Fresh Blood for Fresh Water

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BOOK OF ABSTRACTS

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Ecosystem functioning

Does the best ecosystem functioning occur under high phytoplankton richness in river environment as well?

Andras Abonyi, Maria Leitao, Judit Padisak

In the River Loire (France), an ecosystem functioning measure based on the total biomass to total phosphorus ratio displayed different relationships with taxa and FG richness of potamoplankton at whole river scale (19 stations, 3-year data). The highest richness was identified as a consequence of physically mixed habitats from either natural or human-mediated sources, while the best ecosystem functioning occurred at low taxa number and at medium FG richness. Accordingly, high richness in rivers might not provide automatic evidence for better ecosystem functioning, and cannot be a general objective either in water quality or in research context without considering the functional properties and nature of controlling factors at different scales. The rivers vs. lakes as well as the nature vs. human impact contexts are also highlighted.

Ecosystem functioning

Testing techniques for establishing diversity gradients within natural phytoplankton communities

Sara Hammerstein, Hannah Vogt, Claudia Büttner-Koch, Maria Stockenreiter, Herwig Stibor

Recent ecological research on the impact of biodiversity on aquatic ecosystem functioning revealed that more diverse communities show higher resource use efficiency and tend to be more stable in terms of community biomass fluctuations. To date experiments in this field are mainly done on artificially assembled phytoplankton communities with laboratory algal strains. Hence, due to technical constraints, there is a lack of studies on naturally diverse phytoplankton communities with a shared evolutionary background. Removal experiments which are common in terrestrial ecology are difficult to perform with microbial communities such as phytoplankton. Therefore we tested two different methods, namely dilution and disturbance, to establish diversity gradients originating from a common natural algal community. Both methods resulted in a clear measurable gradient in species diversity, mimicking either the loss of rare or stress sensitive species. To test the performance of such species reduced natural communities we performed eutrophication experiments. Here we show first results indicating that a loss of species from natural communities resulted in a less stable course of biomass development in response to nutrient enrichment.

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Ecosystem functioning

Simulating an extreme weather event in large mesocosms changes phytoplankton community dynamics

Géza B. Selmeczy, Stella A. Berger, Jens C. Nejstgaard, Darren P. Giling, Hans-Peter Grossart, Peter Kasprzak, Peter Casper, Mark O. Gessner, Judit Padisák

Increasing frequencies of extreme weather events are predicted to affect lake ecosystems as a consequence of global climate change. These events can impose dramatic threats on lake ecosystems as was observed in 2011 in the deep, mezo-oligotrophic Lake Stechlin, Germany. A summer storm altered the stable summer stratification of the lake, which resulted in dispersal of the metalimnetic cyanobacterial layer into the epilimnion and initiated a cyanobacterial bloom with massive calcite precipitation. In summer 2014, such a storm event was experimentally simulated in 4 of 8 mesocosms (9 m diameter, 20 m depth), with the other four mesocosms serving as controls. In the short term, mixing caused an immediate decrease in epilimnetic water temperature and total phytoplankton biomass, but an increase in nitrate and soluble reactive phosphorus concentrations. After that, the epilimnetic phytoplankton biomass increased in the mixed mesocosms with a first peak of Cryptomonas and a second peak of Dolichospermum species, but stayed low in the epilimnetic control mesocosms. Highest phytoplankton biomasses were observed two weeks after the experimental summer storm, which declined below the initial level after. The dominant phytoplankton functional groups were H1, Y and X2. Extreme weather events such as summer storms can cause strong shifts in phytoplankton community dynamics that are likely to transfer to higher trophic levels and to impact sedimentation rates and thus the biogeochemical cycles in lakes.

Nutrients/Chemistry

Effects of increased atmospheric nitrogen load on phytoplankton in a primary phosphorus limited lake

Poxleitner Monika, Trommer Gabriele, Stibor Herwig

The increasing proportion of reactive nitrogen in the atmosphere is a rising problem for terrestrial and aquatic ecosystems. So far, effects of increasing nitrogen deposition from the atmosphere have mainly been studied in nitrogen limited lakes. However, in phosphorus limited lakes additional nitrogen input would increase the degree of phosphorus limitation and arising effects for plankton communities are difficult to predict and to quantify. To estimate effects of increasing nitrogen load on phytoplankton communities in a primary phosphorus limited system, a mesocosm experiment was performed in an oligotrophic lake, in which a gradient of 6 increasing nitrogen fertilization levels was applied. Overall, we detected highest total phytoplankton biomass at intermediate nitrogen fertilization levels. However, different taxonomical groups and species of phytoplankton responded different. Whereas dinoflagellate biomass showed a unimodal relationship with increasing nitrogen fertilization, the chrysophyte biomass increased linearly. Total diatom biomass did not seem affected by nitrogen load; however Cyclotella showed a unimodal reaction and Asterionella a linear increase with nitrogen enrichment. Overall, we detected changes in the phytoplankton community with increasing nitrogen supply which translates into an altered food composition for zooplankton and thus further consequences for higher trophic levels.

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Nutrients/Chemistry

Increased atmospheric N-deposition can lead to shifts in zooplankton densities in P-limited lakes

Patrick Lorenz, Gabriele Trommer, Herwig Stibor

During the last decades anthropogenic activities such as fertilizer production and the use of combustion engines have increased the atmospheric N-deposition into terrestrial and aquatic ecosystems. In lakes where primary production is often P-limited, an increase in N-deposition can intensify the existing P-limitation of phytoplankton growth. Additionally, N-deposition can alter the community composition of phytoplankton. Both, increasing P-limitation and changes in community composition affect herbivorous zooplankton. We investigated in mesocosm experiments the responses of herbivorous zooplankton to shifts on phytoplankton community level as an effect of N-enrichment. We simulated an increasing N-deposition gradient starting from concentrations of natural, to 32-fold the natural N-deposition via precipitation. Our results indicate in general a unimodal response of mesozooplankton densities with N-enrichment. Rotifer species seem to profit from N-enrichment since they increase their abundances. These changes in zooplankton densities derived from increasing N-deposition can be transferred to higher trophic levels and may have consequences for fish production.

Nutrients/Chemistry

The proof of the hidden - Evaluating the relevance of vivianite for the phosphorus retention in recent freshwater sediments

Matthias Rothe, Andreas Kleeberg, Thomas Frederichs, Michaela Eder, Björn Grüneberg, Michael Hupfer

Phosphorus (P) sequestration in sediments and the functioning of iron in P binding has been studied intensively for decades. It is well known that iron in its oxidised (ferric) state effectively binds phosphate. However, under anoxic conditions it is subjet to chemical and microbial reduction and hence iron-bound P is considered to be potentially mobile. Many studies report iron-bound P to be a significant burial form in strictly anoxic sediments. This might be due to the formation of reduced (ferrous) iron phosphate minerals such as vivianite. Here, we applied a novel approach which enables us to directly identify vivianite nodules within a sediment matrix, and evaluate the contribution of vivianite to P retention. By studying P-rich freshwater sediments with artificially elevated, or naturally high iron content we can show that: (1) vivianite can significantly contribute to P retention in surface sediments, (2) artificial amendment of iron as a lake restoration measure can trigger vivianite formation and leads to lasting iron-associated P burial, (3) a process restricting vivianite formation is the extend of sulphide formation leading to a lack in available iron and (4) vivianite supersaturation of pore water is not sufficient to cause mineral formation. Our results emphasise the role of iron in lasting P burial and suggest vivianite formation to be much more common during early diagenetic transformations in surface sediments than previously thought.

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Nutrients/Chemistry

Aquatic Redox Processes: Drivers on small scales

Maximilian Lau, Michael Hupfer

Benthic microbial activity shapes the redox regimes in many freshwater ecosystems. When microbial respiration exceeds oxygen supply, respiration with other electron acceptors results in the reduction of organic and inorganic geochemical phases. These aquatic redox processes control the chemical speciation, bioavailability, toxicity, and mobility of both natural and anthropogenic compounds. This contribution will give a brief introduction into the ecology of aquatic redox processes from a mechanistic perspective. Recent methodological advances in the field of electrochemistry allow for a more holistic investigation of electron fluxes in freshwater sediments. Our work generally aims for the integration of redox-driven biogeochemical processes into the biological and hydrological conception of the sediment-water interface. Here, implications for lake oxygen regimes, carbon cycling and greenhouse gas emissions will be discussed.

Nutrients/Chemistry

Effect of Beaver dams in mercury methylation and the role of DOM quality

Sonia Herrero Ortega, Nuria Catalán, Hannes Gröntoft, Stefan Bertilsson, Pianpian Wu, Kevin Bishop, Erik Björn, Andrea G. Bravo

The 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 is still unclear in aquatic systems. Here, we studied DOC quality and MeHg formation in 9 beaver ponds of different ages across Sweden. We found a decrease in MeHg production with the age of pond, with a decrease of 65 % in average between the ponds younger than 7 years and those older than 18 years. An increase of DOC in the pond in comparison with the upstream part of the river has been observed in ponds <7 years. We found a significant positive correlation between MeHg and specific ultraviolet absorbance (SUVA254), indicating that the presence of aromatic compounds might lead to increase of Hg methylation in these systems. A deeper characterization of the dissolved organic matter carried out by fluorescence will further evaluate the changes of DOM quality in these systems.

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Nutrients/Chemistry

CO2 evasion from river-floodplain system

Anna Sieczko, Katalin Demeter, Magdalena Mayr, Karin Meisterl, Peter Peduzzi

River-floodplains are highly diverse systems, which are considered as hot spots for organic matter processing. The complex DOM, delivered during flooding events, enhances bacterial respiration and CO2 evasion. Although CO2 flux from inland waters lately received increased attention, the contribution of floodplain areas is not particularly considered. Especially CO2 evasion from European river-floodplain systems is not studied in detail. In our study we focused on two different river-floodplain sections: semi-natural and highly human-impacted systems located downstream of Vienna. We investigated CO2 evasion from floodplain waters with different connectivity to the main channel with a special focus on two types of flood events (a 1-year flood and a 100-year flood). We also aimed to answer how the CO2 fluxes are partitioned between floodplain and its main stem. Our findings reveal that floodplain waters were always supersaturated with CO2 therefore serving as source to the atmosphere. Our results show that the changing hydrological conditions had significant impact on CO2 evasion. Additionally, semi-isolated floodplain backwaters appeared to be potentially stronger sources of CO2.

Nutrients/Chemistry

Optics and biodegradability of fluvial DOM across a catchment landuse gradient and as influenced by mixing of waters at confluences

Barbara Behounek, Thomas Fuss, Amber Ulseth, Gabriel Singer

Fluvial dissolved organic matter (DOM) is derived from autochthonous production or terrigenous inputs and sustains microbial metabolism at the base of the aquatic food web. In fluvial ecosystems, the variety of sources of DOM and the continuous mixing during downstream transport imply a high compositional diversity which controls DOM transformation processes en-route to the ocean. This study investigates the impact of landuse and the effect of water mixing at river confluences on DOM composition and subsequent implications for microbial degradation. We hypothesize that DOM from tributaries draining catchments differing in landuse is highly differentiated, thereby promoting changes of both DOM composition and likely biodegradation at confluences. We investigated DOM and its biodegradation across a gradient of 16 confluences differing in tributary landuse differentiation. DOM quality dynamics were characterized using absorbance and fluorescence measurements. Our results reveal a clear dependency of DOM quality on landuse and various scenarios of DOM differentiation between tributaries. Links of DOM composition to biodegradation are complex and potentially confounded by nutrient limitation effects in our natural study gradient arising from different landuses and water mixing.

FBFW 2015 – LECTURES

Fish

Temporal and Spatial Comparison of Benthic Danube Fish Species in the Area of Hydropower Plant Freudenau

Dominik Bernolle, Silke-Silvia Drexler, Paul Meulenbroek, Pablo Rauch, Herwig Waidbacher

The construction and operation of the run-of-the-river power plant Freudenau is influencing the benthic Danube fish fauna. In this study the effect of the hydropower plant on temporal and spatial distribution and abundance of benthic fish fauna between river kilometer 1917 and 1935 are evaluated. We therefore set 99 longlines in the sampling area and compared our results with longline fishing outcomes of the years 1993/94 by C. Matschnig (during the construction of the power plant) and 1999/2000 by M. Straif (after reservoir filling). The longlines were 50m long polyamide lines, carrying side leaders at 1m intervals, ending in baited hooks. For all longlines exposure time (overnight), hook size, line strength and bait (Eisenia fetida) were used to enable comparability. Furthermore, by numbering the hooks on the longline we could spatially locate every caught fish regarding distance from the riverbank. This allows to assess whether the set of fish species caught on Longlines is showing dependence on distance to the riverbank. The fish community was found to have shifted from rheophiic towards more indifferent species. Additionally invasive Gobiidae species like Neogobius melanostomus and Ponticola kessleri, which probably found suitable living conditions in the altered river stretches, are dominating the catches. In contrast, the abundance of former common native species like Barbus barbus and Zingel zingel is decreasing.

Fish

Gastro-intestinal analysis of *Neogobius melanostomus* (Pallas, 1814) in the area of hydropower plant "Freudenau"

Nadine Ebm, Silke-Silvia Drexler, Paul Meulenbroek, Pablo Rauch, Herwig Waidbacher

Within the scope of this master thesis, feeding profiles of the alien species Neogobius melanostomus was analysed in consideration of the impacts of impoundments in the area of the hydropower plant Freudenau. Moreover, four spatial locations were distinguished (free flowing, head of the impoundment, transition zone and impoundment) and were compared. The free flowing section is sampled in the Nationalpark Donau-Auen. First results have shown that 227 fish individuals could be assigned to four clusters of feeding profiles. Feeding profile 1 (most essential food items: crustaceans, dipterans, abiotic material and trichoptera) is dominant in the head of the impoundment, transition zone and the impoundment (>62.4%) whereas unimportant for individuals in the free flowing section (15.8%). Feeding profile 2 (dominant food categories are crustaceans and diptera) is the highly represented by individuals of the National park (49.1%). Feeding profile 3 (dominance of diptera) is featured in the free flowing section with 33.3% while this feeding habit is missing in the transition zone at all and poorly occurring in individuals of the remaining sample sites (<4.3%). Furthermore, the feeding profile 4 is characterised by a high proportion of molluscs and crustaceans in their diet. This profile is highly represented in the impoundment (25.8%) and the transition zone (10.8%) respectively, underrepresented in the national park (1.8%). More analysis concerning seasonal variations and size dependent habits are still in progress.

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Fish

No evidence for increased rate of chromosomal evolution in asexuals: karyotype stability in diploids and triploids of the clonal hybrid fish (Cobitis, Cypriniformes, Teleostei)

Zuzana Majtanova, L. Choleva, R. Symonova, P. Rab, J. Kotusz, L. Pekarik, K. Janko

Spined loaches (Cobitidae) represent a characteristic element of the Eurasian ichthyofauna. In the last 20 years, new species, asexual reproduction, polyploidy and hybridization have all been reported within the genus Cobitis. Among asexual vertebrates, they represent a unique example, where gynogenetic clonal lineages of different ploidy levels coexist reproductively independent of one another. Transitions from sexuality to asexuality have been assumed to play a significant role in the initiation of chromosomal rearrangements, causing increased rates of karyotype evolution. In order to study the karyotype stability and evolution in sexually reproducing Cobitis species and their di- and polyploid hybrids we used genomic in situ hybridization (GISH) and molecular dating of cladogenetic events. We found no detectable recombinations between the parental genomes in hybrids suggesting that genomes inherited from respective parental species maintain their integrity even in a long term. Contrary to other asexuals, the switch to asexual reproduction did not provoke significant acceleration of the rate of chromosomal evolution in Cobitis. Considering that asexual animals in other case studies reproduce ameiotically, while Cobitis hybrids form eggs likely through modified meiosis our findings point to the hypothesis that the effect of asexuality on the rate of chromosomal change may be context-dependent rather than universal and related to particular type of asexual reproduction.

Fish

Identification of Central European fish species via multiplex PCR

Bettina Thalinger, Johannes Oehm, Hannes Mayr, Christiane Zeisler, Michael Traugott

The morphological identification of fish samples can be difficult, for example, when dealing with eggs, larvae, tissue samples or feces of piscivores. In the best case, hard parts such as otoliths, chewing pads, pharyngeal bones or scales are present in a sample. These, however, are often not species-specifically identifiable. Here, present a two-step multiplex PCR system, composed of six assays, tailored for rapid, sensitive, and specific detection of Central European fish species. It covers 79 fish and lamprey species and enables the identification of 31 species, six genera, two families, two orders, and two fish family clusters. So far the assays have been successfully applied to identify fish prey in feces of the Eurasian otter, the Common Kingfisher, as well as feces and regurgitated pellets of cormorants. The cost-effectiveness and speed of the multiplex PCR system allowed analyzing more than 4,000 diet samples from cormorants collected within a two-year field study in the Alpine foreland, providing a detailed picture of cormorant diet in relation to fish phenology. Besides detecting and identifying fish DNA in dietary samples, the high sensitivity and specificity of the multiplex PCR system also enables its application in studies focusing on environmental DNA or the identification of juvenile fish.

FBFW 2015 – LECTURES

Invertebrates/Zooplankton

Analysis of influences of climate variations on running waters in low mountain range (focus National Park Kellerwald Edersee (Hesse, Germany))

Julia Wrede, Ulrich Braukmann

Study areas with few anthropogenic disturbances over a long period are rare in Germany. Ecological analyses in these areas could give a detailed view on influences of rapid climatic changes, like increase of temperature and precipitation. Ecosystems with low ability for rapid adaption, e. g. running waters, are therefore especially endangered. In this study we focus on the effects of changes in temperature (air and water) and precipitation on macroinvertebrate communities in the National Park Kellerwald Edersee (Hesse, Germany) and the Arnsberger Forest (North Rhine-Westphalia). The macroinvertebrate fauna (mayflies, stoneflies and caddisflies) was studied using hand nets for aquatic invertebrates and light traps for insect imagines at three study sites from 2010 to 2014. In 2012 the investigations were extended up to three further study sites and an emergence trap was placed additionally. The research concentrates on the temporal and spatial occurrence of the taxonomic groups, mentioned above. In addition, besides precipitation and air temperature, discharge, and chemical parameters (pH, oxygen, electrical conductivity) were continuously registered at a measuring station since March 2010. The study shows a high variability in emergence and abundance of benthic macroinvertebrates during these five years mainly according to variable weather and climatic conditions. The results show a close relation between oxygen content, electrical conductivity, discharge and precipitation. We also focus on the increase of summer drought and the colonization strategies of stenoecious macroinvertebrate species, typical for central German mountain brooks. The results of our studies may display the beginning of noticeable climatic changes in small streams which could serve as references for other similar streams in low mountainous areas in Germany.

Invertebrates/Zooplankton

Effect of different types of salinities on the hatching and survival of the living fossil Triops cancriformis

Dunja Lukić, Csaba F. Vad, Zsófia Horváth

Large branchiopods are a flagship group for conservation and represent a key group of temporary wetlands. Along with climate change, the salinity of wetlands is going to increase in the future. Salinity is a key factor in shaping invertebrate communities and influencing diversity in wetlands. In this study, we investigated how different salt concentrations and types of salt affect hatching rates, speed of hatching and life span of Triops cancriformis (Branchiopoda, Notostraca). T. cancriformis eggs were separated from the sediment collected at a soda pan in Eastern Austria, and then they were incubated on 7 different concentrations and 2 different types of salt. Hatching rates and life span decreased with increasing the salinity both in the case of sea salt (sodium chloride, NaCl) and soda (sodium hydrogen carbonate, NaHCO). Life span was shorter in soda water than in water with NaCl. Hatching rates were higher in soda water compared to the same concentrations of NaCl. Hatching generally happened later with increasing salt concentrations. In conclusion, we found that both types of salinities affected negatively the hatching patterns and survival of T. cancriformis, which presence and absence has a great significance for temporary wetland ecosystems, as this key species has a strong effect on the invertebrate communities, especially through predator-prey relationships. Therefore its habitat tolerance is important for understanding its possible role in these aquatic systems.

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Invertebrates/Zooplankton

The resistance of thick and thin morphotypes of *Aphanizomenon gracile* to *Daphnia* grazing

Lukasz Wejnerowski, Sandra Moskalik, Slawek Cerbin, Marcin Dziuba

Thickness of cyanobacterial filaments seems to play an important role in life history of filter-feeders like *Daphnia* and filtering apparatus morphology of these animals. For instance, daphnids exposed to cyanobacteria with thicker filaments have smaller size at reproduction and produce less number of neonates than those fed with thin filaments. In addition, thick filaments occuring at high biomass can damage *Daphnia*'s filtering appendages. These examples indicate that thick filaments are more detrimental for daphnids than thin ones but the reason for it is not fully known. Therefore, we decided to check feeding preferences of *Daphnia* in terms of filament thickness. We hypothesized that thick filaments are more resistant to grazing than thin filaments what could explain why thick filaments suppress life history of *Daphnia* more than thin filaments. To test our hypothesis, an experiment was performed where daphnids of similar size were exposed directly for 24-hours to cyanobacterium Aphanizomenon gracie having two filament morphotypes: thick and thin (> 2.5 µm , <2.5 µm; respectively). Cultures without daphnids were used as a control. At the beginning and at the end of the experiment, cyanobacterial samples were collected in order to determine filament thickness distributions. The experiment revealed that Daphnia grazing affects markedly the numbers of thin and thick filaments of A. gracile. The number of thin filaments decreased while the number of thick ones increased after Daphnia grazing. Such changes were not observed in controls. Our results indicate that thicker filaments are more resistant to grazing by Daphnia than thinner filaments.

Invertebrates/Zooplankton

Cryptic diversity of rotifers: case study *Keratella cochlearis*

Adam Cieplinski, Ulrike Obertegger, Thomas Weisse

Rotifers are one of the most prominent groups of animals used in environmental research due to their short life span, ubiquity and fast reproduction rate. Many rotifer species are known to be in fact composed of different morphologically indistinguishable species – so called cryptic species which are the interest of my research. My PhD project focuses on disentangling the influences of spatial versus environmental processes on the genetic diversity of the rotifer Keratella cochlearis. For this purpose lakes with different environmental (temperature, conductivity and trophic state) parameters were chosen for investigation and are regularly sampled. In this presentation I will expose the main objectives of my PhD project and our most current results: finding cryptic species based on DNA barcoding, success in triggering appearance of males and establishing successful cultures of Keratella cochlearis.

FBFW 2015 – LECTURES

Invertebrates/Zooplankton

Temperature-dependent effect of filamentous cyanobacteria on reproduction-related traits of Daphnia

Anna Bednarska

Cyanobacteria are considered a poor food source for herbivorous zooplankton (especially for large bodied, unselective cladocerans of Daphnia genus), and many argue that forecasted global warming will intensify the negative influence of cyanobacteria on Daphnia fitness. The increase of mean water temperature can extend the period of cyanobacteria dominance in phytoplankton, thus Daphnia will be exposed to cyanobacteria for many generations. This study tested the intergenerational differences in the response of Daphnia to the presence of cyanobacteria and elevated temperature, and their ability to survive these conditions over long periods. Daphnia magna from three clones were fed for five generations with green algae Scenedesmus obliguus or cyanobacteria Cylindrospermopsis raciborskii and kept in 20° or 24°C. The key life history parameters were recorded. Even when cyanobacteria were the only available food, they sustained the growth and reproduction of Daphnia for five generations. However, detrimental effects of cyanobacteria on Daphnia increased with increased exposure time. Moreover, elevated temperature intensified the negative influence of cyanobacteria on Daphnia fitness, with reproductive-related traits being most affected (e.g. occurrence of non-reproductive instars, egg malformation or abortion, or switching of the reproductive mode).

Working strategies

Potential of collaborative open experiments between young scientists: the example of the DOMIPEX project

Núria Catalán, Ada Pastor

Collaborative experiments can help to detect large-scale patterns and processes, providing predictive ability that can be difficult to capture only by observational networks. A successful collaborative environment includes coordinated research methods, a team of cooperative scientists, adequate communication, and a philosophy of respect for input from all collaborators. 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 leader a collaborative experiment during two years, open to participate to all the young members of the association. The granted project was DOMIPEX (Dissolved Organic Matter in the Iberian Peninsula EXperiment). The main aim of DOMIPEX was to examine the changes in stream Dissolved Organic Carbon (DOC) and nitrogen uptake due to flow changes (minimal summer flow vs initial peak of the expansion phase in autumn) by conducting experimental solute additions (acetate and nitrate) in a range of streams across Europe. Nowadays, the project gathers together 40 young limnologists working in 11 study sites in Switzerland, Germany and Spain. Here, we present the early results of DOMIPEX and provide specific advice and relevant considerations to researchers interested in developing collaborative experiments by presenting our experience managing, developing and coordinating DOMIPEX . Our experience shows the potential of young scientists to work independently and to develop a strong research environment, and demonstrates how science does not need to be expensive, as long as there is a motivated team behind.

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Working strategies

Finding the red line

Simone Peter

It seems to be of a common concern for young researchers to find their own place or niche in a research community and to find the “red line” that is specifying their own research. This presentation will be a synthesis of my previous and current research and an attempt to find combining elements and identify research questions possibly combining the different components of my previous work. It will be a journey from lake bacterial communities to organic carbon and nitrogen cycling in a river-groundwater system and to coupled iron and organic carbon processes in lake sediments. Although these studies involve a broad range of different freshwater systems and subjects, the role of OC and the importance of transition zones (both spatial and temporal) that lead to the formation of biogeochemical hot spots and moments may be identified as the most overarching elements. I would also like to discuss on the example of my own experience the pros and cons of having a more diverse experience from studying different subjects in contrast to starting to build up a more narrow professional expertise already early in the career. With this I hope to stimulate discussion about scientific career planning and future directions in research among young scientists.

Microbiology

Patterns in the bacterioplankton community composition along environmental gradients in a river-floodplain (Austria)

Magdalena Mayr, Anna Sieczko, Katalin Demeter, Katharina Besemer, Irene Teubner, Karin Meisterl, Peter Peduzzi

In river-floodplain systems the changing occurrence of low and high water events create a temporal and spatial mosaic of habitats, along which the bacterioplankton community composition (BCC) is related to different environmental factors. Danube side-arms, with a gradient from frequently connected (dynamic) to permanently isolated from the main channel, were investigated under various hydrological conditions. Bacterial 16S rRNA gene fingerprints (T-RFLP, terminal restriction fragment length polymorphism) showed that dynamic sites were highly similar to the main channel during connection, but diverged from each other when disconnected. Resources, biotic and abiotic factors were significantly related to the BCC patterns. The BCC of semi-isolated sites was less influenced by hydrological changes and harbored a BCC distinct from the main channel. The isolated site showed a strongly varying BCC, which was different from all other sites. Low oxygen saturations and the presence of bacteriochlorophyll-a containing bacteria supported the particular status of this water body. The temporal and spatial resolution of this study allowed us to increase our understanding of the BCC in this river-floodplain system, thus emphasizing the fluctuating and tessellated character of this ecosystem.

FBFW 2015 – LECTURES

Microbiology

Diversity within the bacterial genus *Limnohabitans*

Vojtech Kasalicky, Jan Jezbera, Jitka Jezberova, Karel Šimek

Microbial ecology has a challenging question – which microbial taxa are present in a specific habitat? This is crucial to estimate the community diversity changes, to explain the ecology of an individual or to describe species-species interactions. We will illustrate the impact on dynamics of the bacterioplankton ecology with the *Limnohabitans* genus example. The genus is constituted of bacteria sharing > 95% similarity of the 16S rRNA gene, and > 97% within the individual lineages. Most of them are thus considered as only one taxon by most of the culture-independent methods. To understand the microdiversity, we designed specific probes for Reverse-Line-Blot-Hybridization and targeted individual genotypes during a spring algal bloom in the Římov reservoir. Moreover, we sequenced genomes of 12 isolated strains from three lineages of the *Limnohabitans* genus. We found heterotrophic strains, as well as strains with photosynthesis with or without CO_2-fixation genes. The distribution of the traits is partly lineage-related, partly of a mosaic distribution. Some of the genomic traits were solely present in one strain. Both these methods confirmed that closely-related microbes have different metabolic types and they appear *in situ* in distinct period of the year. We can conclude that underestimating the diversity leads to an important lack in ecological studies.

Microbiology

Heterotrophic bacteria associated with the toxic bloom-forming cyanobacteria *Planktothrix*

Pavla Urbánková, Qin Chen, Nadine Münzberg, Eva Skerekes, Rainer Kurmayer

Cyanobacterial nuisance blooms cause ecological, economical and health problems all over the world. Understanding this phenomenon has therefore an utmost priority. Dynamics of cyanobacterial populations is influenced by physiochemical factors as well as biological interactions. Heterotrophic bacteria are the key and understudied players of these interactions. Diversity within bacterial communities and the factors influencing their composition are currently unknown. To better understand diversity of bacterial consortia co-occurring with cyanobacteria, we examined heterotrophic bacteria attached to single filaments of the cyanobacteria *Planktothrix* by culture- independent molecular methods. Examined filaments originated from five Alpine lakes. Phylogenetic position (rbcXL and cpcBA) and the ability to produce toxic microcystin (*myc* cluster genotype) were determined for each filament in a previous study. In the present study, we amplified 16S rRNA of associated heterotrophic bacteria. Resulting PCR products were used to establish clone libraries that were quantitatively characterized by RFLP (restriction fragmentation length polymorphism). To identify present bacterial taxa, we sequenced 16S rDNA from all clones with unique restriction patterns. Composition of bacterial communities was correlated with phylogenetic affiliation and *mcy* cluster genotype of individual *Planktothrix* filaments.

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Microbiology

Microdiversity in *Polynucleobacter* bacteria

Matthias Hötzinger, Martin W. Hahn

The bacterial species Polynucleobacter necessarius subsp. asymbioticus (further abbreviated as P. necessarius) shows cosmopolitan and ubiquitous distribution in the plankton of standing freshwater habitats. P. necessarius comprises on average about 10% of total bacterioplankton cells in various freshwater habitats and was detected in all climatic zones and over a wide pH range (3.8 – 8.5). The ubiquity of P. necessarius was explained by intra-taxon ecological diversification, i.e. specialization of lineages to specific environmental conditions. Genetic data indicates an unforeseen high number of closely related genotypes even among strains of a single lineage (microdiversity). The genetic differences between these strains might either be the consequence of neutral diversification by genetic drift or of positive selection, i.e. represent adaptations to different habitats or niches within a single habitat. Genome analysis of six strains, associated to the same lineage but isolated from three different locations provides insights on specific adaptations of closely related genotypes.

Microbiology

Antagonistic interaction between heterotrophic bacteria and cyanobacteria

Omneya Ahmed Osman, Stefan Bertilsson

Microcystis is one the most common cyanobacterial strains with high toxins production capacity, microcystin, causing human liver damage and serious problems to lake ecology and water supply. Predatory bacteria or cyanolytic bacteria living in the same habitat of algal blooms are friendly approach for algal bloom termination. We isolated over 100 different cyanolytic bacteria belong to genus Pseudomonas, Stenotrophomonas, Acinetobacter and Delftia from 3 freshwater lakes in Sweden (Mälaren, Erken and Funbojön). Four potential strains with high lytic activity were chosen for epifluorescent microscopic observation and metatranscriptomic analysis. The antagonistic interaction were performed by 1:1 (prey: predator ratio), cyanolytic bacteria increase in number and completely surrounds Microcystis cells causing low light irradiance and release of extracelluar lytic compounds between 24-72 h incubation time followed by distortion of Microcystis cells and leakage of cell content at 96 h incubation time. Thirty transcripts were highly expressed during the antagonistic interaction at 24 h incubation time among the studied samples. Transcripts associated with cell wall-associated hydrolase facilitating the invasion of prey cells was one of the most differentially significantly expressed across samples. Phycobilisome, photosystem II and heat shock putative proteins were highly expressed in Microcystis as a survival mechanism against cyanolytic bacteria attack. This is the first report describing the metabolic genes involved heterotrophic bacteria interaction with algal blooms and targeting specific cyanolytic bacteria with high lytic activity with possible future control of harmful algal blooms and improve water quality in nature.

FBFW 2015 – LECTURES

Phytoplankton

Ecophysiological characterization and metabolic stress response of the red alga *Batrachospermum turfosum* Bory de St.Vincent (Rhodophyta, Florideophyceae) under enhanced UV-A and UV-AB exposure

Siegfried Aigner, Erwann Arc, Andreas Holzinger, Ilse Kranner

The colonization of terrestrial land was a pivotal event, requiring numerous evolutionary innovations to support survival in this new environment. It is commonly accepted that the transition occurred from marine via freshwater habitats to a terrestrial life style, were algae were exposed to harsh and strongly fluctuating abiotic factors, mainly intense irradiation, desiccation and nutrient deprivation. Here we show for the first time that different molecular photoprotective mechanisms help the filamentous freshwater alga Batrachospermum turfosum (Rhodophyta/Florideophyceae) to cope with enhanced ultraviolet (UV) A and UV-B irradiation. The ecophysiological characterization of this alga has shown acclimation to low-light and cool-temperate environment and metabolic changes during the stress treatment were analysed. Fatty acids, primary and secondary pigment compositions as well as the induced synthesis of antioxidant photoprotective compounds were identified with chromatographic applications. Our results highlight the evolution of several metabolic pathways in freshwater red algae and show the requirement for regulated synthesis of photoprotective compounds, which is an ancient relict and seems not to be required nowadays, but these metabolic pathways are revitalised if exposed to enhanced UV-irradiation. We anticipate that red freshwater algae still possess molecular strategies for photoprotection against UV-irradiation, although they inhabit light deprived habitats after their transition from a marine to a terrestrial environment. The regulation of absorbing light and the synthesis of antioxidant photoprotective compounds are the essential metabolic strategies to cope with enhanced UV-irradiation.

Phytoplankton

Benthic diatom composition of Lake Stechlin (Germany)

Beáta Szabó, Géza B. Selmeczy, Lothar Krienitz, Judit Padisák, Csilla Stenger-Kovács

Lake Stechlin is located in North-eastern Germany on the southern border of the Mecklenburg Lake District (53°10’/13°02’). Contrary to phytoplankton communities, attached diatoms of the oligo-mesotrophic lake have got much less scientific interest. The aim of this study was to determine and compare the current composition of benthic diatoms between the three basins (north, west, south basin) of the lake in spring and autumn. Phytobenthos samples were taken on 3th May 2013 and 26th September 2014 from 23 different sites of the littoral region of the lake from natural, stone substrate. Species composition was determined with light and electron microscopes. 116 taxa were identified, some of them are in regression (e.g. Cavinula scutelloides, Cocconeis neothumensis, Cymbella helvetica) or endangered (e.g. Achnanthes trinodis, Planothidium joursacense, Rossithidium petersenii) according to the German Red List. Species number (32±4), Shannon-Weaver diversity (2.43±0.24) and Pielou’s evenness (0.71±0.06) did not show any differences between the basins. Diatom composition showed uniform picture however, due to the high relative abundance of the centric species (e.g. Stephanodiscus minutulus and Stephanodiscus neoastraea), the spring samples differed significantly from the autumn samples.

FBFW 2015 – LECTURES

Phytoplankton

An in-detail morphological, phylogenetic and ecophysiological analysis of four benthic Anabaena strains (Nostocales, Cyanobacteria) confirms deep heterogeneity within the genus

Andreja Kust, Eliska Kozlikova, Jan Mares, Klara Rehakova

Following new ways of characterization based on polyphasic approach, many traditional cyanobacterial genera were divided, including the genus Anabaena Bory 1822. After revisions the generic name Anabaena has been preserved for the species without gas vesicles (benthic, periphytic, soil). Our study is the first detailed investigation of benthic Anabaena spp. combining the morphological, phylogenetic and ecophysiological approaches. To gain more insight into the biology of these organisms we examined morphological traits of four benthic Anabaena strains and assessed their phylogenetic relationships based on the 16S rRNA gene. We further investigated the temperature and light (irradiance) optima of the strains by exposing them to various combinations of these two parameters to enable the estimation of their potential ecological niches and their comparison to related planktic taxa. Results of the combined analysis showed a distinct morphological dissimilarity among the studied strains, which were further found to be highly polyphyletic based on 16S rRNA phylogeny. The experiment revealed unexpectedly high temperature and light optima for some of them, while others showed preferences similar to previously studied planktic species of related heterocytous genera. Comparing outputs of these three approaches may give a complex picture of previously little studied benthic Anabaena and provide a starting point for further research.

FBFW 2015 – POSTER PRESENTATIONS

Ecosystem functioning

Impact of melioration on river hydromorphological quality in wetlands: example of Northern Latvia

Jolanta Jekabsone

There has not been a comprehensive study about wetland rivers in Latvia. Melioration in the context of this research is understood as drainage of wetlands, straightening and impoundment of rivers. Massive drainage work occurred in the beginning of the 20th century and in 1950-1970. Rivers were straightened in order to increase the slope and elevate the water removal rate, resulting in drier agricultural land with unflooded floodplains. Small rivers in wetlands usually were transformed in ditches and incorporated in a drainage system. The aim of this research was to find out, if exists wetland rivers, which corresponds to reference conditions (small deviation from natural conditions). In the whole, there are no fully natural rivers in Northern Latvia wetlands (fens, bogs) and no reference site was found. Existing pristine or semi-natural stretches are very fragmented and short. Most of watercourses are partly or fully regulated. To determine river habitat quality, Lawa-vor-Ort hydromorphological assessment method, developed in Germany, was used and German river typology was adapted (types 11 and 12) to Latvian conditions. Drained or natural fens or mires cover only 2% of area of Gauja RBD. According to the type of land use, most of the drained wetlands belong to pasture or arable land and relatively small areas have been turned into cut-over bogs. Thus, this has decreased not only river hydromorphological, but also hydrochemical quality. Natural wetland areas have replaced agricultural lands, which are characterized by increased nitrogen and phosphorus runoff.

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Ecosystem functioning

Fine-scale biogeography in freshwater lakes along a trophic gradient in the Osterseen Lake District, Bavaria

Katrin Zwirglmaier, K. Keiz, M. Engel, J. Geist, U. Raeder

Biogeography in aquatic ecosystems is commonly applied to study diversity along large spatial scales or environments separated by physical barriers that hinder dispersal of organisms. Few natural systems offer the opportunity to study biogeography on a smaller scale in an aquatic environment, where organisms can freely disperse, but which nevertheless is split into areas with stable and distinctly different chemical and physical conditions. The Osterseen Lake District (OSL) in Bavaria consists of 19 interconnected lakes that exhibit a pronounced trophic gradient from eutrophic to oligotrophic. Here we used pyrosequencing of 16S rRNA amplicons to analyse the microbial diversity in all 19 lakes. We compared diversity patterns between lakes and seasons and correlated the bacterial community composition with key chemical and physical parameters. Distinct patterns of bacterial diversity only emerged at the level of individual OTUs, but not at the level of the major bacterial phyla. This emphasises the high functional and physiological diversity among bacterial species within a phylum and calls for analysis of biodiversity at the level of OTUs in order to understand fine-scale biogeography. This was the first study of the microbial diversity in the Osterseen Lake District. Due to its unique properties and trophic gradient it should prove useful as a model system for microbial ecology studies regarding the long-standing “everything is everywhere, but the environment selects” hypothesis.

FBFW 2015 – POSTER PRESENTATIONS

Ecosystem functioning

Gradostat - an experimental meta-ecosystem for studying coexistence along environmental gradients

Tamara-Antonia Baron von Löwenstern

Most of the knowledge about resource competition within communities so far is based on homogenous environments whereas the dynamics in spatially heterogenous systems still is a challenge within the field of ecology. In nature spatially separated habitats are never completely isolated but linked with each other providing an exchange of biomass, resources and matter therefore those systems are called meta-ecosystems. An approach to experimentally investigate spatially heterogenous aquatic habitats is the Gradostat, a system with which it is possible to simulate a patchy meta-ecosystem to enhance the understanding about the coexistence and competition of communities in complex aquatic environments. The Gradostat is a Chemostat consisting of three vessels. Each vessel is designed as a Chemostat, with in- and outflow. In addition, the chambers are linearly connected through diffusion. By providing medium different in resource concentration a gradient can be created among the connected vessels. Therefore, niches generated by those gradients are able to form. Within this work, a model community of 2 phytoplankton species was studied and growth, dispersal and competitional behavior along the gradients were observed.

Ecosystem functioning

Biological field stations - a global infrastructure

Laura Tydecks, K. Tockner, V. Bremerich, I. Jentschke, G.E. Likens

Biological field stations form a global infrastructure of strategic relevance. They provide a setting for education and short and long-term ecological and biodiversity research, forming often a last enclave of nature in a domesticated region. They play a key role in monitoring environmental change and in competently informing the public and policy makers. More than 1000 biological field stations have been established since the 19th century throughout the world. They cover a broad range of biomes and are currently active in terrestrial, freshwater and marine research on-site.

FBFW 2015 – POSTER PRESENTATIONS

Ecosystem functioning

The effect of soil additions on DOM dynamics and biofilm growth in stream mesocosms

Lukas Thuile Bistarelli, Tom J. Battin, Jakob Schelker

Dissolved organic carbon (DOC) is known to be a major player in the biogeochemical cycling of carbon in freshwater ecosystems. Here we use six stream mesocosms of which three are treated with a soil addition, as well as three acting as a control to test the impact of allochthonous organic matter (OM) on streams and rivers. Our results show, that despite substantial carbon additions (200 dm^3 per flume, C content = 8%), differences in DOC concentrations were not significantly changed by the treatment (two-way ANOVA; factor 1= treatment, factor 2= time). However, we observed biofilm growth over time. Also DOC concentrations showed a significant increase over time ($F = 4.39$, d.f.= 1, $p<0.05$). Similarly, Nitrate concentrations (NO3-) increased as the experiment proceeded, but no treatment effect could be detected. Further analysis of biofilm biomass and chlorophyll a will help to better understand the observed patterns. Overall, we hypothesize that biofilm growth acts as an important driver of DOC concentrations in Alpine streams, as biofilm exudation and/or leaching of OM can alter stream DOC levels.

Ecosystem functioning

Chironomidae (Diptera) are a promising tool for monitoring environmental status and change in alpine headwaters

Georg Niedrist, Leopold Füreder

Climate change is a significant contributor to the worldwide threat of freshwater biodiversity. Especially in alpine catchments, terrestrial and aquatic communities will be strongly affected. Within a freshwater monitoring program in the Hohe Tauern NP (Austria) selected river reaches (non-glacial, glacial) were investigated to (i) characterize the abiotic conditions and biotic patterns of the streams, (ii) elucidate important variables being responsible for species occurrence, richness, diversity and abundance, and (iii) define appropriate indicators showing environmental conditions and change. In defining species specific niches in the Chironomidae, the key component of the benthic invertebrate fauna, we were able to show their high potential to be used as indicators. Two-Way-Clustering-Analysis defined stream-type specific chironomid assemblages, RDA elucidated significant relationships of assemblages and dominant species to key environmental parameters, indicator value analysis qualified specific chironomids as adequate indicators. Our study showed that chironomids are best suited for monitoring environmental status and change in alpine headwaters; however fundamental requirements are a robust taxonomy and a comprehensive set of physico-chemical data to characterize their specific ecological preferences.

FBFW 2015 – POSTER PRESENTATIONS

Ecosystem functioning

Consequences of glacier retreat for the structure and function of alpine lakes

Hannes Peter, L. Moya, T. Dittmar, R. Sommaruga

The ongoing melting of glaciers is one of the most alarming signs of global climate change, which threatens biodiversity in glacier-fed freshwater ecosystems. Many low lying glaciers are expected to completely vanish within the next decades. One characteristic of glacier-fed freshwater ecosystems is the high load of minerogenic particles, which are formed by the erosive activity of the glacier. Turbidity in glacier-fed lakes affects light penetration and thus temperature and primary production, however also interferes with the feeding mode of keystone species (e.g. Daphnia and heterotrophic nanoflagellates). Moreover, glacier store ancient organic carbon which is released to downstream ecosystems upon melting. Hence, glacier retreat has multiple facets and how biodiversity and function in glacier-fed lakes may respond once the glaciers are completely vanished is unknown. We have sampled a set of turbid lakes in the Austrian Alps and use pyrosequencing and ultra-high resolution mass spectrometry to gain insight into the structure and function of proglacial lakes.

Ecosystem functioning

Effect of human influences on the dynamical changes of the aquatic habitats at the Danube river

Kinga Farkas-Iványi, Trájer Attila

Human impacts are increasingly taking a strain on rivers. Water demand escalates as the population grows and as the industrial technology evolves. The river regulation works of the 19th and the 20th century and the hydroelectric power plants of the 20th century generated significant hydro-morphological changes in the Danube river. The aim of the research was to study the long-term dynamics of aquatic habitats of the river Danube focusing on the Bodaki-branch system (rkm 1832-1827) and to evaluate the processes of human modifications. Based on a series of historical map surveys and satellite images (representing the period 1790-2013) the spatio-temporal changes of the aquatic habitats were determined. The development of aquatic habitats was related to the co-evolution of the islands and the coastline vegetation, while the large-scale dynamics of the river-system was determined by the spatial patterns of flow conditions and accumulation processes.

FBFW 2015 – POSTER PRESENTATIONS

Nutrients/Chemistry

Fluctuations in periphyton community composition and biomass due to pharmaceutical compounds and environmental factors

Teofana Chenova, François Keck, Bernard Montuelle, Frédéric Rimet, Agnès Bouchez

Hospital wastewaters (HWWs) contain more pharmaceutical compounds than urban wastewaters (UWWs), but they are generally discharged in sewers without pretreatment. Since traditional urban wastewater treatment plants (WWTPs) are not improved to treat such hospital effluents, their pollutants may attain receiving aquatic environments. Better understanding of pharmaceuticals toxicity and persistence in the environment is needed in order to develop more accurate environmental risk assessment and management strategies. Due to their feature to respond to physical, chemical and biological fluctuations by changes in its structure and composition, biofilms are suitable in comprehending the environmental impacts of pharmaceuticals. This study evaluates 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 discharge. Six successive monthly colonizations of biofilms were carried out. Results indicated that UWWs and HWWs affect differently biofilm communities. Pharmaceuticals` concentrations in the hospital effluent were generally higher, which caused decrease in the biomass and bacterial richness and strong differences in the community composition. Fluctuations in environmental factors led to seasonal gradient in both basins. River communities located up- and downstream from the WWTP discharge showed only small differences between each other, but they were very different from communities observed in the basins effluents. According to our results, biofilm communities revealed contrasting impacts from UWWs and HWWs effluents linked to pharmaceuticals exposure, impacts that may affect the receiving river ecosystem.

Nutrients/Chemistry

The δ13C values of organic matter, carbonate encrustations and ambient waters of two morphologically different charophytes co-occuring under similar lake conditions

Eugeniusz Pronin, Mariusz Pelechaty, Karina Apolinarska, Andrzej Pukacz

The study aimed at the δ13C analysis of carbonate encrustations (δ13CCARB) and organic matter (δ13CORG) in two charophyte species, Chara tomentosa and Chara globularis. These values are compared with the δ13C values of dissolved inorganic carbon (δ13CDIC) of waters above the charophyte stands. We hypothesized that the contrastive morphology and growth form of the studied species result in the species-specific relationships between δ13CCARB, δ13CORG and δ13CDIC. Despite morphological differences, these submerged macroalgae can form dense and extensive charophyte meadows in lakes and may significantly contribute to the calcium carbonate precipitation and deposition of marl lake sediments, an archive of past environments in palaeolimnological studies. In July 2012, for isotopic analyses, the whole thalli of 10 individuals of each studied species and water directly above the charophytes were collected in three lakes and at three sites per lake. Carbonate encrustations of C. tomentosa were enriched in 13C relative to both organic matter and DIC. Encrustations of C. globularis were also 13C-enriched compared to organic matter but, by contrast to C. tomentosa, were depleted in 13C relative to water DIC. The differences between isotope values of organic matter and carbonates were substantially greater for C. globularis although the δ13CDIC values were similar above the stands studied in the same lake. In addition, the δ13C values of organic matter of C. tomentosa were higher in comparison to C. globularis. The differences in morphology and the source of CO2 the studied species use (HCO3- for C. tomentosa and, for C. globularis, CO2) are postulated to be the key factors influencing the δ13C values in the studied species.

FBFW 2015 – POSTER PRESENTATIONS

Nutrients/Chemistry

The role of acidity in the measurement of particulate and total phosphorus

Christian Preiler, Robert Ptacnik

Detection of phosphorus as molybdenum blue is a conventional method in water analytics. Due to its sensitivity it is widely used in manual and automated methods. Both, reaction time and final absorbance were found to be fundamentally influenced by the ratio of acid to molybdate. A surplus of acid leads to slow and incomplete colour formation, while too little acid causes self-reduction of molybdate which results in biased absorbance signals. As the method can only detect PO4, for measurement of POP and TP, all phosphorus compounds must be transformed into PO4 prior to measurement. The digestion procedures involved in the measurement of TP and POP typically employ a combination of acid, oxidant and heat to break up polyphosphates and organically bound phosphorus. Preservation of samples can be another reason to introduce acid. Acidic samples cause delayed signal development which increases the overall duration of sampling processing. Moreover, incomplete reactions will result in reduced analytical sensitivity and precision. To compensate for acid introduced with the digested sample, the acid concentration of reagent solutions should be adjusted accordingly. I present experimental data to illustrate the role of the acid : molybdate ratio on the duration and precision of the molybdenum blue method.

Nutrients/Chemistry

Identification of different chemolithotrophic CO_2-fixation pathways present in bacteria and archaea exploiting distinct ecological niches in stratified lakes

Monika Summerer, Michaela Salcher, Andreas Baumer, Thomas Posch, Albin Alfreider

Stratified lakes with their pronounced oxygen gradients and different redox states of nitrogen and sulfur enable the investigation of different CO_2-fixation strategies of chemolithoautotrophic prokaryotes in distinct ecological niches. The Calvin-Benson-Bassham cycle with its key enzyme RubisCO, the 3-hydroxypropionate/4-hydroxybutyrate (HP/HB) cycle and the reductive citric acid (rTCA) cycle were selected for investigation. From 52 DNA samples collected from six stratified lakes over 1000 clone-inserts coding for key enzymes in the corresponding CO_2 fixation pathways were screened and phylogenetically analyzed. The obtained sequences revealed the presence of different forms of RubisCO (IA, IC and II) in almost all lakes and depths whereas the key enzymes of the rTCA pathway were exclusively detected in anoxic/sulfidic zones and those of the HP/HB cycle mainly in the aphotic/(micro)oxic zone of deep lakes. The HP/HB cycle was associated with Thaumarchaeota and ε-proteobacteria werethe dominant group using the rTCA pathway. For predominant clades in the RubisCO-gene trees we designed specific rDNA-probes for CARD- and MAR-FISH to verify the presence and investigate the activity of the affiliated taxonomic groups in the respective environment at the single-cell level. Our future goals are: design of further specific probes for the identification of chemolithotrophic groups of interest, and finally the identification of key enzymes of the CO_2-fixation pathways together with the taxonomic characterization as single-cell approach.

FBFW 2015 – POSTER PRESENTATIONS

Invertebrates/Zooplankton

Genetic and ecological characterization of the invasive freshwater jellyfish *Craspedacusta sowerbii*

Katrin Schachtl, Sabine Gießler, Herwig Stibor

The introduction of the freshwater jellyfish Craspedacusta sowerbii from China created a new functional guild within freshwater plankton communities. In Germany, C. sowerbii is present since about 100 years and reported from at least 100 locations. It has a metagenetic life cycle, with benthic polyps (0.5 cm) and free-swimming medusae (2 cm). Medusae densities of 1000 ind/m2 were found, however with unknown significance for aquatic food web dynamics. As polyps release medusae above certain water temperatures only, global warming is expected to favour medusae abundance in previously too cold habitats. In field mesocosm experiments we will investigate the trophic position of jellyfish, cascading effects and pelagic-benthic fluxes dependent on jellyfish abundance. Preliminarily, we determined food selectivity, functional response and carbon assimilation of the carnivore jellyfish and the polyp in laboratory experiments. Moreover, jellyfish within populations are assumed to be unisexual and genetically identical suggesting the spread of only one or few clones. After using barcoding for species identification of medusae and polyps we will determine clonal diversity and the likelihood of multiple introductions by high-resolution microsatellite analysis. The combination of ecological and genetic approaches will allow a better understanding of the colonization history and will reveal cause and effect relationships within aquatic food webs exposed to invasion by non-native species.

Invertebrates/Zooplankton

Potential effects of microplastics on Daphnia magna

Saskia Rehse, Werner Kloas, Christiane Zarfl

Microplastic particles (MP, < 1 mm) are not only abundant in marine but also in freshwater ecosystems. While there is evidence that MP can cause adverse effects in marine organisms, not much is known about the fate and effects of MP in freshwater systems. Our aim is to systematically test the uptake and effects of MP on freshwater organisms. As a model organism for limnic zooplankton we exposed Daphnia magna to different types of MP using raw material (PE, 1 µm and 100 µm). Before exposing the daphnids the behaviour of the particles in water was characterized. The majority of 1 µm particles remained in the water column after vigorously shaking. In contrast, the 100 µm particles were floating back to the surface immediately. This led to different exposure scenarios. After exposure, the 1 µm particles were ingested by the daphnids and attached to the carapax. Ingestion and accumulation increased with higher concentrations. The 100 µm particles, in contrast, were neither ingested nor accumulated at the carapax. We conclude that different sizes of MP (1) lead to different behaviour in water followed by different exposure scenarios for organisms and (2) induce different effects, e.g. physical effects by accumulation on the carapax of daphnids. Attached particles might cause problems with molting and lead to differences e.g. in growth. Our results thus provide a first basis to systematically identify parameters of MP that determine adverse impacts on freshwater organisms.

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Invertebrates/Zooplankton

Testing and Adapting Casimir for Predicting Alpine Benthic Invertebrate Communities

Bernhard Wegscheider, I. Kopecki, L. Füreder

Ecohydraulic modeling has become a powerful tool in evaluating river systems. Whereas, up to now this approach has been used to model fish habitats or riparian vegetation, only a few studies have dealt with modeling of benthic invertebrate communities, despite their essential role they play in river ecosystems. As also available data are frequently based on investigations in lowland rivers, questions arise about different preferences of macroinvertebrates in mountainous systems. Here, we test the validity of the habitat modeling software CASiMiR to predict benthic invertebrate communities and their habitat conditions in an Alpine river. At the river Rom, South Tyrol, two hydromorphological contrasting stretches were selected for measuring hydrologic parameters in 10 transects. Benthic invertebrates were sampled in different habitats. Physical conditions were simulated with a hydrologic model, and linked with 1) generated (Rom specific) and 2) standard (database) preference curves in order to calculate habitat suitability classes for benthic invertebrates. The model results for both methods were tested for four target organisms by analyzing the weighted usable area (WUA) in the studied stretches. Statistic analyses revealed a significant difference between modeled standard preference functions and river specific preference functions of the target organisms. Thus the CASiMiR approach has been successfully tested as a suitable tool for predicting Alpine benthic invertebrate communities. Moreover, these findings suggest that habitat modeling of benthic invertebrates should be based on site specific measurements and preference functions of abiotic factors.

Invertebrates/Zooplankton

Protist community composition along an elevational gradient in Costa Rican bromeliads

Annika Busse, Marcia Andrea Adler Yanez, Jana S. Petermann

Climate warming, habitat fragmentation, environmental pollution and other anthropogenic stressors have been observed to affect ecosystems and their functions. Therefore, the ability to predict these changes will be of great importance for future conservation attempts. Naturally changing gradients of environmental variables are a popular approach to study this topic in the field. One of the best known opportunities is provided by elevational gradients. They are prevalently used in studies to assess changes in community compositions induced by, for example, changes in temperature. We conducted a field survey along three different mountainsides in Costa Rica to assess the community composition of protists (inter alia flagellates, ciliates, amoeba) living in the water-filled tanks of epiphytic bromeliads. Our aim was to investigate if a change in community composition occurred along the elevational gradient and to identify the relevant environmental variables that can cause such a shift in community composition. Within the scope of our field survey, water samples of bromeliads belonging to the genera Werauhia and Guzmania were taken during the wet season 2014 (May-August) along three different transects on inactive volcanoes in the Área de Conservación Guanacaste, Costa Rica. Altitudinal gradients ranged between 683 - 1906 m above sea level. Parameters measured included water temperature, dissolved oxygen concentration, pH, dry weight of detritus and light availability. Protists were preserved with Lugol solution and identified and counted under the microscope after the end of the field period. We found that temperature is the only environmental variables that significantly changes along the elevational gradient. However, preliminary results show that there is no change in protist community composition along the three studied transects. This indicates that the composition of protist communities is probably regulated by other factors such as predation pressure through insect larvae. Within the scope of our field work another study on aquatic insect community composition in bromeliads along an elevational gradient was carried out. Results from this other study will be used to gain further insight into the factors driving protist community structure.

FBFW 2015 – POSTER PRESENTATIONS

Fish

Same old, same young? – Is adaptive radiation measurable across different life stages?

Dominik Schmid, Blake Matthews, Rebecca Best, Jaime Mauricio Anaya-Rojas

The ability to detect, track, capture and assimilate food is of vital importance for the condition, growth, survival, and reproduction in any organism. Naturally, this is also true for fish. Furthermore, the foraging behavior of fish has important consequences for the structure, functionality and energy balance within ecosystems. However, most studies in foraging or community ecology, functional or evolutionary biology test their assumptions only on the adult life stage, although the selection pressure may change with age and potentially is strongest at the early life stage. My proposed study aims to assess the foraging ecology of juvenile stickleback, Gasterosteus aculeatus, from an allopatric community from Lake Constance in the light of evolutionary background and ecological interactions. Through this study we hope to find whether phenotypic and ecological differentiation within a rapidly diverging population of stickleback can be detected as early as in their juvenile life stage.

Fish

The electrified benthic frame trawl (EBFT) as a potential tool for sterlet (*Acipenser ruthenus*) sampling in large rivers – results from the Third Joint Danube Survey (JDS3)

Ágnes Irma György, András Weiperth, Zoltán Szalóky

Sterlet is one of the six sturgeon species that used to inhabit the River Danube and the only one still present with substantial stocks in the Upper and Middle Danube, but also facing increasing population decline due to overfishing and habitat loss. In Hungary, no field research has been done focusing on the natural populations of sterlets. Most of the available data are based on fishermen's and angler's catches which are highly unreliable and due to the lack of information on fishing effort, estimations are even more uncertain. Furthermore, River Danube is a large river and as such the standardised and representative sampling of fish is problematic. Until now the most comprehensive fish assessment method used is night time shoreline electrofishing and yet this method is not suitable for detecting sterlets. Drift nets while effective require thorough knowledge of the bottom structure and may cause harm in the fish. In 2010, we developed an electrified benthic frame trawl (EBFT) which due to its robust frame can overcome bottom structures and gives important complementary results on offshore benthic fish species. This method was adopted by the core team of the JDS3 in 2013, providing an opportunity of catching sterlets along the Danube. Data were collected parallel with shoreline electrofishing at 22 sites between rkm 2214 and rkm 15 (Sulina arm). The EBTF was successful in catching sterlets and confirmed its common occurrence in the Lower Danube, but no individuals were caught above the inflow of River Tisa, which suggests a very rare occurrence. To reveal the real status of sterlet populations more comprehensive, targeted surveys are needed in the Middle Danube and further development and optimisation possibilities of the EBTF may be also considered.

FBFW 2015 – POSTER PRESENTATIONS

Microbiology

The importance of the rare biosphere on bacterial diversity-functioning relationships

Jolien Scholten, Hannes Peter, Ruben Sommaruga

Bacterial communities are immensely diverse and are suspected to harbor many functionally redundant species. However, the links between diversity and function remain hard to predict. Bacterial communities typically harbor a few dominant and many rare taxa, which are referred to as the rare biosphere. Members of the rare biosphere are often in a dormant state and exhibit low metabolic activity, suggesting that these taxa do not contribute to community functioning. However, once environmental conditions become favorable, rare taxa can rapidly become active and contribute to community functioning. We present an experimental design which aims to better understand the role of the rare bacterial biosphere for community functioning. The main hypothesis is that abundant taxa perform the bulk of ecosystem function, but that dormant cells are important for future community functioning under altered environmental conditions. For this, bacterial communities will be sampled from three different lakes, located along an altitudinal gradient, which differ in DOC quality and quantity (Piburgersee, 915 m, Obernbergersee, 1590 m and Gossenköllesee, 2417 m). Using fluorescent properties of a DNA stain, bacteria will be classified as high- and low nucleic acid cells (H-NA and L-NA, respectively) and sorted by flow cytometry. In order to compare the functional potential of H-NA and L-NA cells under changing environmental context, we will inoculate sterilized lake water with H-NA and L-NA cells from the original and the other two lakes and measure using substrate utilization potential (biology EcoPlates). We predict that H-NA cells perform optimally under unchanged conditions, while the greater diversity will allow the L-NA population to better perform under altered environmental conditions.

Microbiology

Does disturbance history affect the resistance and resilience of bacterial communities?

Sophia Renes, Johanna Sjöstedt, Ingo Fetzer, Silke Langenheder

Bacterial communities play a central role in ecosystems and studying their resistance and resilience provides an important step towards predicting the response of ecosystems to environmental disturbances. Since natural communities undergo regular disturbances and incidences of extremes in environmental conditions, communities ‘accumulate’ a disturbance history over time. It is generally assumed that recurring disturbances increase resistance and resilience through selection processes, but on the other hand too many disturbances may result in more vulnerable communities and slow down recovery. Moreover, any change in resistance and resilience due to adaptation might be specific to the type of disturbance that caused the selection pressure, or confer a more general advantage in the face of a broad range of disturbances. Here we hypothesize that (a) resistance and resilience of bacterial communities increases over time when communities are exposed to recurring disturbances and (b) that communities with a history of frequent exposure to strong disturbances of one type, will be less sensitive and more resilient to a novel type of disturbance. In order to test these hypotheses, natural lake bacterioplankton communities were subjected to weekly temperature shocks of two different intensities for four weeks, and subsequently exposed to an acidification event. Throughout the experiment bacterial abundance and bacterial production were measured daily, whereas enzyme activities and bacterial community composition were determined every week. The results from this experiment will therefore show how functional as well as compositional resistance and resilience changes over time in response to changes in the disturbance regime.

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Microbiology

Geo-physical conditions and microbial lifestyles in stream ecosystems

Robert Niederdorfer, Tom J. Battin

Streams are highly heterogeneous ecosystems, both in space and time. Microorganisms adapt to different geo-physical conditions, resulting in distinct morphological and lifestyle adaptation strategies. High export rates and sheer forces on the streambed enforce the formation of biofilms, as this adaptation is more resilient under such conditions. Laminar flow regime supports biofilms as well as other microbial lifestyles, e.g., suspended aggregates or free-living bacteria. We tested effects of flow conditions on microbial communities in a mesocosm approach. Bench-top flumes (length: 2 m) were designed to accommodate turbulent, transitional and laminar conditions along a single flow continuum thereby ensuring the same inoculum and chemical environment. In these flumes, we grew phototrophic biofilms mimicking the benthic zone of a small stream. Rolling tanks simulating continuous vertical flux were used to grow suspended aggregates. We analyzed the architecture of biofilms and suspended aggregates in each of these hydraulic environments and established vertical oxygen profiles using microelectrodes. We expect our results to clarify if different flow conditions indeed control microbial lifestyle adaptions in stream ecosystems.

Cyanobacteria

Geneexpression studies on toxicity genes of *Microcystis aeruginosa* in response to environmental stressors

Pia Sharma

Microcystis aeruginosa is a potentially toxic cyanobacterium commonly found in freshwater reservoirs around the world. Many strains can produce the hepatotoxic secondary metabolite microcystin. Previous studies have demonstrated that the genes for the synthesis of this toxin are not constitutively expressed but are upregulated under various conditions. This study aims to shed further light on the factors that trigger the onset or upregulation of microcystin gene expression and therefore microcystin formation by exposing laboratory cultures to potentially stressful conditions that are thought to trigger toxic cyanobacteria blooms or that are likely to occur more often in the future due to global warming. Cyanobacteria bearing toxicity genes and belonging to different genera have been identified using PCR methods in several freshwater lakes in Bavaria. Bavarian freshwaters are intensely used for recreation, tourism, and fishery. Therefore it is of great interest to assess the risk of having to deal with more frequent toxic cyanobacterial blooms in the future.

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Cyanobacteria

Phytoplankton diversity in Bavarian lakes: Impact of trophic level and seasonal shifts

Franziska R. Bauer, Jürgen Geist, Katrin Zwirglmaier

In aquatic ecosystems cyanobacteria represent an important part of the phytoplankton and therefore play a major role in shaping the ecosystem. Cyanobacteria are a very diverse group – from useful oxygen producing picocyanobacteria to harmful bloom forming species. These different species are likely to be adapted to different environmental conditions and trophic levels. Furthermore, the community structure follows seasonal shifts during the year. The aim of the study was to determine the impact of different trophic levels and seasonal shifts on the community structure of cyanobacteria in lakes. The microbial diversity in four Bavarian lakes of different trophic level (lake Ostersee: oligo-mesotrophic, lake Ammersee: mesotrophic, lake Schliersee: mesotrophic and lake Bergknappweiher: eutrophic) was studied by Illumina MiSeq sequencing of the 16S rRNA gene. Using universal primers for bacteria it was furthermore possible to study not only cyanobacteria, but the whole bacterial community. This approach also provided an insight into the eukaryotic phytoplankton because the primers also amplified the 16S rRNA genes encoded on the chloroplast chromosome. To show seasonal fluctuations, the communities in spring (beginning of the phytoplankton growth period) and late summer (peak of cyanobacterial growth) were compared. We show that lakes of different trophic levels vary in their microbial diversity, which is also reflected in the community structures of cyanobacteria. The seasonal shifts in the community structure within each lake were more pronounced than the differences between lakes.

Cyanobacteria

Nitrogen uptake of Arthrospira fusiformis

Anna Gschwandner, Michael Schagerl, Dagmar Wöbken

East African soda lakes also known as flamingo lakes are amongst the most productive ecosystems worldwide. Driving force behind is the filamentous cyanoprokaryote Arthrospira fusiformis (formerly Spirulina platensis). Compared to phosphorus and carbon availability, the lakes show a tendency towards nitrogen limitation. How is Arthrospira supplied with nitrogen? We suppose that this taxon is able to fix molecular nitrogen although it does not develop heterocytes. We designed an experimental setup and cultivated nine strains of A. fusiformis originating from various lakes systems of East Africa under different conditions of nutrient and oxygen supply. Genetic analysis showed that all of them hold the nifH gene which is commonly used as a genetic marker for identifying nitrogen fixation. Further investigations revealed that six of these strains also express the nifH gene.

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Cyanobacteria

Microevolution of the Bioactive Peptide Anabaenopeptin in Cyanobacteria

Elisabeth Holzweber, Guntram Christiansen, Judith F. Blom, Jakob Pernthaler, Rainer Kurmayer

Bloom-forming cyanobacteria such as the genus *Planktothrix* sp. form a large number of bioactive peptides, e.g. the family of the Anabaenopeptins (AP) through nonribosomal peptide synthesis (NRPS).In total 140 *Planktothrix* strains, isolated from various climatic zones, were phylogenetically assigned into three major lineages that differed in ecosystem type colonization. We analyzed the distribution and recombinations of the AP synthesis gene cluster (*apn*) by polymerase chain reaction (PCR) and sequencing of certain PCR products. We found that the majority of strains of lineage 1, occurring in shallow lakes, carried specific *apn* remnants in parallel to the full gene cluster. The recombinations occurred within adenylation domains, resulting in rare structural variants of the peptides, as well as a fusion of part of the ABC transporter domain from another NRPS gene cluster. In contrast, strains of lineage 2, isolated from deep lakes, did not contain *apn* remnants but always contained the full gene cluster. Strains of lineage 3, isolated from tropical regions, did not carry any sequence related to *apn*. Overall evolutionary diversification of *apn* genes was congruent with ecological diversification. Because of the occurrence of *apn* remnants and recombination events within the *apn* in lineage 1 we hypothesize that its ancestor lost the *apn* genes but some of the genotypes regained it through horizontal transfer.

Phytoplankton

Effects of non-successful invaders (ghost species) on phytoplankton community dynamics

Felicitas Buchberger, Maria Stockenreiter, Herwig Stibor

Species invasion dynamics are a core topic in ecology and the effects of species invasions on ecosystems are well described. However, the knowledge about the mechanisms during the invasion process itself is limited. During the invasion many interaction between different species (invaders and resident species) occur and contribute to individual species abundance and therefore community composition. These interactions are driven by functional traits characteristically for each species and determine the outcome of a potential successful invasion. However, invaders are often unsuccessful, but even the interaction with the resident species may influence the species occurrence and therefore community composition. In theoretical invasion models of microbial food webs it was shown already that these unsuccessful invaders (so called ghost species) can have important effects on final community composition. To test empirically the effect of such ghost species on a resident community we conducted a mesocosm experiment in an oligotrophic freshwater pond. Results of this experiment show that ghost species, which are not established during an invasion process, can still play an important role in the development and dynamics of a resident community.

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Phytoplankton

Growth rates of Chrysophytes in dependence of light intensity and bacteria abundance

Claudia Pezzei, Robert Ptacnik, Sarah Lena Eggers

Mixotrophic algae have to maintain cell structures for photosynthesis and phagotrophic nutrition. Such a reduced efficiency could result in overall higher light requirement and/or lower maximum growth rates. In this study the growth rates of three different species, Poterioochromonas malhamensis, Ochromonas tuberculata and Dinobryon divergens, were studied under different light conditions. Algae were grown as monocultures in batch experiments on WC-medium. A clear tendency was found that mixotrophs exhibit lower maximum growth rates than photoautotrophic algae. Compared to the photoautotrophic species Asterionella formosa, D. divergens required more light. Glucose addition was used to trigger bacterial growth and resulted in higher growth rates of mixotrophic phytoplankton species. Effects of glucose addition at low light were species specific. It did not support growth of D. divergens under light limitation. Obviously D. divergens cannot supplement energy demands by phagotrophy. Knowing how dependent on light and bacteria a species is, can lead to predictions where in the water column it will find its ecological niche. Also assumptions can be made on how the algae will react when competing with other species, e.g. phototrophic phytoplankton.

Phytoplankton

FlowCAM – a novel method for analysing protist populations

Victoria Kremser, Peter Stadler, Thomas Weisse

Phytoplankton is of utmost importance for primary production and cycling of matter in the ocean and inland lakes. It is also a key component for assessing the biological quality status of water bodies according to the EU Water Framework Directive (WFD). So far, quantitative phytoplankton analyses include identification, enumeration and calculation of biovolumes of Lugol's iodine preserved water samples in sedimentation chambers with an inverted microscope (Utermöhl 1958). However, the Utermöhl technique causes cell loss and shrinkage upon fixation, which may lead to incorrect biovolume estimations. The Flow Cytometer And Microscope (FlowCAM) measures optical and fluorescence parameters of live and fixed samples. We use it to establish taxa specific libraries for oligotrophic alpine lakes (Mondsee and Irrsee). Comparisons with microscopic analyses show a lower discrimination of some taxa, but cell numbers were comparable and FlowCAM analyses were far less time consuming. Using FlowCAM, we also found changes in populations of *Cryptomonas* spp. during heavy rain events, with population numbers rising in general and more cells showing phycoerythrin-fluorescence after heavy rain events compared to previous measurements. It is our goal to establish a new time-saving method for analysing phytoplankton communities by combining FlowCAM, microscopy and flow-cytometry. We will focus on changes in protist communities during extreme weather events like heavy rain and heat-waves.

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Phytoplankton

Phytoplankton diversity in Alpine lakes – gradients along altitude and longitude

Theresa Lumpi, Karin Meisterl, Christian Preiler, Robert Ptacnik

Alpine lakes are important elements in the landscape. Being distinct systems, they are very suitable for testing the role of spatial factors versus local environment as predictor of community assembly. In context of the debate about dispersal limitation in microscopic organisms, we analyze phytoplankton diversity in the Alpine region. 59 lakes were sampled in Switzerland, Germany and Austria spanning a longitudinal distance of 650 km. Lakes ranged from oligotrophic to mesotrophic conditions, and were located from 400 to 1600 m above sea level. Our analysis shows that lake productivity is a dominant factor for phytoplankton community composition in those lakes. Moreover, multivariate analysis revealed longitude as an important geographic predictor. Altitude, on the other hand, did not contribute much to community composition though lakes spanned a 1000 m gradient in altitude.

Macrophytes

A Spectral Signature Database of Aquatic Plants for a bio-optical model inversion based on satellite data

Christine Fritz, Jürgen Geist, Thomas Schneider

In their role as long-term indicators, macrophytes have important functions in lake ecosystems by characterizing the trophic state of freshwater lakes. As required in the European Water Framework Directive, periodic monitoring cycles of aquatic plants are passed every three years. This monitoring is currently still based on in situ measurements. Due to presently observed high invasion dynamics for some submersed species, a higher monitoring frequency is required. The presented research deals with a subtask of an integral concept for a remote sensing based monitoring system for freshwater lakes. Combined growth and reflection models adapted from in situ data collections and bio-optical model inversion, derived from satellite data parameters, are components of this system. To collect the species-specific remote sensing reflectance of macrophytes, in situ mapping with a submersible RAMSES spectroradiometer were obtained in shallow water. Presently, spectral signatures of four macrophyte species from two study sites in southern Germany are integrated in the data base. A limiting factor for continuous measurement series throughout the vegetation period is the “cloudless sky” precondition. For signature retrieval an interpolation model was developed and two different interpolation methods of the statistic software R implemented. As result species-specific reflectance spectra (wavelengths from 400 to 700nm in 1nm intervals) for any specified day throughout the vegetation period can be generated for each of the four macrophyte species. The data base should be completed by other macrophytes species within the next years.

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Macrophytes

Lakes during climate change - How enhanced flooding changes light conditions and its' influence on macrophyte vegetation

Stephanie Rueegg, Markus Hoffmann, Uta Raeder

Climate change will affect precipitation on a global and local scale. The predictions indicate an increase of heavy rain and flood events in the future. Consequently, the input of sediments, nutrients and humic substances from catchment areas will increase and thereby considerably influence aquatic ecosystems. Each substance possesses different optical features that influences the light transmission in the water column. Especially the macrophyte vegetation, which is limited by light, will react sensitive on the altered environmental conditions. However, certain non-native and possibly invasive species are expected to cope better with the changed and /or unfavourable light conditions than the native macrophytes. This will affect the species composition as well as the assessment systems that are used for monitoring water quality. To predict the possible outcome a study was initiated to research the effects of altered light conditions on native and invasive macrophyte species. The goal of the study is to reveal potential invading macrophyte species and to determine possible shifts in species compositions of the submersed vegetation. Aquaria experiments (factorial designed) and field studies (enclosure/ vegetation surveys) are conducted to simulate and study changing environmental factors (light / temp.). Additionally, optical measurements (hyperspectral / multispectral data) supported by pigment analysis (HPLC / PAM) are used to characterize the experimental conditions (indoor and outdoor). Statistical analysis will be consulted for drawing coherences. Invasive neophytic species are expected to show faster growth and regeneration than native species under turbid water conditions. Those non-native species are expected to prevail under a “low light climate”, especially in lakes and lake sections where flooding is or will become more frequent. As a result, the EWFD (European Water Framework Directive) assessment systems might have to be adjusted to account for the light limitation, rather than the trophic state, as main limiting factor.

Telmata

Fungal consortia and its place in the food-web of dendrotelmata

Máté Vass, Magyar Donát, Judit Padisák

A number of terrestrial plants possess morphological structures for collecting and retaining water. These bodies of water (telmata) provide habitats for numerous organisms. According to their properties, these microhabitats are considered as temporary waters which are fascinating objects to study species adapted to living in highly variable environments. In our study, three dendrotelmata were examined over a year (2013-2014) to detect the succession of the fungal consortia and macroinvertebrates, and to reveal the place of fungi in the food-web of these micro-ecosystems. The dataset is still under analysis. The results of this study will be presented.

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Fish

Meta-analysis of cytogenomic and ecological features of ray-finned fishes (Actinopterygii) in a phylogenetic context

Vera Pircher, Viktoria Thöni, Constanze Zacherl, **Radka Symonova**

In mammals, it has been shown that some cytogenetic traits might correlate with the rate of evolution and with ecological traits (Qumsiyeh, 1994). In fishes, such analyses were not routinely performed because of the general lack of data. However, the first attempts limited to several groups appeared during the last 15 years. We have utilized existing data (and in the meanwhile newly available data since the last study) on chromosome and chromosome arms numbers, karyotypes, genome sizes and basic ecological features (specialists vs. generalists) in the group Protacanthopterygii (Teleostei). This group involves freshwater as well as marine species, and our study thus extends the work by Phillips and Rab (2001) focused on salmonids. Our preliminary results indicate that 1/ graylings (*Thymallus* sp.) are a perspective and so far kind of neglected group for further cytogenomic investigations because of opposing trends identified between their genome size and their chromosome number; 2/ the highly specialized group Stomiiformes (deep-sea ray-finned fishes) verifies Qumsiyeh´s hypothesis in another fish group since Phillips and Rab (2001), and 3/ the approach of meta-analysis is a relevant and perspective tool to be explored and extended to the whole group of ray-finned fishes. This study was performed by Bachelor students as a seminar work in the framework of the “Genome Evolution” course at the University of Innsbruck (9. 2. - 20. 2. 2015).

Aquaculture

Effluent Treatment of a Flow-through Fish Production System by Constructed Westlands in Hungary

Flórián Tóth, Zoltán Nagy, László Berzi-Nagy, Dénes Gál, Éva Kerepeczki

The aquaculture is the fastest growing animal husbandry sector in the world. The expansion of the fish production can cause increased load to the environment. To mitigate nutrient discharge into the natural recipient water body a pilot-scale constructed surface-flow wetland system was built at the NARIC HAKI (Szarvas, Hungary) in 2000. The studied system consists of two stabilisation ponds and two macrophyte ponds (total area: 1 ha), where the total discharged effluent (approx. 220 000 m3) of an intensive, flow-through African catfish (Clarias gariepinus) production plant was treated. Samples were taken from the water column of all four units and from the effluent of the catfish production system monthly in 2014. The main water chemistry parameters and concentrations of the nutrient compounds were analysed to determine the treatment efficiency of the constructed wetland system. Regarding the nutrient masses 1.28 kg/m2 of organic matter, 0.25 kg/m2 nitrogen and 0.02 kg/m2 phosphorus was retained annualy by the wetland system, which counts as 90, 40, 32 % OM, N, P decrease, respectively. The results on nutrient removal of the investigated system can be adopted to other intensive fish production plants to decrease the nutrient content of the effluents.

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Aquaculture

Effects of plant-based fish diets on the water quality in a pond experiment

László Berzi-Nagy, Flórián Tóth, Zsuzsanna Jakabné Sándor, Zoltán Nagy, Dénes Gál, Éva Kerepeczki

In project ARRAINA (Advanced Research Initiatives for Nutrition & Aquaculture, EU FP7) carp broodstock was reared on three different feed types (FB: fish meal and fish oil, VB: plant meal and plant oil, CT: winter wheat with low polyunsaturated fatty acids content) using a total of 6 ponds (2 for every feed type). The research continued on their offspring, which were fed with same diet as their parents respectively. According to our previous results the plant based feed substitution does not inhibit the growth parameters of the carp offspring. In this study, conducted in 2013 and 2014 we compared water quality parameters between the ponds of different food types in order to clarify if any significant changes can be detected due to the plant based feed. The VB ponds were more prone to high algal activity in 2013. However these differences seemed to fade away in 2014 when besides VB ponds having similar high COD (chemical oxygen demand) values as FB ponds, the produced parameters of all the three treatment units were seemingly alike in water quality. All in all it seems that the experimental plant based fish feed compared to the fish based and cereal based feed types, did not cause significant detrimental changes in water quality in our experiment to the end of 2014. The plant based feeds might serve as suitable and sustainable substituents for fish based feed types.

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