures include pond rehabilitation and restocking with crucians from local dense populations, and these efforts have re-established pond biodiversity and reproducing crucian populations. Analysis of crucian presence, pond invertebrate and macrophyte diversity and the occurrence of the protected great crested newt Triurus cristatus found that, contrary to previous studies, no obvious detrimental impact due to crucian presence. These results are discussed in the context of wider European conservation of this threatened, typical pond fish.

SS15 - Oral

BIODIVERSITY PATTERNS IN HIGH ALTITUDE LAKES: A 66 POND STUDY IN THE TATRA MOUNTAINS (SLOVAKIA, POLAND)

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In the Tatra Mountains (Central Europe), limnology of high altitude lakes have been studied intensively over the last decades, while pond ecosystems of the region, constituting the majority of standing waters, are virtually unknown. In period of 2000–2013 we collected samples from 66 Tatra ponds located between 1,089 and 2,201 m a.s.l. As much as 90,000 specimens of aquatic invertebrates were collected and identified as 122 taxa. The most diverse pondsupported 28 taxa and, mean diversity was 10.7 taxa. The richest group was Chironomidae with 58 taxa, followed by Trichoptera with 15 taxa. The chironomid *Derotanypus sibiricus* and the waterbug *Arctocorisa carinata* were new for Slovakia. While total diversity was decreasing with elevation considerably (b=-0.01, r^2=0.24), chironomid diversity showed weak response to altitude (b=-0.003, r^2= 0.08). Significant changes were, however, obvious in the chironomid assemblage structure: proportion of Tanypodinae and Chironominae were decreasing along increasing altitude, while ratio of Diamesinae and Orthocladiinae increased. We think that this interesting pattern is a result of phylogeny and in turn different competitiveness of particular chironomid taxa. The project was funded by the Slovak Research and Development Agency, contract no. APVV-0059-11 and by the Slovak Scientific Grant Agency, VEGA, contract no. 2/0081/13.

SS15 - Poster

WATER QUALITY OF RURAL PONDS IN THE EXTENSIVE AGRICULTURAL LANDSCAPE OF THE CERRADO (BRAZIL)

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The Cerrado is a biodiversity hotspots under increasing pressure from the intensification of agriculture. Man-made ponds are currently widespread in the rural areas and provide many ecosystem services such as cattle watering, fish production, irrigation and erosion protection. These waterbodies are likely to play a critical role in the conservation of freshwater biodiversity, but there is still little known about their biota. Good water quality is a key factor in maintaining aquatic biodiversity. Therefore we assessed the water quality and conducted socio-economic inquiries for 56 waterbodies in the Goiânia Cerrado (Brazil) in 2012. Overall, differences in water quality seemed to be linked to the type of pond use. The trophic level was greater in fish ponds than in ponds used for cattle watering in the extensive agricultural landscape. Good water quality in pasture ponds may be maintained by spring water inflow or heavy precipitation. Overall, water quality of the Cerrado ponds was good if compared with the same type of waterbodies in other regions of the world. These results highlight the high potential of the Cerrado ponds in extensive agricultural landscapes to provide an important habitat for aquatic biodiversity.

SS15 - Poster

ALPINE PONDS - AN IMPORTANT SOURCE OF GENETIC DIVERSITY OF AQUATIC INSECTS

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High-altitude ponds of glacial origin represent a specific category of aquatic ecosystems inhabited by unique assemblages of invertebrates. Their high environmental heterogeneity allows fauna to reach high levels of regional diversity. On the other hand, their small area, depth, and catchment area make them very sensitive to various external effects, mainly if compared to larger lakes. Albeit research interest in species diversity and ecological processes controling these ecosystems tend to increase recently, critically scarse data are available on genetic diversity of its dwellers. Within this study we analysed genetic diversity of alpine ponds in the Tatra Mts (Western Carpathians) and their contribution to the overall regional genetic diversity in comparison with larger lakes. In 2009-2014, more than 100 alpine ponds (<1ha) and 40 lakes (>1ha) were sampled, from which four model species of aquatic insects (representing water beetles, caddisflies and chironomids) were selected for molecular analyses. Genetic structure and diversity was assessed based on two mitochondrial markers, which revealed relatively high level of genetic differentiation. This confirmed these ecosystems are an important source not only of species but of genetic biodiversity too.

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SS15 - Poster

PESTICIDES IN SMALL PONDS IN NORTH EAST GERMANY

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Small water bodies have a high importance for a lot of endangered species and for the nature protection. A lot of amphibian, fishes and insects live here. Friends of the Earth Germany (BUND) made pesticide tests at small water bodies in intensive agricultural areas in the region of Brandenburg in 2012 and 2013 and in the region of Mecklenburg-Vorpommern in 2014. And they found a high number of different pesticides. A lot of those are dangerous for water bodies.

SS15 - Oral

CONSEQUENCES OF POND MANAGEMENT FOR BIODIVERSITY CONSERVATION IN AGRICULTURAL LANDSCAPES

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The agricultural landscapes of east and north-west England are dotted with ponds at a density >10 ponds/km^2. However, these agricultural pondscapes are often overlooked as resources for biodiversity, being dominated by overgrown, highly terrestrialised ponds. Recent pond studies have suggested that an increase in pond heterogeneity at the landscape-scale should be beneficial for aquatic biodiversity. To investigate this recommendation, we compared two pond landscapes in Norfolk, eastern England; a managed pondscape with ponds at different stages of succession and an adjacent unmanaged pondscape dominated by overgrown ponds. Monitoring of the ponds was conducted over April 2012 - July 2013, comprising four seasonal field visits focussing on water chemistry and macrophyte, invertebrate and amphibian communities.

Pond management positively impacted on macrophyte and invertebrate species richness and diversity at both the pond and landscape scales. Significant differences between the managed and unmanaged ponds were also evident in terms of pond communities. We conclude that active pond management may provide a cheap and sustainable means of bringing more high diversity, open, macrophyte-dominated ponds into pond landscapes. As such, in addition to pond creation, we advocate pond management as an important conservation tool that needs to be widely promoted by agri-environment schemes.

SS15 - Oral

CURRENT CHALLENGES IN THE MITIGATION OF IMPACTS OF PLANT PROTECTION PRODUCTS ON SMALL WATER BODIES

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Small water bodies within arable fields are important structures contributing to biodiversity and ecosystem services in agricultural landscapes. However, small water bodies in such areas are particularly sensitive to entries of plant protection products (PPP) which limit their ecological functions. Our results demonstrate that PPP and their metabolites are frequently found in small water bodies, partly at unacceptable high levels. We present data from various regularly and event-based PPP monitoring programs of small water bodies (kettle holes, ponds and ditches) in Germany over several years. However, we identified a variety of challenges emerging during the mitigation of PPP effects on small water bodies which call for future research priorities.

Currently, the implementation of effective mitigation strategies is hindered by various knowledge gaps. Furthermore, PPP detection is limited at the time scale (short disappearance times (DT_{50})) and local scale (downstream transport via flow). Finally, identification of maximum acceptable concentrations for aquatic ecosystems does not yet consider ecological functioning. Hence, reliable analyses of the integrity of small water bodies are needed to protect such vulnerable ecosystems. Our results highlight the importance of specific mitigation concepts at a local or field scale, such as effective buffer zones and improved application techniques.

SS15 - Poster

LOW DIVERSITY OF CADDISFLIES IN CENTRAL EUROPEAN PONDS: FAILURE OF SAMPLING TECHNIQUE, SAMPLING TIMING OR NATURAL PATTERN?

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We present the results of study on caddisfly communities' composition and diversity in Central European ponds. During the years 2012 – 2014 we took samples from 94 ponds in Slovakia. Studied ponds span wide range of sites from lowland to mountain zones across the complex gradient of different geographical and ecological conditions. Our ponds, regardless of their origin (natural or artificial), harboured very few caddisfly species (a total of 26) and no rare or uncommon species were recorded. The material based on summer sampling using the PLOCH method revealed very low diversity of caddisflies (an average of 1.2 taxa per site). For 35 ponds, we processed also the summer samples taken by a combination of kicking technique and sweeping the aquatic vegetation. Finally, samples taken by the latter method from the whole set of ponds in spring season were complemented. When we compared the summer PLOCH sampling with other sampling techniques and dates, average number of taxa remained roughly the same and only few additional taxa were recorded, suggesting that the low diversity observed was not a result of inefficient sampling design or bad timing.

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0059-11.

SS16 - Oral

BIODIVERSITY CONSERVATION IN FISH PONDS: HOW DETERMINE TIPPING POINTS LINKED TO PHYTOPLANKTON BIOMASS?

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The management of biodiversity in aquatic ecosystems requires knowing the state of water quality linked to regime shifts in various taxonomic groups. High levels of nutrients due to certain fish farming practices may cause significant eutrophication leading to loss in biodiversity and for example a shift from high coverage of aquatic vegetation to phytoplankton dominance may be observed. We examined this question by studying tipping points, thresholds where systems change, in fish ponds in the Dombes region, France. Tipping points were assessed along a gradient of chlorophyll a in different taxonomic groups: aquatic vascular plants, phytoplankton, dragonflies and aquatic macro-invertebrates. We compared tipping points for the different taxonomic groups by using five different diversity indices and three different statistical methods. Our results showed that the estimation of tipping points vary strongly depending on the statistical methods used and between diversity indices. We showed that the first order of Jackknife is more suitable in the determination of tipping point in comparison to the other diversity indices. We also recommended using a method of linear regressions with a pivotal tipping point to show the gradual effect of chlorophyll a on the biodiversity.

SS16 - Oral

RELATION BETWEEN ECOSYSTEM-SERVICES PERCEPTION AND ENVIRONMENTAL PERFORMANCE ASSESSED BY LCA AND EMERGY ACCOUNTING IN POND FARMING

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The framework of ecosystem services proposed by the Millennium Ecosystem Assessment (2005) is suitable for representing the multiple roles of fish ponds; nevertheless, assessment of these services remains difficult and controversial. Environmental assessment methods such as Life Cycle Assessment (LCA) or Emergy Accounting (EA) have been developed in the aquaculture sector to highlight the environmental performance of fish farming. However, no relations have been established between the environmental performance of farming systems and perception of their ecosystem services. Our study was conducted in two different fishpond farming areas of France: Brenne and Lorraine. We surveyed 29 fish farms, combining LCA and EA with a ranking of their ecosystem services as perceived by the fish farmers. Correlation analysis was performed to analyze relations between the environmental indicators and ecosystem-service perceptions. Perceptions of ecosystem services by fish farmers are driven by provisioning services but also by regulation services (hydrological regulation and biodiversity support) and cultural services. Significant correlations appeared between perception of ecosystem services by fish farmers and some LCA and EA indicators. The results of this study show agreement between the approaches of perception analysis and environmental assessment, and show their potential, for services evaluation in pond systems.

SS16 - Oral

ECOSYSTEM SERVICES OF FISHPONDS – RETENTION OF NUTRIENTS AND MICROPOLLUTANTS

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Fishponds are man-made aquatic ecosystems representing the most frequent type of stagnant water bodies in the Czech Republic. These shallow lakes are managed aquatic ecosystems where water level, fish stock, and partially also nutrient input are under control of the owner. Fishponds exhibit naturally high retention potential of phosphorus and nitrogen coming in them from non-point, diffusion, small point sources and also from fishery management. Results of a mass balance monitoring (esp. of total phosphorus – TP and total nitrogen - TN) of nine large fishponds (60 – 449 ha) during 2010 – 2014, showed high nitrate retention (>80%) and both negative (P release) and positive (P trapped) retention of TP. Some pharmaceuticals (esp. ibuprofen, paracetamol, diclofenac), antibiotics and musk substances (esp. galaxolide HHCB tonalide AHTN) were effectively eliminated, too. High amounts of TP, TN and other nutrients are deposited in fishpond sediments and could be exploited in agriculture what means that nutrient cycle could be closed in small river basins. This concept could bring better quality of surface waters, decrease of water reservoirs infilling and also elimination of nutrients and soil particles loss from agricultural landscape. Nutrient recycling belongs to fishponds important ecological functions and is necessary for effective landscape management.

SS16 - Oral

STAKEHOLDERS' PERCEPTIONS ABOUT ECOSYSTEM SERVICES OF FISH PONDS: USES, FUNCTIONS AND GOOD FISH PONDS

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Fish ponds deliver a broad range of ecosystem services, but many of these services are interpreted and valued differently by stakeholders. Therefore, divergent opinions on their management might arise and hinder good cooperation and implementation of best management. The objective of this presentation is to show the different stakeholders' perceptions of fish ponds and to evaluate stakeholders' knowledge and understanding related to their ecosystem services. The analysis is based on a comparison of qualitative data from two different pond areas in France. Extensive interviews with different stakeholders (fish farmers, public institutions, local policy makers, inhabitants) were conducted in order to understand the diversity of their perceptions of fish ponds. We questioned the uses and functions of ponds, the services they deliver, and which qualities were attributed to 'a good pond'. Main findings are that all stakeholders have a clear perception of a number of pond functions but they prioritize these functions differently. Stakeholders' perceptions on fish ponds are in most cases clearly connected to the activity of stakeholders, and how they use ponds. We think that using an ecosystem services approach in discussions and communication will facilitate future joint management or use of fish ponds by the different stakeholders.

SS16 - Oral

INTEGRATED MANAGEMENT SUPPORTS EFFECTIVE AND SUSTAINABLE BIODIVERSITY CONSERVATION IN LARGE POND COMPLEXES

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The concept of ecosystem services is rapidly gaining importance, especially in anthropogenic landscapes where biodiversity and nature values largely depend on human interference. An increasing number of studies suggest that ecological restoration of landscapes promotes the delivery of multiple ecosystem services , while other investigations report the existence of major trade-offs.

In Europe, many lakes and ponds have historically been used for extensive fish farming. Such management resulted in high levels of biodiversity. Recent socio-cultural developments have, however, led to the intensification of farming practices, which resulted in ecological degradation and species loss.

Our study combines an elaborate ecological study with an empirical economic cost-benefit analysis on 60 ponds representing different management types. We explored the association of biodiversity (7 taxonomic groups) with pond management, and combined these findings with an assessment of management costs. Based on these results, we develop a framework for optimizing costs/benefits in nature conservation at larger spatial scales.

Our analyses demonstrate the existence of important trade-offs between fish farming and nature conservation at the local spatial scale (one pond), but clearly show that integration of extensive fish farming into nature conservation is the most effective and sustainable management option at a regional scale (multiple ponds).

SS16 - Oral

BIOLOGICAL AND FUNCTIONAL EFFECTS OF FISHPONDS ON HEADWATER STREAMS: FIRST RESULTS FOR A BETTER UNDERSTANDING OF INTERACTIONS BETWEEN LENTIC AND LOTIC SYSTEMS

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In order to reach the goals set in the Water Framework Directive (1), barrage fishponds are criticized in particular for having a strong impact on sedimental and biological continuities. At the same time, researches have highlighted some ecosystem services rendered by fishponds, among which fish production, biodiversity maintenance or pesticide retention (2). This implies that a better knowledge of the influence of barrage fishponds on headwater streams functioning is necessary.

In this context, we studied leaf decomposition, an important component of the ecosystem integrity in headwater streams (3) and the invertebrate communities both upstream and downstream of five fishponds (three in forest watershed and two in agricultural zone). The leaf decay was quickest in forest streams, with an increase of the leaf decomposition rate downstream from the barrage ponds. The trend was opposite on the agricultural catchments.

These results highlight that the impact of fishponds on headwater stream functioning is complex and depends on land use. Hence it is necessary to clarify the different mechanisms (*e.g*. competition for food resources, complementarities between autochtonous and allochtonous organic matter) that control the ecosystem functioning in different contexts in order to optimize fishpond management.

SS16 - Poster

WHAT ARE THE POTENTIAL ROUTES FOR THE DEVELOPMENT OF ECOLOGY-BASED ALTERNATIVES FOR FISH PRODUCTION IN SHALLOW LAKES?

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Fish farming in pond is a commonly used rearing system worldwide (FAO, 2014). This is more often polyculture in a variety of environments and with highly diversified methods of management. With this in mind, we sought to identify the ecology-based alternatives for fish production in ponds based on a literature review. Dumont *et al*. (2013) proposed five ecological principles on which our analysis is built. These principles are: (i) adopting management practices aiming to improve animal health, (ii) decreasing the inputs needed for production, (iii) decreasing pollution by optimizing the metabolic functioning of farming systems, (iv) enhancing diversity within animal production systems to strengthen their resilience and (v) preserving biological diversity in agroecosystems by adapting management practices. What are the various forms of management and practices in fish farming in ponds which could be assigned to these principles, leading them towards systems more agro-ecological? It is to that question that we try to provide parts of the answer here.

SS16 - Poster

CAN TRADITIONALLY MANAGED FISH PONDS FAVOR DRAGONFLY CONSERVATION?

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Fish ponds are characterized by high nutrient levels and are therefore expected to support a low biodiversity. However, several empirical assessments indicated that some taxonomic groups can be species rich in such ponds. Therefore, this study aimed at assessing i) the capability of traditionally managed fish ponds of the Dombes and Forez regions (France) to support rich and diverse dragonfly communities, and ii) the influence of pond morphometry and habitats diversity (macrophyte beds) on dragonfly species richness of these ponds. A regional richness of 34 species was observed, including one endangered species on the EU directive (*Leucorrhinia pectoralis*). The Dombes ponds hosted in average 13 species, whereas for the Forez ponds 16 species could be found. Pond dragonfly species richness was significantly positively related to pond size, and also to submerged, floating and emergent macrophytes. Our study demonstrated that fish ponds, can play an important part in dragonfly conservation, in particular when they are large and/or characterized by well-developed macrophyte beds.

SS17 - Oral

WATER QUALITY AND TROPHIC STATUS OF ARVAND RIVER,NORTHWESTERN OF PERSIAN GULF

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Ecological indicators are commonly used to provide synoptic information about the state of ecosystems. Their main attribute is that they combine a range of environmental factors in a single value which is thought useful for management and for making ecological quality concepts easily understandable by the general public. In this study, the trophic status and water quality of Arvand River has been evaluated by using the trophic index TRIX. Water collection has been carried out at 9 sampling stations along the river between 2012 and 2013. The TRIX index integrates chlorophyll a, oxygen saturation, dissolved inorganic nitrogen and phosphorus. The index is scaled from 0 to 10, covering a range of four trophic statuses (high, good, moderate and degraded). The results demonstrate the river is in the first trophic state (0-4) which represents high quality and low trophic level.

SS17 - Poster

ECOLOGICAL INDICATORS OF AQUATIC BIODIVERSITY IN URBAN LANDSCAPES: THE CASE OF MONTRÉAL, QUÉBEC, CANADA

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Urban ponds and lakes are important habitats which play an essential role in the conservation of aquatic biodiversity in urban area. Therefore it is necessary to develop knowledge on aquatic ecosystems in large cities in order to select the best bioindicators for assessing their ecological integrity, and particularly their water quality. In this study, we tested the potential of metrics based on plankton and benthic communities as useful bioindicators to evaluate biodiversity and water quality in 20 urban waterbodies (ponds, lakes and wetlands) of the Island of Montréal. Metrics based on the richness and composition of phytoplankton, zooplankton and macroinvertebrates served to distinguish specific groups of permanent and temporary waterbodies. Despite their location in an urban landscape and the consequently human stressors, waterbodies in Montréal are essential habitats for sustaining aquatic biodiversity at local and regional scales, as showed for pelagic and benthic communities. Aquatic vegetation in littoral habitats constitutes an important refuge for biodiversity, and temporary ponds offer unique conditions for very rare species. We evaluated the relationships between metrics and environmental characteristics to (pond origin and management, urban landscape, water quality and eutrophication) to select the best bioindicators for the future assessment of biodiversity conservation and water quality of urban ponds and lake in Montreal.

SS17 - Oral

ECO-PHYSIOLOGICAL CHARACTERIZATION OF THE MACROINVERTERBATE COMMUNITIES OF AN URBAN STREAM (RIO TINTO, PORTUGAL)

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Eco-physiological characterization of the macroinverterbate communities of an urban stream (Rio Tinto, Portugal) The Water Framework Directive (DQA-2000/60/EC) establishes as its main objective the achievement of a good ecological quality of all inland surface waters and groundwater by 2015 , and introduces the concept of ' ecological status ' of an ecosystem , which includes the study of a wide range of parameters and factors for determining the ' health ' system '. This work, carried out within a project which main objective is the rehabilitation of a small watercourse in high degree of ecological degradation, aims to make the study of benthic macroinvertebrate communities and some parameters related to the ecological state of Rio Tinto (Douro watershed) in order to determine the main sources of pollution and to propose measures for its rehabilitation. This study compare results (metrics and functional structure) of samples of the benthic macroinvertebrate communities collected at 10 sampling sites along the river in 2013/14 and values of some hydro-morphological, physical and chemical parameters. The results indicate that it is a water course which presents a high degree of degradation due to problems with artificiality of the channel and receipt of domestic and industrial effluents.

SS17 - Oral

PROMOTING BIODIVERSITY IN URBAN PONDS: IDENTIFICATION OF THE MAJOR DETERMINANTS OF SPECIES RICHNESS AND IMPLICATIONS FOR POND MANAGEMENT

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Urban ponds are often characterised by a low biodiversity, hosting mainly generalist species. An appropriate management can nevertheless optimize the biodiversity and promote for example flagship groups such as dragonflies or amphibians. Here we aimed at identifying the main parameters explaining the species richness of contrasted taxonomic groups (aquatic plants, dragonflies, aquatic beetles, molluscs, amphibians) in about hundred ponds of a large European city (Geneva, Switzerland). At pond scale, richness of most taxonomic groups was positively correlated with the surface area, the pond naturalness (i.e. vegetated shoreline), the coverage of the water surface by vegetation, and the naturalness of the substrate. Fish and waterfowl occurrence, a disturbance frequent in urban ponds, led to a decrease in species richness. Sealed areas (e.g. roads, buildings) located in the surroundings of the ponds also negatively influenced richness of all taxonomic groups. Based on our results, we produced an 'Urban Pond Management Guide' providing recommendations for pond creation and management in cities. As an example, a new urban pond should be large and located in a 'green' environment in order to host potentially a high biodiversity. Further, diverse aquatic vegetation structures should be favoured and the development of fish and waterfowl population restricted.

SS17 - Oral

WHICH SPECIES BENEFIT FROM URBAN FRESHWATERS? – A LARGE-SCALE APPROACH

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Urban ponds can be of great value maintaining aquatic biodiversity and research on the diversity of various taxa in urban ponds is increasing. In previous studies we found that urban ponds can host high numbers of dragonfly species and distinct dragonfly assemblages indicating that a wide range of species can cope with urban conditions. Considering larger scales can be a promising approach to reveal the effects of urbanisation on the aquatic fauna. To get deeper insights into the response of dragonfly species to urbanisation we correlated species' abundance with the amount of various types of land-use (urban, agriculture, forest and natural vegetation) in regions of central and northern Europe. We performed this analysis for common, widespread species and the results showed distinct patterns: the abundance of some species (e.g. *Ischnura elegans, Anax imperator*) was positively correlated with highproportions of urban area while others were negatively (e.g. *Enallagma cyathigerum, Lestes sponsa*) or not at all correlated to urbanisation (e.g. *Libellula quadrimaculata, Sympetrum vulgatum*). This indicates that there may be species that benefit from urban environmental conditions and others do not. Such knowledge will help to develop conservation strategies in urban areas.

SS17 - Oral

FRESHWATER WATCH: UNDERSTANDING URBAN FRESHWATER QUALITY AND ECOLOGY THROUGH A GLOBAL CITIZEN SCIENTIST PROGRAMME

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FreshWater Watch is a global citizen science project carrying out research into freshwater ecosystems in 32 urban areas across the globe. Following a globally consistent training programme, citizen scientists support local scientific research partners to collect hydrological, ecological and chemical data to answer research questions related to freshwater quality and ecosystems. The data are uploaded to an online database using smartphone technologies. An international team of scientists use the data to explore and compare the driving factors of freshwater ecosystem dynamics with respect to differences in climate, land use and catchment conditions.

Preliminary results from more than 6000 data sets obtained by over 4000 citizen scientists suggest population density, land cover and precipitation are key factors controlling aquatic ecosystem dynamics. Furthermore, data from across the globe indicate that smaller water bodies present better ecological conditions than larger waterbodies. The use of micro scale citizen science collected data together with macro scale satellite and remote sensing information enhances the ability of scientists to identify potential areas of concern. FreshWater Watch provides an integrated approach to address and involve new audiences in data collection, interpretation and stewardship, which is key to ensuring the sustainable use of our freshwater resources.

SS17 - Oral

USING IN-SITU FLUOROMETRY TO EXAMINE EFFECTS OF ARTIFICIAL LIGHT AT NIGHT ON PERIPHYTON IN AN ALPINE STREAM

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Artificial light is a widespread human-induced change that disrupts natural light regimes and transforms nighttime environments in urban and suburban areas. Incrising number of studies report ecological effects of light pollution over a broad range of species, trophical levels and ecosystems, raising concerns for conservation of biodiversity and ecosystem services. The importance of light availability for growth and development of autotrophs is well known and the variation in light quality and quantity potentially accounts for much of the variation in the physiology, population growth and community structure of freshwater producers. However, the understanding of ecological implications of low-level artificial light on aquatic primary producers is still scarce. Primary production of many rivers and streams is mainly driven by benthic autotrophs that develop complex periphyton communities closely interacting with bacteria, protozoa, fungi and detritus. They play major ecological roles in food web structuring, nutrient turnover, sediment stabilization and recovery after physical disturbances. We simulated conditions of a light-polluted alpine stream in an outdoor flume mesocosm experiment and investigated how artificial light-naive periphyton respond to alterations of natural light regime by applying low-level LED light at night. We here present the effects of such exposure on community composition of periphytic autotrophs.

SS17 - Poster

SURVIVAL, GROWTH AND CONDITION OF FRESHWATER MUSSELS: EFFECTS OF MUNICIPAL WASTEWATER EFFLUENT

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Freshwater mussels are among the most imperiled group of organisms in the world, with nearly 65% of North American species considered endangered. Anthropogenic disturbances, including altered flow regimes, habitat alteration, and pollution, are the major driver of this group's decline. We investigated the effects of tertiary treated municipal wastewater effluent on survivorship, growth, and condition of freshwater mussels in experimentalcages in a small Central Texas stream. We tested the effluent effects by measuring basic physical parameters of native three ridge mussels (*Amblema plicata*) and of non-native Asian clams (*Corbicula fluminea*), before and after 72-day exposure at four sites above and below a municipal wastewater treatment plant outfall. Survivorship and growth of the non-native Asian clams and growth and condition indices of the native three ridge mussels were significantly higher at the reference site above the outfall than at downstream sites. We attribute this reduction in fitness below the outfall to elevated nutrient and heavy metal concentrations, and the potential presence of other untested-for compounds commonly found in municipal effluent. These results, along with an absence of native mussels below the discharge, indicate a significant negative impact of wastewater effluent on both native and non-native mussels in the stream.

SS17 - Oral

WHAT MAKES AN URBAN POND? INSIGHTS FROM A COMPARATIVE ANALYSIS OF UK CITIES

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Research over the past 20 years has demonstrated that ponds (lentic water bodies <2ha in area) are an important biodiversity resource in a variety of contexts. Furthermore, strategic use of such habitats can bring a range of other ecosystem services, contributing to floodwater management, water quality, carbon sequestration, and green space in urban areas (Hassall, C. 2014, WIREs Water). Despite this, the impacts of anthropogenic stressors in urban areas on aquatic habitats are still poorly understood. We present a comparative analysis of pond datasets, incorporating six previous studies conducted in Leeds (x2), Bradford, Birmingham, Huddersfield, and Merseyside, alongside the National Pond Monitoring Network dataset of pond surveys for a total of ca. 1000 ponds. We show that ponds designed for specific functions (industrial, water management, biodiversity) differ little in their capacity to enhance biodiversity in urban areas. We further test the hypothesis that urbanisation acts as a force for biological homogenisation, creating similar biological communities in all urban areas, using a sample of ponds from across a large number of urban areas. The conclusions show that the classification of urban ponds by function can mask their value to different ecosystem services. However, the corollary is also true: that managing ponds for a given function will not necessarily reduce the value of that water body for other services. We conclude with a discussion of research needs, particularly in the context of studying socioecological factors and public engagement with urban wetlands.

SS17 - Oral

MANAGING URBAN POND QUALITY IN ILE-DE-FRANCE REGION. CO-CONSTRUCTION OF QUALITY INDICATORS AS A SCIENCE POLICY INTERFACE

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Île-de-France is the most populated region of France (11.7 10^6 inhabitants) and the fourth most inhabited area in the European Union (973.5 inhabitants/km^2). In this highly contrasted region, mixing highly urbanised area (90 % of its population concentrated on 20 % of its area) and dense transport infrastructure with fields, forest and natural areas, aquatic ecosystems are more important than generally supposed. The region has 1,700 km of rivers and 990 lakes and ponds. The management of these water bodies must deal with different quality criteria corresponding to the biological, social-economical services provided. This article shows how quality indicators for this kind of highly modified aquatic ecosystems can be constructed as a science policy interface, by putting together social criteria and bio-physical criteria. We present the interdisciplinary and participatory approach developed by PULSE (Peri-Urban Lakes, Society, and Environment) research project, in order to deal with the socio-ecological uncertainty in urban ponds management. A quality index was built by integrating scientific indicators (different quality indicators were measured on 49 ponds during three years, 2011-2013) and social preferences informed with two categories of stakeholders (users and administrators). This quality index provides managers with a regional quality reference that can help them to improve their actions.

SS18 - Oral

USING NEMATODES AS BIOINDICATORS OF ANTHROPOGENIC INFLUENCE IN THE WONDERFONTEIN CAVE (WITWATERSRAND BASIN, SOUTH AFRICA)

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The Witwatersrand Basin (South Africa) is one of the biggest gold producing fields in the world. Unfortunately, many associated surface and subterranean water systems, including the underground river system found within the Wonderfontein Cave, are subjected to the adverse effects of metal pollution. This study was aimed at reporting on the occurrence and distribution of nematodes within the Wonderfontein Cave, as well as exploring the possibility of relating nematode community structure to ecosystem disturbance. Although nematodes are commonly used to evaluate surface ecosystem disturbances, its application in cave environments has never before been documented. Cave substrates (soil and sediment) were sampled in April (end of high flow) and September (end of low flow) 2013 at various subterranean sites to allow for spatial comparisons. Metal enrichment of substrates was determined and nematode specific indices applied. Although many previously unreported cavernicolous genera were found, a direct relation between nematodes and metal enrichment was not supported. This study acts as a baseline and shows that efforts should be made to gain a better understanding of the occurrence, distribution and functioning of cavernicolous nematodes, as well as their applicability as bioindicators of subterranean ecosystem disturbances.

SS18 - Oral

THE EARLY FISH CATCHES THE WORM: ABOUT FREE-LIVING NEMATODES IN FRESHWATER FOOD WEBS

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Freshwater benthic micro-metazoans (also referred to as meiofauna) have been fascinating and popular subjects of research ever since microscopy made them accessible to observation in the late 17th century. Despite this promising start, there has been little quantitative evaluation of the role of meiofauna in freshwater ecosystems. By contrast, important progress has been made by including mesofauna and meiofauna in models of soil and marine benthic food webs, respectively. Free-living nematodes are a diverse and major component of meiofaunal communities. Their high-degree of intraguild species diversity may be a consequence of trophic niche specialization based on the diversity of their potential food resources (organic matter, bacteria, fungi, protozoans, micro- and macrophytes, invertebrates). In turn, larger benthic and pelagic invertebrates and vertebrates can feed substantially on nematodes, suggesting their pivotal position in freshwater food webs as trophic intermediaries between benthic microbial production and macroscopic consumers. Here, we shed light on the 'nematode trophic link' by giving an overview of recent empirical results tackling 1) the effects of nematodes on primary producers and microbial decomposers, and 2) the relevance of nematodes in the diet of various macroscopic consumers.

SS18 - Oral

CAN AN INTERDISCIPLINARY APPROACH OF HYDROGEOLOGY AND BIOLOGY (FOCUS: MEIOFAUNA NEMATODES) PROMOTE GROUNDWATER KNOWLEDGE?

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Groundwater (GW) representing one of the most important and over-exploited freshwater resource on earth is addressed by hydrogeology and limnology. Hydrogeology deals with flow dynamics and the chemical interaction between water and lithology which means the abiotic background of groundwater, while comprehensive biotic GW research is a limnological sub-branch aside surface waters' and surface/subsurface transition zones' investigations (i.e. springs and hyporheos as groundwater dependent ecosystems – GDEs). However, both disciplines differ between porous, carstic and fractured aquifers as base characterisation and have gaps in knowledge especially of the latter.

Crustacean data, and copepods as highly prominent meiofauna group therein, contributed majorly to the understanding of carstic and porous aquifers, and GDEs. Biological gaps still exist and specifically refer to free-living nematodes. The few available data (literature, unpublished - presented here) point clearly to nematode importance (diversity, function) and thus to the need of further research to complete our understanding of groundwater and GDEs.

An interdisciplinary focus on widely unknown fractured aquifer habitat types in comparison with other relevant GW/GDES profit from both disciplines' strength to fulfil their both needs (i.e. open research questions), which is important, for instance to our understanding of drinking water reservoirs and their potential threats.

SS18 - Oral

THE EFFECTS OF ROTIFERS ON BIOFILM N-NO3- UPTAKE

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Biofilms play a key role in self-depuration processes in rivers. Whilst meiofauna is known to be abundant within river phototrophic biofilms and to perform both grazing and bioturbation within these matrixes, it is still unknown whether the activity of biofilm-associated meiofauna can influence the ability of biofilms to improve river water quality. In this study, we explored the effects of additional rotifers on biofilm N-NO_3^- uptake rates in microcosms for 10 days with a cross-design of two levels (low *vs* high) of nutrient availabilities (L *vs* H) and rotifer densities (M *vs* M+) i.e. LM, LM+, HM, HM+ respectively. At day 5, biofilm N-NO_3^- uptake rate in HM+, as well as bacteria density, was significantly higher than that in HM, but not algal biomass. Significantly lower of biofilm biomass in HM+ than that in HM was found. Besides, a positive correlation between bacteria density and rotifer density was found in LM, LM+ and HM+. Our results suggest that the presence of rotifers could contribute to the biofilm depuration processes through interaction between bacteria and rotifers.

SS18 - Oral

GASTROTRICHA: ADAPTATIONS AND EVOLUTION IN FRESH WATERS

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Gastrotricha are a small phylum widely present in aquatic systems as a common and significant component of meiofauna. Two orders are recognized by current taxonomy, Macrodasyida and Chetonotida, very different in morphology, biology and ecology. All but two freshwater species globally known so far (ca. 330 species) belong to Chaetonotida. Most freshwater gastrotrichs are known from eutrophic-mesotrophic habitats in standing waters, where they live as epibenthic and periphytic, and reach considerable densities (up to 170 ind/cm^2). But also few interstitial species, even in running waters, have been detected in freshwater sandy sediments. Morphological as well as biological adaptations of freshwater species clearly related to different habitats have been reported: an overview of these adaptations is advanced. Fresh waters appear to host a large majority of species of Chaetonotida, an order also present in marine and brackish waters, but only two species of Macrodasyida, an order entirely marine/estuarine: the question of the relationships and evolution of Gastrotricha between the sea and the inland waters is discussed.

SS18 - Oral

THE MICROSCALE IS A MAJOR DRIVER FOR SUBSURFACE FAUNA

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While it is well acknowledged that subterranean ecosystems, their functions as well as their elements, are influenced by large scale impacts from the catchment, glaciation, and climate, micro-scale effects from the bottom up have not been at the centre of attention yet. However, as in other systems, micro scale heterogeneity guarantees that a plethora of ecosystem services can take place at the same time. Even if the resources occur extremely patchily due to grain scale processes, they are thus used when and where they become available, e.g. by microbial microcolonies. Bacterial microcolonies are probably the major food source for protozoa and metazoan fauna, and from the bottom up, thus influence faunal occurrences. Fauna, being larger by several orders of magnitudes than most microbes, integrate over this micro scale and vice versa acts on an intermediate scale. In order to understand groundwater ecological processes, the interplay between influences on the various scales need to be integrated in a similar way as they are for abiotic conditions.

SS18 - Oral

FROM SMALL TO LARGE AND FROM SIMPLE TO COMPLEX UNITS OF ORGANISATION: THE MEIOFAUNA APPROXIMATION TO COMMON CONCEPTS IN RIVER RESEARCH

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Running water research is more often preoccupied with macro- and microbiota than with the intermediate meiofauna, regardless of whether important structural-functional aspects [ranging from simple (i.e. species numbers) or more complex systemic descriptors (e.g. food web, co-occurrence and turnover patterns)] are being addressed. This also holds true for monitoring and conservation studies. As a result, meiofauna distribution patterns still remain largely unknown. This not only hinders a thorough understanding of riverine systems but also withholds proof for the universal validity of widely applied concepts in riverine research. This contribution starts with high-altitude glacier catchments as examples of (seemingly) simple, less diverse and highly threatened systems. It shows that the glacier river meiofauna not only provide earliest colonisers and numerous species, but also a certain stabilizing and indicative capability with respect to their (potential) food web patterns describing these highly variable systems. The subsequent evaluation of beta and gamma diversity as well as co-occurrence patterns –frequently used surrogates for complex processes – extends from glacier catchments to different stream and river types at lower altitudes. These approaches inform a brief discussion of common concepts in river research.

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