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ABSTRACT BOOK

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SIL

THE NEXT 100 YEARS:
SENSING AND SAFEGUARDING INLAND WATERS

CONTENT

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ORAL ONSITE

ON156

Spatiotemporal dynamics of dissolved organic matter reactivity and drinking water treatability in a Swedish great lake

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Freshwater ecosystems are critical resources for drinking water. In recent years, dissolved organic matter (DOM) inputs into aquatic systems have increased significantly, particularly in the Nordic countries, due to climatic and anthropogenic drivers. The associated increase in dissolved organic carbon (DOC) concentration can decrease water quality and adversely affect drinking water treatment processes. In this study, we examined spatial and temporal patterns of DOM treatability and biological reactivity at 11 sites across Mälaren during six time points between July 2019 and February 2021. Mälaren is the third largest lake in Sweden and provides drinking water for over 2 million people including Stockholm. We investigated long term monitoring trends in nutrient levels, cation/anion concentration, algal abundance, and water discharge. Variations in DOM composition was characterized using optical measurements and Orbitrap mass spectrometry. We examined DOM treatability with granular activated carbon (GAC) as an adsorbent and measured bacterial respiration using dissolved oxygen concentrations. Results from multivariate statistical analyses suggest that temporal variability in DOM composition is greater than spatial variability, which shows a clear separation between colder and warmer months. Results from mass spectrometry and optical measurements indicate that DOM removal efficiency by GAC is higher in less aromatic aquatically produced DOM.These findings help to advance our understanding of spatiotemporal dynamics of organic matter composition in freshwaters and use such information to improve our ability to predict DOM reactivity and treatability.

ON446

Salinity affects freshwater invertebrate traits

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The projections of the International Panel on Climate Changes foresee scenarios of sea level rise and extreme weather events, resulting in the intrusion of coastal ecosystems by seawater. We evaluated the effect of seawater intrusion on the invertebrate communities in six outdoor freshwater mesocosms containing fauna and flora, to which increasing volumes of seawater were added. The resulting salinity values were 0.28 (control, freshwater only), 2.0, 3.3, 5.5, 9.3 and 15.3 mS cm^{-1}. The invertebrate communities were sampled two times before and six times (during 65 days) after seawater intrusion. The effect of salinity was assessed by computing the deviation of values in each treatment in relation to the control. We conclude that seawater intrusion into freshwaters will affect the invertebrate communities. There was a net negative effect of the intermediate salinity levels on abundance and richness. Invertebrate life cycle traits conferring resilience and resistance tended to increase with low and to decrease with high salinity values, while avoidance traits showed an opposite trend, and these responses were more pronounced on the later stage community. These wave-like responses of the invertebrate species traits to increasing salinity suggest that the life-history and physiological adaptations most suitable to cope with osmotic stress will differ between low and high salinity levels.

ON230

The conflict between the positive diversity-functioning and the positive dominance-functioning relationships in natural phytoplankton communities

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Mounting empirical evidence suggests that both diversity (BEF) and dominance enhance resource use efficiency (RUE), an ecosystem functioning measure, in phytoplankton. As dominance is associated with competitive exclusion and biodiversity loss, the positive dominance-functioning relationship conflicts with the positive biodiversity-functioning relationship. Recent research implies that the BEF relationship is not necessarily positive in field data (i.e. in realised diversity) and it should rather be understood in the context of community assembly from a species pool. Here we evaluate a large-scale phytoplankton data set from Fennoscandia, which covers a natural diversity gradient: from low diversity in Norway to high diversity in Finland. Our data confirm that phytoplankton RUE scales positively with both richness and dominance, in all individual subsets along the E-W natural diversity gradient but also the pooled data. Further analysis of Swedish lakes with seasonal resolution suggests that the diversity effect weakens, while the dominance effect strengthens in predicting RUE when moving from spring to summer. Our findings suggest that considering community assembly including competitive exclusion is a key to understand the positive relationships of diversity and dominance with RUE. Finally, we argue that one way to unlock the conflict is to identify phytoplankton taxa that are rather associated with community dominance (active members), while others that are rather associated with diversity (non-active members).

ON330

Can POC increase reactive nutrient uptake by stream biofilms? – a laboratory experiment

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Many agricultural streams are organic carbon (OC)-limited; thus microbial nutrient uptake is stoichiometrically constrained in such streams. A stoichiometric shift towards a higher availability of natural OC could improve the nutrient uptake capacity of agricultural streams. Our study aimed at analyzing the effects of particulate organic carbon (POC) on the uptake of reactive inorganic phosphorus (P) and nitrogen (N) by dark- and light-grown biofilms. In the flumes, sand was colonized under nutrient-enriched conditions, both optimum C:N:P ratios, and C limited, under dark and light conditions. Undisturbed samples were incubated in nutrient-enriched water with fresh and leached leaves. Nutrient uptake rates were determined by changes in water column nutrient concentrations over time. A primary leaching effect was observed from leaves indicating they were a source of nutrients. Dark-grown biofilms stimulated the uptake of P and N after the addition of leaves, resulting in coupling of C:P and C:N with increased supply of POC. The effects of increased POC supply were stronger for P uptake from dark-grown biofilms under optimal C:N:P conditions than those grown under C-limited conditions. In addition, fresh leaves had stronger effect than leached ones. The light-grown biofilms, regardless of pre-conditioning or treated with different POC intensity, did not stimulate P and N uptake. This indicates that there is no coupling of C:P and C:N in autotrophic biofilms, presumably because of algal induced negative priming. Overall, our experimental study shows that increases in supply of POC have the potential to boost heterotrophic activity and nutrient processing in streams.

ON044

Zooplankton body size changes in a warming experiment spanning a large thermal gradient

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The projected impacts of the fast-increasing global warming on aquatic food webs are primarily expected to manifest with a change in the organism's body size-spectra (the relationship between abundance and size) (Woodward et al. 2010). Body size is the most influential trait in structuring interspecific variability in metabolic rates (such as respiration and reproduction) and is therefore a fundamental variable and a "master trait" in food web ecology (Woodward et al. 2005). It has been suggested that rising temperatures might shift the size spectrum in aquatic communities towards a prevalence of smaller organisms, both within and across species, as large individuals are lost (e.g., Petchey et al. 1999). However, very little is known about this, since the available techniques are either outdated and slow, or have not yet advanced to the level where they can give us important trait information (Jackson et al. 2016b). In this experiment, high-throughput flow microscopy is used to rapidly characterise zooplankton body size and abundance in freshwater ecosystems (i.e., mesocosms) subject to experimentally manipulated temperature stressor scenarios (from +1˚C to +8˚C temperature increase). Because zooplankton are ectotherms, their metabolic rates and the ecosystem processes they underpin will be largely driven by their body size and the temperature of their environment. The large amount of data rapidly generated with the flow cytometry technique allow to make general predictions about how global warming will affect food webs in terms of shift in body size spectra and specie richness.

ON118

Pesticide exposure affects community dynamics in zooplankton strengthening dominance patterns

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Pesticides can impact the dynamics of natural communities. However, competition among species and how it relates to inter- and intraspecific variation in pesticide sensitivity is rarely considered in ecotoxicological studies. We used a mesocosm experiment to assess the effect of pesticide (chlorpyrifos) exposure on the relative abundances of cladoceran species, to what extent intraspecific genetic variation contributes to differential community responses, and whether community responses affect phytoplankton biomass. We exposed 5 zooplankton communities, composed of different clonal lineages of 4 cladoceran species (*Daphnia magna, D. pulicaria*, *D. galeata* and *Scapholeberis mucronata)* to increasing levels of chlorpyrifos or to control conditions. Pesticide exposure negatively affected abundances of all species, but also resulted in changed relative abundances. Chlorpyrifos differentially impacted the fastest growing *Daphnia* species, first leading to a reduction in the abundance of *D. galeata* to the benefit of *D. pulex*, and subsequently to a reduction in densities of *D. pulex* to the benefit of *D. magna.* This resulted in a dominance of *D. magna* by the end of the experiment, even more in the chlorpyrifos treatment than in the control treatment. Differences in genetic composition did not lead to different responses of the communities. We observed a temporarily increased phytoplankton concentration in the chlorpyrifos treatment, likely linked to a reduced top-down control on phytoplankton in the pesticide treatment. Our results emphasize that in this study system there is no trade-off between pesticide sensitivity and competitive strength. Our results also show that pesticide exposure affects ecosystem features such as algal densities.

ON209

Integration of space-borne Thermal and Synthetic Aperture Radar data with atmospheric and hydrodynamic models for mapping and monitoring lake surface dynamics

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In the last decades, satellite-based remote sensing has been widely used to monitor lake water surfaces thanks to its synoptic (and global) coverage, increasingly fine spatial resolution and repeated regular sampling. Most consolidated lake applications exploit visible and infrared wave band sensors to map water quality parameters, while quantitative information on wind and water velocity in lakes has been so far obtained only through sparse in-situ measurements and numerical models. In marine and coastal environments, however, Synthetic Aperture Radars (SAR) are used for the retrieval of spatially resolved information on wind, waves and water currents at the water surface. In this contribution we present the results of a feasibility study on Lake Garda, Italy, where space-borne thermal and SAR data are combined with numerical models for retrieving fields of wind speed and lake surface velocity. Thermal maps are first used to validate the hydrodynamic model and to extract qualitative information on the horizontal and vertical exchanges of water. SAR images of the test site from C-Band sensors are then processed to obtain Doppler Anomaly and backscatter amplitude maps. The first is used to obtain maps of the ground radial component of the flow velocity, the second to extract wind fields over the lake surface. The results of atmospheric and hydrodynamic models previously validated for the case study are used to interpret the SAR-derived maps and to understand the limits and potentialities of Earth Observation (EO)-based methods for the quantitative estimation of surface currents and wind speed in lakes.

ON301

Impacts of salinization on shallow lakes: synchronized long-term gradient mesocosm experiments in two different climates, Turkey

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To understand the effects of salinization on shallow lakes, we are performing two parallel long-term mesocosm experiments (September-2021 to May-2022), with 16 different salinities (0-50 g/L), in two places with different climate conditions in Turkey (Ankara, mean temperature: 12.6˚C; and Mersin, mean temperature: 20.1˚C). The experiments were divided into three periods: increasing (30 days), stable (six months), and decreasing (40 days) salinity. The physicochemical data were analysed using two-way ANOVA and generalized additive models to test the effects of salinity and climate. The water temperature was 5-10˚C higher in Mersin (23.6˚C) than in Ankara (15.8˚C). During the stable period, the mesocosms in Mersin showed significantly higher concentrations of total phosphorus, nitrate-nitrite, total nitrogen, chlorophyll-a, and suspended solids, while the mesocosms in Ankara showed higher oxygen saturation, pH, alkalinity, and transparency. In both places, salinization increased the total phosphorus, soluble reactive phosphorus, chlorophyll-a, alkalinity, and suspended solids, usually being more pronounced at

salinities >20 g/L. Furthermore, the concentrations of nitrate-nitrite and total nitrogen decreased, and pH increased, between salinities of 0-10 g/L in Ankara, and 0-20 g/L in Mersin, respectively. The salinization significantly decreased the oxygen in Mersin, while it increased at intermediate salinities in Ankara (10-30 g/L). Furthermore, water transparency decreased linearly in response to salinity in Ankara, while it was not affected in Mersin. Accordingly, these results highlight that salinization significantly impacts water quality, being also affected by temperature and climate. We further found negative effects on biodiversity, ecosystem metabolism, and thus, ecosystem functioning.

ON382

Urban greenhouse-gas dynamics: A 3D-printed autonomously operating floating chamber for high-frequency measurements of CO2 and CH4 emissions from freshwaters

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Urban freshwaters provide environmental conditions that favour high rates of microbial CO2 and CH4 production. When released from freshwaters, these greenhouse gases (GHG) impact global climate, particularly since urbanisation trends worldwide subject an increasing proportion of freshwater bodies to these conditions. Despite this, few studies have investigated GHG emissions from urban freshwaters, partly because representative sampling in heterogeneous urban areas involves particular challenges. In addition, measurement techniques available to date limit the data resolution, making GHG budget estimations imprecise. This study developed and piloted a 3D-printed low-cost floating chamber capable of measuring GHG fluxes at temporal resolutions unattainable through traditional chamber methods. The design is highly repeatable, requiring little engineering experience, while being versatile, operating with low-cost CO2 and CH4 sensors (ACS) or Cavity-RingDown-Spectroscopy (CRDS). The technique thus enables high-frequency GHG flux measurements in urban environments, where frequently lost sampling equipment must be replaceable and low investment, whilst remaining mobile and relatively inconspicuous. The technology was proven across seven ponds in the city of Berlin, Germany, throughout February 2022. Duplicate GHG flux measurements were made at half hour intervals across 24 hours per site, pairing one ACS to one CRDS analyser. Additionally, a suite of physico-chemical drivers was measured. Results demonstrate the robustness and effectiveness of the chambers, capturing a 24-hour GHG flux timeseries at a resolution previously unattainable. From these detailed time series, GHG dynamics proved spatially heterogenous, being pond specific, but also temporally variable over the diel cycle, to some extent, depending on environmental drivers.

ON114

Long-term ecological research on the exceptional dominance of heterotrophic flagellates in the plankton of the River Rhine (Cologne)(LTER REES)

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Knowledge of the long-term dynamics of protists in riverine ecosystems, as well as their relationship to hydrology, temperature, phytoplankton, and other drivers that may affect their dynamics, is essential for predicting long-term changes in the future. Protozooplankton is an important component of river systems but is rarely studied over a long period of time. Here we report data from a 20-year study on abundance, community structure, and morphological and molecular diversity. At the River Rhine at Cologne we focused on heterotrophic flagellates and long-term changes in community structure and altered functions for the river system. In contrast to most other studies considering planktonic protists in large rivers, the biovolume of plankton (excluding bacteria and algae) is dominated by flagellated protists, which far exceed the biovolume of ciliates and metazooplankton. Heterotrophic flagellates generally peak in April and decrease dramatically in summer and fall. However, there are significant changes in seasonal and annual patterns. Most important are chrysomonads, bicosoecids, choanoflagellates, and kinetoplastids among a large variety of other taxonomic groups. The reason for the overwhelming importance of heterotrophic flagellates within the plankton community lies mainly in man-made changes of the river system. Their relationship to the effects of unnaturally high current velocities, the importance of grazing by invasive clams, the retention effect of biofilms on the plankton community, and the influence of long-term trends in other environmental parameters are considered.

ON012

Oxygen-dependent phosphorus dynamics on short and long time scales for a eutrophic cascade reservoir system

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Under the pressures of global warming the pressure on surface waters for irrigation, drinking water and recreation will increase. Reservoirs play a vital role in satisfying these (ecosystem) needs. A great risk to sustainable reservoir use, exacerbated by climate change, are however prolonged droughts, extreme rainfall, harmful algae blooms, temperature increase and increased deoxygenation. The Franconian lake district was constructed for water storage and is a set of reservoirs with different depths, morphologies and trophic states. Monitoring data from 2000 to 2020 showed climate change effects on temperature and oxygen concentrations as well as heightened phosphorus concentrations. A phosphorus balance was employed to investigate the role of the sediment in long-term P-burial. The nature of this burial was cross-checked by performing sequential extraction of phosphorus on intact sediment cores in combination with lead dating. Short-term, seasonal, P-release under anoxic conditions was examined by the anoxic incubation of intact cores from the different lakes. The shallow hypertrophic basin exhibited a release of 22±5 mg $Pm^{-2}d^{-1}$ and the deep eutrophic basin a release of 48±12 mg $Pm^{-2}d^{-1}$. Interestingly, P-release was not coupled to iron-release for the shallow basin, but, for the deep basin it was, indicating a different release mechanism. Lake-sediment sequential extraction results were similar and therefore do not hold great predictive power for the release mechanisms nor rates observed. Man-induced temperature increase will likely increase sediment release rates and internal-loading severity.

ON072

Small-scale heterogeneity of diel carbon dioxide patterns and the consequences for estimating emissions in pre-alpine streams

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Streams, especially headwater streams, emit a large fraction of the carbon they receive as carbon dioxide (CO_2) to the atmosphere. The partial pressure of CO_2 (pCO_2) in and emissions from streams can show diel patterns. These diel patterns were shown to vary between seasons and different streams, but so far not much is known about the diel variability of pCO_2 in the water and air within short distances inside streams, their drivers, and how this affects the calculations of CO_2 emissions from streams. To fill these gaps, we measured the diel pCO_2 and oxygen (O_2) variability in five pre-alpine headwater streams. Inside each stream, we equipped three sites in close proximity (~1 km) with automatic logging stations and measured pCO_2 and O_2 (water) and pCO_2 (air) in five-minute intervals for two to four days. All five streams and their sites showed diel changes in water and air pCO_2, however, with differences in the level and diel amplitude of water and air pCO_2 between nearby sites, leading to variable areal daily CO_2 fluxes at the air-water interface from -1.48 to 0.75 mmol m^{-2} d^{-1}. Drivers of these changes across all sites were gas exchange velocity and ecosystem respiration. Our results suggest that local physical and biological drivers might vary on small spatial scales, which causes a high heterogeneity in CO_2 fluxes in pre-alpine headwater streams. This small-sale spatiotemporal heterogeneity of CO_2 dynamics in pre-alpine headwater streams should be considered to accurately estimate the amount of CO_2 emitted from these ecosystems.

ON248

Effect of warming and nutrient enrichment on nitrous oxide emissions from shallow lakes mesocosms

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Fresh waters, in particular shallow lakes, are key hot spot for nitrogen processing. However, nitrogen transformation processes such as nitrification and denitrification may release nitrous oxide to the atmosphere. Nitrous oxide is a strong greenhouse gas and ozone depleting substance and therefore its emission is of environmental concern.
Warming and nutrient enrichment may increase nitrous oxide emissions due to increased nitrogen supply and boosting of temperature dependent processes. Warming and nutrient enrichment may also affect nitrous oxide emission by affecting the biological structure and interactions in shallow lakes as these ecosystems may shift from clear water, plant dominated lakes to turbid and algae dominated lakes.
Here, we take advantage of the longest-running warming and eutrophication shallow lake mesocosms experiment worldwide, running since August 2003 to study the effect of warming and nutrient enrichment on nitrous oxide emissions from shallow lakes mesocosm. The experiment consists in 24 mesocosms divided in two nutrient treatments, (low and high nutrient) and three warming treatments (ambient, +2–3°C, +4–5°C). Nitrous oxide concentration (used as a proxy for emissions) were measured monthly over three different years between March 2011 and March 2020.
Overall, nitrous oxide concentration varied greatly across and within treatments and our preliminary results showed that nitrous oxide concentration was significantly higher in the enriched mesocosms while the effect of the temperature treatment was not significant.

ON292

Century-scale carbon burial trends from over 100 temperate and boreal lakes in Canada

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In the context of global changes, carbon (C) burial in lake sediments is no exception and is altered by these changes. Indeed, we have increasing evidence that C burial rates may have increased over the last few decades. Yet, the number of studies that have assessed this temporal variation is still modest and the datasets often remain scattered. Moreover, it is still poorly understood what aspects of the burial process are involved in this pattern of increase : 1) shifts in the sedimentation rates; 2) changes in the composition of sedimented material; 3) changes in the post-deposition organic matter processing. Here we present a large-scale empirical study to explore potential shifts in lake C burial rates and drivers of change, including lake morphometry, trophic status and watershed properties. The pan Canadian LakePulse survey provides us a unique opportunity to achieve our goals, since we have been able to derive C burial rates for a subset of 112 lakes for which sediment cores have been collected out of the 680 initially sampled, spanning 11 ecozones across Canada. The sediment cores were dated based on ^{210}Pb profiles assuming a constant rate of supply, and C and N burial rates were calculated from the resulting of sediment mass accumulation rates combined with organic or inorganic C and N profiles. Our preliminary results suggest a clear increase of the C burial rates induced by the surge of sedimentation rates. These results suggest that increases differ in relative magnitude both across lakes and among ecozones.

ON275

Microplastic Quantification in Nissan and Lagan River Systems in Shore and Bottom Sediments

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Jakobs sjö, an electricity dam of the Nissan River system (Southwest Sweden) is contaminated with large microplastics sedimented out at its shores. In 2021 a field survey of microplastics was carried out in the Nissan River with the Lagan River as reference. We sampled three locations in each river (upstream, lake/dam and downstream). Four replicate bottom and shore sediment samples were taken at each location. Dried samples were fractionated into three size categories (> 2 mm; 2 – 0.9 mm; 0.9 – 0.55 mm) and microplastics per area and weight were estimated. We found a higher concentration of large shore microplastics in Jacobs sjö and downstream from it than upstream in the Nissan River. We found no large shore microplastics in the Lagan River system. Smaller size fractions of microplastics were omnipresent in shore and bottom sediments of both rivers. However, the smallest size category tended to be proportionately more dominant at upstream than at downstream locations. This could be explained by biofilm-microplastic floc formation and sedimentation as particles travel downstream. Concentrations of toxicants such as heavy metals can increase thousandfold on the surface of microplastics and since the five heavy metals most likely to sorb to microplastics in a freshwater environment (Cd, Cu, Ni, Pb and Zn) were all present in Jacobs sjö, we conclude that the high concentrations of microplastics in Jacobs sjö may pose a threat to aquatic life.

ON394

Morphological defenses of *Daphnia* species within the *Daphnia longispina* species complex to coexisting invertebrate predators

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Induced anti-predator defenses are a common and widespread response among plants and animals to predators. Although single predator-prey induced plasticity has thus far thoroughly studied, differences in morphological defense traits within the species of the *Daphnia longispina* species complex in a multi-predator context have not been analysed. Here, using a common garden experiment, we studied the morphological responses of three species (*Daphnia cucullata, Daphnia galeata,*and*Daphnia longispina)*within the *D. longispina*species complex to two co-occurring predators, *Bythotrephes longimanus* and *Leptodora kindtii,*in a deep peri-Alpine lake. We used linear mixed-effect models to compare various response traits between treatments for the two predators. Results show that that the responses of *Daphnia* were species-, predator-, and trait-specific. At the end of the experiment (after 10 days), only *D. galeata,*but not the other two species, was larger in both predator treatments compared to the control.In contrast, morphological defenses were observed for two*Daphnia species, D. galeata*and*D. cucullata,*but not for*D. longispina.*Furthermore,*D. galeata*and*D. cucullata*differed in the magnitude of the response to both predators: for*D. galeata,*helmet induction differed strongly between the two predators, whereas for *D. cucullata,*differences between predators were not significant. Likewise, only *D. galeata*, showed longer spines in both predator treatments. These differences in inducible defenses may have then important implications for the coexistence of the three species in the presence of *Bythotrephes* and *Leptodora*.

ON232

Trends in limnological research in world's drylands: a scientometric review

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Rainfall reduction is expected in dryland regions over the next few years, influencing hydrological regimes and, consequently, the resilience and dynamics of aquatic biological communities. Occupying approximately 50% of the Earth's surface, dryland zones harbor 2 billion people, which are limited by water scarcity. Accordingly, in this study, we present an overview of studies on aquatic ecology in drylands, aiming to identify research gaps and current conservation status. Our results indicate that most studies were developed in countries with higher Gross Domestic Product - GDP, showing the impact of economic inequality also on research development across dryland zones. Considering the relevance of the water resources to economic development and the high vulnerability to climate change and human pressures, studies in aquatic ecosystems in dryland zones have been historically neglected. This underestimation negatively impacts the conservation strategies for aquatic ecosystems, resilience building, and mitigation of the negative impacts of overpopulation under different climate change scenarios.

ON350

Studying the long-term dynamic of freshwater ecosystems through sedimentary DNA research: a potential tool for management and conservation

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The sedimentary DNA approach is rapidly evolving, opening new avenues to the field of aquatic ecology and paleoecology. In the context of freshwater habitats, molecular archives have allowed us to give a broad perspective about biological change, and new insights into ecosystem functioning, food-web dynamics and biodiversity of aquatic ecosystems over long time scales (i.e. centennial to millennial). Moreover, sedimentary DNA-based methods represent innovative ways towards the reconstruction of full trophic networks. This presentation will be a brief introduction of this session. Through the use of examples, we will provide an overview of the research conducted in the field to demonstrate how the approach can help improve our understanding of the long-term dynamics of freshwater habitats in a complex multi-stressor world (e.g. eutrophication, invasive species, catchment alteration), to help improve freshwater management and conservation.

ON459

Summary of the workshop: „Limnology at the crossroads: its role in freshwater conservation and management?"

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The field of limnology is multidisciplinary in essence. Thanks to this multidisciplinary dimension, limnological studies have been able to tackle complex and pressing ecological questions related to the growing environmental and human pressures on freshwater ecosystems. From improving our understanding on the extent and cause of environmental stressors to finding solutions to mitigate the impact of these stressors, limnologists have helped to improve our understanding and stewardship of inland waters. A workshop untitled "*Limnology at the crossroads: its role in freshwater conservation and management?"*was held at the beginning of the congress (Sunday Aug 7th) to discuss how we can improve our communication to demonstrate the role of limnology in tackling important inland management and conservation issues. We also explored how limnologists can build on strategies to raise awareness around inland water conservation and management partly through the inspiration of successful stories from the field of oceanography and limnology. In this presentation, we will be presenting a summary of our discussion and outcomes of our workshop.

ON138

The FlowCam Cyano: A Rapid Detection and Screening Tool for Algae Monitoring Programs

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Various technologies utilize fluorescence measurements to detect cyanobacteria and estimate biovolume or cell counts within a water system.While useful in trending applications, results from these instruments can be significantly skewed by turbidity and the presence of other fluorescing pigments, and little if any taxonomic information can be obtained. Instruments like the FlowCam by Yokogawa Fluid Imaging Technologies can detect the presence of the phycocyanin pigment in cyanobacteria and combine fluorescence detection with imaging technology to enable organism identification, biovolume calculation, growth rate monitoring, population health, and many other population-specific dynamics.In addition to detecting phycocyanin, the instrument is also able to detect and characterize chlorophyll, allowing for one instrument to be used in the detection, monitoring and identification of all microalgae.Here we present an overview of the technology along with field data and various case studies.

ON441

The effect of forest management and connectivity loss on water-filled tree hole communities

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Small aquatic habitats are becoming increasingly threatened by climate change and habitat degradation. In forests, water-filled tree holes are unique habitats that harbour aquatic communities and may provide refuge for aquatic microbes and invertebrates. However, our current knowledge of such communities is limited. Therefore, this study aims to explore the community composition of water-filled tree holes and to understand the effect of forest management and connectivity loss on these communities. We carried out an experiment repeated in three countries across Europe (Hungary, Austria, and the United Kingdom), at highly comparable sites. In total 120 water-filled microcosms were set up at the three locations, in a 2x2 factorial design: natural or non-native plantation forest; connected or non-connected. Connectivity was achieved by mixing 10% of the water between the 10 microcosms biweekly, while non-connected sites did not receive the treatment. After three months, the experiment was terminated and various physical and chemical parameters were measured. The community composition of prokaryotes and microeukaryotes was determined using 16S and 18S rRNA gene amplicon sequencing, while macroinvertebrates were counted and identified to the lowest taxonomic level possible. Community composition and diversity differed significantly between all treatments, while forest type was more determining than connectivity. Our results have important implications for forest management that have overarching effects on the often neglected small aquatic habitats hosted in forests.

ON312

New insights into Danube's macroinvertebrate communities from DNA metabarcoding as part of the Joint Danube Survey 4 (JDS4)

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The Joint Danube Survey (JDS) is a multinational effort in monitoring the Danube's water quality, which provides a unique opportunity to collect comprehensive data on both abiotic parameters and organisms. As one biological key element in JDS, macroinvertebrates are monitored as indicators for various environmental conditions. However, due to their diverse taxonomic composition, associated difficulties with their morphology-based identification and their sheer abundance, macroinvertebrates are often analyzed with a low taxonomic resolution (i.e., above species level). As an alternative, DNA metabarcoding offers a promising approach to capture this species diversity more accurately. Here, we used DNA metabarcoding to investigate the macrozoobenthic diversity of 46 sites from the latest JDS sampling campaign in 2019. DNA was extracted from collected water samples, bulk sample fixatives and complete organisms, subsequently amplified and sequenced, and the obtained sequences compared to reference databases for taxonomic assignment. Over 1000 Molecular Operational Taxonomic Units (MOTUs) and over 350 assigned species were detected, of which Insecta showed the highest taxonomic richness. In particular for Chironomidae and Oligochaeta but also meiofauna taxa (e.g., Branchiopoda, Copepoda), DNA metabarcoding identified a large number of species undetected by morphology. For instance, this includes the detection of *Nais stolci* (Oligochaeta) with increasing occupancy from the upper to lower Danubian reaches or the invasive decapod *Pacifastacus leniusculus*in the upper reach. DNA-based identification in the context of the Joint Danube Survey offers to complement the knowledge on Danube's macroinvertebrate communities, which can be relevant for future monitoring as well as protection and restoration efforts.

ON115

Using functional diversity components to describe phytoplankton community assemblage processes in Turkish shallow lakes

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The recent increase in biodiversity loss due to varies antropogenic effects make it crucial to understand the relationship between biodiversity and ecosystem functioning (BEF) for the conservation and preservation of the ecosystems. Classically, BEF studies used species diversity as a measure of biodiversity, however, functional diversity may have some advances in explaining and predicting ecosystem-level processes. Species coexistence and community assembly are of main interests of ecology since the early days of ecological research, but the mechanisms behind the community assemblage can also be investigated with a functional diversity approach. In this study, dispersal, environmental filtering, and limiting similarity as assembly rules were investigated for phytoplankton communities from a total of 44 Turkish lakes. While dispersal is the process that integrates both local and regional diversity patterns, environmental filtering and limiting similarity are processes that influence local community structure. When these processes act on the species' traits, traits may converge or diverge. We initially found that dispersal limitation was not important for phytoplankton community assamblage. Then, whether environmental filtering or limiting similarity were elucidated for each trait using a null model approach. Rao's quadratic entropy was used as a measure of functional diversity and standardized effect sizes (SES) were calculated from null models. We found that functional traits were affected individually by environmental filtering (i.e. unicellularity, silica demand etc.) and limiting similarity (i.e. toxin production, mixotrophy) or both processes acted simultaneously on the same traits (i.e. sexual reproduction). Also, effects of different assembly processes varied along different environmental gradients.

ON023

Polintoviruses in freshwater ecosystems

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Metagenomics has recently revealed highly abundant and diverse polintoviruses present in alpine lakes. These viruses, which infect unicellular eukaryotes, are related to virophages (large virus associated or dependant viruses) and maverick/polintons (virus-like elements found in the genomes of some eukaryotic organisms). Despite their abundance, a comprehensive analysis of polintovirus diversity and hosts is lacking, which is essential for future isolation and study of these new eukaryote-virus systems. Here we show that polintoviruses are not only cosmopolitan members of freshwater viromes, but are integrated into the genomes of dominant protists, often hundreds of times. The implications of this integration are discussed along with possible life strategies of these enigmatic new viruses.

ON213

Combining remote sensing and ethnography to study social-ecological flows in the Draa River Basin, Morocco

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World-wide, dams are on the rise for hydropower generation and to increase water storage capacity in light of decreasing precipitation and water scarcity. These changes in water flows have far-reaching social-environmental consequences over decades to come that are not always fully understood and considered in the decision-making and management plans.
The aim of this study is to understand the long-term social-ecological impacts from changing water flows in the Draa River Basin, which is the driest watershed in Morocco and has seen the construction of three large dams in 1972, 2013 and 2021.
To do so, we combine a time-series analysis of land cover changes from 1988 to 2021 using available satellite imagery from the LANDSAT mission with precipitation patterns, dam discharge data and local accounts on the implications of changing water flows on livelihoods, farming practices and labour activities from in-depth interviews conducted from 2019-2021.
Results indicate overall an increase of agricultural activities and improvement of living conditions from the 80s onwards, however not all people have benefited equally within the Basin. Especially downstream Oasis ecosystems are in decline and marked by changing livelihoods in which farming activities are increasingly combined with other economic activities. Moreover, extensions of irrigated lands fully dependent on groundwater, offer new farming possibilities to local farmers, but also increase pressure on the availability of water resources.
We argue that a better understanding of the interrelationships between availability of water resources, water infrastructure and agricultural practices is crucial for the survival of ecosystems, livelihoods, and culture.

ON132

Lake phytoplankton under multiple stress: browning counteracts nutrients impact on cyanobacteria – a multiscale study

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A large fraction of lakes in Northern Europe and elsewhere are exposed to multiple stressors, such as nutrient enrichment and browning by humic substances, which affect their ecological status. Extreme weather events like summer storms often cause massive loads of nutrients and humic substances and simultaneously influence lake stratification patterns. To mechanistically understand and quantify the combined effects of browning, nutrients and deep mixing on phytoplankton, we performed two consecutive large-scale enclosure experiments in a stratified,oligo-mesotrophiclake,Lake Stechlin in Northeastern Germany. The experiments demonstrate that browning counteracts the stimulating effects of phosphorus on cyanobacteria and chlorophytes, resulting in a shift to mixotrophic cryptophytes. Deep mixing increased cyanobacteria biomass in non-humic and highly nutrient-enriched enclosures, buthadno effects in humic enclosures. The experimental results were compared with a 20-year time-series from the stratified meso-eutrophic basin of Lake Vansjø (Vanemfjorden) in Southeastern Norway and a large spatial data set including more than 700 Northern European lakes. Together, these three data sets support the conclusion that browning curbs the development of cyanobacteria, reducing both their absolute biomass and their share in the total phytoplankton biomass. Theexperimentaldataindicate that the reduction of light availability by browning is instrumental as a mechanism underlying this phytoplankton responseacross large spatial and temporal scales. The implications for lake management is that humic lakes with a colour above 40 mg Pt L^{-1}have a lower risk than non-humic lakes of developing harmful cyanobacterial blooms.

ON024

***Legionella* adaptations to high-sodium and grazing pressure in four natural spring-clusters surrounding the sea of Galilee**

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Legionella are responsible for most waterborne related outbreaks worldwide. Parasites of freshwater Protozoa, they are ubiquitously found in natural and man-made freshwater habitats. *Legionella*-host survival requires the function of a type IV secretion system, rendering the bacteria sodium-sensitive. High sodium concentrations have been shown to inhibit laboratory strains, particularly in elevated temperatures. In this work we examine how opposing selection pressures – sodium and grazing – help shape *Legionella* ecology within natural environments. Utilizing *Legionella* genus-specific primers, we examined abundance (qPCR) and community-composition (NGS), in water and biofilm samples from four natural spring-clusters. We identified environmental strains related to high-sodium concentrations and examined their co-occurrence with potential protozoan-hosts. Two of the spring clusters (Tiberias-Hot-Springs (THS) and Haon-Borehole) were characterized by high-sodium concentrations, with THS exhibiting high-water temperatures. Surprisingly, in these spring-clusters higher *Legionella* abundance was noted, in both water and biofilm samples. In contrast, NGS results indicated significantly lower*Legionella* alpha-diversity. Community-composition also differed, with few-dominant-unique *Legionella* ASVs. Phylogenetic analysis showed most environmental strains were not closely related to known species. Protozoan microbial-community structure and composition patterns were similar to those of *Legionella*, indicating similar selection pressures. Co-occurrence analysis revealed an association between *Legionella* to Ciliophora and Amoebozoa representatives. Surprisingly, although Amoebozoa were prevalent in biofilm samples, associations were noted only with Ciliophora. These results indicate that the extreme conditions observed in THS and Haon-Borehole may have led to selection forces favoring a relatively small but abundant group of *Legionella* species, that have evolved mechanisms to cope with both high-sodium and grazing pressure.

ON198

Assessment of the wastewater depuration capacity of natural microbial communities in a bench scale bioreactor

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The combination of community and whole-reach scale experiments focusing on the role of natural freshwater microbiota in river ecosystems contribute to an improvement of the knowledge on ecosystem processes over a global change scenario. In this experiment, we assessed the efficiency of benthic and planktonic natural communities as nature-based solution to improve the wastewater depuration capacity. A set of 18 independent bench-scale reactors composed by benthic and planktonic compartments, separately and in combination, was used. The effect of the addition of natural inoculum from freshwater ecosystems affected by treated wastewater release was also evaluated. Different indicators of water quality (nutrients concentrations, faecal bacteria abundance, and contaminants of emergent concern) were monitored to calculate the removal efficiency in each reactor and compare the performance of these communities. A set of biological parameters of the benthic and planktonic communities (organic matter content, algal biomass and composition, and its photosynthetic efficiency) were also measured simultaneously to be related with bio-reactor removal performance. The results demonstrated that benthic microbial communities (alone or in combination with planktonic organisms) showed the highest removal capacity of nutrients (65 to 99% removal capacity). The addition of the inoculum from a freshwater natural ecosystem affected by treated wastewater release did not increase the attenuation capacity of the bioreactors (52 to 99% removal capacity). These results are the first step to upgrade this nature-based reactor at larger scale, with the aim to improve performance and reduce costs of wastewater treatment, mainly in small facilities still lacking specific nutrients removal treatment.

ON313

Taxonomic and ecological characterization of new and poorly-known *Nitzschia* (*Bacillariophyta*) species from the Island of Cyprus

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During our studies on the diatom communities of perennial and intermittent streams of the water-stressed Island of Cyprus in the Eastern Mediterranean, several interesting (new, rare, poorly-known) diatom species of the genus *Nitzschia* were encountered. This contribution addresses three of these with specific aims. *Nitzschia ditmarmetzeltinii* sp. nov., morphologically superficially resembling short and stocky morphotypes of *Nitzschia fonticola*, is described as new to science. The recently (2018) described *Nitzschia pseudalpina* E.Reichardt is characterized ecologically using datasets of diatom counts, and of hydrological and chemical data collected over several years. Finally, observations on the taxonomy and distribution of the Sardinian morphotype / variant (sensu E.Morales) of *Nitzschia transtagensis* E.Morales et al. 2020 are provided. The taxonomic and ecological in-depth investigation of characteristic diatom species in these streams of an island in a geographic area facing rapid and extensive climate change is of great relevance to use these organisms as effective indicators of the ongoing changes.

ORAL ONSITE

ON089

Mainstreaming the restoration of rivers and wetlands in Europe

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Europe's environment is in an alarming state, with climate change effects aggravating. To secure economic prosperity, human wellbeing and social peace, systemic transformative change of our society is imperative. Ecosystem restoration using nature-based solutions (NbS) is key to this change, in which freshwaters hold a pivotal role. The EU Green Deal innovation project MERLIN demonstrates freshwater restoration best-practice that implements innovative NbS at landscape-scale. The project's ambition is to upscale systemic restoration, seizing opportunities for green growth and private investment into restoration. MERLIN capitalizes on 17 successful freshwater restoration projects across Europe. With investments of 10 mio Euro in hands-on upscaling measures along scalability plans, MERLIN transforms these projects into beacons of innovation for systemic change. MERLIN's initiatives aim at co-designing win-win solutions with economic sectors (e.g. agriculture, water supply, insurance, navigation) and local communities, spearheading systemic economic, social and environmental change. MERLIN is committed to a sustainable, climate-neutral and -resilient, inclusive and transformative path, mainstreaming restoration as a cornerstone for systemic change. The talk will provide an overview of the MERLIN project and summarizes the project status in its first year of implementation.

ON068

Extreme gas pressures in lakes – from Guadiana Pit Lake (Spain) to Lake Kivu (Rwanda / DR Congo)

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Several lakes show extreme loads of gases in their deep water. In most cases, volcanic sources are responsible for the high gas charge but also geochemical processes and decomposition of organic material have created gas loads of concern. We report, how reliable measurements of extreme gas loads could be accomplished [1]. In the case of Lake Kivu 40 billion m^3 of exploitable methane could be substantiated, while in Guadiana Pit Lake carbon dioxide loads of nearly 3 liters of gas per liter of lake water were detected [2]. We report about possibilities to confirm high gas loads by direct measurements of gas pressure or sound speed [3]. In the case of Guadiana Pit Lake, authorities followed the recommendation to remove the gas load artificially to avert the danger of a limnic eruption [4], while in the case of Lake Kivu prescriptions for the survey of the lake have been issued by an international expert team for the period of methane exploitation.

[1] Boehrer et.al. (2019): Gas in Lake Kivu. *Hydrol. Earth Syst. Sci.* 23 (11), 4707 – 4716.
[2] Boehrer et.al. (2016): Assessing Guadiana pit lake. *Sci. Total Environ.* 563-564 , 486 - 477
[3] Boehrer et.al. (2021): Carbon Dioxide in Lake Nyos. *Front. Earth Sci.* 9 , art. 645011.
[4] SánchezEspaña et.al. (2020): Degassing Guadiana open pit. Mine Water Environ. 39 (3), 517 – 534.

ON183

Taxonomy, ontogeny, and ecology of *Tonnacypris stewarti* (Daday, 1908) comb. nov., an ostracod from high altitudes, Lake Nam Co, Tibet

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Tonnacypris stewarti comb. nov., a microcrustacean (Crustacea: Ostracoda) widely distributed in the Tibetan Plateau, is taxonomically revised in this study. We examined surface sediment samples from Lake Nam Co and the ontogeny of the shells was registered for the first time. Besides, the abundance of this species was related to the type of aquatic ecosystem (lake, lagoon/pond, and river) and limnological variables. Based on the currently available literature and biological material, four synonymies were identified: *Eucypris afghanistanensis, E. gyirongensis*, *Tonnacypris estonica* and *T. gyirongensis*.Shell length and height of the populations of *T. stewarti* from Nam Co, Mongolia, and Afghanistan range from 1000 to 1300 µm, and from 500 to 620 µm, respectively. Seven developmental stages were identified in the Nam Co samples and only females were found, similar to previously recorded Mongolian populations. In contrast, there are populations of females and males in Afghanistan and near the city of Linzhi, China, indicating geographic parthenogenesis. Our results constrain the ecological parameters that could control the abundance of *T. stewarti*. A cluster analysis, shows that highest abundances were found mainly in lacustrine habitats (groups 1 and 2), with depths of 4-14 m, conductivities of 1300-1800 µS/cm, and temperatures of 9 to 12 °C. Group 3 displayed low abundances and the main habitat were rivers with shallow depths (0.2 m) and low conductivities (210 µS/cm). This study highlights the importance of clarifying taxonomic issues with the use of soft parts, as well this is the basis for future paleolimnological studies.

ON157

Spruce cultivation and draining of peatland as drivers of brownification

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Boreal lakes and water courses have become increasingly browner over the past 100 years. Brown water caused by the leakage of coloured terrestrial humic substances is a problem for the drinking water supply since it requires cost-intensive and potentially hazardous chemical treatment. Even in Lake Bolmen, a drinking water source for almost half a million people, steadily increasing brownification has been recorded. This project aims to determine whether spruce cultivation or draining of peat wetlands is causing the leakage of coloured humic substances. We are carrying out a one-year field survey in the Bolmen catchment to monitor the effects of spruce cultivations and ditching of peat wetlands on brownification throughout all seasons. The study examines water colour, dissolved organic carbon and iron in three tributaries to lake Bolmen and their drainage ditches. Our preliminary results show differences in water colour between the rivers. Furthermore, ditches have a significantly higher water colour than the main tributaries and are therefore assumed to be the main contributor to the brownification of lake Bolmen. We will point out particularly important wetlands to protect and detect suitable areas for the rewetting of wetlands with the aim of minimising brownification to ensure Bolmen's water quality and high valued ecosystem services.

ORAL ONSITE

ON261

Wetlands as a dual functioning tool for reduction of nutrients, water colour and total organic carbon

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Wetlands are important ecosystems with multiple ecosystem services, e.g., nutrient retention, increase biodiversity and improving carbon sequestration. Therefore, seen to the benefits, there is an increased interest in restoring and constructing wetlands. Intensified land-use and changes in land-cover have led to increasing organic and inorganic compounds reaching aquatic ecosystems. However, data on the potential of wetlands to reduce humic substances, and thereby also water colour, is scarce. In slow-flowing, shallow waters humic substances are degraded when exposed to UV-radiation and bacterial utilization, consequently, wetlands may have an unexplored potential. Therefore, we here evaluate the potential of wetlands to reduce total nitrogen (TN), total phosphorus (TP), total organic carbon (TOC) and water colour. We performed our study in nine wetlands of different characters and catchment area, over 18 months. By monthly assessing the concentration of humic and nutrient content at the inlet and outlet of each wetland, we estimated reduction of humic and nutrient content. Thus, in this study we test the hypothesis that wetlands situated upstream a lake have a dual function and reduce humic substances and nutrients. The water colour and concentration of TP, TN and TOC varied between wetlands and temporally, however, most wetlands reduced TN and they also generally reduced TOC, with higher variation in the reduction of TP and water colour. We show here that many wetlands have a potential to reduce both TOC, water colour and nutrients. Therefore, wetlands could be a useful tool to mitigate effects of eutrophication and brownification.

ON200

From individuals to communities: Habitat complexity affects all levels of organization in aquatic environments

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Habitat complexity affects aquatic ecosystems on multiple levels from individuals to species interactions and entire communities. We present a conceptual framework to classify these effects, summarize recent advances in the field, and identify main research gaps and limitations. We show that increased habitat complexity appears to, respectively, weaken and strengthen trophic links in 2D and 3D predator–prey interactions and that the effect is contingent on predator and prey traits. Moreover, most studies examine habitat complexity on the presence-absence scale. This limits our ability to recognize nonlinear responses across habitat complexity gradients, for example in trophic interaction strengths. Such nonlinear responses can affect population stability and community dynamics, necessitating higher resolution of habitat complexity in future studies. Finally, the effects of habitat complexity on communities and ecosystems can involve feedback loops on lower levels of organization including the habitat complexity itself. Such feedbacks can influence habitat formation and amplify or mitigate the direct effects of habitat loss and simplification or habitat restoration on populations and communities, yet are surprisingly little understood. We conclude that currently degraded habitats offer exciting opportunities for combining restorative efforts with research that could combine multi-level experiments and monitoring to improve our understanding of the role of habitat complexity across aquatic ecosystems.

ON171

Development of a natal origin reattribution model using otolith microchemistry for the anadromous Allis shad (*Alosa alosa*) in the Rhine system

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The allis shad *Alosa alosa*, an anadromous species, has been extinct in the Rhine system since the mid-20th century. A reintroduction program started in 2008. To protect the newly established fish stocks, it is important to know their active spawning areas in the Rhine system. Otoliths record chemical signatures of their surroundings and can be used to determine the natal origin of recaptured individuals. To establish reference values for Sr/Ca ratios and $^{86}Sr/^{87}Sr$ isotope ratios, we reared shad larvae in tanks fed with river water for up to 100 days in four subcatchments of the Rhine system (Lippe river, Sieg river, Neckar river and Middle Rhine). Water samples were taken weekly from the rivers and tanks at each location and analyzed with a multicollector coupled to an ICP-MS. Otoliths of the reared fish were extracted and prepared. Sr/Ca ratios and $^{86}Sr/^{87}Sr$ isotope ratios were measured with a laser ablation coupled to an ICP-MS and compared to the chemical signatures of the water samples. We found clear differences in the chemical signatures of the different rivers and could confirm these differences also in the otoliths. We used these microchemical signatures to train a random forest model to attribute the microchemical signatures of the otoliths to the signatures of the surrounding water, which had a success rate of 100%. This model will now be supplemented with chemical signatures from further subcatchments of the Rhine and will then be used to determine the natal origin of recaptured fish during their migrations.

ON411

River network connectivity – An ovearching approach

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Rivers have always been closely related with society development wich has resulted in a a high degree of human induced impacts forced upon freshwaters. Among all the pressures, river network fragmentation by artificial barriers is considered one of the most damaging, especially for freshwater fish species that see their longitudinal movements impared. This affects the ability of systems to maintain their fish biodiversity, affecting population maintenance and promoting meta-community unbalance. To properly address fragmentation problems in river systems it is important not only to be able to acuratly quantify the structural and funtional imparement of river networks, but also to develop cost-effective approachs to facilitated connectivity management and fashion effective connectivity enhancements solutions suitable for different barreirs types serving different fish comunities. In this work we demonstrate how this overarching approah is the most comprehensive way to tackle rivernetwork fragmentation. Here we present the main findings and contributions of a 15 year research path centered on river network connectivity. These results spur from theoretical, laboratory-controlled and fiel experiments, extending from historical fish records to predictions of future fish occurences and habitat suitability, and from fish passage research, small barriers negotiation and fish behaviour, to management and planning techniques to enhance connectivity at large spatial scales. This research path demonstrates how benefitial it is to take this holistic prespective at multiple temporal and spatial scales.

ON346

Paleoenvironmental changes recorded in two small Arctic Lakes from the Northwest Territories, Canada

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Previous studies show that the Holocene Thermal Maximum (HTM), a period of strong summer warming between ~11,000 to 5,000 years ago, led to increased tree cover in tundra regions. This research aims to determine how primary production in lakes just north of the latitudinal treeline is responding to warming today in comparison to changes during the HTM, to increase our knowledge of Arctic lake sensitivity to warming. Sediment cores were retrieved from Queen's and McMaster lakes, situated in the Canadian Arctic. Changes in total algal and diatom production were estimated using sedimentary chlorophyll *a* (chl*a*) and biogenic silica (BSi), respectively. Past lake-water total organic carbon (TOC) was reconstructed using VNIR spectroscopy to study the relationship between TOC and algal production. Diatoms were enumerated to provide information about environmental change. During the HTM, TOC, chl*a*, and BSi increased, suggesting that with warming and treeline movement, decreased ice cover and possibly increased nutrients from the catchment increased production. However, in response to recent climate warming, TOC values remain low, while both algal and diatom production began increasing around 1850 CE. This indicates that there is a lag in the terrestrial vegetation response, and has not yet led to increased terrestrial matter and nutrient supply. Instead, the recent increase in algal production is driven by prolonged growing seasons related to shorter ice cover, indicated by changes in diatom community composition. This research is important as increased production can potentially decrease water quality and increase lakes carbon storage.

ON324

Terrestrial dissolved organic nitrogen uptake in streams: just another form of nitrogen or part of the carbon cycle?

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Headwater streams are tightly coupled to their catchment via terrestrial dissolved organic carbon (t-DOC) and nitrogen (t-DON) inputs. While the role of t-DOC for carbon cycling has been described, the efficiency at which streams retain t-DON remains unclear. We tested whether t-DON uptake differs between streams with contrasting land use and whether it is coupled to t-DOC uptake. We conducted a stable isotope addition experiment, where we added an isotopically enriched (99 at% ^{13}C and ^{15}N) leachate extracted from ryegrass, a riparian plant typically found at stream margins. The leachate consisted of 85% DON and 12% ammonium, which allowed us to differentiate the role of the nitrogen form on uptake rates. The tracer was added to artificial flumes and streams, and whole-stream and biofilm-specific uptake rates were calculated based on temporal changes in $\delta^{15}N$. Whole-stream t-DON uptake was four times lower than ammonium uptake in the forested stream, while there was no measurable uptake in the agricultural stream. Surprisingly, whole-stream t-DOC uptake in the forested stream was not coupled to t-DON but ammonium uptake. Areal uptake of t-DON by biofilms was an order of magnitude higher in the agricultural than in the forested stream and unrelated to biofilm t-DOC uptake. Our results highlight that t-DON plays a distinct role in stream ecosystem function and demonstrate that the loss of active uptake compartments from agricultural streams may be the reason for their limited nitrogen retention efficiency.

ON133

The combined impact of low temperatures and shifting phosphorus availability on the competitive ability of cyanobacteria in natural phytoplankton communities

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In freshwater systems, enhanced temperature and eutrophic conditions have given cyanobacteria a strong competitive advantage. To predict their response to future conditions it is necessary to understand their adaptive and evolutionary potential to multiple environmental states. In order to understand if further adaptation gives certain cyanobacterial species a competitive advantage, a single strain of *Microcystis aeruginosa* was inoculated into natural phytoplankton communities under three different nutrient conditions: oligotrophic, eutrophic and eutrophic with the addition of bentophos®. We determined that the use of the bentophos® treatment caused significant differences in prokaryotic and eukaryotic communities leading to reduced biodiversity among the eukaryotes and a decline in cyanobacteria suggesting phosphorus limitation had a substantial impact on the community structure. The low temperature during the experiment caused the disappearance of *M. aeruginosa* in all treatments and gave other phytoplankton groups a competitive advantage leading to the dominance of the eukaryotic families that have diverse morphologies and nutritional modes. These results show that low temperature can dampen the competitive advantage of cyanobacteria, so controlling phosphorus concentrations could be a possible mitigation strategy for managing harmful cyanobacterial blooms in a future warmer climate.

ON376

Urban Footprints and Urban Shadows – Determining A Framework for Analyzing Greenhouse Gas Emissions from Urban Waters

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As cities around the world embark upon efforts to reduce their carbon footprints, it is becoming particularly critical to understand how these same cities interact with their natural environments, including their urban waters, and what those interactions mean for their anthropogenic greenhouse gas (GHG) emissions. Defining the direct effect of urban environments on local aquatic GHG emissions can be a surprisingly complex challenge, with both cultural and climatic facets to consider. I here present some of these considerations across multiple locations including urban areas in the western United States, the Laurentian Great Lakes region, and Europe. Drawing from recent research at the interface of water management, climate change, aquatic metabolism, and GHG emissions, I will discuss the development of a framework for considering how, when, and why we should be accounting for aquatic GHG emissions associated with urban areas.

ON217

Effects of nutrient enrichment and top predator loss on oxygen concentration variability in small ponds

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Stability is an important ecosystem property and is assumed to allow maintenance of communities and functions in ecosystems subjected to external stressors. Ecosystem stability may decrease when a threshold in the stressor's intensity or frequency is reached, or when under the influence of multiple stressors. In lakes, geomorphometric characteristics can also explain different degrees of vulnerability to the same stressor. However, it remains partly unclear how the morphometric (e.g., lake depth) and

other ecosystem characteristics (including stressors, e.g., nutrient levels and trophic structure) interact to explain lake stability. We present 5 years of high-frequency data for sixteen experimental ponds (15x30m, 2.7m-deep), with a full factorial design (presence/absence of predator, low/high nutrient level), in Saint-Pierre-les-Nemours (France). Temperature and oxygen are habitat-defining variables, and their day-to-day fluctuations can inform on the general ecosystem stability. We found no impact of the top-predator loss on the different measures of stability we tested for, although this could be due to the difficulty of removing top-predators from the ponds. However, we found that oxygen variability and the number of outliers was higher in enriched ponds, and at higher temperatures. The ponds thermal structure's response was similar across treatments, so the oxygen patterns may be tied to the biological communities. Using an experimental approach, we were able to remove the geomorphological variability that is usually inherently part of the picture when comparing multiple lakes' responses. We show that even subtle levels of enrichment can result in a change in the pond's habitat stability.

ON219

Environmental niche modelling for a rare charophyte species suggests that it may benefit from climate warming

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In this study, multiple species distribution models (SDMs) were used to reveal the potential climatic habitats and ranges of *Lychnothamnus barbatus* which is one of the rarest charophytes worldwide and the only extant representative of the genus *Lychnothamnus*. We aimed to (1) indicate the most reliable SDM for this rare hydrophyte; (2) determine the major bioclimatic factor(s) affecting the species distribution; and (3) estimate the current, past (ca. 130 ka) and future (up to 2100) potential range of *L. barbatus* as a rare aquatic species in Europe and North America. Future climate scenarios were calculated using four global climate models (GCMs). We documented that Support Vector Machines (SVM) outperformed commonly used MaxEnt and Random Forest models. The most important predictors for the SVM (i.e., temperature in wettest, warmest and driest quarters; precipitation in warmest and wettest quarters) were partly different than those for MaxEnt (temperature in wettest quarter and annual temperature range). The SVM used predictors more efficiently than did MaxEnt to achieve good performance. Thus further exploring the potential of SVMs as SDM is recommended. Moreover, the predicted future range of *L. barbatus* is heavily dependent on the GCMs type. Although, even when the pessimistic scenarios were considered all the models indicated expansion of *L. barbatus* to other areas in Europe. The study results suggest high climatic adaptivity of *L. barbatus* since the last interglacial and emphasize the need for cautious biological conservation of rare species. More effort is required to conserve warming-vulnerable species.

ON029

Distribution of fish species in a boreal stream network mirror spatial patterns in the landscape, mediated by stream water chemistry and physical habitat

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We used the spatial distribution of four common fish species (determined by electrofishing surveys) in a 67 km^2 boreal catchment to explore the ecological importance of environmental organizing factors at a range of spatial scales, including whole-catchment characteristics derived from map data, and stream reach chemical and physical characteristics. Two acid-sensitive species, bullhead (*Cottus gobio*) and brook lamprey (*Lampetra planeri*) were only present in streams with pH > 6 at the time of sampling, suggesting that acidity plays a major role in limiting their spatial distribution. Benthic substrate type was strongly correlated with brown trout (*Salmo trutta*) distributions in this stream network, with acidity appearing to place an additional restriction. The less acid-sensitive brook trout (*Salvelinus fontinalis*) had a broad distribution and was found in some of the smallest, most acidic streams. Multivariate ordination was used to determine the groups of factors most strongly correlated with species distributions. Local site characteristics (substrate type, bottom topography, stream width, dominant algal type) were able to explain 40% of the spatial variation in fish species distributions, while stream chemistry (primarily pH) was able to explain only 20% of the variation. Both local site characteristics and stream water chemistry are determined in large part by landscape characteristics of the drainage area, in particular local slope, soil type, forest development, and amount and location of peatlands. Thus, the observed fish distributions can be envisioned as reflecting patterns in the terrestrial landscape, mediated by the stream physical and chemical environment.

ON081

Will treated recycling wastewater cause algal blooms? A study of the effect of nutrient inputs on algal blooms in a drinking water reservoir

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Increasing water demand from a growing human population, and a changing climate are placing pressures on water supplies. Treating and recycling water from sewage treatment plants provides a means of enhancing water supplies, particularly during droughts. However, treating wastewater using advanced treatment technologies will not remove all the nutrients, and the impacts of these nutrients on ecosystem health remains poorly studied. Therefore, a study was conducted in an inlet in the drinking water reservoir to determine the impact of nutrients on algal growth. The nutrients were added at concentrations and ratios typically found in highly treated recycled water. The study found that addition of nitrate resulted in an increase in nitrate concentrations in the inlet, but phosphate concentrations, at analytical detection limits, did not increase. Algal biomass increased over the three weeks of addition, with chlorophyll values doubling but the high nitrogen:phosphorus ratios in the recycled water likely limited further growth. Despite the biomass changes, the proportion of different algal species did not change. The extensive macrophyte beds also accumulated nutrients, essentially competing with algae for nutrients. Therefore, assessing the nitrogen:phosphorus ratios in recycled water is likely to be critical to determining the scale of algal blooms that may result.

ON440

Distribution patterns on multiple spatial scales reveal reproductive isolation and frequent syntopy among highly divergent lineages of the*Gammarus fossarum* species complex in the Western Carpathians

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Recent discoveries of vast cryptic diversity among various aquatic invertebrates pose a challenge for understanding of their ecology and biodiversity patterns, as well as for conservation. We studied distribution, potential hybridization and habitat preferences of divergent lineages of the hyper-diverse *Gammarus fossarum* species complex (Crustacea: Amphipoda) in their contact zone in the Western Carpathians (Central Europe), to get insight into processes that may influence lineage coexistence. We initially screened over 60 sites to determine regional lineage distribution (confirming the presence of four) and detected syntopy of two to three lineages at almost half of the study sites. Subsequently, nine syntopic localities were studied in detail for mesohabitat distribution (fast vs. slow water flow), pairing preferences, and temporal stability of *Gammarus* community. A significant fraction of regional spatial variation was explained by distance in the dendritic river network, altitude, stream width, and anthropogenic stress. At local scale, however, we did not find differences in distribution between mesohabitats with contrasting flow rate. Mixed

precopulatory pairs in syntopy were extremely rare, even under very imbalanced lineage ratios, confirming a strong prezygotic reproductive barrier between studied lineages; this was congruent with the species delimitation analyses on both nuclear and mitochondrial markers, which confirmed the absence of any recent gene flow. Frequent and apparently temporally stable syntopy of these reproductively isolated lineages warrant further research on processes that may facilitate it, focusing on potential finer differences in ecology, functional morphology, or biotic interactions within the stream communities.

ON341

Water hyacinth infestation in Lake Tana, Ethiopia – a review of population dynamics

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Lake Tana, the largest and most important lake in Ethiopia, has been severely threatened by water hyacinth infestation. First recorded in 2011, this invasive weed increased rapidly along the northeastern shore and covered nearly 25 km^2 by the end of 2019. Since water hyacinth is extremely difficult to eradicate, performing sustainable management strategies is important to reduce its negative impacts on local ecological and socio-economic systems, which requires a better understanding of the population dynamics. Here, we reviewed the seasonal change of water hyacinth coverage in Lake Tana and explored its linkages with various environmental factors. During the rainy seasons, increased nutrient concentrations, humidity, and especially water level can promote the formation of extensive water hyacinth mats. In the dry season, diminishing lake water in surrounding floodplains, along with concomitantly increased temperature and solar radiation, may support seed germination and lead to the next life cycle. Currently, water hyacinth mainly occurs in northeastern Lake Tana due to coastal eutrophication, lake topography and westerlies. The increase of water hyacinth infested area was in a downtrend. However, further spread of water hyacinth is still possible in other parts of the lake basin due to changing climate and environmental conditions. Integrated control methods should be put in place in the near future to avoid worsening of water hyacinth infestation in Lake Tana, and upstream basin management is vital to reduce nutrients transportation into the lake as a long-term plan.

ON037

On the use of satellite data to investigate the overturning behavior of lakes within a warming world

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Global warming affects ecosystems worldwide. A notable implication of global warming in lakes is an increase in surface water temperature. This surface warming can have a knock-on effect on physical environment of lakes influencing, among other things, their stratification and mixing regime, with implications for the entire aquatic ecosystem. Typically, an increase in lake surface water temperature can intensify thermal stratification, likewise resulting in a decrease in vertical mixing. Reduced mixing between surface and bottom waters can have critical implications for the ecosystem, including a decrease in upwelling of essential nutrients from deep-water to the lake surface, and the transport of oxygen in the opposite direction.
Lake water temperature analysis are mostly based on spatially aggregated averages. However, the spatial component of satellite Earth Observation (EO) data could reveal further information about lake mixing. Although the spatial dimensions of satellite EO data lack a vertical component, the horizontal gradients could improve understanding of internal lake processes and the identification of mixing anomalies. Seasonal overturning, indeed, often occurs with different timing across the lake. Thus, the spatial character of satellite EO data can reveal important processes in lakes, and can help assess the long-term variability in their overturning behavior under climate change. In our project, we analyze the spatial patterns of remotely sensed lake water properties, and link such patterns to documented anomalies or shifts of lake mixing regimes. Different mathematical approaches are evaluated to facilitate the detection of recurring spatial patterns and anomalies using case studies distributed across continents.

ON128

A framework for the assessment and forecast of the carbon retention and GHG exchanges of wetland ecosystems: Linking conservation, management, restoration and climate policy

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Anthropogenic climate change is caused by the huge increase of Greenhouse Gases (GHG) emissions mainly resulting from fossil fuel combustion, but also from the alteration of the functioning of biogeochemical cycles on Earth's ecosystems linked to other components of the global change (e.g land use changes). A multi-scale approach requires fixing the relative importance of ecological processes and that of anthropogenic pressures and impacts, and the interconnections among scales, from the microbial world to the biosphere, but also including the social and economic aspects at the proper level. Here we present an integrated approach to afford this challenge. The rates of biogeochemical processes mediating GHG exchanges between wetlands and the atmosphere are determined in situ under different conditions in representative sites, then assayed under experimental controlled conditions. These data serve to calibrate C-cycle and GHG-exchange models to see how driving factors (e.g. temperature, hydrological patterns, meteorology, salinity, etc.) can affect C and GHG fluxes. Multilevel models integrate C-cycle, hydrology and climate, allowing to forecast how human actions and future climate can influence C and GHG fluxes under different management/restoration/policy/climate-change scenarios. These models can be extrapolated when applying the conditions generated by climate change models, but also be related with the conservation/ecological status obtained from land uses and their changes (LULUC) applying novel methods (LUPLES^2 method, Land Uses – Pressure Level – Ecological Status – Ecosystem services). This work was supported by projects CLIMAWET-CONS (PID2019-104742RB-I00), funded by AEI (Spanish Government), and Wetlands4Climate (LIFE19 CCM/ES/001235), funded by the EU-LIFE programme.

ON273

A standardized method for the analysis of microplastics in lake environments

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Microplastic pollution is considered a global concern that involves all environmental compartments. To date, there are still no standardized methods for conducting research on microplastics, nor a univocal classification of them. This leads to a large number of non-comparable data, which is fundamental for understanding the extent of this type of pollution. This work, inserted into a larger project, aims to propose a standardized method for the analysis of microplastics in lakes' surface water. We determined microplastics concentration and characterized the particles found by their size, shape, color and polymer. The data obtained were correlated with information related to the catchment area, to understand how features of a lake and anthropogenic impacts act in determining the abundance and characteristics of the detected microplastics. We present the data obtained from the application of this methodology on Lake Iseo (IT) where the concentrations are $8{,}7*10^8$ MP/km^3 and the microplastics found are mainly fragment consisting of polyethylene. In this study, to investigate the polymer composition, we used Raman micro-spectroscopy, an optimal technology in microplastics analysis thanks to its high spatial resolution, but limited due to the presence of additives that, sometimes, imped to determine the polymer. The presence of additives generates two phenomena, both occurred in our investigations: the fluorescence and the overlap of the additives' spectra on the spectra of the polymer. This latter may represent an advantage since, occasionally, it is possible to identify the additives and thus getting a deeper understanding of the composition of the plastic analyzed.

ON141

Diatoms as indicators of the effects of enhanced water-level fluctuations (artificial-snow production) in high ecological integrity high-mountain lakes of the south-eastern Alps

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A high-mountain lake (Monticello) of the south-eastern Alps impacted by enhanced water-level fluctuations due to water diversion for artificial-snow production was studied for five years (2017-2021) and compared with three similar lakes of the nearby Adamello-Brenta Nature Park. We focused on epilithic diatoms and physical and chemical parameters, though data on macroinvertebrates are available as well. Diatoms were sampled once a year at the beginning of August collecting cobbles and small boulders with a zoobenthos net with waders on the shore. Water samples for hydrochemistry were collected and analysed in due course. All these lakes have, potentially, very high ecological integrity, and consequent important occurrence of rare and sensitive diatom Red-List species. The three reference lakes are almost un-impacted, though at least one of these appears to undergo natural relevant water-level changes. The results clearly showed lower diatom diversity in the lake used for artificial-snow production. *Denticula tenuis* was confirmed to be a reliable indicator species of pronounced water-level fluctuations also in low-conductivity lakes. Further comparisons will be possible with data collected for the reference lakes more than 25 years ago, and including in the comparison a high-altitude low-conductivity lake of the same area, which has been the object of long-term ecological research (including benthic diatoms), and in which the depth-distribution of epilithic diatoms has been as well investigated. Due to the ever increasing pressure to use the water of high-mountain lakes in the face of climate change, a finer understanding of the ecological impacts on biodiversity is highly desirable.

ON111

Bacterial and microalgae colonization of microplastics: composition and function in a eutrophic lake (Lake Lugano, Switzerland)

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Lakes receive large inputs of plastic particles, which accumulate in water and sediments. Here, microplastics (MPs) are rapidly colonized by microorganism, that could induce changes in MP buoyancy, due to the increase in particle size and density, and a decrease in surface hydrophobicity. Therefore, the community composition of biofilms (*plastisphere*) likely influences MP dynamics in lakes. However, the plastisphere of freshwater environments is little known, and most of research has been based on laboratory experiments. In this study, we seek to gain new insight into the composition of the plastisphere and its influence on MP vertical dynamics, in a lake highly polluted by MPs (Lake Lugano). With this aim, we applied a combined approach based on a field study and in-situ experiments. MP-biofilm aggregates were analysed from samples collected on the surface and in the water column in spring, using optical, electron, and fluorescent microscopy. In parallel, we incubated lab-made MPs in the euphotic zone and we deployed sediment traps below the metalimnion to quantify downward fluxes. Our results showed that in the euphotic layer the biofilm was dominated by diatoms, especially large species. Diatoms were also observed on MPs in the hypolimnion, which suggest an effect of diatom colonization on MP settling, owing to the dense siliceous frustules. This hypothesis is supported by an increase of MP sinking rate observed during the spring diatom bloom. These preliminary results open new questions regarding the effect of MPs on sedimentation fluxes in lakes and the toxicological impact on primary producers.

ON117

Three constructed wetlands within a severely polluted Mediterranean natural park increase plankton diversity of the resulting outflow communities

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Constructed wetlands (CWs) are green infrastructures close to natural wetlands widely used at present with multiple objectives. Three surface-flow CWs were constructed in 2009-2011 surrounding the hypertrophic Albufera de València lagoon within a Spanish natural park. The area (and mainly the water) was deteriorated since the 1970s due to intensive agriculture, urbanization and industrial activities, and nowadays the problems persist. Despite this, the area is considered one of the most important wetlands in the Iberian Peninsula and the Mediterranean region, being under various forms of protection (Ramsar List and Natura 2000 Network). One of the aims of the CWs initiative was the recovery of the lost biodiversity (both species and habitats) to improve the ecosystems' functioning. We have monitored the plankton diversity (both phytoplankton and zooplankton) of the three CWs since their implementation. Changes in plankton diversity were analyzed over a decade at several sites within the CWs (inflows, inside and outflows) to understand the community dynamics as water flows through them before being discharged to the lagoon. The data analyses allow us to asseverate that both within-water and the outflows of the CWs increase the plankton diversity of the protected area. The CWs' outflows represent a source of species to the receptor waterbody, particularly regarding large herbivores, such as cladocerans, which cooperate in an important ecosystem function such as the clearance of the lagoon waters to increase transparency and promote, in this way, the return of submerged vegetation, the desired goal for the restoration of the area.

ON054

Geomorphology defines the impact of climate change on organic carbon processing in NE Greenland streams

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Global change is strongly impacting Arctic freshwaters, integrated in a landscape that is quickly warming, suffering strong changes in hydrological processes and permafrost thaw. All those processes will impact the soil organic carbon (SOC) cycling as well as its export from soils to the adjacent streams, both as particulate and dissolved organic matter (POM and DOM respectively). DOM chemical diversity defines its availability for the microbial community and thus, ultimately the carbon (C) export to the Arctic Ocean. Here we aim to link different geological settings in NE Greenland (Zackenberg) with the composition, stability and degradation of organic matter in riparian soils and streams. We selected 14 small streams across a gradient in geomorphology and vegetative cover, and sampled early, mid, and end of the summer 2021 open-water season. We determined C and nitrogen concentrations in soils and water, SOC and POM persistence (determining its thermal stability) and DOM chemical composition and degradation (through ultra-high resolution mass spectrometry and bacterial respiration). Our results link the surrounding watershed geology and SOC stability with the organic matter chemical diversity and cycling in streams. We show the indices describing DOM chemical diversity that appear to be most responsive to bacterial respiration and relate their seasonal changes with variation in discharge, vegetation and inorganic nutrient. Our results provide valuable information to assess stream biogeochemical responses to climate change, which are poorly understood on a landscape scale.

ON462

Women in Limnology: from a historical perspective to a present-day evaluation

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Research in limnology is nurtured by the work of many fascinating and passionate women, who have contributed enormously to our understanding of inland waters. Female limnologists have promoted and established the bases of our knowledge about inland waters and fostered the need of protecting the values of those ecosystems. However, on numerous occasions, their contribution to the advancement of limnology has not been fully recognized. Here, we review the presence of women in limnology through the history of the discipline: from the pioneers who contributed to the origins to present day' developments. We aim at making those scientists visible and establish them as role models. We also analyse in a simple and illustrative way the current situation of women in limnology, the scientific barriers they deal with, and their future prospects. Multiple aspects fostering the visibility of a scientist, such as their presence in conferences, awards or representation in societal or editorial boards show a significant gap, with none of those aspects showing a similar visibility of women and men in limnology. This talk rises awareness of the obstacles that women in limnology faced and still face, and encourages to embrace models of leadership, scientific management and assessment of research performance far from those commonly established.

ON254

Mutual Support of Cyanobacteria and Methane Oxidizing Bacteria: Linking Methane Oxidation to Cyanobacterial Growth

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There are many uncertainties in methane dynamics in surface waters especially in oxic and unoxic microniches, e.g. zooplankton microbiome or bacteria attached to phytoplankton. Aerobic Methane Oxidizing Bacteria (MOB) are present in such microhabitats and can benefit from cohabitation with photoautotrophs which produce oxygen, enhancing CH_4 oxidation. On the other hand, methane oxidation can account for accumulation of CO_2 and the release of exometabolites that may both be important factors influencing the structure of phytoplankton communities. The MOB were previously detected on the cells of algae and cyanobacteria. Thus, we hypothesized that MOB could be an alternative C source to support cyanobacteria growth in freshwater systems that may have important consequences for lake ecosystem functioning and release of greenhouse gases into the atmosphere. We detected metabolically active MOB on cyanobacterial filaments in field samples using the fluorescein isothiocyanate (FITC) based activity assay, and *pmoA* gene in several nonaxenic cultures of isolated cyanobacteria. Experiments comprising the co-culture of the cyanobacterium *Aphanizomenon gracile* with the methanotroph *Methylosinus sporium* proved that cyanobacterial growth was significantly improved in the presence of MOB. Cyanobacteria presumably utilized CO_2 released by MOB, and ^{13}C-CH_4 labelled incubations showed the uptake and assimilation of MOB-derived metabolites. On the other hand we also observed a higher growth of MOB in the presence of cyanobacteria underpinning the bidirectional influence.

ON274

Evidence of microplastic pollution in Croatian rivers

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The ubiquity and extent of microplastic pollution in aquatic environments worldwide constitutes a growing problem. Although microplastic particles are frequently detected in marine environments, their presence in freshwater environments has received less attention to date. Here, we report on microplastics (<5 mm) in biota from rivers across Croatia. Samples of benthic macroinvertebrates (Trichoptera and Oligochaeta) were collected to determine the presence of microplastics in lower trophic level consumers. Microplastics were detected in all collected samples, with the majority of particles constituting fibers and, to a lesser extent, fragments. Oligochaeta accumulated higher concentrations of microplastic particles than Trichoptera, with smaller individuals accumulating greater concentrations per dry weight than larger individuals of the same species. Given the prevalence and high concentrations of microplastics measured in biota in Croatian rivers, their transfer up the riverine food web through ingestion by fish and predatory macroinvertebrates warrants further investigation.

ON053

Space-for-time: Shifts in Arctic and sub-Arctic freshwater food webs along latitudinal gradients using stable isotopes and fatty acids as trophic biomarkers

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ARCTIC-BIODIVER is a multidisciplinary project among collaborative research groups of Europe and North America. It aims to facilitate baseline information on freshwater biodiversity as well as development of biodiversity scenarios at national and circumpolar scales. In a multi-site space-for-time field study in Arctic and sub-Arctic regions we investigated the changes freshwater food webs along latitudinal gradients (from 61º to 69ºN). In our study, we sampled primary producers and invertebrate consumers from benthic and pelagic habitats in lake and stream ecosystems along with environmental variables (e.g. temperature, nutrients, water color). In our analysis, we related changes in environmental variables across latitudes with changes in food web topology (by analyzing at community composition), food web function (by investigating trophic interactions and community niche, using bulk $\delta^{13}C$ and $\delta^{15}N$) and food quality (by measuring concentrations of polyunsaturated fatty acids, PUFAs, of different prey). Such food web patterns obtained across spatial gradients may help predict the potential long-term consequences of climate change in the functioning of Arctic and sub-Arctic freshwater ecosystems, which are particularly vulnerable to rising temperatures and anthropogenic disturbance.

ON221

Smoke on the Water! The Influence Regional Wildfires on the Ecological Structure of Castle Lake (CA, USA)

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Increasing in frequency in the last decades and predicted to increase in intensity in the future, wildfires can influence the airsheds and aquatic ecosystems far from their source of ignition.We quantify the influence of wildfire smoke on Castle Lake (CA, USA) to understand the impacts on the physical, chemical, productivity, and fishes. Comparing a year with heavy smoke generated from regional fires with previous years, we found a 31% reduction in incident light an 11% reduction in photosynthetically active radiation (PAR). Underwater ultra-violet light and PAR was reduced by 65 and 44%, respectively.Lake habitats (littoral-benthic and epilimnion) respond differently to changes in light from smoke; pelagic primary production increased with no change to littoral metabolism.Epilimnetic productivity of algae increased despite a decrease in heat content perhaps due to release from UV-B photoinhibition.Littoral-benthic productivity did not change,possibly reflecting adaptation to high-intensity UV-B light in these habitats.Deeper metalimnetic and profundal chlorophyll and productivity was significantly reduced. Surprisingly, zooplankton composition biomass, composition, and diel vertical migration patterns was not significantly different however trout were notably and uncommonly absent from the littoral-benthic habitat. Our study, while a single lake case study, indicates the varying but dynamic impacts of wildfire smoke on a lake ecosystem from the physical and chemical dynamics to the individual animal and ecosystem scale traits.We offer conceptual models to guide our understanding of wildfire smoke influences on aquatic ecosystems.

ON243

Comparative metabolites and ecotoxicities of toxigenic and non-toxigenic *Microcystis aeruginosa* strains

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Cyanobacterial harmful algal blooms (cHABs) dominated by *Microcystis aeruginosa* threaten the ecological integrity and water security of lakes owing to their harmful secondary metabolites. However, research on the metabolites of *M. aeruginosa* has mainly focused on microcystins (MCs) and other peptide toxins that they release upon cell lysis. Exudates from *M. aeruginosa* exhibited biotoxicity but the chemicals in these mixtures are unclear. Natural populations of *M. aeruginosa* contain toxigenic and non-toxigenic strains according to whether they produce microcystins or not, but their respective differential metabolites (DMs) and ecotoxicities other than MCs remain unknown. We compared metabolites of *M. aeruginosa* exudates (MaE) from a toxigenic and a non-toxigenic strain at exponential and stationary growth phases. *Daphnia magna* was employed to compare the ecotoxicities of MaE. A total of 409 metabolites were identified, of which 71 were different between strains and growth phases. The top metabolites quantitatively were lipids, organoheterocyclic compounds, organic acids and benzenoids. Many metabolites with cytotoxicity, apoptosis-inducing effects and reproductive toxicity were detected in both strains, with concentrations of some toxic metabolites higher in the non-toxigenic strain than the toxigenic one. Meanwhile, the filter feeding action, heart rate and mitochondrial function of *D. magna* was more inhibited in stationary phase than exponential growth phase cultures, while the non-toxigenic strain showed a greater inhibitory effect than the toxigenic strain. In the non-toxigenic strain, these highly toxic DMs included 7-ketocholesterol, myristoleic acid, sinapyl alcohol and dibutyl phthalate. Further studies could be focused on the molecular pathways of these toxins production.

ON140

Cattle-grazing effects on diatom assemblages and physical and chemical parameters in peat cores from Alpine mires

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Besides being the most important terrestrial carbon sink, peatlands are valuable ecosystems for biodiversity conservation. In Alpine peatlands overgrazing is a main problem for habitat integrity and biodiversity due to increasing nutrient (N) inputs. Seven 50-cm deep cores were sampled from several mires located in the Adamello-Brenta Nature Park (Italy) along a grazing-induced disturbance gradient. Main physical and chemical features of peat were determined, and taxonomy and ecological characterization of subfossil diatom algae carried out. Diatoms were identified and counted (400 valves) at x1000 magnification. The absolute abundances (n-valves/g-peat-dw) were also calculated. Exploratory data analysis was done with Non-Metric Multidimensional scaling. To test for possible differences among the grazing gradient, a Permutational Multivariate Analysis of Variance was used. Grazing-gradient indicator species were identified with IndVal. Data underlined that grazing influence was limited to the top 20 cm, and resulted in an increasing of density (up to 2×), N concentration (up to 3×) and a lower gravimetric water content (up to 50%). No significant differences were observed below 30 cm of depth. In total, 190 diatom taxa were recorded throughout the 7 cores, and several of them are included in threat categories of the Red List for central Europe (e.g., *Cymbopleura valaiseana*, *Eunotia hexaglyphis*, *E. triodon*). Data also showed that diatom tafocoenoses respond to cattle-grazing-driven shifts in trophic status. In particular, high intensity grazed sites had higher species richness, because of moderately-sensitive, opportunistic mire species, that can become more competitive in the presence of increased nutrients.

ON035

Emerging technologies to address current gaps in satellite remote sensing

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Maximizing the interaction between Remote Sensing (RS) limnology communities is a needed step for developing an integrated approach for a coherent and consistent inland water monitoring system.
The use of of alternative and innovative data sources and tools (drones, autonomous underwater vehicles, citizen science, etc.) have the potential to be a cost-effective solution for establishing an additional data layer to satellite remote sensing. They can provide a critical approach to fill the temporal gaps between satellite observation, either as a result of revisit times or due to interference from cloud cover. The combined approach of*in situ*and satellite data can deliver a powerful combination to observe and verify change at the needed frequency to respond to hydrological events and provide early warning. There are also ample opportunities to calibrate and validate atmospheric correction approaches.
In the framework of the H2020 Water-ForCE, innovative methods for data acquisition are being identified and evaluated for possible integration with satellite RS data streams. The results of this assessment will be presented, including the analysis of the responses to a survey of experts on the use of these emerging technologies to address currents gaps in satellite RS. We will evaluate the perception of added value of these technologies and aspects related to the data quality associated with such observations. We will present our results on how these data sources can be the complement for the next 100 years of inland water RS.

ON185

An examination of sediment algal interactions in the enrichment of cyanobacterial blooms in Lake Superior

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Cyanobacterial blooms are a growing water quality and public health concern in Lake Superior, a typically pristine lake. There has been a potential link between storm events and cyanobacterial blooms. As climate change predictions suggest an increase in storm frequency and intensity, this knowledge gap was examined. Phosphorus in the sediments along the southwestern region of Lake Superior and the nearby rivers is known to be largely mineral-bound, raising questions about bioavailability. The research objective examined the role of sediment bound inorganic phosphorus on the enrichment of cyanobacterial blooms in the southwestern arm of Lake Superior. Sediment samples were collected from the watershed and various forms of phosphorus were measured. As labile phosphorus is the limiting factor in Lake Superior the question of whether the erosive red clay from the landscape or the resuspension from the lake bottom was more integral in supplying P to cyanobacterial blooms was studied. To assess the various forms of phosphorus; ashed TP, anion exchange resin, and the dual culture diffusion apparatus (DCDA) methods were examined. Results from ashed TP and resin extractable P showed the lake sediments were generally higher in TP and resin extractable P compared to river sediments. Results from the DCDA showed that sediments do stimulate algal growth. The findings also revealed the concentrations of P differed among sediments, which could lead to better management strategies identifying hotspots of P to reduce future cyanobacterial blooms.

ON196

Human pressures and functional status of Atlantic river ecosystems

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Rivers are being increasingly affected by human impacts such as pollutants, flow regimens alteration and morphological modification, impairing their structure and functioning. Consequently, ecosystem services such as self-purification or the store and process carbon ability can be crucial to improve river ecological status and mitigate global change. Ecosystem services are sustained by ecosystem functions, which in turn are related to river ecosystem processes, such as river metabolism, organic matter decomposition (OM) or nutrient uptake (U). However, it is challenging to assess the effects of multiple pressures on river ecosystems and understand their combined impact on multiple ecosystem functions. We address this question by quantifying human pressures in 63 rivers of the north of Iberian Peninsula and assessing their relationship with river metabolism, U and OM. We measured river metabolism from oxygen changes, U by a field bioassay, and organic OM decomposition using tongue depressors. We combined functional measurements with data on water quality, ecological status and basin land-use. Measured ecosystem processes showed no-relationship between them neither to invertebrate-based ecological status, highlighting that they responded to different abiotic variables. For instance, OM was correlated with heavy metals (R^2=13%), whereas U-NH_4^+ was correlated with NH_4^+ water content (R^2=17%) and artificial land-use (R^2=23%). Results indicate that ecosystem processes are sensitive to multiple stressors, offering complementary assessment tools to the methods currently used in river ecosystems. Overall, our study highlights the need to promote the use of functional variables on the assessment of river ecosystems, and to understand how ecosystems respond to global change.

ON180

Long-term functional responses of macroinvertebrates to flow restoration in an alpine river

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Alpine streams are dynamic systems, subject to strong disturbance drivers. Environmental conditions are characterized by high discharge variability and large sediment loads. Flow regulation for hydropower is widespread in the alpine area, where numerous dams have been built to exploit the high-head potential of steep valleys. Dams alter both water and sediment regimes, modifying the habitat template and the equilibrium between abiotic conditions and biota. This habitat degradation affects the assembly of aquatic organisms, thereby modifying ecosystem function by filtering for specific traits favoured by stable flow conditions. Adaptive dam management can use experimental floods to maintain periodic disturbance, which is extremely important for such ecosystems. However, these experimental floods are not frequently implemented and knowledge on the topic is limited, therefore research is needed to enable the design of ecologically-sound environmental flows. In this study, we analysed macroinvertebrates and environmental data collected during the monitoring of a 17-year experimental flood program on the Spöl, a regulated alpine river. By comparing the temporal patterns of functional indices and single traits between the Spöl and two unregulated streams, we observed shifts that were compatible with the functional adaptation of macroinvertebrates to the new flow regime. These shifts reflected an increased frequency of traits linked to resistance/resilience and greater functional redundancy. Despite an improvement in the river's ecological conditions, the experimental floods did not generate a complete ecological restoration, indicating that the environmental impacts of flow regulation may be deeply embedded in the system.

ON125

Internal lake and pond dynamics drive greenhouse gas fluxes to the atmosphere

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Although lakes, wetlands, and streams release greenhouse gases at a rate equivalent to over a third of total greenhouse gas emissions via fossil fuel burning, we do not understand what important internal and climate feedbacks might be for these systems. Warmer conditions could lead to increased strength of stratification and degradation of organic matter under anaerobic conditions in lakes with increased production of methane and nitrous oxide, both primarily produced anaerobically. These two gases are particularly problematic because they have global warming potential 85-300 times that of carbon dioxide (depending on time scale). Many other related aspects of greenhouse gas dynamics in freshwater ecosystems are also poorly understood, such as seasonal dynamics and the importance of deep-water habitats. We examined the dynamics of these three greenhouse gases in two lakes and a pond in Minnesota in 2020 and 2021 using both water column measurements and surface to atmosphere measurements including an eddy covariance system. These observations indicated that all of these gases are incredibly dynamic through the summer, with surface waters near equilibrium with the atmosphere in the spring followed by an accumulation to orders of magnitude above saturation in mid- to late summer. There was a gradual increase of the carbon dioxide flux in the most strongly stratified lake after the spring bloom as concentrations increased in the hypolimnion while methane accumulation occurred at a slower rate. Deep water accumulation of these gases can lead to super-saturation and increased fluxes in late summer through fall.

ON097

Effects of multiple stressors on nitrate and cyanobacteria in a large shallow lake

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We used a model chain to predict cyanobacteria biomass and nitrate (NO_3^-) concentrations in Lake Võrtsjärv (Estonia), a large, shallow, and eutrophic lake. The model chain was based on the succession of a mechanistic model (INCA-N) and an empirical, generalized linear model. Model calibration and validation were performed with long term climate and catchment parameters. We constructed scenarios as combinations of climate forcing from the Intergovernmental Panel on Climate Change (IPCC, 3 scenarios), land conversion (forest to agriculture, 2 scenarios), and fertilizer use (2 scenarios). Models predicted half of the variance of cyanobacteria biomass and two-thirds of that of NO_3^- concentrations. Scenarios comprising both forest conversion to agricultural lands and a greater use of fertilizer would cause rises in lacustrine NO_3^- (up to twice the historical mean) and cyanobacteria biomass (up to a four-fold increase compared to the historical mean). The changes in NO_3^- concentrations and cyanobacteria biomass were more pronounced in low and moderate warming scenarios than in high warming scenarios because of increased denitrification rates in a warmer climate. Our findings show the importance of reducing anthropogenic pressures on lake catchments in order to limit harmful pollutant and microalgae proliferation, and highlight the counterintuitive effects of multiple stressor interactions on lake functioning.

ON010

Internal loading in slow-motion: High resolution in situ monitoring of benthic P-fluxes reveals pulsed regimes in a polymictic lake

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Benthic phosphorus (P) release can be a major trigger of phytoplankton growth in many lakes. This so-called “internal loading” can persist for several years after external nutrient reduction. Internal loading is seen as a long-lasting problem but often takes place at short time scales and at high fluxes. However, up to now, internal loading has not been resolved at high-temporal resolution due to constraints in methods and the enormous efforts associated with the acquisition of such data. The new generation of in-situ wet chemistry analyzers now enables us to measure benthic nutrient pulses at high temporal resolution. Our objective is to gain more understanding of short-term P dynamics in shallow polymictic lakes. We hypothesize that P release in shallow polymictic lakes occurs in pulsed regimes. Pulsed regimes are especially important in polymictic shallow lakes where nutrients are directly released back into the euphotic parts of the water column i.e. can be immediately used by phytoplankton. We deployed an in-situ wet chemistry analyzer (HydroCycle PO4, Sea-Bird Scientific) in a shallow polymictic lake for 3 months enabling novel insights into high temporal resolution in-situ P dynamics. We also confirm that indeed P release occurs in pulsed regimes. In-situ P measurement, if combined with phytoplankton monitoring, can provide important insights into the consequences of short-term P pulses on phytoplankton dynamics.

ON080

Ecosystem drivers of leaf traits and resource-use strategies in nymphaeids

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Macrophytes are a fundamental component of aquatic ecosystems by linking riparian (e.g. terrestrial) to aquatic (e.g. pelagic, deep water) domains and offering multiple services. However, eutrophication, invasive species and habitat degradation are threatening macrophytes and terrestrial-wet-aquatic ecotones globally. In this context, approaches based on functional traits (i.e. specific features measured at individual level) are often implemented to quantify plant responses to ecosystem conditions. Here, we carry out a trait-based investigation on local to regional scale (within and among lakes), focusing on four species of nymphaeids: *Nelumbo nucifera* Gaertn., *Nuphar lutea* (L.) Sm., *Nymphaea alba* L. and *Nymphoides peltata* (S.G.Gmel.) Kuntze. Our aim is to gain insights into resource use strategies of nymphaeids (including leaf economic spectrum and biochemistry), integrated with spectral reflectance data at leaf to canopy scales and genetic information, in response to varying stressors and drivers. Data were collected from four lakes in Central-Northern Italy, covering a gradient of physical-chemical water and sediment conditions. We found evidence of wide variability in traits among species, as well as considerable species plasticity within and across sites. Site-specific conditions – mainly driven by surrounding land uses – seem to determine intraspecific differentiation especially in structural traits (e.g. leaf area), while biochemical traits (e.g. pigments) show a high local variability, which is probably due to plot-specific conditions. This evidence suggests a relevant environmental filtering force on resource allocation in response to abiotic factors and reinforces the key contribution of intraspecific trait variability to shed light on spatial patterns within and among ecosystems.

ON405

Effects of salinization, temperature rise and low flow on leaf litter decomposition in small experimental stream channels

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Urban freshwaters are often exposed to a multitude of anthropogenic stressors which affect biological communities and a wide range of ecosystems processes, including the decomposition and microbial decomposers of plant litter. Salinization, temperature increase and low flow are among the most common stressors, and are exacerbated by global climate change. However, their effects on litter decomposition and associated decomposers are not well known. The present study focused on the effect of salinity, temperature increase, low flow and their combination on leaf decomposition and colonization by a particular group of fungi known as aquatic hyphomycetes, the main microbes associated with decomposing leaf litter in streams. We exposed alder leaves in a total of 128 stream channels of an outdoor mesocosm facility (ExStream), where salinity varied from 100 to 700 mg Cl^-/l, temperature was increased by 4°C and flow velocities were either normal or reduced. We determined leaf mass loss and analyzed the litter-associated fungal communities by determining their biomass, their sporulation rates as well as community composition of aquatic hyphomycetes based on microscopic analyses. Fungi colonized the leaf litter in all mesocosms, and this was accompanied by significant leaf decomposition for all treatments. However, there were no indications that fungal biomass or community structure differed strongly between leaves exposed to different salinities, temperature or flow regimes. These results suggest that microbial decomposers and the decomposition of leaf litter supplied to urban streams are barely affected by exposure to low levels of the three stressors characterizing these environments, even in combination.

ON212

Towards a new indicator of ecological integrity based on the fine scale detection of submerged aquatic vegetation patterns in fluvial lakes

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Acting as ecological indicators and engineers, submerged aquatic vegetation (SAV) species are sentinels of shallow freshwater ecosystems. Despite this fact, their use as indicators is often limited to abundance metrics, which are ill-fitted in the detection of non-linear ecological transitions. To facilitate the monitoring of fluvial ecosystems, the main objective of this work is to develop and evaluate methods to quantify fine scale organisation of SAV landscapes in fluvial lakes of the Saint-Lawrence River, Quebec, Canada. To do so, an open-sourced method for high resolution remote sensing of SAV is proposed based on geographic object-based image analysis (GEOBIA) and tested of Worldview-03 and Quickbird-02 imagery. The sensitivity of this classification to environmental and sensor noise was evaluated for simulated and real landscapes using multiple landscape indexes. For model images, binary SAV cover detection performed well (< 10% error) for all vegetation types except deep SAV covers in highly turbid waters, suggesting sufficient performance for larger scale monitoring. Preliminary results associated with spatial organisation detection show strong interactions between spatial resolution and noise that could limit the detection and quantification of SAV landscapes. These results suggest that very high to high (1-10 m) resolution sensors could be used to monitor SAV landscape complexity and organisation through time if noise is minimized and robust organisation index are selected. This work shows that fine scale spatial organisation of SAV is a strong candidate for ecological monitoring in fluvial lakes.

ON224

Priority effects in aquatic systems

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Priority effects are largely overlooked as a structuring element in determining both population and community assembly in aquatic systems. Yet, priority effects are expected to be common in inland waters because of their typical spatial organization, strongly affecting connectivity of local populations and communities. I will illustrate how priority effects can affect both the assembly of populations and communities, and how these two can influence each other. I will illustrate consequences of priority effects on local and regional biodiversity and on landscape genomic and metacommunity structure. Using the water flea *Daphnia* as a model system, I will illustrate that even a few colonists can be sufficient to bring substantial standing genetic variation to local populations, and will expand on implications of this observation for conservation and the interpretation of spatial patterns in genetic and species diversity. Finally, I will highlight the need to better explore functional and ecosystem consequences of priority effects.

ON155

Landscape-drivers of Carbon sources and processes in Boreal rivers of Québec

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From the recognition of rivers as active pipes of biogeochemical processing to current times, efforts have been made to effectively incorporate these aquatic ecosystems into global C budgets. Boreal fluvial networks stand out as hotspots of biogeochemical transformation and emission due to their hydrological complexity and landscape-scale features such as vast drainage areas of peatland and organic rich soils across these water-rich regions of the planet. Here, we present a study of large river watersheds spanning a wide range in area and landscape properties across a geographic gradient within the boreal biome of Québec (Canada), where we address the variation and identify the major drivers of C concentrations and fluxes in riverine surface water. We seek to understand how external versus internal C sources influence the balance between C emissions to the atmosphere and C export to the ocean, and how these processes are influenced by the surrounding landscape. For that we sampled chemical properties and dissolved and gaseous C concentrations in the main channel of these major rivers, and in a subset, we monitored streamflow in an hourly basis using hydrometric stations, and installedminiDOT optical loggersto monitor water temperature and dissolved oxygen to further model ecosystem metabolism. This was combined with data on watershed features, land cover and soil properties to identify potential drivers. We will discuss how landscape properties influence the concentration and fate of C in these systems, including the important role of lentic surface water cover as a sink of C within fluvial networks.

ON179

Lake density across altitude shapes macroinvertebrate biodiversity in mountain areas

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In mountain areas, relief imposes dispersal barriers and shifting environmental conditions to species distribution. Also, adequate environmental conditions to survive may be scattered, and the patch size and density of fragmented habitats introduce additional constraints, which can vary across altitude. Mountain lake districts constitute a paradigmatic case of such situation. In this study, we aimed at assessing the relevance of both lake size and the density of lakes for biodiversity, as well as their interaction with environmental and boundary factors across altitude. We focused on some groups of macroinvertebrates with contrasting dispersal capabilities and environmental requirements (i.e., Chironomidae, Oligochaeta, Nematoda, Ephemeroptera, Plecoptera, and Trichoptera). We found that lake area plays a minor role in species richness compared to altitude, as all groups show the highest species richness in the high lake-density belt, which occurs at intermediate elevations. This effect increases within subsets of species with wider ranges, and is induced by the high-altitude boundary alone, rather than by both boundaries, in contrast to the effect of lake density, which applies throughout. Some species certainly follow specific environmental gradients (e.g., temperature, macrophytes, organic matter and acid neutralizing conditions), but the influence of environmental factors on species richness is strongest in the high-density belt. Also, beta diversity is most reduced therein. Both suggest that priority effects might be relatively more determinant in more isolated lakes. All in all, our results confirm an increased metacommunity connectivity with lake density, and also that species richness benefits more from lake density than from lake area.

ON177

Comparative phylogeography of alpine/subalpine Himalopsyche species revealed distinct genetic structures in the Himalayas and Hengduan Mountains

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As two adjacent mountain regions surrounding the Qinghai–Tibetan Plateau, the Himalayas and Hengduan Mountains are characterized by their unique topographical features and complex climates. Under the joint influence of topology and climate, these mountains are the most important freshwater sources in Asia: most of the major rivers originate or flow through these

regions. These mountains and their rivers are also known to be hotspots of freshwater biodiversity and endemism. To exemplify the contributing roles of geology and historic climate on the evolution of present-day biodiversity, we conducted a comparative phylogeographic study on four endemic species of *Himalopsyche* (Trichoptera, Rhyacophilidae) in this area. These four species are preselected as two species pairs with alpine or subalpine lower altitude distributions in the Himalayas and Hengduan Mountains, respectively. We inferred the population structure and historical demography using genome-wide sequences, as well as a species distribution model at present and the last glacial maximum for each species. The results show that the alpine species are structured by the mountain range and independent of catchment, while the population of subalpine-distributed species is most likely structured by catchment system. Moreover, most of the four species went through a population expansion during the last glacial maximum. Our research not only reveals the different genetic diversity patterns of the four *Himalopsyche* species inhabiting alpine and subalpine regions in the Himalayas and Hengduan Mountains but also illustrates how these patterns are shaped by the local landscape and historical climate changes.

ON304

Breaching barriers to open mesocosm science

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Open science describes the practice of carrying out science in a completely transparent way, and making the results available to everyone. Although this practice should apply to science in general, the reality is that the mesocosm science community has proven hesitant in fully embracing the principles of open science. Open science covers different aspects of the scientific process, including open access, open data, open reproducible research, open science evaluation, open science policies, and open science tools. Identified challenges towards open science are socio-cultural, legal, economic, political and organizational, and call for an integrated approach to breach the barriers of open mesocosm science. For the past years, the EU-funded RI-projects **AQUACOSM and AQUACOSM-plus** (**www.aquacosm.eu**, 2017-2021/2020-2024) have taken significant steps towards open mesocosm science, by e.g. creating a centralized (meta)dataportal, generating standardized operating procedures for collecting data, providing online training modules, and developing tools to reduce heterogeneity in data processing. I will showcase each of these steps, and exemplify the benefits of open science by showing the development of remotely controlled mesocosms, with near-realtime open data streams allowing for wider user access. Adoption of open mesocosm science workflows will allow a broader user base to tackle grand research challenges.

ON151

Toward long-term modelling of the thermal regime and oxygen solubility of perialpine lakes

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Climate change modifies the thermal regime and oxygen solubility in lakes globally, resulting in the alteration of lake habitats. The use of 1D lake models has become the standard in lake research to evaluate the effects of climate change. However, the required global scale forcing parameters have several limitations, such as the need of downscaling. Here, we evaluate the possibility to force mechanistic models by following the long-term evolution of shortwave radiation and air temperature while providing realistic seasonal trends for other meteorological parameters. The performance of 1D hydrodynamic lake models was assessed for long-term variations based on 70 years of limnological data collected by the French Observatory of LAkes (OLA). Further, the effects of climate change on the thermal regime and oxygen solubility were analyzed in the four-largest French peri-Alpine lakes. Our results show that 1D models forced by air temperature and short-wave radiation accurately predict variations in lake thermal regime, with RMSE of 1.14°C. According to model simulations in the epilimnion and hypolimnion respectively, during the last three decades, water temperatures have increased by 0.46°C/decades (±0.02°C) and 0.33°C/decades (±0.06°C). Accordingly, O_2 solubility decreased by -0.104mg/L/decades (±0.005 mg/L) and -0.096mg/L/decades (±0.011 mg/L) due to thermal change. Based on the ssp370 socio-economic pathway of the IPCC, perialpine lakes will face an increase of 3.80°C(±0.20°C) in the future until 2100. These results suggest important degradation in lake thermal and oxygen conditions as well as habitat loss for endemic species.

ON268

Sudden eutrophication in a German drinking water reservoir after 20 years of stable mesotrophic state and good water quality

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In drinking water reservoirs, water quality management and nutrient control are important aspects for safeguarding drinking water security. In this work's study object, the German drinking water reservoir Dröda, a range of measures have been successfully implemented: improving wastewater management, Phosphorus (P) elimination in pre-dams, and reservoir aeration. Despite these measures, an ongoing recent eutrophication tendency called for a throughout analysis of nutrient dynamics. The unknowns were the nutrient retention capacities of Dröda's two pre-dams. A 30-year time series (1991-2021) allowed analyzing P removal in both pre-dams based on annual load estimated for orthophosphate (SRP) and total phosphorus (TP) using four different methods: Through weighted and unweighted averaging of concentration and discharge, and by means of non-linear statistical concentration dynamics predictions based on GAMs, and the USGS-package EGRET. All methods delivered similar loads. However, unweighted averaging exhibited significant divergence for large discharge deviations from the typical runoff regime. The average SRP retention efficiencies were 25.2% and 39.8% in the pre-dams. Concerning TP, those lowered to 9.1% and 21.5%, respectively. Less than 25% of the present P is dissolved, so SRP retention does not severely impact the overall TP budget. Although the transfer of dissolved P into particulate P worked properly, subsequent sedimentation was insufficient, especially during flash floods. While P-load comes mostly from the catchment, higher tendencies toward hypolimnetic anoxia point to the increasing importance of internal loading. A discussion of options for future-proof adaptive management concludes the work.

ON129

Combining mesocosm experiments with dynamical modelling – the synergy of two powerful approaches

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Disentangling the contributions of multiple environmental drivers and ecological interactions to complex ecosystem dynamics is typically not feasible based on observational data alone. In this context, mesocosm experiments provide two main advantages. First, many putative drivers can be controlled or manipulated. Second, the physical environment and the community of interacting organisms are often simplified, reducing noise and enabling a focus on a limited number of key processes. As a corollary, a small number of processes in a simple environment can often be adequately described with dynamical models. Combining mesocosm experiments with predictions from process-based dynamical models therefore creates synergies between these two powerful research tools. I illustrate this with two examples in which dynamical models were used to predict and explain the responses of mesocosm communities to climate dependent drivers. The first study explored consequences of browning and warming for primary production in shallow waters. The second study explored consequences of warming for spring succession of the plankton. In both cases, the physical and biological setting could be approximated with relatively simple models that predicted strong biotic

feedbacks on the light and/or nutrient environment. The experimental results (to which many people contributed!) were largely in line with model predictions, suggesting that asymmetric competition between benthic and pelagic producers and stoichiometric constraints on zooplankton growth, respectively, were responsible for the observed system responses.

ON210

Dimensioning artificial floods for restoration of a complex floodplain system using hydromorphological modelling, UAV remote sensing and in situ measurements

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The alteration of natural flow and sediment regimes for hydropower production is a major factor driving floodplain structure and function. Artificial floods are becoming more common as operational measures to restore hydrological and ecomorphological dynamics in floodplains downstream of dams. Major challenges arise in dimensioning artificial floods are the magnitude, duration and frequency of flood releases with regard to their general applicability and implementation. Here we used a combined approach of 2D hydromorphological modelling, UAV remote sensing and in situ measurements to predict and plan the ecomorphological effects of artificial floods in a residual flow section of a complex river floodplain, consisting of main and side channel as well as islands, gravel areas and floodplain forest. Input data for the hydromorphological model were digital elevation models (DEM) and hydrological and morphological parameters obtained before and after three artificial floods of different magnitude, duration and frequency released in the past 6 years. The DEM including the bathymetry for the model was built from UAV data before and after each flood and with the help of correction factors and cross sections taken with RTK-GPS. These data served to validate the simulated results. Morphological impacts were correlated with biotic changes such as the succession of periphyton growth or the benthic community. This approach allows us building artificial flooding scenarios varying in magnitude, duration, and frequency to simulate ecomorphological changes qualitatively and quantitatively to support the dimensioning and implementation of artificial flood programs for restoration in complex floodplains.

ON031

Hydrography90m: a new global seamless, standardised hydrographic network

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Streams and rivers drive several processes in hydrology, geomorphology, geography and ecology. A stream network that precisely delineates streams and rivers, along with their topographic and topological properties, is required for freshwater ecology, predictive models, management and conservation. We aimed to address this need by using the MERIT Hydro Digital Elevation Model at 3 arc-sec (~90 m) to derive a globally seamless, standardised hydrographic network, the „Hydrography90m“, with corresponding stream topographic and topological information. A central feature of the network is the minimum upstream contributing area of 0.05 km^2 (or 5 ha). This value defines the channel initialization and allowed to extract headwater stream channels in great detail. By employing a suite of GRASS GIS hydrological modules, we calculated the range-wide upstream flow accumulation and flow direction to delineate a total of 1.6 million drainage basins worldwide, and to extract 726 million unique stream segments with their corresponding sub-catchments. In addition, we computed 42 stream topographic variables comprising stream slope, gradient, length, and curvature attributes, as well as stream topological variables to allow for network routing and various stream order classifications. The validation of the spatial accuracy and flow accumulation of Hydrography90m against three other global hydrographic network datasets showed that the newly developed Hydrography90m has the highest spatial precision, and contains more headwater stream channels than the other datasets. Hydrography90m thus provides a long-overdue baseline for assessing streamflow in headwaters, and opens new research avenues for high-resolution studies regarding biodiversity patterns worldwide.

ON334

The role of the atmosphere as an oxygen source in a temperate reservoir: a case study of Rappbode Reservoir, Germany

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Dissolved oxygen (DO) of a temperate drinking water reservoir in the Harz Mountains (Germany) was investigated over a time period of 18 months. Via depth-specific fortnightly sampling of DO concentration, saturation, and stable isotope ratios of dissolved oxygen (expressed as $\delta^{18}O_{DO}$) we were able to trace DO dynamics with respect to lake stratification and a Metalimnetic Oxygen Minimum (MOM). DO isotopes were used to separate respiration from photosynthesis and atmospheric exchange. Samples of the MOM zone showed the highest R/P ratios and had amongst the most positive $d^{18}O_{DO}$ signals caused by respiration. These values may serve as supporting indicators of MOM zones. Over the evaluation period, 19.4% of the reservoir had $\delta^{18}O_{DO}$ values that were compatible with atmospheric equilibration (+24.6 ‰ ± 0.4 ‰), thus indicating an atmospheric DO source. With values smaller and larger than this threshold, the remaining $\delta^{18}O_{DO}$ values showed that 40.8% of our database was dominated by photosynthesis and 39.8% by respiration. From April to December, the reservoir was stratified and overall DO consumption by respiration exceeded the amount of DO producted via photosynthesis. Quantification of respiration (R) and photosynthesis (P) confirmed the epilimnion as a photosynthetic environment, while the hypolimnion was mostly dominated by respiration at various degrees of their maximum values. Overall, the combination of DO concentration patterns together with its isotope ratios proved useful to quantify sources and sinks as well as the major processes affecting oxygen dynamics in aquatic sciences.

ON201

Riffle and pool macroinvertebrate communities are differently affected by species sorting based on the position in the river network: a case-study from an alpine river basin

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The aim of this study is to shed light on the spatial and temporal variation in the diversity and composition of benthic invertebrate communities at river network scale by examining simultaneously the role of the mesohabitat type. Six central (<1 Km from the mainstem) and six peripheral (>1 Km from the mainstem) river reaches, belonging to 12 different tributaries, were selected in the upper part of the Po River Basin (Italy; elevation range: 658-1525 m asl). All river reaches were pristine and showed very comparable conditions in terms of land use, climate, geology and channel morphology. At each river reach, three riffles and three pools were selected: one Surber sample was collected from each of them, along with several near-bed (i.e. flow, substrate, CPOM and periphyton) and physical and chemical variables (i.e. pH, water temperature, conductivity and dissolved oxygen). Macroinvertebrate sampling was carried out on three different seasons: spring (April 2021), summer (July 2021) and Autumn (November 2021). Preliminary results show that, on average, riffles had higher macroinvertebrate richness and abundance than pools. When looking at the effect of environmental variables on the community composition we found that, on average, species sorting was higher in riffles than pools. Moreover, among riffles, the effect of species sorting on the macroinvertebrate community composition was higher in peripheral reaches than central reaches; while this trend was not corroborated with respect to pool communities. These results highlight the importance of the mesohabitat type when studying the biodiversity variation at river network scale.

ON052

Rising algal- and soil-derived dissolved organic matter modifies interactions between bacteria and phytoplankton in a high-altitude lake

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Allochthonous and autochthonous dissolved organic matter (DOM) concentrations are expected to increase in high-altitude lakes with climate change and could modify interactions between bacterioplankton and phytoplankton. We performed laboratory experiments in microcosms amended with glucose, algal lysate, or soil extract, either enriched with inorganic nutrients or not. Planktonic community from a high-altitude lake was incubated for 10 days, either in the dark or under artificial dark:light cycle. Both bacterioplankton and phytoplankton appeared to be highly limited by inorganic nutrients in early summer in Lake Cordes, since nutrient enrichment increased drastically their biomass and the proportion of autotrophs. Bacterioplankton consumed more dissolved organic carbon with algal lysate but bacterial biomass increased more with soil extract amendments. Rising the carbon source increased phytoplankton biomass when ciliate abundance was high, suggesting that the top-down control by ciliates over bacteria regulates the interaction between bacteria and phytoplankton. Mixotrophic phytoplankton taxa were stimulated with glucose, algal lysate, and soil extract when light or nutrient limitation occurred. Under non-limiting light conditions, the proportion of autotrophs increased more with algal lysate than with soil extract. Our results support the hypothesis that relationships between phytoplankton and bacterioplankton shift with DOM increase in high-altitude lakes. The expected climate-driven changes in DOM in high-altitude lakes may greatly alter aquatic food webs and the C transfer through the trophic chain. This study addresses the large question the consequences of climate change on the functioning of the base of planktonic food webs.

ON030

Spatial patterns and knowledge gaps of the threats to European freshwater fishes

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Freshwater fish species are the second most threatened animal group while the richest among European vertebrates. The International Union for Conservation of Nature (IUCN) Red List contains information on species' populations, distribution, ecology and threats, setting the foundation for a comprehensive evaluation of species extinction risk. Using this information, this work aims to detail geographical patterns of threat incidence using species richness, conservation status and migratory phenology while identifying the knowledge gaps in scientific referencing of the threat identification process. The analysis includes 434 species for which 837 threats were identified, but only 11 were supported by valid scientific literature. This lack of scientific support affects the reliability of the UICN assessments, species conservation and threat management. The migratory phenology with the highest number of threatened species is "resident" (46.3%) and the most frequent threat type (>50%) was "Dams & water management/ Use". Geographically, there is an overall high level of imperilment in European freshwater fishes, with central Europe having high richness and threat incidence but a low proportion of species threatedness, while southern Europe, particularly Iberia, presents low richness but high threat incidence and species threatedness. River network fragmentation by instream barriers will be the most relevant challenge to future river restoration. The current level of freshwater fish species imperilment is overall high across Europe, particularly in southern regions. Scenarios of global change forecast that alterations will be more pervasive in southern Europe, restoration efforts and scientific funding are thus crucial for climate adaptation and conservation in these areas.

ON303

Effects of the psychoactive drug Venlafaxine on freshwater food-web dynamics and ecosystem functioning

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In the last few decades, emerging pollutants such as pharmaceuticals have been detected in surface waters, raising concerns about potential threats to ecosystem functioning and consequences for associated services delivered to people. Pharmaceuticals reach wastewater primarily through excretion from households and discharge from hospitals. Subsequently, there is incomplete removal in varying degrees during the wastewater treatment. One such pharmaceutical of emerging concern is Venlafaxine (Effexor), a commonly prescribed antidepressant recently added to the European Water Framework directive watchlist. The addition was based on the criteria that the available monitoring data, although insufficient, suggests that the substance is persistent and toxic. Therefore, there is an urgent need to ascertain the long term effects this pollutant and its metabolite can have on the aquatic ecosystem. This study uses a mesocosm approach to quantify the effects of Venlafaxine on freshwater food-web structure and ecosystem functioning by assessing functional and structural endpoints. A replicated gradient design was used with a chronic 2 month exposure period followed by a 2 month recovery period. The functional endpoints included primary productivity and respiration, decomposition and nutrient analyses. Structural endpoints included periphyton, phytoplankton, zooplankton, macrofauna and bacterial community composition. Our results suggest that venlafaxine and its metabolite accumulate in the sediment, and this accumulation continues to persist in the recovery period. The functional endpoints showed non-monotonic dose responses. Structural endpoints showed variable trophic group-specific responses. Our results underline the importance of adopting mesocosm approaches in testing ecosystem level consequences of emerging pollutants.

ON321

Fecal Indicator Bacteria modelling in rivers with a deterministic approach

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Fecal Indicator Bacteria (FIB), used to control water quality in water, are directly linked to anthropogenic contamination of water resource by wastewater discharges. Recreational water activities like bathing is becoming an emerging objective in many European cities, therefore making important the control of water quality in order to prevent bathers from health issues. While a water quality measurements are necessary to define safe bathing places, modelling can be used for predicting the future water quality following meteorological events, expanding the spatial and temporal information brought by single measurements, and identifying most damaging discharge points in order to prepare management plans.
The Paris region case represents a great opportunity for FIB modeling as the Olympic and Paralympic Games will take place in 2024 with the opening of numerous bathing sites as a legacy in the Marne and Seine rivers. Under these circumstances, many FIB measurements have been done in rivers providing a substantial data set to calibrate models. However, the FIB measurements requires either long or expansive methods resulting in poor datasets for urban discharges or small tributaries.
This presentation focuses on the utilization of a deterministic model (ProSe) to simulate FIB in rivers offering different possibilities. First, to simulate the impact of planned changes in the urban networks evolutions or climate change and to provide estimates of future concentrations, then, to develop a data assimilation method to recalibrate the model with currently developing on-line FIB measurements to finally develop real time model for continuous simulation of FIB concentrations in rivers.

ON409

Habitat coupling is modified by dissolved organic carbon in lake ecosystems

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Generalist predators play an essential role in lake ecosystems by linking spatially distinct habitats. By using a wide array of resources while moving between littoral and pelagic habitats, they can link food webs potentially providing critical habitat stability. As climate change is expected to affect ecosystem stability, our attention should focus on how habitat coupling in these predator-stabilized systems is altered by climate change. Expected climate change effects in boreal regions are increases in temperature and dissolved organic carbon (DOC) concentrations. Therefore, we used stable isotopes and a space-for-time approach to examine the impact of DOC and temperature on resource use and habitat coupling in a generalist predator, European perch (*Perca fluviatilis*), in 17 lakes in Sweden and Germany. We found that the impact of DOC on habitat coupling depended on fish ecotype, with littoral perch showing a unimodal response in habitat coupling to increased DOC and pelagic perch showing decreased coupling with increased DOC. Though we found no direct effect of temperature on habitat coupling, we did find that fish size, which is negatively related to temperature, has an impact. We show that in the future, as fish size decreases and DOC increases, generalist predators will couple habitats less and have a narrower dietary niche width. This shows that while perch will respond flexibly to changes in resource availability, stability may decrease in the process.

ON246

Mobilomics of toxic/bioactive peptide production in the bloom-forming cyanobacterium *Planktothrix*

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It has been generally hypothesized that mobile elements can induce genomic rearrangements and influence the distribution and functionality of toxic/bioactive peptide synthesis pathways in microbes. In a recent study, we performed in depth genomic analysis by completing the genomes of 13 phylogenetically diverse strains of the bloom-forming freshwater cyanobacteria *Planktothrix* spp. to investigate the role of IS elements in seven pathways. Genome size varied from 4.7–4.8 Mbp (phylogenetic lineage 1 of *P. agardhii*/*P. rubescens* thriving in shallow waterbodies) to 5.4–5.6 Mbp (Lineage 2 of *P. agardhii*/*P. rubescens* thriving in deeper lakes) and 6.3 Mbp (Lineage 3, *P. pseudagardhii*/*P. tepida* including planktic and benthic ecotypes). Although the variation in genome size was positively related to the proportion of IS elements (1.1%–3.7% on chromosome), quantitatively, IS elements and other paralogs only had a minor share in genome size variation. Six of seven peptide synthesis gene clusters were found located on the chromosome. In general, no increased IS element frequency in the vicinity of peptide synthesis gene clusters was observed. We found a higher proportion of IS elements in ten breaking regions related to chromosomal rearrangements and a tendency to colocalization of toxic/bioactive peptide synthesis gene clusters on the chromosome. Likely orthologous genes inserted by horizontal gene transfer led to genome increase during evolution from Lineage 1 to Lineage 2. Six of seven peptide synthesis gene clusters occurred already in the ancestor of *P. agardhii*/*P. rubescens*, and became partly lost during the evolution of Lineage 1.

ON336

Tracking the establishment and effect of neozoa in Lake Constance using (historical) environmental DNA

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Recent decades have seen an increase of the establishment of non-native species, many of which pose considerable threats as invasive alien species (IAS). Time series of species occurrence can elucidate the tempo and mode of establishment, as well as their effects, but real time monitoring data is not universally available. An alternative source of data on the establishment and effects of invasive alien species is historical environmental DNA, such as obtained from lake sediment cores. The large perialpine Lake Constance has witnessed the establishment of a number of neozoa in the past decades - in addition to severe eutrophication and subsequent oligotrophication in the past century, and currently rising temperatures. As it is a very well studied system that is routinely monitored, establishment dates for recent neozoen arrivals are quite well known. Thus it is an ideal system to evaluate the sensitivity and fidelity of sedimentary DNA to track the establishment of neozoa.
Using a combination of species-specific reactions and DNA metabarcoding, we here investigate the reliability of sedimentary DNA to track the presence of different neozoa in the lake. Both surface sediments collected across the lake, as well as sediment core DNA recorded the presence of different neozoa, but with varying sensitivity. For invasive dreissenid mussels, DNA could be recorded in the core, and the records are in good accordance with previously supposed time spans of arrival. Sediment core DNA is thus a valuable archive to retrospectively investigate the tempo and mode of invasions in freshwater systems.

ON385

Effects of environmental variability and flood intensity on aquatic macroinvertebrates in the Karun river catchment (Iran)

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In spring 2019, streams in the Karun River catchment, the biggest river in Iran, experienced three major waves of rain within two weeks, which resulted in extreme floods. Floods generate natural disturbance in river systems, promoting fluvial dynamics and sustaining eco-morphological processes. Macroinvertebrates play a key role in fluvial ecosystems, governing many ecosystem functions and services. Macroinvertebrates show life history and ecological adaptations to the hydrological regime, with peculiar resistance/resilience traits to flood disturbance. However, such extreme floods are increasing in frequency and magnitude due to global warming, holding potential effects/repercussions on aquatic ecosystems. In this study, we will present how structural and functional characteristics of local macroinvertebrate communities responded to extreme flooding. We measured different habitat characteristics and sampled macroinvertebrate communities in 44 sites across the Karun river catchment before and after the extreme flood event. We calculated the return period of the flood as a disturbance gradient, which revealed substantial differences for the different streams of the catchment. Moreover, we calculated different taxonomic and functional diversity indices based on existing traits databases. We used generalized linear mixed models (GLMMs) to investigate taxonomic and functional diversity indices' responses to flooding intensity. We observed that baseline community composition, and flood intensity were the main drivers of structural and functional responses. Our findings benefit the understanding of the impacts of environmental variability on benthic macroinvertebrate communities and contribute to the prediction of the effects of extreme floods intensification in a relatively understudied region.

ON447

Accumulation of caratenoids as an adaptation to extreme environments in calanoids from temporary Antarctic ponds on Livingston Island (Maritime Antarctica)

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Temporary shallow ponds are emerging on Livingston Island as a result of snow and ice retreat and concurrent thawing of permafrost during the last decades. Such hydroecosystems could provide suitable habitats for development and dispersion of crustaceans of subclass Copepoda. These invertebrates have developed various evolutionary adaptations that assist their survival in extreme environments. Pigmentation is among the means adopted by copepods enabling them to thrive in ponds exposed to intensive ultraviolet radiation (UVR). Our aim was to study the type of pigments and their distribution in males, ovigerous females and their eggs. We collected Boeckella poppei from a shallow temporary pond above the Bulgarian Antarctic Base on Livingston Island. The red pigments were extracted with 99% ethanol and analysed spectrophotometrically. We recorded a distinct peak at 480 nm, corresponding to the expected absorbance peak of astaxanthin or a similar carotenoid. Quantitative analysis demonstrated significant differences among the studied groups: the pigment concentration was about twice higher in females as compared to males and circa 2.5 times higher in eggs, as compared to females. Although the accumulation of carotenoids in calanoids is well-documented for "extreme environments", e.g. at high elevations or in (sub)Arctic regions with higher exposure to UVR, this is the first study to explore and empirically confirm concentrating astaxanthin in eggs of B. poppei. It is likely a means of progeny protection. Further analyses are needed to explore the origin of pigments and mechanisms of accumulation while accounting for differences in females, males and eggs.

ON060

Assessing the importance of cobalt as a micronutrient for freshwater cyanobacteria

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Micronutrients play key roles in numerous metabolic processes in cyanobacteria. However, our understanding of whether the micronutrient cobalt influences the productivity of freshwater systems or the occurrence of cyanobacterial blooms is limited. This study aimed to quantify the concentration of Co necessary for optimal cyanobacterial growth by exposing *Microcystis aeruginosa* to a range of Co concentrations under culture conditions. Extended exposure to concentrations below ~0.06 µg · L^{-1} resulted in notable inhibition of *M. aeruginosa* growth. A clear negative relationship was observed between Co concentration in solution and intracellular Fe quota of *M. aeruginosa*, possibly due to decreased transport of Fe at higher Co concentrations. Cyanocobalamin and any Co within the structure of cyanocobalamin appears to be non-bioavailable to *M. aeruginosa*, instead they likely rely on the synthesis of a structural variant – pseudocobalamin, which may have implications for the wider algal community as the variants of cobalamin are not necessarily functionally exchangeable. To evaluate the likelihood of Co limitation of cyanobacterial growth under field conditions, a survey of 10 freshwater reservoirs in South-Eastern Australia was conducted. Four of the ten sites had dissolved Co concentrations below the 0.06 µg · L^{-1} threshold value. All four of these sites rarely undergo cyanobacterial blooms, strengthening evidence of the potential for Co to limit growth, perhaps either alone or in combination with phosphorus.

ON026

Hierarchical modelling of lentic odonate communities using opportunistically sourced data

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Small waterbodies play an important role in the conservation of freshwater biodiversity. Understanding the local and regional processes that drive the structure of freshwater metacommunities is of key importance to advance our knowledge of freshwater systems and to inform management decisions. Typically, studies on freshwater biota are both costly and time-consuming, resulting in a limited spatiotemporal extent and resolution. At the same time, online biodiversity portals have recently facilitated the collection of a wealth of biodiversity data, mainly driven by expert naturalists. The use of such opportunistically sourced data, however, poses several challenges including imperfect and heterogeneous detection probabilities as well as the lack of a rigorous sampling design. We developed a Bayesian joint species distribution model (jSDM) that aims to closely mimic the data-generating process underlying opportunistically sourced data on lentic systems by naturalists. We apply our model to analyse a dataset encompassing over 500,000 records of lentic odonate species across thousands of waterbodies in Flanders (Belgium), primarily collected by the Flemish Dragonfly Society through the online biodiversity portal Waarnemingen.be. By doing so, we are able to disentangle spatial patterns, species-to-species associations and environmental drivers of odonate (meta)community composition, as well as the influences of traits and phylogenetic relationships thereon. In summary, our approach enables the study of freshwater metacommunity data at unprecedented scales using opportunistically sourced data.

ON085

Hydrophysical models document impact of global warming on water availability of a drinking water reservoir

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Reservoirs are crucial to manage water resources, specifically in regions with a temporal or spatial mismatch between water demand and availability. An increasing number of reservoirs serve multiple purposes like drinking water production, flood protection, or energy production. Managing the limited storage volume requires trade offs because reservoir functions such as flood protection and drinking water production, have conflicting targets. In addition, global warming increases water temperature, decreases ice cover duration, and changes mixing dynamics in reservoirs. This threatens water quality and increases pressure between the management targets. Mitigation strategies are needed to cope with the impact of global warming. For a case study (Lichtenberg Reservoir) an ensemble of hydrophysical models (GOTM, GLM, Mylake, Simstrat, Flake) was used to predict future development of water temperature, stratification duration, ice cover development, and hypolimnetic drinking water availability. We used regionalized climate data provided by statistical downscaling using the WETTREG2010 method and following the A1B SRES as described in the fourth IPPC report. We found an increase in surface water temperature of almost three degrees and a lengthening of the summer stratification duration of 25 days until 2100. We expect a decrease of ice cover probability from nearly 100% in the past to below 25% in 2100, which could lead to a stratification regime shift from dimictic to monomictic. Our study suggests a management of reservoirs using a dynamic withdrawal strategy from the epi- and hypolimnion, as it maintains a colder hypolimnion water temperature.

ON406

Leaf litter from banana plantations slows down the decomposition of native leaves but does not influence the invertebrate assemblages

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Natural forest land-use changes to agricultural purposes have largely impacted the biological structure and functioning of low-order streams. For instance, agriculture not only affects water quality by the increase of chemicals and sediments but also alters leaf litter inputs into streams. Herein, we evaluated (i) the downstream effects of agricultural areas and (ii) the effect of banana leaves on the decomposition rates and the structure of aquatic invertebrate assemblages in forest stream reaches. For this, we incubated leaves of the native tree species Miconia chartacea and the exotic Musa spp. (banana) in single and mixed-species litter bags (10 mm mesh) on forest reaches located in upstream and downstream agricultural areas. The presence of upstream agriculture did not change leaf decomposition rates, nor the abundance and taxonomic richness of invertebrate assemblages. However, upstream agriculture affected the taxonomic composition of invertebrate assemblages and reduced the richness of shredders. Leaves of the native species decomposed faster than those of banana. In the mixed-species treatment, the decomposition rates of M. chartacea decreased by 32% compared to the single treatment, while the rates of banana leaves did not change. Contrary to expectations, leaf species did not affect the structure of invertebrate assemblages. Thus, the negative effect of leaf mixture on M. chartacea decomposition might relate to the altered activity of both microbial and invertebrate decomposers. Our findings corroborate the negative effect of agriculture and exotic leaf litter on the structure and functioning of forest streams.

ON169

European-wide river restoration needs

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River systems represent ca. 1% of the Earth's surface, and are disproportionally important for biodiversity maintenance, as they maintain a high number of species. Furthermore, these systems provide a multitude of ecosystem services on which society is dependent. Because of this dependence, rivers have long been affected by anthropogenic pressures, that are still increasing and that will potentially be exacerbated due to climate change. For instance, in Europe, around 50% of the human population lives in former floodplains, and 95% of these areas have been lost along with over 85% of alluvial forests. The present work aims at mapping areas where legally binding targets still to be achieved concerning the Habitats (both for species and for habitats) and Water Framework Directives. This mapping will also take into account the EU Biodiversity Strategy 2030, river connectivity targets (focusing on river longitudinal connectivity affected by instream artificial barriers) and the EU adaptation to climate change strategy (future global changes concerning climate, land-use and water demands/necessities predictions). The results will help to identify areas in Europe where river restoration is needed and will provide an overall context to European-wide river restoration management and design, hopefully influencing public policies and facilitating the achievement of the directives' goals, while contributing to biodiversity conservation and ecosystems' functional resilience.

ON194

Can grazers control eutrophication in streams? How biofilm food quality mediates stream ecosystem health

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Both bottom-up and top-down factors control the biomass of primary producer communities such as benthic algal biofilms (periphyton) in streams. Both mechanisms were demonstrated to impact periphyton biomass, but with strong variations in the strength of top-down control in different natural settings. We here investigated the hypothesis that the strength of top-down control of algal biofilms is determined by the food quality of the algae, which is in turn regulated by allocation of essential resources. We tested this hypothesis on different scales and complexity levels in both highly controlled laboratory experiments and field-related mesocosm experiments. This includes the homogenous local patch size, the multi-patch level with spatial heterogeneity and the choice for gazers as well as high-complexity level under consideration of growth and migration behaviour of grazers in mesocosm experiments. Our data show that anthropogenic eutrophication leads to a reduction of top-down control exerted by herbivores via both alterations in grazing activity and spatial structuring of the biofilms. This demonstrates how the strength of top-down pressure on biofilms is regulated and contributes to our understanding of eutrophication control in natural surface waters.

ON413

Restored river-floodplain connectivity promotes woody plant establishment

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Riparian forest ecosystems are declining globally. Many floodplains no longer flood and thus cease to satisfy the hydrologic requirements for riparian tree maintenance and regeneration.To promote woody riparian plant recruitment where flood regimes have been altered by flow regulation, effective approaches to restoration need to be developed. We implemented a landscape-scale experiment in a remnant, temperate floodplain forest. By constructing two weirs within channelized reaches of a stream, we redirected flows into networks of historic distributary channels, which facilitated widespread floodplain inundation. Using a control-reference-impact study design, we assessed the establishment and growth of planted seedlings of three woody species (*Eucalyptus camphora*, *Leptospermum lanigerum* and *Melaleuca squarrosa*) over 13 months in response to flooding achieved by floodplain reconnection. Planted seedlings had higher height and diameter growth rates at both induced (19–29 cm, 1 mm) and naturally flooded (34–44 cm, 3–5 mm) than at non-flooded (4–10 cm, -5–-3 mm) sites. However, survival rates and temporal growth patterns differed between species according to variation in flood duration and soil moisture, illustrating the different hydrological requirements of the coexisting species. This highlights that variable flooding and drying patterns are essential to create recruitment niches for different riparian plant species and shows the importance of river-floodplain connectivity for providing adequate flooding regimes. Our study demonstrates the suitability of two complementary restoration approaches – restoring hydrology and active revegetation – for promoting the regeneration of riparian forests.

ON283

Fluorescently labelled bacteria in combination with FACS successfully discriminate actively-feeding mixotrophs in a lake water sample

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Mixotrophic protists are capable to act both as primary producers and primary consumers at the base of the aquatic food web, thus constituting key organisms in ecosystems where they are abundant. However, their identity, abundance, ecological dynamics and biogeochemical impact in aquatic ecosystems remains understudied in comparison to those organisms matching the classical dichotomy between heterotrophy and autotrophy. In this study, we present a method based on fluorescently labelled prey and fluorescence-activated cell sorting to taxonomically identify actively-feeding individual mixotrophic flagellates in natural lakewater samples. A proof-of-concept experiment was carried out where water from an oligotrophic lake was exposed to several types of fluorescently labelled prey and a complementary treatment based on food-vacuole staining. A total of 996 individual isolates were successfully recovered, and all treatments exhibited high sensitivity for putative mixotrophic taxa: overall, 87% of the occurrences could be assigned to dictyochophytes, 9% to chrysophytes and 3% to dinoflagellates. In addition, taxonomic profiling of the sample showed no presence of other putative mixotrophic species, indicating high specificity of the method. We argue that this methodological approach can be a valuable tool to uncover relevant and unexpected active mixotrophic species in a wider range of aquatic environments, and could easily be coupled to other techniques to describe the finer details of the trophic status of aquatic microbial communities.

ON091

Is hydropeaking pushing hydropower beyond the limits of renewability?

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Climate emergency poses new challenges for the ecosystemic management of reservoirs, which introduce impacts of an unprecedented magnitude so far. One of them relates to the marginal cost pricing procedure for energy (so-called „skyfall profits of electricity companies“). The other is reversible pumping with surplus energy for later turbination when demand increases. Besides the known environmental impacts on the ecosystem services of rivers, there is now the uncertainty posed by the new model of hydropower management for our adaptation to climate change, especially in Mediterranean zones. This work analyzes the issue in six large Spanish reservoirs (total reservoir capacity between 40 and 1,446 hm^3), in which the 2021 hydropeak led the government to open proceedings for malpractice in their hydropower management. For this purpose, time series analysis is carried out over the whole available historical period (discharge, reservoir volume, inflows, outflows and energy price), comparing what happened in 2021 with previous periods. In terms of discharge, decreases of between 54 and 76 % were recorded in the middle of Mediterranean summer, corresponding to variations of 47.8-78.6 % in terms of reservoir volume (36.8-73.9 % on average over the last 10 years). We investigated which of these parameters is more determinant or limiting in explaining the timing and magnitude of the hydropeak. The results are discussed in the light of information on the ecological status of the reservoirs and measures are proposed to value the ecosystem services of the reservoirs in the face of climate change.

ON340

Limnoperna fortunei infestation estimation in the Urubupungá Complex, Brazil

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Golden mussel is a species originally from China that invaded South America 30 years ago and expanded threateningly northward. *Limnoperna fortunei* is currently the top 3 invasive species in Brazil, being found in almost all watersheds, affecting energy production, altering the physical and chemical conditions of rivers, competing with native species, and negatively impacting tourism. In search of an effective and sustainable technological solution to estimate the infestation of the species and potentially eradicate it, a mathematical model of the dynamics of mussel populations in larval and adult stages and algae (food) as a function of the velocity field, based on the Navier-Stokes equations, type and area of substrate and carrying capacity was carried out. Model was solved by the Finite Element Method, using linear triangular elements, and applied to three reservoirs located in southeastern Brazil: Três Irmãos, Ilha Solteira, and Jupiá. Simulations use known data on the golden mussel biology, as well as topo bathymetric, physicochemical, and biological information obtained from field work. Três Irmãos is estimated to be the most infested site with ~233 billion individuals in a useful perimeter of ~130 Km, while Ilha Solteira contains ~196 billion individuals in ~116 Km and Jupiá 97 billion individuals in ~75 Km, with average densities (Kg/m^2) of 0.19, 0.09 and 0.08, respectively. Mathematical estimate is alarming, considering that the region studied holds the main hydroelectric production area in Brazil. This study is a baseline for the biotechnological solution of producing genetically modified organisms to successfully control *L. fortunei* infestation.

ON379

Mediterranean streams vulnerability, functions and services for the cities: The case of a hyper-salinized stream in Marseilles

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Over half of the Earth's population currently lives in cities and this number is projected to increase in the future. In a context of global changes, Mediterranean urban areas must face with increasing temperature, scarcity of resources (food and water), flooding risks, and increasing pollutions. Adaptation plan for these cities have the object to make transition from "Sanitary City" to "Sustainable City," which has focused on green infrastructure and urban ecosystem restoration. Among these ecosystems, urban streams and their riparian vegetation are strongly impacted by human activities and must be able to provide functions and services such as cooling effect. This study explores and identifies physicochemical and ecological degradation observed in a Mediterranean urban stream „Les Aygalades“ located in Marseille agglomeration. Hydrobiological monitoring integrates abiotic and biotic compartments such as cartography of mesohabitats, water chemistry, and sediments, algae, macro-invertebrates and riparian vegetation). in addition to the classic symptoms described in the urban stream syndrome (altered channel morphology, regulated hydrology), our results relate an excessive increase in conductivity and metallic concentrations leading to reduced and altered ecological capitals (decrease of aquatic communities richness and riparian composition changes) . A discussion is proposed about the abilities of sick rivers to provide services in cities and the necessity to restore all the catchment area or to find alternative solutions.

ON193

Biofilm extracellular enzyme activities in response to temperature: a latitudinal study

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The extracellular enzyme activities released by microbial biofilms are a primary mechanism for organic matter decomposition. Microbial activity is highly responsive to temperature increase, but this response could change depending on the temperature sensitivity of microbial communities adapted to different climates. Global warming predictions suggest an increase of mean air temperatures, expected to be different at each latitude. Our objective was to examine the temperature sensitivity of 6 different enzymes in epilithic biofilms at 5 different sampling sites across a latitudinal gradient (from 69ºN to 6 ºN). From each site, we measured water quality and we characterised epilithic biofilm functional and structured parameters. Additionally, we incubated extracellular enzyme activities at 5 different temperatures ranging from 4ºC to 32ºC.
Our results showed a remarkably higher temperature sensitivity in the Artic region (69ºN) than sampling sites located at lower latitudes, especially showing higher leu-aminopeptidase activity (organic nitrogen compounds degradation) and phosphatase activity (organic phosphorous compounds degradation) at that site, probably indicating limitation of N and P at higher latitudes in contrast to carbon. Complementary, we observed that activity of enzymes related with organic carbon degradation (β-glucosidase and Cellobiohydrolase activity) clearly decreased as latitude increased, indicating a C-limitation at lower latitudes. Our results help to improve the prediction about temperature responses of organic matter degradation to global warming in river systems around the world, showing different responses in nutrient stoichiometry depending on the latitude of the river sampling sites.

ON001

Short term population trends for freshwater fish species in Germany – The decline of the common species and a new data-set to aid conservation efforts

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More than 6000 freshwater fish species are listed as threatened by extinction by the IUCN globally. Until the late 20th century, German freshwater fishes suffered massively from pollution, habitat destruction, and unsustainable stocking. After a strong recovery starting in the 1980th, most populations have reached population plateaus at low or very low levels, possibly because other poorly analysed threats drive population trends of the 117 native and alien freshwater fish species in Germany. However, high-quality freshwater monitoring data, data access, data harmonisation, and data integration remain challenging to support conservation efforts. With all its data specialities for each federal state, federalism still hinders nationwide analysis, and even in 2022, not all German states will make their data available. We compiled, harmonised and analysed high-quality fish abundance data for 16 federal states to assess population trends from 2004 to 2020 for native and invasive freshwater fish species. Our analysis was part of the re-assessment of species for the national Red List, and it was the first time that data educated short-term population trends. From 34 native and six alien species having sufficient time-series data, we found 11 native species with significantly negative population trends. In addition, all but one alien species showed pronounced increases in abundance over the past 15 years. Almost the complete data-set is published and made open source for further research.

ON454

Development of a cellphone-based alarm system for harmful algal blooms

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In recent years, global climate change has affected various environments, including aquatic ecosystems. Increased nutrient influxes due to heavy rain or increased solar radiation may lead to a significant expansion of harmful algal blooms in surface waters. There also exists serious concerns about potential contamination of domestic drinking water supplies. Thus, a quick alarm system needs to be created to notify the public when harmful algal blooms appear on water surfaces. Historically, investigators collected water samples in the field and analyzed them in a laboratory to identify the algal species and their concentrations. However, this method requires much time and money to obtain results. Today, many citizens use their cellphones to easily take high precision pictures anywhere. Also, they can send the data quickly via the internet and share the observed data with many people thorough the network. That is why we want to develop a cellphone-based alarm system and construct a platform on the web to provide a public early-warning system to make alerts about the development of harmful algal blooms. This platform will combine essential information such as the images, locations and dates. After the data are transmitted to a server, the uploaded images will be analyzed using image processing software and species names and abundance will be available to the public. Furthermore, the large amount of data that will be accumulated in the database can also be used to simulate for nowcast or forecast conditions of water bodies.

ON202

Using metacommunity ecology to understand the relationship of periphyton community structure and niche partitioning across a river network

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The trait-based partitioning of species within a local habitat plays a critical role in biodiversity-ecosystem function relationships. This niche partitioning drives and depends on community structure, yet this link has never been explicitly studied in the context of a metacommunity, where local community assembly is dictated by regional dispersal alongside local environmental conditions. This is a substantial shortcoming particularly in river networks, where local habitats are highly connected by water flow in a spatially complex network structure and frequent disturbance makes community structure strongly dependent on recolonization. Here, we show that taxa turnover between periphyton communities colonizing deployed bricks (microhabitats) also implied a turnover in traits; we interpret this finding as strongly indicating niche partitioning within sampling sites (local habitats) across a river network. Spatial stream network models identified richness of periphyton communities to increase along the longitudinal gradient, suggesting downstream dispersal to increase the regional metacommunity pool. Further, niche partitioning showed a hump-shaped relationship with richness, which suggests that increased richness ensured the colonization by taxa possessing diverse traits to efficiently partition into environmentally different microhabitats. However, at excessive dispersal, mass effects inflated richness with less suited taxa from upstream communities that co-occupied several microhabitats and swamped niche partitioning. Accordingly, efficient niche partitioning depended on communities rich in rare taxa, an indication for the importance of specialists. Alarmingly, richness and rare taxa declined with high phosphorus concentrations and conductivity, respectively, two parameters which potentially reflected anthropogenic activity.

ON106

(Temporal) sinks of microplastics in freshwaters and implications for biota

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It is assumed that 80% of the marine plastic originates from land and major parts may be transported via rivers. In each river studied so far for plastic contamination, plastic was found. However, the longitudinal distribution of plastic in rivers is largely unknown. We investigated the microplastic distribution along a 70 km long stretch of a German river, starting at the source. We sampled floating microplastic every seventh kilometer and upstream and downstream of major inflows, towns and waste water treatment plants. Results showed that the amount of suspended plastic does not correlate with the kilometers flew. Some sampling points downstream other contain less plastic than sites located more upstream. Weirs and reservoirs may act as sinks for microplastics as decreasing flow velocities lead to higher sedimentation rates. This may enhance the uptake of plastic by benthic organisms and (temporally) excludes plastic from the water column. This may result in unexpected patterns of plastic distribution in freshwaters and diverse impacts on freshwater fauna.

ON287

Mysterious ciliates: seasonally recurrent and yet hard to predict

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Ciliates consume approximately 50% of the primary production and thus represent a crucial link between phytoplankton and bacteria and mesozooplankton in pelagic food webs, but little is known about the processes influencing the dynamics of individual species. Using 12 years of long-term, high frequency observations, we compared the diversity and the temporal variability in biomass and species composition of the ciliate community in large, deep, mesotrophic Lake Constance to that of the phytoplankton and rotifer communities in the same lake. Furthermore, we used boosted regression trees to evaluate possible environmental predictors (temperature, bacteria and different algal prey groups, daphnids, calanoid and cyclopoid copepods as predators or competitors) influencing ciliate net growth. The biomass of all ciliate species showed a common, recurrent seasonal pattern, often with peaks in spring and summer. The ciliate community was more diverse than the rotifer community, exhibited highly synchronous dynamics and its species were regularly encountered during the season. The top-down control by copepods likely contributed to the ciliates' synchronized decline prior to the clear water phase when food concentration was still high. The high temporal autocorrelation of the ciliate biomasses together with the inter-annual recurrent seasonal patterns and the low explanatory power of the environmental predictors suggest that the dynamics of individual ciliate species are strictly controlled, yet it remains difficult to determine the responsible factors. This raises the question whether a niche based perspective or one based on neutral theory is more appropriate to understand ciliate community composition and its dynamics.

ON087

Effect of predams and catchment on thermal and mixing regime of Germany's largest drinking water reservoir under climate change

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One of the most severe challenges to aquatic ecosystems in lakes and reservoirs is climate change. Reservoirs integrate atmosphere and catchment, thus ultimately capturing climate signals. Climate change alters the discharge and temperature of inflows, which have a significant effect on thermal structure of reservoirs, but little is known about how catchment changes affect reservoirs. To better characterize the evolution of the thermal and mixing regimes of drinking water resources in Germany under climate change, we investigated the Rappbode Reservoir, Germany's largest drinking water reservoir as well as two of its predams. A one-dimensional lake model (GOTM) was established on both predams and the main dam, and was coupled to the catchment model mHm, which supplied flow rates into the predams and main reservoir under climate change. We used representative concentration pathways (RCP) 2.6, 6.0, and 8.5 from 4 different GCMs, which are available through the ISIMIP dataset to simulate the water temperature distribution from 2005 to 2099. The effect of predams under climate change and the future projection of thermal regimes considering changes in catchment were investigated. Our results highlight that the use of predams decreases the hypoliminion temperature and shortens the stratification duration of the main reservoir, indicating the predams shield the main dam not only from nutrients, but also from warming. The inflow temperature affected stratification in the predams, but in the main dam the effect was small compared to atmospheric forcing. In future work we will assess reservoir management to derive recommendations for climate adaptation.

ON250

Chironomid reduction alters carbon cycling in ponds

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Ponds are important repositories of organic carbon (C) and hotspots of C cycling and greenhouse gas emissions. Tube-dwelling invertebrates, such as chironomids, can be key players in C processing, particularly in shallow aquatic systems such as ponds. Their effects on C fluxes and pools at the ecosystem level, however, are poorly understood. We tested whether a reduction in chironomid abundance by application of the biocide *Bacillus thuringiensis israelensis* (Bti), has implications for C fluxes and pools in replicated experimental ponds. Seasonal sampling was conducted over one year in shallow and deep zones of the ponds. C-fluxes included CO_2 and CH_4 evasion, and C efflux as emerging aquatic insects. C-pools included dissolved inorganic and organic C in surface- and pore-water, sediment organic C, C in plants, and C in macroinvertebrates. Most C fluxes and C pools varied strongly over seasons and differed systematically between shallow and deep zones. Yet the reduction of chironomids resulted in a reduction of dissolved organic C in the deep zones, and an increase in CH_4 evasion from shallow ones. Our results point out that structural changes in the macroinvertebrate community can cascade to ecosystem-level C biogeochemistry, which is of special significance for understanding the biogeochemical implications of anthropogenic stressors.

ON073

Bti-based mosquito control agent alters natural benthic community composition in replicated pond systems

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Bacillus thuringiensis israelensis (Bti)-based larvicides are widely used to combat mosquito populations and considered to be environmentally safe for non-target organisms. However, recent studies found that Bti can reduce the number of non-biting chironomids (Diptera: Chironomidae). As chironomid larvae are a key food source for many aquatic predators, such as dragonfly and damselfly larvae (Odonata), the reduction of chironomids can affect the macroinvertebrate community composition in aquatic-terrestrial ecosystems by bottom-up effects. We applied the maximum field rate of Bti to six ponds a replicated freshwater pond system, a total of three times, while the remaining six ponds were untreated. Three weeks after the last Bti application, we found

a significant reduction of chironomid larvae up to 40% in Bti-treated ponds and a difference in macroinvertebrate community composition driven by the reduced number of chironomids and Libellulidae (Odonata) in Bti-treated ponds. Additionally, the number of Odonata exuviae (cast-off skin) that we collected during the second year of the experiment to determine long-term effects of Bti on the number of emerging dragonflies (i.e., Libellulidae), was significantly reduced in Bti-treated ponds by 55%. Since Odonata larvae are not directly susceptible to Bti, our results suggest an indirect effect of Bti on Libellulidae larvae due to reduction of chironomids as prey and therefore reduced emergence success. The effect of Bti is not limited to the reduction of a single taxa, i.e. chironomids, but cascades on to the aquatic food web and the linked terrestrial ecosystem.

ON134

Skyglow effects on lake primary producers in an ecosystem-scale enclosure experiment

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Diel cycles of light and darkness play a key role in structuring aquatic communities and ecosystems. This role could be disrupted by globally growing light emissions at night, even in rather remote areas when skyglow resulting from light scattered in the atmosphere is returned to the Earth' surface. Despite this recognition, the impact of skyglow on lake ecosystems is poorly understood. We assessed responses of primary producers to experimental skyglow in 15 large enclosures deployed in a clear-water lake in one of the darkest spots of Central Europe. Diffuse white light emitting diodes (LEDs) were installed above the enclosures to ensure three levels of nighttime illumination: dark controls (0 lx), low (0.06 lx) and high (6 lx) levels of skyglow. Results of the six-week experiment showed no detectable effects on total phytoplankton biomass, production, or any of the four physiological variables tested (cell viability, cell death, production of reactive oxygen species, chl-*a* fluorescence). In contrast, skyglow altered individual phytoplankton size fractions by reducing pico- and nanophytoplankton biomass. Differences in the size distribution of phyto- and zooplankton in illuminated and control enclosures suggest that these shifts were due to size-selective grazing on small phytoplankton, possibly mediated by consumers attracted to light at night. These results indicate that low intensities of artificial light at night can indirectly affect primary producers in lakes, while direct physiological effects are undetectable. This points to the need of experiments in realistic settings reflecting the complexity of lake ecosystems to determine ecological impacts of low-level light pollution.

ON233

Artificial ditches support populations of rare insects in temporary streams

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Dominant in drylands and widespread in cool wet countries such as England, temporary streams often occur in agricultural areas. Here, ditches with similar flow regimes to temporary streams increase the extent of temporary habitats, but – as artificial watercourses that drain farmland – are particularly exposed to stressors such as nutrient and sediment runoff. Despite these stressors, rare drying-tolerant specialist insects (DS) from pollution-sensitive mayfly and stonefly families have been reported from ditches. Thus, we aimed to determine whether ditches consistently provide suitable habitat for DS, and whether ditch populations have the potential to support DS populations in nearby temporary streams. We surveyed DS species in groundwater-fed temporary streams and ditches across nine sub-catchments in southern England. We identified the Nationally Rare DS stonefly *Nemoura lacustris* and the Nationally Scarce DS mayfly *Paraleptophlebia werneri* in six of nine streams, and in six sub-catchments, ditches also supported DS. Ditches thus provide suitable habitat for DS, which may be more widespread than previously recognised. However, communities sampled from temporary streams had a higher probability of containing DS than ditches—whereas the abundance of DS in temporary streams was higher when the sub-catchment also contained a ditch-based population. Our results suggest that DS prefer the habitat conditions in temporary streams, but that ditches may enhance resilience to environmental variability in temporary streams by providing colonists that support population recovery after disturbances such as flooding or drying.

ON192

Microbial invasion and resistance profiles of river biofilms under flow constrain and rising temperature

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Because of the close proximity and high densities of microbial cells, river biofilms could be primary facilitators of antibiotic resistance dissemination by horizontal gene transfer. Here, we investigated whether climate warming could promote microbial invasion and resistance transmission within river biofilms, especially when grown close to pollution sources and experience unusual warm conditions. In this work, river biofilms grown in proximity of wastewater effluent were relocated in microcosms and subjected to three scenarios for a duration of 14 days: water flow circulation at 20°C, stagnant water at 20°C, and at 30°C. A genetically tagged *E.coli* was added as microbial invader at the beginning of the experiment. Quantitative PCR and amplicon sequencing were applied to quantify bacterial abundance, bacterial diversity, and a pool of antibiotic resistance markers (*sul1, sul2, ermB, tetW, tetM, tetB,* $bla_{CTX\text{-}M\text{-}1}$, *intl1*), and to measure the *E.coli* invasion success under rising water temperature and flow reduction. Our results show that the abundance of all resistant genes significantly decreased over time regardless of the treatment applied. Initially, the tagged*E.coli* successfully invaded the biofilm communities, but then rapidly decreased in abundance. Neither stagnancy nor high water temperature allowed the invasion to last more than three days. The absence of continuous inputs of wastewater bacteria and pollutants potentially led to a reduction of the antibiotic resistance background and made the communities diversity and composition more similar to each other. These results suggest a low permissivity of the river biofilms to exogenous bacteria and antibiotic resistance invasion.

ON239

Pool-to-flow alternation and inter-basin water transfer determine functional responses of invertebrates in intermittent rivers

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We aimed to investigate the effects of environmental changes promoted by pool-to-flow alternation and by inter-basin water transfer-IBWT on invertebrates' functional traits in intermittent rivers. The study was carried out in the Rio Paraíba Watershed in the Brazilian semiarid region, with collections in the pool phase in 2018 and the flow phase in 2019. We used resistance (body armoring, body size, and respiration) and resilience (adult life span, dispersion, and swimming ability) functional traits to determine the functional dominance and only effects traits (body size, dispersion, and swimming ability) to determine functional redundancy.

We observed the dominance of drought resistance categories in the pool phase and drought resilience in the flow phase. Traits dominance in the IBWT differed from all other scenarios in the flow phase (PerMANOVA: $p<0.05$). The functional redundancy was lower in the pool phase (0.37±0.22) than in the flow phase (0.63±0.17) in almost all scenarios (PerMANOVA: $p<0.05$, except for scenario 2). Only one scenario without IBWT showed significant differences in functional redundancy for the IBWT scenario (PerMANOVA: $p<0.05$, for scenario 3). River phase alternation increased the number of dominant functional strategies due to functional redundancy. The greater dominance of categories that confer respiration and aquatic dispersion in the flow phase of the IBWT scenario expressed the most prolonged period of connectivity of these aquatic habitats concerning the other scenarios. The perpetuation of intermittent channels and the consequent changes in the transition of aquatic phases in intermittent rivers can impact the invertebrate functional strategies.

ON191

Rapid and enigmatic eutrophication of a clear water lake: Potential causes and consequences

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Evidence is mounting that various remote lakes worldwide that have been little influenced by human activities are undergoing unexpected nutrient enrichments in recent years. The reasons for these developments are not well documented and rarely understood. Here we present the case of an endorheic clear-water lake, Lake Stechlin in northeastern Germany, where eutrophication has dramatically accelerated since about 2011. Long-term monitoring data of the lake reveal that the annual concentration of total phosphorus (TP) more than quadrupled over the last decade, from 13±3 µg L^{-1} (1970-2011) to 61 µg L^{-1} (2020), although the lake is situated in an almost entirely forested catchment. Hypolimnetic O_2 consumption rates during summer stratification have more than doubled, which has resulted in increasingly large volumes of the hypolimnion becoming anoxic towards the end of the stratification period. Despite these dramatic changes, there are no indications that phosphorus inputs to the lake from the catchment have increased. Long term data of TP vertical distribution in the lake water, multi-year sediment trap measurements and P analyses of sediments were used to detailed analyses of internal P pools and fluxes. Scenario analyses based on a one-box model showed that the P supply required for the observed TP increase is much higher than the sum of all external P sources currently identified. These results suggest a dominant role of internal P loading from both profundal and littoral sediments, possibly triggered by prolonged stratification as a result of climate- change, loss of submerged vegetation, and other mechanisms.

ON315

Applicability of DNA-based macroinvertebrate identification in the IBMWP index for ecological status assessment. Strengthens and issues to be solved for routine Iberian biomonitoring national program

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Morphology-based identifications are currently used for biodiversity assessments and biomonitoring of freshwater ecosystems. However, up to date molecular tools can provide a much higher taxonomic resolution and better community structure data, to overcome well-knownlimitations of conventional approaches such as being time-consuming and prone to misidentifications. Despite its future potential to fulfil the European Water Framework Directive, important challenges must be previously tackled mainly regarding the lack of coverage for problematic taxa. For that purpose, a study was carried out by using a benthic macroinvertebrate "mock community" previously identified by a morpho-taxonomic approach. This mock community was also representative, both in taxa presence and relative abundance, of a natural Mediterranean river community (R-T09 river type, according to the RD 817/2015). Additionally, benthic macroinvertebrates samples from other river types were collected in spring 2020 at 11 sites across Ebro Basin (Spain) as part of an official national stream monitoring program. These were further included in the study.The mitochondrial gene for the cytochrome-c oxidase subunit I (COI) was used for DNA barcoding.We hypothesized that both the macroinvertebrate community structure as well as the results of ecological status assessment obtained from metabarcoding on macroinvertebrates could be comparable to those obtained using the conventional morpho-taxonomical approach. Our results show concerns about databases and, more specifically, on the incompleteness of the reference database for Iberian rivers and the high level of endemicity for some Iberian taxa. Other important issue to be tackled is the amplification success and scarce recovery of endemic Iberian taxa.

ON167

Effect of anionic surfactant on the demography of *Plationus patulus* (Rotifera)

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Aquatic environments are continuously altered by different types of pollutants, many of them are of xenobiotic origin and among those that most affect water bodies are antibiotics, microplastics and surfactants. This last group is highly diverse since it is found in a large number of industrial products of daily use. Cleaning and disinfection properties of surfactants are enhanced by additives such as wetting agents, adherents and emulsifiers. Anionic surfactants are generally of synthetic origin such as sodium dodecyl sulphate (SDS). SDS has been found to have negative ecological effects on aquatic organisms. Currently anionic surfactants in Mexico have scarce regulation. Therefore, the aim of this work was to investigate the effects of SDS on a common rotifer, *Plationus patulus*. We tested the effect of different concentrations (1.25, 2.5, 5, 10 and 20 mg/L) of SDS on population growth and life table demography of rotifers. Our resulted showed that with increase in the concentrations of SDS, there was a decrease in the survival and fecundity rotifers. Population growth curves showed decreased abundances with increasing concentration of SDS.

ON222

Climate change as the major driver of changes in shallow lake functioning during the last 1600 years

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Climate change and human activities are the main drivers affecting lake functioning. Using a multi-proxy paleolimnological approach we investigated long-term changes in lake Kakel Huincul (Argentina, South America) to evaluate the impact of climate change. Age-Depth model was based on a combined 210Pb, 137Cs, and 14C dating. According to Generalized Additive Models on principal curve scores, two distinct periods occurred in this shallow lake: 1- a turbid (ca. 1653-1862 AD) and 2- a clear regime (1862 AD- present). Low nutrient load and primary productivity (based on chlorophyll and carotenoid pigments) characterized lake conditions during the turbid regime. Halophilic diatoms and cladocerans (*Daphnia spinulata*) dominated. The shift to a clear lake occurred at the end of the Little Ice Age (LIA) (ca. 1860), changing from pelagic to littoral-benthic primary production, i.e., from *Cyclotellameneghiniana*and *Aulacoseira granulata* to benthic-epiphytic diatoms and submerged macrophytes dominance from 1862 AD to the present. Overall primary production and nutrients increased. Cladocerans shifted from large-bodied *Daphnia* to small-bodied *Ceriodaphnia*. Dry and cold conditions persisted during the LIA, favoring a turbid regime with high water conductivity; however, the increment in temperature and precipitation after this climatic event promoted the shift to littoral-benthic lake pathways and clear conditions. A reduction in lutein and the increment in alloxanthin, cyanobacteria-related pigments, and benthic diatoms suggest a decrease in plant cover since the 1990 AD. Main changes in lake functioning were principally climate-driven; dry and cold conditions prevent macrophyte development, implying diversity loss and turbid scenarios for lakes under dry conditions.

ON387

Global evidence of extreme climate events on river biodiversity and functions

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Gradual and extreme climate changes trigger complex ecological responses to ecosystems. However, it is still unclear to what extent trend- or event-driven climatic disturbances have altered some ecological responses and ecosystems. We fill this gap for river systems, by conducting a meta-analysis on the effects of climate change on their biodiversity and ecological functions. The systematic analysis of global evidence reveals that extreme climate events produce substantial negative impacts on species richness and biomass, while the impacts of climate change trends are generally weak. However, effects on ecological functions (primary production, organic matter decomposition, respiration) are unequal, affecting only primary production. On average, the impact of extreme events on river biodiversity is twice as high as the impact of gradual climate changes. Evidence suggests that extreme climate events such as abrupt water flow decreases may move river biodiversity beyond their dynamic steady states, affecting particularly larger and mobile organisms.

ON226

Measuring the contribution of evolution to community trait structure in freshwater zooplankton

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In this study, we determine drivers of evolutionary trait change that structure community features in natural landscapes. We use data collected from a survey in freshwater cladoceran communities, landscape population genetic data and phenotypic trait data measured in a common garden. Based on the common garden and community composition data, we quantify the impact of local evolution on cladoceran community trait values of a keystone species *Daphnia magna.* Using this quantification as a response in a Bayesian linear model, we assessed whether the spatial variation in the impact of local trait evolution could be predicted by population genetic properties (within-population genetic diversity, genetic distance among populations), ecological properties (Simpson's diversity, phenotypic divergence) or environmental divergence. We found that the impact of local trait evolution varied among communities. We also found that community diversity and phenotypic divergence were better predictors of the contribution of evolution to community trait values than environmental features or genetic properties of the evolving species. Our results indicate the importance of ecological context for the impact of evolution on community features, and the importance of evolution in structuring communities.

ON188

Long-term total nitrogen to total phosphorus ratios might support the management of shallow-lake eutrophication

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We assessed to which extent total nitrogen (TN) or total phosphorus (TP) concentrations can help explain chlorophyll-a (Chla) concentrations given (i) that phytoplankton is included in both the TN and TP pool, (ii) the often weak link between Chla and TN or TP for intra-annual or annual data, (iii) and discussion about whether N, P, or both control system productivity and Chla. We tested these three issues with a shallow-lake dataset (mean depth < 6 m) from the U.S. and Denmark using a novel bootstrap procedure to assess the explanatory power and robustness of generalized linear models (based on Gamma distribution, not log-transformed) for annual means (4053 1-year summer means from 1141 lakes) and long-term means (635 6-year summer means from 145 lakes). We found that the long-term TN:TP means, but not the annual TN:TP means, determined whether TN or TP, or TN and TP, was closely correlated with Chla. For long-term means, TP well explained Chla at molar TN:TP > 50, but weakly below 20, where TN well explained Chla. Between TN:TP ratios of 20-50, TN and TP were highly correlated to Chla. Higher concentrations of inorganic N and P at TN:TP where TN or TP only weakly explained Chla imply that the weak correlations may be due to excess, unused N and P from external or internal sources. We conclude that long-term TN and TP concentrations, together with TN:TP ratios, may help inform shallow-lake eutrophication management but are potentially too simplistic to be used on their own.

ON139

Exploring the use of desmids as a monitoring tool for dystrophic lakes in Western Ireland

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Dystrophic lakes and pools are important freshwater habitats which support several rare and threatened species and are protected in Europe under the Habitats Directive (3160 Natural dystrophic lakes and ponds). Many of these lakes and pools are small in size (< 1 hectare (ha)) and are underrepresented in water quality monitoring programmes such as the European Union (EU) Water Framework Directive. Many tools used to monitor ecological status have been designed with clear water lakes in mind, but dystrophic lakes function differently and therefore have unique physico-chemical and ecological characteristics. Here we propose that desmids could be used as a monitoring tool for dystrophic lakes as they are abundant in acidic, low alkalinity waters. We sampled the phytoplankton and benthic desmid community of 24 lakes and pools in Western Ireland during spring and summer 2021. These lakes ranged in size from 0.03 ha to 8.87 ha, with one phytoplankton and benthic sample taken from small lakes (≤1 ha) and 3 samples taken from larger lakes (>1 ha). Benthic samples were taken from the dominant substrate from each lake (rock scrapes, *Sphagnum* squeezes, macrophyte squeezes). We found that the phytoplankton community was comprised of desmids, diatoms, chrysophytes and dinoflagellates. Although desmids were not always the most abundant algal group, they consistently had the highest species richness and could therefore be targeted for ecological monitoring. The benthic community differed according to substrate with diatoms dominating rock scrapings whereas desmids dominated *Sphagnum* and macrophyte squeezes.

ON258

Connectivity controls on nitrate dynamics in stream-lake networks

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Anthropogenic perturbations of the nitrogen cycle, in particular nitrate pollution, are important stressors in aquatic ecosystems, increasing the risk of eutrophication, hypoxia, and loss of biodiversity. The impact of hydrological connectivity on nitrate transport and biogeochemical cycling is, however, not well understood. Here, we report nitrate concentration and stable isotope data from connected stream-lake networks in the English Lake District, UK. Our results demonstrate that water residence time strongly impacts nitrate drawdown in lakes throughout the year, as well as across a trophic gradient of surveyed stream-lake systems. Phytoplankton assimilation and microbial denitrification were important processes controlling nitrate transport through lakes. Additionally, stable isotope data revealed a substantial contribution of concurrent nitrification in the epilimnion and hypolimnion, supplying recycled nitrate as substrate for subsequent drawdown processes. Export of lake-defined nitrate concentrations and stable isotope composition were monitored within streams fed by lake outflows. While the lake signal dominated in the outflow of the most eutrophic lakes, stable isotope signatures increasingly reflected inputs from other catchment nitrate sources downstream. This research highlights the importance of understanding controls on nutrient biogeochemistry within river-lake networks to assess the fate and impact of nitrate supply within freshwater ecosystems.

ON028

The Global EPTO Database: a worldwide inventory of aquatic insect occurrences

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Aquatic insects represent 64% of the freshwater fauna diversity, yet their populations have been in decline in the recent years. Aquatic insects are widely used as indicator species in macroinvertebrate metrics to assess water quality and overall freshwater ecosystem health. Despite their importance, a comprehensive, global database of aquatic insect occurrences for freshwater biodiversity macroecological studies and applied freshwater research is missing. We aim to fill this gap and present the Global EPTO Database that includes worldwide geo-referenced aquatic insect occurrence records of the orders Ephemeroptera, Plecoptera, Trichoptera and Odonata (EPTO) at the genus taxonomic level. We have collated a total of 8,447,227 WGS84 geo-referenced observation records of EPTO genera globally, with geographic precision of at least 10 m, spanning from 1951 to 2021. Each record is attributed to the corresponding drainage basin and sub-catchment based on the high-resolution Hydrography90m dataset, and is accompanied by the elevation value at the point of its observation, extracted from the 3 arc-second resolution MERIT-DEM.
The harmonised occurrence records can readily be used in species distribution modelling and conservation planning, forming a baseline of past and present EPTO distributions. The database aims to provide a standardised, open-source base of biological data for macroecological analyses at a global scale.

ON402

Adsorption of dissolved organic matter in inland waters: effects on composition and reactivity

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Inland waters receive organic matter from terrestrial ecosystems and in situ production, that is processed on its way to the ocean. Along the aquatic continuum, some of the dissolved organic matter (DOM) may be adsorbed to mineral particles. This process is rarely studied in inland waters, since suspended particles are often in short supply. However, when high particle concentrations occur, adsorption may have a substantial effect on DOM composition and reactivity. A series of batch adsorption experiments investigated the potential for DOM adsorption to inorganic particles and its effect on DOM composition, as well as its biological reactivity. DOM composition was studied based on bulk optical properties and high-resolution mass spectrometry. Adsorption experiments using a reference clay as the adsorbent show a widespread potential for DOM in inland water to adsorb to mineral particles. The extent of DOM adsorption in the experiments was regulated by DOM composition and water chemistry variables, such as pH and base cations. These general patterns were observed across both spatial and temporal scales. However, adsorption to suspended sediment derived from a glacial stream provided contrasting results, illustrating that particle mineralogy determines which DOM compounds can be adsorbed. Experiments examining microbial degradation indicated that the effect of adsorption on the bioavailability of the remaining DOM depends on which DOM fraction is removed. Taken together, the experiments show that adsorption to mineral particles in aquatic ecosystems is a highly relevant biogeochemical process that has the potential to alter DOM composition and thereby affect its biological reactivity.

ON101

Combined impact of agricultural run-off and warming on primary producers and consumers in agricultural streams

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Both warming and agricultural run-off (ARO) composed of nitrate and pesticides affect streams in agricultural landscapes. We hypothesized that ARO would favour filamentous algae over macrophytes in these systems and that warming would enhance negative effects. Further, we hypothesized that ARO will negatively affect primary consumers and warming negatively affect macroinvertebrates sensitive to water oxygenation. We used a factorial design (warming, ARO), set up in 16 artificial channels containing emergent and submerged macrophytes, periphyton, leaf litter and different macroinvertebrates (gammarids, mussels, snails). Initially, ARO significantly enhanced the development of blanketing filamentous algae and periphyton. The high dose of nitrate applied with ARO vanished very fast, probably absorbed by filamentous algae and periphyton. When filamentous algae collapsed towards the end of the experiment, phytoplankton increased, probably triggered by a massive liberation of phosphorus from decaying filamentous algae. Warming had only minor effects on the algae. Macrophytes developed late with a dominance of*Potamogeton perfoliatus*, profiting most from warming. ARO negatively affected its development at a later stage, suggesting indirect effects caused by competition with blanketing filamentous algae. ARO had a strong negative effect on the reproduction of gammarids and snails, likely caused by pesticides and leading to a reduced periphyton control. ARO and warming strongly enhanced the mortality of mussels. Our results reflect observations in early spring in natural streams in agricultural areas, often exhibiting first high densities of blanketing filamentous algae and later phytoplankton development, impeding the development of submerged macrophytes.

ON020

Under pressure: Global change effects on freshwater fungi

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Despite the increasing awareness that aquatic fungi can be key players in freshwater food web relationships and hence in nutrient and carbon cycling, we still lack basic insights how the diversity and the functional roles of these fungi will respond to ongoing global change. I will take you on a journey along several global change pressures (temperature, drought, nutrient loading changes and pollution) and try shedding some light on how these pressures affect the occurrence, diversity and (functional) roles of freshwater fungi, in particular those of chytrid fungi parasitizing phytoplankton.

ON223

Long-term effects of radioactive contamination on aquatic biota in the Chernobyl NPP exclusion zone

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The dynamic effects of chronic irradiation on hydrobionts in closed water bodies within the Chernobyl exclusion zone during 2000-2021 were studied. It is determined that the rate of chromosomal aberrations in the root meristem tissues of aquatic plants in the most radioactive contaminated lakes on average in 2-3 times, and in cells of the pond snail embryos in 4-6 times exceeding the spontaneous mutagenesis level. Analysis of leukograms of fish peripheral blood showed the decrease of lymphocyte cells, as well as the increase in the number of granulocytic cells with increase of radiation dose rate. Along with changes in leukograms an increased level of morphological damages of erythrocytes (structural and proliferation abnormalities) was determined, which is generally for pray fish in 4-12 times and for predatory fish in 7-15 times higher than in fish from reference lakes. High amount of erythrocytes with structural and proliferation abnormalities in blood of fish allows us to assume that the qualitative indexes of red cells in blood of fish are more sensitive to radiation impact in comparison with white blood. A variety of forms of pathological changes in the structure of blood cells, mainly erythrocytes, may indicate low resistance of cytogenetic apparatus of fish in the face of considerable mutagenicity and genotoxicity of environment. Analysis of the viability of the seed progeny of the common reed from contaminated lakes at germination in the laboratory showed a reduction in technical germination, germination energy and seed viability with increase of radiation dose rate.

ON113

Multimodal size distribution of ecologically similar species structures phytoplankton communities after storm-induced brownification

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Exploring the stabilizing and equalizing mechanisms structuring phytoplankton and their impact on community functioning is one of the main challenges in modern ecology. Since cell size influences phytoplankton physiology and species interactions, species diversity is often organized in distinct clusters of high richness along the cell size gradient. Environmental disturbances, e.g. storms with heavy rainfalls may substantially impact phytoplankton dynamics via strong short-time inputs of coloured dissolved organic matter (CDOM) and nutrients to surface waters. Therefore, we ask whether the allometric scaling of species success with cell size along a nutrient and CDOM gradient correlates with biomass clusters observed along the cell size gradient. In a large-scale enclosure experiment, we followed the response of epilimnic phytoplankton to a combined pulse of nutrients and CDOM at increasing concentrations mimicking different terrestrial runoff intensities and inherent changes in underwater light climate. Size distribution was multimodal with two distinct species-rich clusters of small and large cells varying in size by a factor of 10. Clustered species were ecologically (and evolutionary) similar but differed drastically from species belonging to different clusters. Cell size significantly determined the competitive ability of species accounting for more than half of the community biomass along the light gradient alone. The biomass contribution of small-sized species increased with increasing CDOM, while the opposite was true for larger phytoplankton. The combination of stabilizing and equalizing mechanisms explained the structuring of most phytoplankton biomass. This allowed for coexistence of species with contrasting light strategies, conditioning phytoplankton structuring and functioning after storm-induced brownification.

ON323

Food web approximation from empirical data, different clustering methods and their effect on food web model predictions

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Food web models are powerful tools to investigate community responses to environmental change. One major challenge for food web models is to capture important structural properties of the empirical food web while reducing food web complexity to attain a mathematically tractable system. A common approach to reduce this complexity is to lump organisms into functional groups. Functional groups can be based on traits like body size or taxonomy with consequences for food web structure and functionality. An alternative approach is to cluster organisms according to the similarity in their trophic position (shared prey and predator). Such clustering thereby considers the vertical (hierarchical) as well as the horizontal structure of food webs and preserves major energy pathways. In this study, we make use of available monitoring data on the species that are members of the pelagic community of Lake Stechlin, Germany, to derive a highly resolved food web from bacteria through phyto- and zooplankton up to fish. From the empirical food web we derive (1) a functional group food web based on major feeding guilds and (2) a trophic-group food web resulting from the data-driven structural cluster algorithm. We compare the structural and dynamic properties of both food web approximations. The results identify critical levels of resolution for predictions on the community response to eutrophication. Especially the resolution at the micrograzer-phytoplankton level strongly influences the community response. Our study highlights the critical role of aquatic food web structure for predictions on community response under global change.

ON058

Genomic analysis of *Microcystis* reveals improved taxonomy, insight into *Microcystis* evolution, and new opportunities for mitigation

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Cyanobacterial harmful algal blooms (cyanoHABs) are ecologically deleterious, widespread, and expected to increase in frequency with global warming and continued high anthropogenic nutrient loading. Microcystis, a common cyanobacterium, forms large, non-grazable colonies and produces toxins, which reduce water quality, disrupt energy flow, and threaten human and wildlife health. Microcystis taxonomy is controversial due to discrepancies between morphology- and genomic-based classifications. The former recognizes multiple morpho-species, while the latter suggests a singleMicrocystisspecies, due to high DNA sequence similarity. The absence of robust classification hinders ecological and evolutionary research that could improve HAB management.
Pangenome analysis of 122 published Microcystis whole genomes, ranging between 3.85 and 5.89 Mbp, revealed 1,452 single-copy core and 20,241 non-core genes. Phylogenetic and whole genome similarity analyses based on a proposed overall genome-related index revealed 23 monophyletic clusters, 16 of which meet putative genospecies criteria. Fifteen of the 16 genospecies included at least one M. aeruginosa morpho-species, and ten genospecies included two or more morpho-species, and ranged across diverse geographic regions. Further analysis of genome characteristics indicate that genome size scaled inversely with system trophic state. Oligotrophic systems had larger genome Microcystis, with more abundant CDS, pseudogenes, and insertion sequences, while smaller genomes with fewer CDS, pseudogenes, and insertion sequences predominated in eutrophic systems. These signatures are suggestive of reductive gene loss in eutrophic waters through increased reliance on common goods from the microbiome. This classification scheme and knowledge of pangenome flexibility may allow consistent identification of Microcystis and better understanding of its cosmopolitan distribution.

ON360

Automated lake buoys as platforms for discovery

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Lake buoys with automated sensors are providing platforms for discovery because of the unique data they generate, the cyberinfrastructure that makes them accessible, and the collaborative interactions they stimulate and support. At the University of Wisconsin-Madison Center for Limnology (CFL), nearly four decades of buoy deployment have generated an extensive data repository used in lake ecosystems research. We highlight in this talk advancements in our understanding of lake ecosystems ecology that stem from buoys, their data and cyberinfrastructure. Examples from lake physics, biogeochemistry, and phytoplankton ecology demonstrate the utility of information contained in high-frequency data collected under diverse ambient conditions, especially when data span years and are coincident with traditional limnological observations. The added value of making buoy data FAIR (findable, accessible, interoperable, and reusable), along with the local knowledge needed to contextual the information, benefits the global community of lake scientists and is supporting new international collaborations.

ON145

The impact of lake morphometry and mixing on benthic and pelagic primary production – a 2D modelling approach

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Process based modelling has yielded valuable insight into the interplay of fundamental physical processes with the biogeochemistry of primary production and nutrient recycling in lakes. The vast majority of this research has focused on pelagic algae using one-dimensional (1D) models. In contrast, benthic algae have rarely been included in these models, in part because 1D models restrict benthic algae to a single depth. Overcoming this limitation, we have developed a 2D model to explore the impact of physical lake properties such as size, morphometry and mixing on the competitive interaction between benthic and pelagic algae. The model consists of coupled reaction-advection-diffusion differential equations, where primary production is limited by light and a single nutrient. The model is conceptual, so the descriptions of nutrient regeneration processes, transport processes (mixing, sedimentation, resuspension) and the geometry of the lake bottom are kept deliberately simple. We highlight two results of preliminary model explorations. (1) Under a large range of environmental conditions, the model predicts that benthic algae exhibit a biomass and production maximum at some intermediate depth, analogous to the deep chlorophyll maxima that can be found in water columns. (2) For a given hypsographic depth profile and a fixed horizontal mixing intensity, the model predicts that benthic algae contribute proportionally more to total lake primary production in smaller lakes compared to larger lakes.

ON329

Denitrification in vegetated and unvegetated freshwater lakes and rivers

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Due to anthropogenic nutrient loading, many freshwater systems contain high concentrations of dissolved nitrogen (N). Macrophytes can influence N availability through direct uptake. By producing labile organic matter, reducing flow and providing substrate for periphyton, they may also indirectly stimulate denitrification. Denitrification is an important process in meso- and eutrophic freshwater systems, as it permanently removes N from the system by transforming nitrate (NO_3^-) into N_2. While some studies have found NO_3^- levels to be reduced faster and more efficiently in vegetated compared to non-vegetated systems, others have reported neutral or even negative effects of macrophytes on denitrification. These variable responses could be related to differences among macrophyte species, the composition of their biofilms and the relative contribution of the sediment microbiome. To separate the relative contributions of sediment, (2 floating and 2 submerged) macrophytes and their periphyton to N removal, we used incubation experiments with stable isotope tracers. Additionally, we determined N-removal in a temperate lowland river by measuring *in situ* denitrification along a vegetation gradient. Despite high variation in denitrification rates between different species and sediments, incubations with macrophytes and sediment showed higher denitrification rates than sediment alone. We measured significant denitrification activity in separated biofilms and identified denitrifying bacteria within these communities. In our river system, vegetated patches also showed higher denitrification activity than bare sediment or patches where vegetation had been removed. Our findings help to increase understanding of the role of macrophytes in N-removal, which can benefit management of aquatic systems with dense macrophyte presence.

ON458

Start from the local to the world - MLGs Citizen/Youth participation

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The water in Lake Biwa, which is used by one-ninth of Japan's population, has become unhealthy due to an imbalance in the ecosystem. In addition to that, due to an increase in habitat degradation, the water quality itself may be affecting organisms through human influence. To alleviate this situation as much as possible, the „Mother Lake Goals (MLGs)" were proposed. We organized the MLGs Global Meeting as a place to discuss MLGs and environmental issues with about 100 people, from children to adults. Specifically, we had high school and university students including international students, elementary and junior high school students, and also teachers, parents, researchers, government officials, and so on. The discussion theme was different for each session but mainly focused on how to participate to save and love Lake Biwa. We received feedback on Shiga Prefecture's initiatives, and also delivered prospects to the world. From this intergenerational exchange of ideas, various workshops have been developed in Shiga prefecture. It is hoped that this kind of citizen participation, especially by young people, will make water issues more visible and stimulate movement towards solutions. Through surveys from MLGs global meeting, we got some opinions that the world should start making their local SDGs like MLGs. In addition to that, the young generation can take the lead to discuss the activities to attract the citizens so that they can be aware and engaged in the conversation about lakes and the environment. We believe that dialogue and exchange across generations/countries are needed.

ON176

Structuring forces of stream macroinvertebrate communities in the Hengduan Mountains

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Understanding biodiversity patterns and the underlying drivers remains a central topic in community ecology. Beta diversity indicates how communities vary in space and time and provide valuable information for conservation in terms of spatial prioritization. Over the last two decades, multiple-facetted aspects of beta diversity, including taxonomically and trait-based beta diversity and their decomposed components such as turnover and nestedness, have received increasing attention. However, surprisingly few studies have examined the relative contributions of different processes shaping stream communities in high-mountain regions such as the Hengduan Mountains in Southwest China. This stands in contrast to the fact that stream ecosystems in high-mountain areas are subject to rapidly increasing threats such as expanding human activities and climate change. We investigated macroinvertebrate communities in the Zhubaluo and Dulongjiang catchments in the Hengduan Mountains, which have large elevational gradients. We calculated taxonomically and trait-based beta diversity of macroinvertebrates within each catchment and examined the relative contributions of turnover and nestedness to each facet of beta diversity. In addition, we investigated the relative importance of different factors, including local environmental, climatic, topographical, and spatial

variables, in shaping the community composition of stream macroinvertebrates. Given the large elevational gradients in these two catchments, we hypothesize that turnover contributed more to both taxonomically and trait-based beta diversity than nestedness. We also expect that topographic variables play a considerable role in shaping macroinvertebrate communities. Our study emphasizes the importance of considering multiple facets of beta diversity in understanding structuring drivers of stream communities in high-mountain regions.

ON034

Digital applications to access and integrate operational freshwater monitoring from space at highest spatio-temporal scale

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Satellite based inland water quality measurements became increasingly used in decision support by water industries and environmental agencies: Digital data services based on satellite data are providing environmental baseline and actual monitoring data for a large number of small- and large-scaled surface waters across the world. Key prerequisites are the improving accuracy of measurements as provided by the used data analytics software, and a fit-for-purpose spatio-temporal resolution as provided from various technically suitable satellites including and beyond the Sentinel-2 and Planet SuperDove satellites.
In the presentation, we will investigate the accuracy for satellite-based very high resolution measurements of Chlorophyll, Turbidity or Cyanobacteria, using transparent fully physics-based data analytical approaches. Based on actual regulatory and monitoring applications in inland waters, we will then discuss practical aspects on how to implement measurements provided by satellites. The high data volumes provided can create technical barriers to grasp the relevant information: Therefore, we want to discuss practical approaches how to access data online, how to extract and aggregate information to a level that provides a better understanding of environmental processes in freshwater systems. Furthermore online integration techniques of satellite data with in-situ and modelling data shall be adressed, with examples from environmental deparments and hydropower applications.

ON290

Testing the efficacy of restoration measures to re-establish charophyte communities in oligo-mesotrophic hardwater lakes of Northeast Germany

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Charophytes constitute a key component in temperate oligo-mesotrophic hardwater lakes, commonly forming extensive meadows and dominating submerged vegetation. However, eutrophication has led to a decline of charophytes and displacement by vascular macrophytes or even complete loss of submerged vegetation in numerous temperate lakes during the 20th century. This process was stopped or even reversed by re-oligotrophication efforts in many countries. In northeastern German hardwater lakes, including those characterized by low anthropogenic impact, forested catchments and lack of surface inflows, however, a drastic decline of charophytes has still been observed over the past decades. These vulnerable ecosystems require protection by the European Union Habitats Directive (habitat 3140), but their restoration is difficult due to the complexity of potential and often unknown stressors. Nutrient loading, hydrological changes causing dissolved inorganic carbon and/or calcium depletion, water level fluctuations and brownification events, but also pesticides, diseases and changes in the fish community via selective fish removal and/or stocking are among the possible causes of recent charophyte decline. As part of the project “Chara Lakes”, we tested the effects of charophyte restoration measures aiming at selected potential stressors in >30 German oligo-mesotrophic hardwater lakes. Here, we focus on the results for biomanipulation of fish communities through biomass removal. Potential adverse impacts of fish on charophytes include direct effects by herbivory and physical disturbance as well as indirect effects such as increased phytoplankton and periphyton growth caused by resuspension of nutrients and/or reduced top-down control of periphyton by macroinvertebrate grazers, eventually fostering shading of charophytes.

ON046

Temperature and species competition drive co-limitation of light and nutrients in phytoplankton

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For phytoplankton, nutrients and light are major resources controlling phytoplankton community structure, biomass and growth. Besides the basic conceptual understanding of resource limitation deriving from Liebig’s law of the minimum, multiple resources can interactively affect the response of phytoplankton leading to co-limitation. Temperature is among the strongest drivers affecting phytoplankton metabolism and can therefore influence its resource requirements. In this study, we investigated how light and nutrients interactively influence phytoplankton growth and how temperature impacts this co-limitation. We conducted a gradient experiment with 5 levels of temperatures, light intensities and nutrients each using 3 isolated freshwater phytoplankton species in monoculture. To test whether interspecific competition alters the effects of temperature on co-limitation, we compared single species responses with those from a mixture of all species. All species were co-limited by light and nutrients and showed species-specific shifts between sub-additive and super-additive responses in growth with temperature. This temperature driven co-limitation effect differed between species growing in monoculture to those growing in mixture due to species competition. Our results highlight the importance of temperature in mediating interactions between multiple environmental factors and help to understand how temperature influences the resource requirements in isolated species and the ability to compete for limiting resources within species communities.

ON103

Monitoring of plant protection products in small water bodies located in the agricultural landscape of Northern Germany

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A high density of small standing waterbodies characterizes the agricultural landscape in Northern Germany. The majority of these small water bodies is located directly in cultivated areas. These small waterbodies are important biotopes for a variety of water organism and play an important role in water- and nutrient cycling. Residues of plant protection products (PPP) in waterbodies can be a serious threat to water organisms. How agricultural practices in their surroundings actually affect the input and fate of PPP in these small standing waterbodies is so far mostly unknown since national monitoring programs mainly focus on standing waterbodies with surface areas >50 ha (EG WRRRL 2000). This study aims to investigate the occurrence of active substances of PPP in small standing water bodies exemplarily for the federal state of Mecklenburg – West Pomerania. We performed a monitoring of PPP active ingredients during the years 2016 - 2018 in 50 small standing waterbodies all over the federal state of Mecklenburg – West Pomerania. The water samples were analysed for 68 active substances of PPP (herbicides, insecticides, fungicides) using LC-MS/MS. Some active substances, most of which are applied in the most common arable crops occurred ubiquitously in most of the water bodies during all sampling campaigns. Other active substances, as well as the total number of detected substances, the toxicity for aquatic invertebrates (TU) and the number of exceedances of regulatory acceptable concentration (RAK) showed clear temporal variation.

ON084

Optimization of water supply reservoir operation to reduce the effects of eutrophication and increasing concentration of natural organic matter using the model system „catchment - reservoir“

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The operation of water supply reservoirs, in addition to the required quantity of water, must ensure adequate quality of abstracted water. The operational management of reservoir in also challenged by climate change, which affects hydrology and can increase eutrophication and concentrations of natural DOM, especially in catchments that were previously acidified. The study demonstrates the use of a „catchment reservoir“ model system, consisting of the empirical source-apportionment model of nutrient and DOM exports from the catchment and the two-dimensional reservoir model CE-QUAL-W2, to optimize the discharge regime and the outflow depth in the dimictic, moderately eutrophic Římov reservoir (Central Europe), both under current and future conditions. The model system was calibrated and validated using a 40-year monitored data series (1980-2020) that included extreme floods and droughts with recurrence periods exceeding 100 years, significant DOM growth, and changing trophic conditions. The model captured thermal stratification and trophic level indicators, primarily oxygen regime, nutrient concentrations, and seasonality of major phytoplankton groups, as well as the spatiotemporal distribution of DOM in the reservoir. The modelled scenarios then indicated that the water management strategy for this reservoir should apply the following principles: (i) maximise phosphorus load reduction, (ii) keep the reservoir volume as full as possible, (iii) use upper outlets during the growing season. By adhering to these principles, a safe operating space can be created even in the future, both for high quality water abstraction without contamination by DOM, organisms or reduced substances, and for the ecological quality of the aquatic ecosystem.

ON231

Identifying active and non-active phytoplankton taxa based on co-occurrence network analysis

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Phytoplankton coexistence and co-occurrence are often used as synonyms in the literature. Coexistence presumes interactions among taxa, while co-occurrence presumes simultaneous appearance. Recent analysis of empirical datasets suggest that ecological communities may contain active and non-active members, which raises the question of how individuals contribute to community functioning. In phytoplankton, taxonomic richness enhances resource use efficiency (BEF) as well as community dominance. As dominance is associated with competitive exclusion and diversity loss, the two positive relationships contradict each other. Here, we aimed to identify active and non-active phytoplankton taxa based on co-occurrence network analysis in a large-scale phytoplankton dataset from Fennoscandia (Norway, Sweden, Finland). Active phytoplankton taxa are expected to have significant positive or negative relationships with other phytoplankton taxa. Non-active taxa are present in the community without significant correlations. We found the general pattern that the number of positive, negative, and the total number of connections increase significantly with the average relative biomass of taxa. Therefore, taxa with higher potential for dominance (i.e. higher average relative biomass) have higher number of negative connections because of stronger competitive abilities. However, dominance does not equal with exclusion only, some taxa tend to co-exist regularly even with the most dominant ones. Our results may have two implications: 1) dominance is a gradient (not a bloom/non-bloom category); 2) dominance may even help some taxa to co-exist, a phenomenon overlooked in BEF.

ON381

Getting to the bottom of urban lakes – understanding benthic primary producer dynamics to secure high water quality

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Urban lakes are often more severely impacted by warming, pollutants, nutrient loading, and species invasions. High water quality, however, is needed to secure recreation and drinking water production. Monitoring and research still mainly focus on pelagic parameters, while we argue that understanding the dynamics of benthic primary producers is essential for securing high urban lake water quality. Here we provide examples for long-term dynamics and interactions between water quality and benthic primary producers in three urban lakes in Berlin used for recreation and drinking water production. In recent decades, warming, reduced nutrient loading and quagga mussel invasions facilitated a re-colonization with submerged macrophytes known to support high water clarity. However, macrophytes reached nuisance abundances for swimming and boating leading to discussions about the need for their management. They were also associated with the occurrence of toxic tychoplanktonic cyanobacteria. This interaction is far from understood, but beaches needed to be closed after the death of dogs in several years. Warming in late spring and quagga mussels had contrasting effects on periphyton, which was shown to affect macrophyte maximum colonization depth and the transformation of trace organic compounds. While this could positively affect bank filtrate quality, model simulations indicated negative effects of bank filtration on macrophyte abundance in shallow lakes. We thus argue that benthic primary producers respond strongly to multiple stressors in urban lakes and several positive and negative feedbacks with water quality and use need increasing attention to secure their effective management.

ON007

Towards a species-specific migration barrier to stop invasive fish

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Man-made barriers in rivers are a major conservation issue, because they reduce ecosystem connectivity by e.g. impeding fish migrations to upstream spawning grounds. Invasive round goby goby (*Neogobius melanostomus*) are currently spreading into upstream river at both sides of the Atlantic. In this situation, the re-design of the man-made barriers could give reasons for a re-think: would it not be ideal to keep the blocking function for the invasive species, whereas native species would be able to overcome the barrier? In this contribution, data on recent research towards a species-specific migration barrier is presented: We conducted swimming speed experiments in a swimming chamber using the invasive round goby (*Neogobius melanostomus*) and two native species, the bullhead (*Cottus gobio*) and the gudgeon (*Gobio gobio*). Based on these experimental data, we constructed a barrier-prototype to be applied in a vertical-slot fish pass. We tested this barrier in dispersal experiments at different flow velocities in a life-sized model of such a fish pass and monitored the behavior and the dispersal success of all three species. The results show, that the native gudgeon is the best swimmer and could pass through the barrier at the highest tested velocities. However, both the round goby as well as the native bullhead could not. After presenting these results, a discussion on the possible trade-offs connected to such species-specific barriers will be instigated. Moreover, a digital and anonymous audience-voting on different priorities connected to such trade-offs is thought to be organized as part of the contribution.

ON207

Impact of fish ponds on temperature regimes of streams with endangered freshwater pearl mussel

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The temperature regime governs in-stream physico-chemical processes, in turn affecting biological conditions and aquatic community structure. Conservation of endangered, cold-stenothermic organisms such as the freshwater pearl mussel (FPM) and its salmonid host fish is particularly challenging in headwater streams which are the last refuge areas for those species. Evaluating the impact of anthropogenic catchment features such as fish ponds on the hydrologic and temperature regime of adjacent streams is therefore important. In this study, water temperature was monitored along three FPM streams receiving discharge from multiple fish ponds. Hourly measurements were conducted at 12 sites along the stream course with monitoring points upstream and downstream of the inflow of pond outlet channels to compare the temperature regime over a three-year period. Temperature metrics were also related to catchment land cover within a 180 m buffer strip along the streams. In summer, temperature in pond effluents was higher than in the receiving stream, depending on the proximity of the inflow points. Discharge from close-by ponds increased summer stream temperature directly downstream of the inflow by up to 2.5 °C. These increased temperatures were partly compensated by forested area along the stream course. In contrast, stream temperature significantly further increased along stretches flowing through open land, persisting independently of pond inflows. We suggest incorporating this knowledge on pond- and land use-dependent effects on stream temperature regimes into the conservation management of FPM and other cold-stenothermic species, as well as into climate change mitigation strategies targeting an increased resilience against temperature extremes.

ON109

Microplastic burden in *Daphnia* is aggravated by elevated temperatures

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Contamination of limnic habitats with microplastics is a particular threat to non-selective filter-feeding organisms such as the genus *Daphnia*. In this way, microplastics can accumulate in the animals' digestive tract. Using the model organism *Daphnia*,the effect of food quantity and ambient temperature on the uptake of polysterol beads (Ø 1µm, 200 ng/ml) was studied. At low food quantity and elevated temperature, the uptake rate of microplastic beads was increased. This reflected the complex regulatory patterns of the water flow generated by the animals' thoracopods: within one hour, an accumulation of microplastics in the animal to 1160 times the concentration in the ambient medium was observed. The energy reserves of *Daphnia* after microplastic ingestion were used as an indicator of the animals' metabolic status. Microplastic exposure over three days with and without feeding with *Desmodesmus subspicatus*had no effect on the glycogen reserves of the animals beyond the response to the prevailing feeding and temperature conditions. Thus, despite a microplastic-filled digestive tract, digestive processes occurred sufficiently when food was available. A proteomic study comparing animals with and without microplastic exposure revealed significant changes. The differential expression was partly related to stress response mechanisms. Metabolic processes, however, were not affected. Projecting the laboratory experiments to the situation in the lake habitat thus allows the assumption that an increased load of microplastic particles can be expected during the filter feeding of zooplankton organisms in warm waters and a scarce food supply, as occurs during the clear water phase of lakes in summer.

ON443

Characterising the nature and source of nutrient impairment in small streams in Ireland

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Recent research has highlighted the need to refocus research and management on small streams, to address catchment water-quality and biodiversity concerns together with the sustainable management of ecosystem services.
The key contribution of this research is the nutrient characterisation of a portion of Ireland's non-compliant small stream network (SSNet) based on historic water quality data from the Irish EPA national dataset coupled with temporal analyses of flow, water level, and rainfall, across the major catchment typologies of Ireland.
What is evident from these analyses is that many of the small stream sites had nutrient impairment with almost half exceeding concentration thresholds for molybdate reactive phosphorus, forty-one per cent exceeding thresholds for total ammonia and over one quarter exceeding non-statutory total oxidised nitrogen levels. This study demonstrates that the small stream sites exist in multi-stressor environments with multiple nutrient pathways. The nature and source of these pathways must be identified and addressed to reduce the nutrient concentrations of the SSNet and improve water quality further downstream. The research also points to a need to increase the number of monitoring sites across the SSNet with a more frequent monitoring schedule to truly characterise the nutrient conditions and dynamics of these influential water bodies.

ON175

Genetic population structure of the critically endangered stellate sturgeon (*Acipenser stellatus*) in the Black Sea basin: : implications for conservation and sustainable use

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Stellate sturgeon (*Acipenser stellatus*) is a species of high conservative concern throughout its range. Its populations experienced a dramatic decline in abundance and distribution in the Black Sea basin. Information regarding the genetic structure of this species is limited in the region. We used mitochondrial DNA markers (*cytochrome b* and *D-loop*) and microsatellite genotyping to investigate the genetic diversity, gene flow and population structure of stellate sturgeon in the North-Western and Southern parts of the Black Sea. Both genetic markers revealed high genetic diversity (153 haplotypes and 264 alleles) and low genetic differentiation of marine and freshwater catches in the two regions, most probably due to sporadic reproduction events in Turkish waters and human-induced gene flow. The only two genetic clusters we identified indicate the loss of spawning grounds on the natal rivers and the existence of a remnant stellate sturgeon micro population spawning outside the Danube River, in Turkish or Georgia rivers. It requires outreach initiatives and urgent actions to foster the recovery of this Critically Endangered species. Sturgeon fishing ban and restocking activities, carried out during the last decade, mainly without a prior genetic assessment of the sturgeon populations, added little conservation value. Reconstruction of the connectivity of the rivers and the enhancement of habitats and spawning grounds have to be considered to benefit all sturgeon species.

ON088

Dynamic climatic impacts on the hydrology of a large, shallow lake

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Lake Balaton – the largest lake in Central Europe – has extreme surface-to-volume (mean depth 3.5 m) and surface-to-catchment area (1:8) ratios in its size class all over Europe. This implies an elevated hydrological sensitivity to climate change, notably changes in precipitation and evaporation. Indeed, starting with the multi-year drought during 2000-2003, the repeated occurrence of years with net negative natural water balance became the new norm, while such years did not occur in the first 80 years of hydrological observations starting in 1921. Climatic predictions for the region are quite unambiguous with regard to temperature increase in the next decades, while forecasts of annual precipitation diverge from a slight increase to a sharp decline. To assess the perspective for water level management, 24 GCM-RCM chains from the RCP4.5 experiments of EURO-Cordex were used to predict natural water balance and possible water levels under different regulation strategies with a simple hydrological model until 2100. The results reinforce the climatic sensitivity of the lake. The farther we progress in the future, regardless of the relative change in precipitation, more and more model chains indicate a declining water balance surplus, which manifest in multi-year excursions to very low water levels and up to decades without any drained water. These go well beyond the ranges accustomed by the society, which will soon re-heat the debate about transferring water from an external catchment. Recent observations suggest that future fluctuations and regulation of water level may profoundly influence the trophic status of this shallow lake.

ON289

Morphological responses of Dolichospermum to protozoan grazing revealed by transcriptome and proteome analysis

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Lake ecosystems around the world are suffering from harmful cyanobacterial blooms as a result of global warming and eutrophication. The new biological blooms-control technology based on the grazing relationship between cyanobacteria and protozoan shows great application potential in the early-bloom period, which is usually dominated by nitrogen-fixing cyanobacteria like *Dolichospermum*. *Dolichospermum* can achieve nutrient compensation through heterocyst differentiation for rapid population growth. Recently, we found that both the *Paramecium multimicronucleatum* and *Ochromonas gloeopara* graze on the filamentous *Dolichospermum*, partially suppressing the population growth of cyanobacteria. Protozoan grazing reduced the number of short filaments remarkably, resulting in the increased average length of filaments in cyanobacterial population. In addition, heterocyst differentiation was induced by protozoan grazing. The higher the grazing intensity faced by cyanobacteria was, the earlier the heterocyst was formed, together with the higher frequency of heterocyst detected. Transcriptome and proteome analysis revealed that grazing by *Paramecium* induced changes of multiple pathways in *Dolichospermum*, including carbon fixation, biofilm formation, nitrogen metabolism, pentose phosphate pathway, oxidative phosphorylation, photosynthesis, ABC transporters and others. In particular, the genes encoding nitrate/nitrite transport system substrate binding protein and nitrogenase molybdenum ferritin chain in nitrogen metabolism were significantly up-regulated, indicating the enhanced nitrogen fixation. The pathways associated with phosphorylation and carbon fixation were also upregulated with predicted increased energy production. The findings highlight the possible ecological function of heterocyst differentiation in mediating protozoan and nitrogen-fixing cyanobacteria interactions.

ON142

Sensing freshwater biodiversity in remote and understudied regions with DNA-based methods: insights into regional and local biodiversity patterns on Sicily

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Even though the Mediterranean region is among the top biodiversity hotspots, its freshwater biodiversity still remains understudied. Due to increasing anthropogenic pressure and ongoing climate change, Mediterranean freshwaters are also among the most threatened ecosystems worldwide. Given the scarcity of knowledge, particularly about insular freshwater ecosystems, the current situation calls for novel ways to study regional and local freshwater biodiversity. DNA-based methods, such as environmental DNA (eDNA) metabarcoding, provide an opportunity for rapid, straightforward large-scale species assessments in aquatic ecosystems. Furthermore, with growing evidence for presence of overlooked, often cryptic diversity on the islands revealed with mitochondrial data, using genomic profiling methods allows to zoom further into species diversity by assessing species status of highly diverse taxa.
We here present results of the first eDNA metabarcoding study from Sicily revealing interesting regional biodiversity patterns using an exact-sequence variant (ESV) based approach and indicating presence of new taxa for Sicily. Furthermore, results from genomic data (ddRAD-seq) revealed the complexity of observed species diversity on example of *Echinogammarus sicilianus*, a freshwater amphipod, exhibiting extraordinary levels of intraspecific diversity revealed with mitochondrial data. Although DNA barcoding indicated presence of multiple cryptic species in the studied river system, genome-wide data revealed that most of mitochondrial diversity can be ascribed to single species, highlighting the importance of using genome-wide data for species validation in highly diverse species complexes. By providing insights into regional as well as local biodiversity patterns, our findings indicate that DNA approaches provide a promising solution to sensing remote and understudied regions.

ON009

Biogeochemical focusing in stratified lakes: Unexpected consequences for redox-controlled P release

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Due to climate change and eutrophication, the anoxic zone in lakes is expanding vertically. Depending on the lake morphology the shift of the oxicline can lead to geochemical focusing, which increases the transport of phosphorus (P) towards the sediment surface at the deepest point. Using mass balances within the hypolimnion, it could be shown in the monomictic Stechlinsee (NE Germany) that the increased sedimentation of particulate P lead to a lower areal related accumulation rate of phosphorus in the anoxic hypolimnetic water compared to water layers that are still sufficiently oxygenated. With beginning of full circulation and sufficient oxygen supply, these sediments lose the accumulated redox-sensitive P again because the P supply by precipitation at the oxicline is interrupted. Under laboratory conditions with undisturbed sediment cores from the deepest point demonstrated that the sediments enriched with redox-sensitive P have similar high P release rates under oxic and anoxic conditions in the overlying water. The geochemical focusing in Lake Stechlin triggered by the shift of the oxicline thus paradoxically can lead to anoxic P enrichment at the sediment surface in summer, while during winter circulation this P is released again to the oxic overlying water. Investigations of the sediment stratigraphy showed that the simultaneous temporary enrichment of iron and phosphorus under non-sulfidic conditions increases the permanent P binding through vivianite formation.

ON371

Indirect effects of stream pollution on riparian food webs: activity and hunting behaviour of terrestrial insectivores

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Flying insects emerging from streams provide an important source of high-quality prey to terrestrial insectivores, including bats, beetles, and spiders. However, stressors such as chemical pollution from agricultural and wastewater inputs can directly affect emergent aquatic insects and alter the magnitude and composition of emergence. This can lead to indirect effects on the terrestrial predators depending on emergent insect prey, but this has yet to be thoroughly investigated. Thus, we conducted a 13-week field study at 16 forested streams in Germany, to evaluate how stream pollution indirectly affects riparian bats. We measured insect emergence, wastewater and pesticide pollution, nutrient concentrations, bat activity and hunting behaviour, among other parameters. We expected that higher pesticide toxicity and wastewater pollution in streams would be associated with lower insect emergence and, consequently, decreased bat activity and hunting success. Preliminary results did not reveal an overall reduction in insect emergence, but a change in emergence composition, with higher Diptera emergence at more polluted sites. We also saw that the activity of the bats *Myotis* cf. *brandtii*, and stream-specialist *M. daubentonii* was higher at more polluted streams, but that there was no effect on the more generalist *Pipistrellus pipistrellus*. Nutrient levels of streams could have been an important factor for the emergence, leading to indirect effects on the associated riparian insectivores. Analysis of bat hunting behaviour is still underway, but is expected to more concretely describe the effects of stressors and altered emergence on riparian insectivores.

ON399

Natural phytoplankton trait diversity affects intraspecific competition in*Daphnia*– The role of essential dietary fatty acids

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Global biodiversity loss, driven by anthropogenically induced environmental changes, has been shown to affect ecosystem functioning, however, the underlying mechanisms are yet to be revealed. Recent studies, following a trait-based approach to examining the role of functional traits have shown that loss of such traits alters key processes of ecosystems, and may have cascading effects on multiple trophic levels. This is of particular interest for the phytoplankton-zooplankton interface in aquatic ecosystems, as the phytoplankton content of dietary polyunsaturated fatty acids (PUFAs) was found to be crucial for the fitness of the herbivorous grazer *Daphnia,*which is not capable of *de novo* synthesis of such PUFAs. However, fatty acid composition of the phytoplankton was shown to be taxon-specific. Thus, we hypothesized that the composition of essential dietary fatty acids is directly related to the diversity of the phytoplankton community, and that alterations in PUFA availability will affect the intraspecific competition in *Daphnia*. To address these hypotheses, we performed a common garden experiment with diversity-manipulated natural phytoplankton community and naturally coexisting *D.longispina* genotypes with pronounced differences in their susceptibility to limitations by dietary PUFAs. Our findings demonstrate that altered phytoplankton community composition results in an altered composition of dietary fatty acids, and that single PUFAs directly affect competitive interactions between naturally coexisting *D. longispina*genotypes. We thus show that essential PUFAs are a functional phytoplankton trait that affects the dynamics between the primary producers and consumers in aquatic ecosystems.

ON208

Unraveling a widespread algal bloom in a deep large lake: Challenges and opportunities of combining remote sensing, in situ data and numerical modeling

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Water quality remote sensing is increasingly used in an operational context, and several studies in particular for perialpine lakes showed how hydrodynamic modeling can greatly improve the utility of remotely sensed products. Conversely, remotely sensed products can help to improve the performance of hydrodynamic models as a source of dynamic input data, by means of data assimilation, or for validation. With such an interdisciplinary integration of Earth observation techniques, we can take advantage of the forecasting capabilities of data-driven hydrodynamic lake modeling and the synoptic coverage, as well as a regular sampling of high-resolution in situ data and satellite imagery, i.e., from Sentinel-2/3. As part of the ESA Regional Initiative for the Alpine Region, the project AlpLakes aims to extend this framework functionally and spatially. To demonstrate such functionality, we investigated a widespread algal bloom even in Lake Geneva (Switzerland/France). Chlorophyll-a and Secchi depth products from various satellites, high-frequency in situ bio-optical and physical measurements from an autonomous profiler, biological water sample analysis, as well as a high-resolution 3D hydrodynamic model together with a particle tracking module were used to analyze and understand the underlying processes resulted to such a widespread algal bloom. Our results express the challenges and opportunities of integrating remote sensing, in situ data and hydrodynamic modeling in inland waters.

ON025

Hybrid species distribution models inform flow management in a world of water scarcity

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With flow alteration a pervasive issue worldwide, flow managers are tasked with assessing the ecological impacts of water allocation for industrial and social needs. Commonly, benchmarks for such assessments are based on the presence of a species and the ability of the system to provide species' habitat requirements. Flow-ecology analyses are instrumental in relating flow alteration to its impacts on biological communities, and predictive models, such as species distribution models (SDMs), are useful tools in such analyses. Nonetheless, current SDM approaches comprise varying levels of requirements and abilities. Statistical SDMs are most common however, they are limited in their application and interpretation due to e.g., broad-scale applicability and high data requirements. Mechanistic models are more comprehensive however, due to e.g., the vast amount of expert knowledge and/or practical experiments necessary, tend to be scarce. A hybrid approach, a combination of the two, is an emerging method that utilizes the strengths of both approaches and can be tailored to specific species, systems, and management concerns. We present the concepts behind the hybrid approach through its application in highly urbanized, semi-arid systems in Southern California where altered flow has been identified as a key issue. The models are applied on various species groups, incorporating different life stages and associated phenology. We discuss the advantages and challenges of the hybrid approach, as well as potential future directions.

ON211

Hydrodynamic drivers of nutrient and phytoplankton dynamics in a subtropical reservoir

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In freshwater reservoirs, the nutrient concentrations and the physical conditions that control phytoplankton growth, vary along their longitudinal extent. Here we analyze how the flow paths of inflowing waters into density-stratified reservoirs affect the vertical and longitudinal distribution of nutrients and chlorophyll-a (chla). We combine spatially resolved and high-frequency measurements of chla from satellite remote sensing and in-situ sensors, with numerical simulations using a three-dimensional hydrodynamic model to assess the influence of density currents on chla dynamics along different regions of a drinking water reservoir in subtropical region in south of Brazil for a complete seasonal cycle. The mean chla could be well predicted from total phosphorus concentration at annual scale. Chla did not have clear seasonal dynamics, instead, spatial variability along the reservoir was more pronounced. Most of the nutrients from the inflowing river were consumed in the upstream region, and phytoplankton in the lacustrine zone depended on internal loading. Phytoplankton produced in the upstream area was transported downstream by density currents, resulting in large concentrations of chla below the euphotic zone. Results of model simulation reproducing the present state had good agreement with observations, in addition two scenarios where density current patterns were altered indicated that the influence of the main inflow was of minor relevance in chla concentrations in downstream regions.

ON017

Protists with different phagotrophic modes differently structure freshwater bacterial communities by selective grazing

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Mixotrophic and heterotrophic protist as phagotrophic consumers hold a key position in aquatic microbial food webs. Those two protistan groups account for the bulk of bacterivory in pelagic systems, but apart from this general appraisal, the potential structuring effect of heterotrophic and especially mixotrophic protist on microbial communities is far from clear.
We conducted standardized short-term grazing experiments, to test for the overall impact on bacterial community structure and possible prey preferences of protist taxa with different phagotrophic nutritional modes. The used protist taxa covered a range from more phototrophic towards heterotrophic strategies, with mixotrophic taxa employing phototrophy as the dominant strategy, towards mixotrophic taxa relying more on phagotrophy, with the end of this spectrum being covered by a phagoheterotroph lacking phototrophic capacity. Natural plankton communities were harvested from different lake systems and manipulated to represent semi-natural bacterial assemblages that served as prey organisms.
Our study showed that similarities in protistan nutritional modes were reflected in similarities of their overall impact on bacterial communities. The impact intensity on bacterial prey communities increased towards clear phagotrophic strategies, with phototrophic mixotrophs having a stabilizing impact on bacterial communities. In addition, the protists used in this study confirmed prey selectivity across all experiments, with selectivity showing similarities between protists related to their nutritional modes.

ON423

Asymmetry drives the cumulative impacts of multiple stressors on freshwater ecosystems

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The interactions between climate warming and other more local stressors associated with anthropogenic land use are poorly understood. Here, we test the ability of three contrasting null models to predict the joint impacts of warming and a second stressor using a new database of 296 experimental combinations. Despite concerns that stressors will interact to cause synergisms (i.e., effects greater than the sum of their parts), we found that net impacts were best explained by the effect of the worst stressor alone (the dominance null model). This suggests that the 'worst', or most impactful, stressor frequently masks the effects of the less damaging one. For instance, when stressors associated with land use (habitat alteration, nutrient addition, or chemical pollution) exerted independent effects >50% larger than temperature, the effect of temperature was negligible. These findings indicate that the impacts of future warming may be harder to detect in previously altered or contaminated habitats.

ON444

Lipid export from water to land: Results from the pan-European project EUROPONDS

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Ponds are among the most numerous water bodies on Earth, and although facing major threats due to human-induced environmental changes they are often neglected in management plans. Ponds are important biodiversity hotspots providing multiple ecosystem services to humans. One ecosystem service that is notoriously understudied in ponds is the provision of high-quality dietary subsidies to the terrestrial environment, particularly through the emergence of aquatic insects rich in nutritional lipids. Aquatic primary producers provide many of these essential nutrients, which are integrated in the food web at the very base, whilst the terrestrial environment is generally deprived of those subsidies. Fluxes of these highly nutritional lipids are fundamental for the fitness of many terrestrial consumers, eventually supporting higher productivity and biodiversity in the recipient systems. In the face of global change, the quantity and quality of pond dietary subsidies will likely change drastically corresponding to alterations in physicochemical conditions and concomitant changes in plankton communities. Here, we investigated the seasonal and spatial variability of aquatic insect fluxes from 55 ponds distributed across Europe, from Sweden to Spain and from Portugal to Romania. Additionally, we explored how fluxes of insect biomass and lipids are connected to surrounding land use, local physicochemical conditions and pond productivity. Our results will help further understand the function of ponds as nutrient providers for surrounding terrestrial ecosystems to better predict impacts of alterations in pond dietary subsidies following global change.

ON038

Weakening of inverse stratification in northern lakes

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Inverse stratification is a defining feature of northern lakes in winter. This thermal state is broadly defined by a 0-4 °C vertical temperature profile, and enables the development of chemical gradients and ecological niches that shape winter food webs. Importantly, the strength of the density gradient modulates the extent and velocity of density-driven currents under ice, including downslope flows and radiatively driven convection. A recent modelling study (Woolway et al., 2021, doi:10.1002/lol2.10231) has shown that the duration of the inverse stratification period is rapidly declining as a result of warmer winters. This work represents a next step, investigating changes in inverse stratification strength. In this study we present a unique dataset of lake water temperature observations from North America and Scandinavia (11140 lakes, 1960-2021) to assess long-term changes in inverse stratification strength. We find that the surface-bottom density gradient has weakened significantly in the last 60 years, and that this is caused primarily by warming of surface waters below the ice. A 1D process-based model (ALBM) is used to identify potential drivers of the surface temperature trend in a subset of 787 trend lakes with ≥15 years of observations. We will present the new dataset and discuss preliminary modelling results.

ON161

Big, deep, warm, or cold: how lakes characteristics determine lake resilience to algal blooms

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Clean water in lakes is essential for food production and drinking water and thus to reach the sustainable development goals. Yet the water quality of many lakes declines due to excessive nutrient input. Excessive nutrient input exerts high environmental pressure that ultimately causes lakes to shift from a healthy and economically productive clear water state into a blooming toxic algal soup. Moreover, global climate change will likely exacerbate the effects of eutrophication on algal blooms. With the global challenges of climate change and pollution from human activities, it is an emerging question of how our lakes will develop in the future. Yet, each lake is unique. There is a great variety in physical and biochemical characteristics such as size, depth, water temperature, and sediment type among lakes. As a result, the multitude of stressors including climate change and land-use change have a different impact on individual lakes. Here we look at the effect of the different lake characteristics on the resilience of lakes to algal blooms. To this end, we built a novel and comprehensive database of lake morphometric, climate, and sediment characteristics of 19,536 lakes, including ponds and reservoirs (>0.1 km^2). We assessed lake characteristics for nine stratification classes and show that a complex interaction between characteristics like stratification, temperature, and depth determines how resilient to algal blooms these lakes are. Our characterization provides an important baseline to inform policymakers and society about the resilience of lakes and the ability of people to use lake resources under increasing stress.

ON260

(In)Coherence? – analyzing lake-to-lake coherence using high-frequency data from a multi-lake study with varied connectivity

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Climate change and anthropogenic forcing affects lake water quality and hence provision of ecosystem services. Lake management usually acts at local scale and focuses on individual lakes, while little attention is paid to lake chains in river-connected ecosystems. Hydrological lake-to-lake connectivity implies a potential propagation of local impacts along the flow path, e.g. via transport of pollutants, nutrients and planktonic organisms which might drive ecological coherence. To track the spread of point source pollution or effects of local extreme weather events in space and time, large spatial coverage and high temporal resolution are required. Here, we report on the usage of a low-cost buoy system equipped with high-frequency multi-parameter probes deployed in 19 lakes in the Northeastern German lowlands. These lakes possess a gradient in connectivity, with some being strongly connected e.g. via the Upper Havel river system while other lakes are only weakly connected to or relatively isolated from neighboring lakes. Between 2019 and 2020 we recorded time-series of pH, oxygen, turbidity, conductivity, temperature, Chl-a and phycocyanin fluorescence, which we analyzed using wavelet coherence. The unique combination of gradient in lake connectivity, high-frequency data and spatial density of sampling locations allows us to gain new insights on intra-lake coherence.

ON383

Under the bridge: light pollution affects zooplankton distribution in an urban river and at illuminated bridges

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Humans live near freshwater bodies and as a result, artificial light at night (ALAN) over-proportionally affects freshwater ecosystems, but the topic remains highly understudied. Two decades ago, a mesocosm study in an urban lake showed that ALAN affects the diel vertical migration (DVM) of zooplankton. However, no in-situ studies of free-swimming zooplankton in urban waters exist. Here we show the first non-invasive in-situ measurements of the impact of light pollution on the DVM of zooplankton in an urban freshwater lake-river system. We determined the vertical distribution of zooplankton in the River Spree and Lake Müggelsee in Berlin at different locations and for different ALAN and natural light conditions (bright ALAN, low ALAN, different moon-phase, clouds, fog). We used an infrared illuminated under-water mini deep-focus plankton imaging system that obtains an uninterrupted image allowing to determine zooplankton vertical distribution at cm-resolution. A deep learning automated image recognition tool was used for taxonomic classification, providing unprecedented spatial and species resolution for freshwater zooplankton. Measurement locations included an illuminated bridge (Oberbaumbrücke) that was part of a light festival the "Berlin Festival of Lights" but also bright and dark parts of the river and the lake. At each location, a measurement was performed during the day and during night. We find clear patterns of DVM for both cladocera and copepods at locations without ALAN and that the DVM is disturbed by bridge illumination and other sources of light pollution.

ON045

Impacts of shelter on the relative dominance of primary producers and trophic transfer efficiency in aquatic food webs: implications for shallow lake restoration

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Wind-induced turbulence can strongly impact ecological processes in shallow lake ecosystems. The creation of shelter against wind can be expected to affect both primary producers and herbivores in aquatic food webs. A reduction in trophic transfer efficiency due to wind-induced turbulence can potentially lead to declines of higher trophic levels, but is generally understudied. We hypothesized that reducing wind-induced turbulence will stimulate higher trophic production in shallow lakes. We tested our hypothesis in the shallow waters of a newly constructed archipelago named Marker Wadden in lake Markermeer in the Netherlands by executing a 2-month field mesocosm experiment. Our results showed that under unsheltered conditions phytoplankton was the dominant primary producer, while in sheltered conditions submerged macrophytes became dominant. Despite that phytoplankton concentrations were 23-fold higher under the unsheltered conditions, this did not result in higher zooplankton biomass, which was equal to zooplankton biomass under the sheltered conditions, resulting in higher trophic transfer between phytoplankton and zooplankton under sheltered conditions. Furthermore, under the sheltered conditions the Gastropoda density reached 746 individuals m^{-2}, while no Gastropoda were found under the no shelter treatment. These findings indicate that for shallow lakes that are negatively affected by wind-induced turbulence, measures aimed at ameliorating this stressor can be effective in facilitating submerged macrophyte recovery, increasing Gastropoda densities and restoring trophic transfer efficiency between phytoplankton and zooplankton. Ultimately, this may support higher trophic levels such as fish and water birds by increasing their food availability in shallow lake ecosystems.

ON308

The intestinal helminth community of the mallard *Anas platyrhynchos* L,1758 from Austria

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A first record of the intestinal helminth community of the mallard *Anas platyrhynchos* from Austria was conducted, including 60 specimens shot by hunters in autumn. The following taxa were recovered (prevalence given in parentheses): Cestoda: *Diorchis* sp. (31.7%) and *Fimbriarioides intermedia* (1.7%); Acanthocephala: *Filicollis anatis*(5%), Polymorphus minutus (30%) and one cystacanth unidentified (1.7%); Trematoda: *Apatemon gracilis* (3.3%), *Echinostoma grandis* (6.7%), *Echinostoma revolutum* (6.7%) and *Notocotylus attenuatus* (23.3%); Nematoda: *Porrocaecum crassum* (1.7%) and one not identified (1.7%). The frequency distribution of parasites showed a typical pattern in which 39 birds (65%) were either not parasitized or were harboring up to five worms, whereas more intense infestations occurred in a lesser number of hosts. Compared to other studies from central and eastern Europe, an extremely depauperate helminth community, particularly of the cestodes and nematodes, was found. Though the particular reasons for this remain unexplained a north - south and east - west slope within Europe is observable, pointing to a negative correlation between land-use as well as other anthropogenic influences on ecosystems and parasite diversity.

ON039

From local to regional and continental scale early warning and forecasting of water quality

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Predicting water quality characteristics in a timely and accurate manner is an essential ingredient of proactive and informed decision making against risks related to degradation in water quality, like algal blooms. To keep track of current and future changes in water quality for large areas, it is necessary to adapt monitoring, modelling and forecasting capabilities of water quality using advanced technology. This combines new in-situ sensor technology with large scale monitoring capabilities of Earth observation systems and physics-based machine learning algorithms. In two complementary projects, the EU Horizon 2020 funded PrimeWater and the CSIRO AquaWatch Mission, we have taken significant steps forward in establishing pathways for better management of our water resources in the future. PrimeWater integrates state-of-the-art satellite technology and in-situ monitoring with advanced hydrological and water quality modelling into a powerful decision support system to achieve operational predictive models for water quality managers (here for algal blooms). While this is done on a case-by-case base, the AquaWatch Mission establishes a pathway to combine ground sensor data, satellite imagery and hydrodynamic models on a regional to continental scale to produce a range of value-added data products, delivered through online AquaWatch web services for use by water managers. In this presentation, we will share our learnings from two Australian case studies on modelling and forecasting algal blooms using hyperspectral monitoring, process models and data-driven approaches: Lake Hume, a large reservoir often plagued with frequent harmful algal bloom outbreaks, and the Melbourne Water wastewater lagoon system with regular algal blooms.

ON006

Suitability models at mesohabitat scale of native freshwater fish and mussels for their application in environmental flows assessment in the NE of the Iberian Peninsula

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Aquatic organisms use specific habitat for rearing, growing, breeding, and wintering. Multiple studies have stated that for multiple species but few for the specific purpose of developing suitability models that feed hydrobiological models for the analysis of environmental flows. We here analyze habitat preferences of five freshwater species of fish and mussels in the NE of the Iberian Peninsula for that purpose.
We use simple decision trees and random forest, a machine learning technique, to develop suitability models that relate habitat preferences of the five species –separately adults and juveniles– to different attributes of physical habitat at the meso-scale. Selected attributes are the surface percentage of depths, velocities and substrates, and absence/presence of refuges. The models were developed to predict three ranks of habitat suitability: absence, presence and abundance, depending on the mentioned attributes of the analysed mesohabitat.
Our results, with more than 75% of accuracy, proved that the adult mussels of *Unio* genus require a minimum of 5% of sand or silt, low velocities and undercut banks; that *Barbus meridionalis*habitat changes considerably among seasons; *Salaria fluviatilis* needs coarse substrates and velocities above 15 cm/s; adult *Squalius laietanus* prefers glides and pools with depths above 60 cm and velocities below 45 cm/s, depending on the season; and that*Anguilla anguilla*prefers intermediate size substrates.
By analyzing how physical habitat changes according to the flow regime, one can see whether the available habitat of fish and mussels increases or decreases and predict periods of danger for the species.

ON384

The sublethal effects of warming – Developmental response of aquatic insects

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We are increasingly receiving reports of dramatic changes in the abundance and composition of insect species communities. These changes are usually described in the form of decreasing and increasing numbers of individuals or species. So far, there has been little systematic research on sublethal effects exerted by environmental stressors during development. Ectothermic insects exhibit plasticity in the timing of emergence and phenotypic development as a response to temperature variation. This developmental plasticity to changing thermal conditions may dictate the vulnerability of some insects to increasing ambient temperatures. I will show results from an emergence trap monitoring that illustrate a general change in the aquatic insect communities, with a substantial decrease of sensitive EPT-taxa (orders Ephemeroptera, Plecoptera and Trichoptera). Additional, yet more specific analyses of phenotypic traits over 9 consecutive years reveal that phenology and phenotype of aquatic insects strongly vary in dependence of ambient environmental conditions. In many species, we found premature emergence, reduced adult body weight, and altered dispersal potential. Such patterns might affect the reproductive potential and persistence of aquatic insect populations, especially for stenoecious taxa with narrow distribution ranges. This calls for integration of information on temperature-induced plasticity of phenotypic traits into models forecasting range shifts in the face of climate change. Furthermore, such patterns are likely to affect metapopulation dynamics of aquatic insects under climate change conditions and may contribute to the ongoing decline of insect biomass and diversity.

ON189

Understanding the time-varying importance of consistent drivers of river phytoplankton dynamics

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When representing phytoplankton dynamics in an ecosystem as a regression model, there are important questions arising. Does the regression relationship maintain at the ecosystem for multiple years and does the variance of phytoplankton depend merely on the drivers' fluctuation? If the relationship itself varies in time, would the same drivers continuously involve in the relationship with varying coefficients? In this study, we used a dynamic linear regression model (DLRM) with time-varying parameter values to model time serieses of phytoplankton abundance. We applied DLRM to monthly concentrations of chlorophyll a (chl-a) along with physicochemical and biological covariates. A single model was built using 28 years data from nine station in the Nakdong River in South Korea, and then applied separately to each year and sites. Unobservable state variables from the model were further analyzed with external forcing such as climate indices. Equivalent static regression models were investigated for the purpose of comparison. Results showed that the relationships of the drivers with the concentration of the chl-a varied with time, a fact that could not be detected with static regression. Moreover, these processes were found across the study sites and controlled by the climatic indices. Overall, the results suggest that the mechanism of phytoplankton proliferation in a specific ecosystem is reluctant to change but the relative importance of the drivers could change in time.

ON078

Export of dietary lipids via emergent insects from eutrophic fish ponds

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Fish ponds, despite being highly abundant across the world, have so far received little scientific attention in terms of their ecological contributions to the surrounding terrestrial environment. In particular, emergent insects from fish ponds may be important sources of lipids and essential fatty acids to terrestrial ecosystems. In this field study, nine eutrophic fish ponds in Austria were investigated during summer 2020 to examine how Chlorophyll-*a*concentrations affect the biomass of emergent insect taxa (i.e., quantity of dietary subsidies) and their total lipids and long-chain polyunsaturated fatty acids (LC-PUFA, i.e., quality of dietary subsidies). Chironomidae and Chaoboridae were the most abundant emergent insect taxa, followed by Trichoptera, Ephemeroptera and Odonata (Coenagrionidae and Aeshnidae). During the study period, a total of 1068 kg of emergent insect dry mass was exported from these fish ponds (65.3 hectares) and the most abundant taxa, Chironomidae, exported 103 kg of total lipids and 9.4 kg of omega-3 PUFA. Increasing Chl-*a*concentrations were associated with a decrease in biomass export and a decrease of total lipids and LC-PUFA export via emergent Chironomidae. The PUFA composition of emergent insect taxa differed significantly from dietary algae, suggesting selective PUFA retention by insects. This research emphasizes the as of yet widely overlooked ecological value of fish ponds as sources of essential nutrients provided via emergent insects for riparian consumers.

ON388

Lagrangian profiles of riverine autotrophy, organic matter transformation, and micropollutants at extreme drought and the consequences in the estuary

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On their way from inland to the ocean, flowing water bodies, their constituents and their biotic communities are exposed to complex transport and transformation processes. However, detailed process knowledge as revealed by Lagrangian measurements adjusted to travel time is rare in large rivers, in particular at hydrological extremes. To fill this gap, we investigated autotrophic processes, heterotrophic carbon utilization, and micropollutant concentrations applying a Lagrangian sampling design in a 600 km section of the River Elbe (Germany) at historically low discharge. Under base flow conditions, we expect the maximum intensity of instream processes and of point source impacts. Phytoplankton biomass and photosynthesis increased from upstream to downstream sites. Concentrations of dissolved macronutrients decreased to almost complete phosphate depletion and low nitrate values. Molecular analyses revealed a longitudinal increase of many DOM components due to microbial production, whereas saturated lipid-like DOM, unsaturated aromatics and polyphenols, and some CHOS surfactants declined. Decomposition experiments suggested predominant oxidation of younger algal DOM over older river DOM. Micropollutants determining toxicity for algae showed higher concentrations from the middle towards the downstream part but calculated toxicity was not negatively correlated to phytoplankton. Overall, autotrophic and heterotrophic process rates and micropollutant concentrations increased from up- to downstream reaches, but their magnitudes were not distinctly different to conditions at medium discharges. In the estuary, however, phytoplankton biomass died off leading to the release of dissolved nutrients and distinct minima of pH and oxygen saturation.

ON135

Comparing four different in-lake treatments to control sediment nutrient release in an enclosure study

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An enclosure experiment was performed between April and August 2020 to compare the efficiency of dredging, adding the aluminium-modified zeolite Aqual-P™ (AMZ), the lanthanum-modified bentonite clay Phoslock® (LMB) and $FeCl_2$ to mitigate nutrient release from the sediment in the eutrophic Bouvigne pond (Breda, the Netherlands). The treatments improved water quality. Mean total phosphorus (TP) concentrations in water were 0.091, 0.058, 0.032, 0.031, 0.030 mg P L^{-1} in controls, and dredged, $FeCl_2$, LMB and AMZ treated enclosures, respectively. Mean filterable P (FP) concentrations were 0.056, 0.010, 0.009, 0.0049, 0.0048 mg P L^{-1} in controls, dredged, $FeCl_2$, AMZ and LMB treatments, respectively. The course of nitrogen species, metals and water quality variables will be discussed; lanthanum was elevated in LMB treatments, Fe and Cl in $FeCl_2$ treatments, and Al and Cl in AMZ treatments. After 112 days, sediment was collected from each enclosure revealing that the mobile P pool in the sediments had reduced by 71.4%, 60.2%, 38% and 5.2% in dredged, AMZ, LMB and $FeCl_2$ treatments compared to the controls. No sign of vivianite formation was obtained. A sediment core incubation experiment was started simultaneously with the enclosure experiment and revealed that FP fluxes were positive in controls and cores from dredged area, while they were negative in LMB, AMZ and $FeCl_2$ treated cores. Dissolved inorganic nitrogen (DIN) release rate in LMB treated cores was much higher than in controls, and other treatments. Overall, the in-lake treatments improved water quality, but what to choose will depend on the target lake.

ON173

Biodiversity and anthropogenic impacts on fishes of Shohimardon River drainage, Ferghana valley, Central Asia

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Central Asia features large-scale irrigated agriculture with a plethora of hydro-technical infrastructure and diversion schemes developed since the 1960ies. At the same time, it is regarded as a data-deficient region regarding freshwater biodiversity and biogeography. To fill these knowledge gaps, this study presents an in-depth analysis of human impacts and fish community status of a mountain river flowing from the northern slopes of the Alai and Turkestan ranges (Western Tyan-Shan) to the Ferghana valley. Here, we present results from fish ecological surveys conducted 2021-2022 in the 112km long Shohimardon River, a transboundary river between Kyrgyzstan and Uzbekistan, within the framework of the Hydro4U project funded by the European Union. The Shohimardon River, particularly its middle reaches, features over ten barriers, of which seven are fully impassible for upstream migrating aquatic biota. The field surveys revealed the presence of the snow trout species *Schizothorax eurystomus*. Snow trout populations between the mapped barriers exist but are likely only kept alive by colonization from upstream reaches. Also, fish in the diverted river reaches are smaller than those upstream. Still, signs of early sexual maturity have been detected, hinting at a slow growth rate of snow trout in Shohimardon River. Another widespread threat to native fish populations is poaching. Overall, this research underlines the high anthropogenic pressure on fishes of the studied river, particularly potamodromous species such as *S. eurystomus*. Management must prioritize fish passage and environmental flows as means of river restoration to protect aquatic biodiversity in Central Asia's mountain streams.

ON393

Eco-Evolutionary dynamics considering incompatible defence with respect to size dependent adaptation of prey against predators and parasites

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In natural communities, prey species are faced with multiple types of consumers and might need to adapt resistance against them simultaneously. Potential consequences of prey adaptation against multiple consumers on species abundance and community feedbacks remain unclear. Here, we have investigated how the isolated and combined presence of predators and parasites affects adaptation of prey resistance and how this influences community dynamics using a differential equation model. The model food web consists of an adaptive phytoplankton species with variable size, a zooplankton species with adaptable size, and parasitic chytrids. We assumed that parasitic chytrids are more likely to infect larger cells of the phytoplankton population, while zooplankton preferentially feeds on smaller cell sizes, but cannot ingest large phytoplankton cells. Furthermore, we assume that the phytoplankton can decrease/increase its size to escape parasite infection/predation. Correspondingly, phytoplankton faces a size tradeoff between their tolerance to predators or parasites. The model results suggest that the adaptation tradeoff may control phytoplankton's biomass and adaptation dynamics. We see that potential indirect facilitation between zooplankton and chytrids occurs. In this case, zooplankton and chytrids reach higher biomass levels and phytoplankton biomass was strongly suppressed compared to the cases with solely the predator or parasite. Yet, competitive exclusion between zooplankton and parasitic chytrids can occur in some cases. We will discuss the key parameters to induce indirect facilitation or competition at the predator/parasite level. Our study provides insight into a potentially important mechanism to control phytoplankton dynamics in response to multiple consumers.

ON347

Methodological Strategies for Extracting Sedimentary Ancient DNA from Tropical Lake Regions

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The Hominin Sites Paleolakes Drilling Project (HSPDP) provides long records from eastern African paleolakes and the Chew Bahir sediment cores in southern Ethiopia provide sediment samples spanning the last ~620kyrs. Sedimentary ancient DNA (sedaDNA) analysis via high throughput sequencing across these cores can provide a record of past environmental conditions via reconstructing past biodiversity. While the approach has high potential to reconstruct past biodiversity responses to drastic environmental change, the tropical climate of this region increases fragmentation and degradation of sedaDNA, and as a result, the amount of analyzable ancient DNA decreases over time. The results of a pilot study found that the number of less abundant eukaryotic sequences could be increased by target enrichment via hybridization capture of barcode regions. This study explored the effect of different DNA isolation protocols, sediment type, and age of sediment samples on the size and quality of sedaDNA extracted from Chew Bahir cores. For this purpose, sedaDNA from 10 sediment samples aged between 4,000 and 200,000 years BP was isolated using six different isolation protocols. Next, single-stranded libraries were prepared for all samples and shotgun-sequenced reads were analyzed to compare the size and quality of aDNA among the samples. Our first results indicate that, even if sediment samples are very old, an optimized isolation protocol can significantly increase the average length of sequences extracted. Comparing yield of different extraction methods is hence an important consideration when designing sedaDNA studies from tropical regions.

ON378

Changes in water quality of Lake Sevan as an ecosystem services provider for urban development

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Armenia is a country that faces water stress in 70% of its territories. Global climatic changes are expected to reduce rainfall in the region and further compound issues of water scarcity, putting the country's food and energy security at risk. Thus, the country's biggest freshwater resource, Lake Sevan, serves as the heart of the region's sustainability. Nonetheless, urban development and erratic extraction of its water for energy production, agriculture and aquaculture usage, have had many negative impacts on the lake's water quality over the past decades. Here, I present results of changes in chl-*a* and other water quality parameters from the past decade attained via remote sensing and *in-situ* measurements, in direct relation to water-level fluctuations and changes in the surrounding land-use and cover. I will discuss potential implications of these changes on ecosystem metabolism, GHG emissions and ultimately the quality of the provided ecosystem services.

ON263

The potential impacts of low-head barriers on aquatic biota in Irish rivers – insights from the Reconnect project

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Reconnect aimed to advance knowledge on the impact of barriers on connectivity in Irish rivers in terms of sediment dynamics and ecology in studies undertaken between 2016 and 2020, and to develop a methodology for prioritising selection of low-head barriers for modification or removal to improve hydromorphology and connectivity. In addition to mapping barriers in 10 sub-catchments detailed investigations on fish, macroinvertebrates, macrophytes, hydromorphology and eDNA were carried out in four core study areas on the Duag, Browns Beck Brook, Dalligan and Burren Rivers which each contained a significant barrier. These included monitoring responses to removal of the ford on Browns Beck Brook. Specific investigations were carried out at 35 other locations across 12 river/ stream systems. The fish studies highlighted issues with upstream fish migration in the Dalligan River where there is a vertical barrier (2.3 m high) about 2 km from the sea. In the other catchments brown trout and Atlantic salmon fry and salmon parr were absent or in low abundances in the impounded reaches, and the impounded reaches did not always hold the highest density of 1+ and older fish. Impacts on macroinvertebrate communities largely related to the change in habitat due to impoundment behind the barriers creating elongated pool habitat.

ON418

***Defence Index*: a framework to simplify studies on complex defence strategies**

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All organisms are able to adapt to environmental stressors and may evolve or enhance special traits to reduce the stressor impacts. Recent research focusses on more complex responses, on several levels, comprising whole sets of organismal traits supposedly protecting, or defending against multiple stressors, often even in various environments. However, this increasing complexity is difficult to analyse and to derive conclusions from. We developed *the Defence Index,* to improve and simplify the analyses and interpretation of complex multidimensional data on organismal adaptations. This straightforward framework can be used to gather all traits of an organism into one number. By doing so, it calculates the overall adaptiveness, or defence, of an organism against a certain environmental parameter or stressor. Furthermore, the *Defence Index* respects maladaptations and each traits' putative defensive value. Additionally, the framework provides the opportunity to qualitatively estimate the adaptiveness of traits (e.g., which trait is (most) important). We will explain how the framework operates and how it can be applied. We re-analysed data of a predator-prey study, with respect to a comprehensive set of defensive morphological structures and show that models using the *Defence Index* outperform established statistical approaches (e.g., in terms of fit quality and simplicity), like complex regression models or principal component analyses. We further assessed the accuracy of the adaptiveness prediction on simulated data with different parameterization, e.g., non-gaussian distribution, or number of replicates. The *Defence Index* will improve future research and understanding on complex defence responses against environmental stressors.

ON335

New perspective of trophic magnification factor reflecting average biomagnification based on multi diets

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In order to understand the effect of pollutants on biota in aquatic environment, several biological factors such as bioconcentration factor, bioaccumulation factor, biomagnification factor (BMF), and trophic magnification factor (TMF) have been proposed as part of the environmental impact assessment (EIA). Among them, BMF is calculated relatively easily with a single diet and consumer, and has an advantage of understanding material transfer between target species, but the information only provides fragmentary feeding relationships. To compensate for the difficulties of BMF, a TMF that can understand the transfer characteristics within the aquatic food web has been newly proposed. However, it does not take into account the contribution of diet, and has a weakness in that labor-intensive sampling. In order to maximize the benefits of BMF and TMF and to overcome the limitations at the same time, this study suggests a new TMF (TMF_D). This is a way of evaluating the relative contribution of potential diets to the top predator through the MixSIAR (R package) using carbon and nitrogen stable isotope ratios, and the multi diet contributions weighted average BMF (TMF_D) were calculated. This has the advantage of being able to represent the TMF with a few target species. As a result of comparing the TMF and TMF_D of mercury, the TMF was relatively over/under-estimated compared to TMF_D (TMF_D = 1.5·TMF – 3.0, R^2=0.98, p<0.01). The difference should be attributed to different diet contributions, suggesting that TMF_D should be more accurate index to assess pollutants transfer through aquatic food web.

ON295

What are lake bubbles telling us? - methane production in littoral sediments

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Lake sediments are a suitable condition for methanogenesis, the final step in anaerobic microbial degradation of organic matter, producing CH_4 as the end product. The biogenically produced CH_4 is released at the sediment-water interface by diffusion. Then, when the production rate exceeds the possible diffusion rate, CH_4 builds up and, when the total gas pressure exceeds local barometric and hydrostatic pressure, starts to form bubbles in the sediment matrix where it equilibrates with the surrounding environment until it eventually escapes to the atmosphere via ebullition. Although the ebullitive flux is one of the dominant CH_4 emission pathways, yet direct measurements of this flux are hampered by its spatiotemporal variability and methodological constraints. Here, we develop a conceptual model to quantify system-wide total CH_4 production from lake sediments and particularly CH_4 fluxes as bubble ebullition based on measurements of bubble gas content (CH_4 concentration and isotopes) and total local pressure at given depths. The developed model is tested by using the measured CH_4 ebullition data in 6 temperate lakes in Quebec. In addition, we apply the model by using a two-points sampling approach, which can be relatively easily taken, to estimate system-wide CH_4 ebullitive fluxes in 428 lakes across Canada. Our approach suggests that the contribution of bubble flux to total CH_4 productions averages 47% in these systems.We expect the model contributes to providing more robust estimates of CH_4 production and emission to the atmosphere in lake systems.

ON310

Identification of biodiversity of the freshwater ecosystem by eDNA from the feces of benthic invertebrates

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Environmental DNA (eDNA) refers to DNA that can be extracted from environmental samples such as soil, water, air and feces and can be used as an efficient tool to compensate for the shortcomings of existing biodiversity surveys. In particular, eDNA in the feces of freshwater benthic invertebrates with unique eating methods is thought to have the possibility of identifying hidden biodiversity in freshwater ecosystems such as streams and rivers. In this study, eDNA was extracted from the feces of species such as *Semisulcospira libertina*, *Lymnaea auricularia* and *Corbicula fluminea* to establish the possibility of examining the biodiversity of freshwater ecosystems. We conducted a field survey in Danjang Stream, Miryang, on August 6, 2021 and Nakdong River estuary, on September 11, 2021. In the Danjang Stream samples (*S. libertina*, n=18; *L. auricularia*, n=5; *C. fluminea*, n=1), feces accumulated in the tube were filtered. While in the case of the Nakdong River samples (*C. fluminea*), feces were extracted through anatomical experiment. Afterwards, the extracted gDNA was amplified using 18S_V9 primer and sequenced using Next Generation Sequencing (NGS). The unique OTUs were identified through BLASTn analysis. As a result, nucleotide sequences were detected for fungi, bacteria, and animals like cattle, a pig, a house mouse, etc. Our results imply that freshwater ecosystem biodiversity can be identified using eDNA from the feces of benthic invertebrates, especially *S. libertina*and *C. fluminea.*

ON455

The Abundance and Composition of Microplastics in Lake Biwa

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A lot of plastics are flowing out from rivers into the ocean, which is becoming a social problem. Lake Biwa, the largest lake in Japan is no exception. Recently, microplastics were confirmed in Lake Biwa, and we decided to conduct research to better understand the situation. In this study, a total of 25 surveys were conducted from March 2019 to January 2022 to investigate the number, color, and size of plastics. In addition, microplastic components were analyzed using the Nile Red staining method to discern if they are microplastics. As a result, several microplastics were found per ton of lake water. We also discovered that there are larger microplastics (>1 mm) in the North Basin than in the South Basin. We concluded that this may be due to the existence of water circulation of Lake Biwa and the difference in residence time between the North Basin and the South Basin. By investigating the types and proportions of plastics, we decided to find out the characteristics of plastics in Lake Biwa.

ON022

Diversity and functional potential of aquatic fungi in permafrost ecosystems

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Fungi are important decomposers of organic matter (OM) in soil, but there is limited knowledge about their ecological roles in aquatic ecosystems. Here, the relationship between fungal diversity and OM was explored in permafrost ecosystems. Climate change causes thaw and collapse of permafrost peatlands, creating water bodies named thermokarst ponds. These ponds are considered hotspots for carbon cycling, as they receive a significant amount of carbon previously stored in the permafrost. To study the fungal ecology in these ponds, five regions across the Arctic were sampled, comprising a thaw gradient: from regions not affected by thaw to degraded regions with thermokarst ponds. The quality of the dissolved organic matter (DOM) was strongly linked with the fungal community composition, and correlated with a significant decline in beta-diversity across individual ponds towards the degraded regions, suggesting a homogenization of pond communities. Also, the functional potential of the fungal communities in the pond water and sedimentat one of the degraded sites showed that sediments had higher relative abundances of fungal isolates with greater potential for degradation of plant litter. In the water, the fungi had a high potential for growth. Correlations between carbohydrate active enzymes and proxies for DOM quality suggested that aquatic fungi are able to benefit from the freshly produced OM of microbial sources and old OM from terrestrial sources. These findings shed light onto the ecological roles of aquatic fungal communities in the carbon cycle of ecosystems affected by a warming climate.

ON356

Dynamics of P or N limitation of phytoplankton in a polymictic lake

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Eutrophication control should focus on the limiting nutrient. However, nutrient limitation may change in the long run by developments in the drainage basin, seasonally due to different balance between sedimentation and nutrient release from sediments or temperature-dependent intensity of denitrification and at time-scales of days or weeks by mixing events. Especially in polymictic lakes, nutrient availability is strongly influenced by the sequence of sedimentation and release. Extended periods of N limitation may favor N_2-fixing cyanobacteria (Nostocales). We analyzed long-term monitoring data of the polymictic lake Müggelsee (Berlin, Germany) to answer the following questions: Did the lake react faster on reduction of external phosphorus or nitrogen load? Did the limiting nutrient change seasonally in a predictable manner? And how did stratification periods influence nutrient remobilization and phytoplankton dynamics?
The external nutrient loading of lake Müggelsee declined by 75% (TP) and by 83% (TN) from 1980-89 to 2012-2021, respectively. N concentrations in the lake declined in parallel to inflow concentrations but P concentrations remained high during summer for another 18 years. P was released from sediments during most of the summer, N only in short pulses. During the 42-years study period, total phytoplankton biovolume was best correlated to TP in spring and TN in summer. Seasonal averages of Nostocales biomass declined with declining concentration of dissolved inorganic nitrogen. After reduction of external nutrient loading, cyanobacteria dominated phytoplankton only in some periods of thermal stratification with increased ammonium remobilization from sediments. *Aphanizomenon* was replaced by *Anabaena* as dominant Nostocales genus.

ON279

Exposure of Plastic Nanoparticles to Freshwater Picocyanobacteria *Synechococcus*

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When microplastics (MPs) end up in water bodies, they can undergo degradation processes to form nanoplastics (NPs), defined as plastics between 1 to 999 nm in size. The small size of NPs enables them to bypass cell membranes and bioaccumulate in tissues and organs. Additionally, NPs can release sorbed contaminants, eliciting additional toxicity to the organism. In freshwater ecosystems, picocyanobacteria (0.2-2 µm) are often major primary producers. Specifically, they have been shown to store and metabolize phosphorus (P) as polyphosphate (polyP) under acute P stress. However, little is known about the impacts of NPs on these microorganisms. The goal of this study is to understand the impact of NPs to the freshwater picocyanobacteria *Synechococcus*. We investigated the potential impacts of synthetic NPs on cell growth and abundance, zeta potential, photosynthetic activity, and the production of reactive oxygen species (ROS) and antioxidant enzymes. Studying the potential impacts of NPs on picocyanobacteria provides insights into their influence on the biogeochemical cycles in aquatic environments, the occurrence of algal blooms, eutrophication, and “dead zones” (areas deprived of oxygen), and the additional threat of bioaccumulation in higher-level organisms, including humans.

ON436

Institutionalizing participatory water monitoring in Mexico

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The knowledge gap around continental waters is stark in middle- and low-income countries, as monitoring activities have been insufficient. Participatory monitoring has been proposed as a tool to generate quality data with a limited budget, besides the possibility to generate local interest in water governance and water body restoration. In Mexico, interest in participatory water monitoring is growing steadily, but existing protocols cannot be used to generate data that comply with the regulatory framework. Also, the implementation of participatory monitoring has been hampered by a lack of funding. Institutionalizing participatory monitoring and to establish a program in the National Commission for Water (CONAGUA) serves to validate existing protocols, create interinstitutional spaces for dialogue and discussion, besides of providing a basic infrastructure for monitoring groups. The validation process consists of contrasting methodologies for physicochemical parameters (air/water temperature, pH, dissolved oxygen, hardness, alkalinity, turbidity), fecal coliforms and bioindicators in the laboratory and in 6 sites, using the Global Water Watch participatory protocol and the official established norms by CONAGUA. The laboratory results show that the proposed techniques have a high level of repeatability and accuracy. The field evaluation shows the learning process of monitoring groups, as the parameters with a deviation higher than 30% to the reference measurements by CONAGUA dropped from 16 to 10 between the first and second evaluation. The parameters with more deviations are hardness, dissolved oxygen and alkalinity but participatory monitoring in Mexico can be used to establish a first alert about problems with water quality.

ON074

Mosquito control agent *Bacillus thuringiensis* var. *israelensis* alters emergence dynamics of insects from freshwater ponds

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Aquatic and adjacent riparian food webs are inter alia linked via the flux of energy and nutrients from emerging aquatic insects which provide a high-quality subsidy to terrestrial predators. Thus, disturbance of emergence induced by anthropogenic stressors can cascade to higher trophic levels with effects across system boundaries. One hotly debated stressor with potential impact on non-target aquatic insects, especially on non-biting midges (Diptera: Chironomidae), is the mosquito control agent *Bacillus thuringiensis* var. *israelensis* (Bti). Chironomidae can constitute up to 90% of aquatic subsidy and thus play a key role in the aquatic-terrestrial linkage. In a semi-field experiment, we investigated insect communities from Bti-treated (three times maximum field rate) and control freshwater ponds over >3 months for changes in community composition, diversity as well as emergence dynamics, and mass of individuals. We found 24 insect families with Chironomidae and Baetidae being most abundant (88% and

9%, respectively). Total abundances did not differ between treatments. However, Bti altered community compositions at different timepoints over the entire study duration which is mainly attributed to a significant earlier (approx. 2 weeks) peak in the emergence of Chironomidae. During Bti application (first 5 weeks) Chironomidae emerging from Bti-ponds were heavier (~26%) than control individuals. None of these effects was observed for Baetidae. Our results indicate a substantial shift in the emergence dynamics by Bti and thus the availability of aquatic prey for terrestrial predators. Consequences of these observations for terrestrial food webs remain unclear but deserve careful consideration.

ON051

Effects of salt stress on microbial diversity and their CO_2-fixing potential in the third pole lakes

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Salinity is one of the most important environmental stresses driving microbial diversity and community structure in worldwide lake waters. This is particularly concerned in Tibetan Plateau lakes, which is called the third pole, for other environmental stresses, e.g. high irradiance, low temperature and high pH collectively constrain the microbial diversity. Herein we disentangled the environmental stresses driving microbial diversity, interactions and their CO_2-fixing potential in the plateau saline lakes. Saline lakes(salinity between 0.5 and 50 g/L) harbored similar or even higher bacterial diversity than freshwater lakes(< 0.5 g/L), while hyper-saline lakes(> 50 g/L) were the lowest. Furthermore, salinity dominated the bacterial community structure in saline lakes, but water temperature and geospatial distance did in freshwater and hyper-saline lakes, respectively. Network analysis demonstrated that hyper-saline lakes exhibited higher microbial competition than freshwater and saline lakes. Similarly, the diversity of microbial primary producers(MPP) was significantly constrained by salinity, but this constraint was offset by nutrients, including total organic carbon and total nitrogen. The nutrient facilitating effect was more pronounced in saline than others. In contrast, nutrients did not increase the CO_2-fixing potential of MPP(measured by $^{13}CO_2$ labelling method) in these lakes, but dissolved inorganic carbon(DIC) significantly did by enhancing the MPP abundance and offsetting the salinity constraint. Diatoms adopt to high DIC and salinity become critical for the CO_2-fixing in the plateau lakes. Our findings indicate that nutrients play an important role in driving microbial diversity and CO2-fixing potential, and thereby inland lakes may maintain higher CO_2-fixing potential than previous recognized.

ON110

Microplastic particle characteristics influence impacts on organisms, communities and ecosystem processes

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Microplastics (MPs) are a diverse set of refractory carbon particles contaminating fine particulate organic matter (FPOM) pools in freshwater ecosystems. Physical characteristics of MP particles (e.g. shape, polymer, size) have been shown to influence MP effects on organisms, particularly those that feed primarily on FPOM. MP particle characteristics may also influence their surficial biofilm assemblages, supporting microbial communities distinct from the surrounding environment. Our study investigated the influence of particle characteristics and concentration on the impacts of MP particles, as a contaminant of FPOM pools, on microbial communities, chironomid larvae *Chironomus riparius*, and associated ecosystem processes. We used a series of MP particles differing in polymer (Polyethylene, Polystyrene, Polypropylene and Polyethylene terephthalate) and shape (Fragments, Spheres and Fibres) at environmentally observed concentrations (0, 1000, 50000 p/$kg_{sediment}$). To simulate environmental exposure of MPs, we added heterogeneous FPOM as a food source and mineral sediment to microcosms, and allowed biofilm to form on particles before commencing the experiment. MP particle shape affected chironomid survival and biomass, and high MP concentration was associated with increased lipid content in chironomid larvae. MP particle polymer, shape and concentration interacted to affect microbial abundance and ecosystem processes. These results highlight the complex nature of MP pollution, with particle characteristics strongly regulating impacts on organisms, communities and ecosystems. Further research into the influence of particle characteristics in diverse MP mixtures would better inform us of the potential effects of environmental MP pollution.

ON351

Lake ecosystem change at the wetland-dominated southern boundary of permafrost in Western Canada

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At its southern limit, permafrost is commonly restricted to permafrost peat plateaus and palsas because the insulating properties of peat maintain permafrost where air temperatures are otherwise too warm. This makes discontinuous permafrost peatlands highly vulnerable to even modest warming of air temperatures. When permafrost thaws, palsas and plateaus can transition into permafrost-free bogs or channel fens (i.e. wetland thermokarst). This results in changes to watershed storage and run-off pathways and biogeochemical cycling. Lakes play an important role in the hydrological and biogeochemical function of watersheds. Consequently, there is a need for improved understanding of the trajectories and drivers of lake ecosystem change in southern permafrost landscapes. The Dehcho region of the Northwest Territories (Canada) is experiencing rapid expansion of thermokarst wetlands that is enhancing the hydrological connectivity of watersheds. Using a combination of remote sensing and paleolimnology, we document extensive environmental changes occurring in lakes of the Dehcho region over decadal to centennial timescales. Examples include broad-scale lake expansion in the Mackenzie Bison Sanctuary and increases in terrestrially derived dissolved organic carbon. We use field data from the Scotty Creek Research Station, a site of eco-hydrological research and monitoring since the early-2000s, to theorize the drivers of limnological change and predict future impacts with climate warming. This work is part of the Dehcho Collaborative on Permafrost, a partnership between the Scotty Creek Research Station and the Dehcho First Nations that fuses scientific and Indigenous knowledge to predict and adapt to permafrost thaw.

ON298

Temporal patterns and potential drivers of CO_2 emission from dry sediments of a large river

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River sediments falling dry at low water level emit CO_2 to the atmosphere. While the general relevance of CO_2 emissions from dry sediments has been acknowledged, knowledge on mechanisms and temporal dynamics is still sparse. Using a combination of high frequency measurements and detailed studies we aimed to identify processes responsible for CO_2 emissions and to assess temporal dynamics of CO_2 emissions from dry sediments at a large German river.
CO_2 emissions were largely driven by microbial respiration in the sediment. Observed CO_2 fluxes could be explained by patterns and responses of sediment respiration rates measured in laboratory incubations. CO_2 emissions were strongly regulated by temperature resulting in large diurnal fluctuations of CO_2 emissions. The diurnal temperature – CO_2 flux relation exhibited a hysteresis which highlights the effect of transport processes in the sediment and makes it difficult to identify temperature dependence from simple linear regressions. Also deeper sediment layers apparently contributed to CO_2 emissions because the CO_2 flux was correlated with the thickness of the unsaturated zone, resulting in CO_2 fluxes increasing with distance to the local groundwater level and with distance to the river. Rain events lowered CO_2 emissions from dry river sediments probably by blocking CO_2 transport from deeper sediment layers to the atmosphere. Terrestrial vegetation growing on exposed sediments largely increased respiratory sediment CO_2 emissions. We show that the regulation of CO_2 emissions from dry river sediments is complex. Diurnal measurements are mandatory when assessing the impact of dry sediments on CO_2 emissions from rivers.

ON429

Salinization decreases methane emissions: short versus long-term effects

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Wetlands are important sources of methane (CH_4). Factors impacting CH_4 emissions such as water temperature, trophic state, and drought have received ample attention. Much less research has been dedicated to the influence of salinity on carbon cycling in coastal wetlands. This is an important research gap as salinization of coastal wetlands is increasing on a global scale, in part related to sea level rising.
We combined a 6 years mesocosms field experiment – in Ilperveld, Amsterdam, The Netherlands - with a 13 weeks sediment core incubation using a wide salinization gradient (0.9, 2.3, 4.5, 9.0 PSU) to compare the long- and short- term effects of salinization on the diffusive and ebullitive CH_4 fluxes. Furthermore, we aimed to disentangle the drivers measuring a wide range of microbial, geochemical and physiochemical variables. We found that salinity decreased diffusive and ebullitive CH_4emissions (up to > 95% above 2 – 2.5 PSU) both in the short- and long-term experiment, albeit that in the short-term experiment initially the CH_4 emission was higher in the highest salinity treatment.
After 6 years of salinization, functional genes for methane production, methane oxidation and sulphite reductase were most abundant at intermediate salinities. Salinity-induced enhanced ionic concentrations, sulfate reduction and induced changes in physiochemical properties of the sediment increasing water infiltration were all related to a decrease in CH_4 emissions. We argue that salinization impacts CH_4 emissions as strong but notably in the opposite direction as warming and eutrophication. Salinization effects on CH_4 dynamics therefore merits further study.

ON160

Organic matter degradation across ecosystem boundaries: The need to move towards a more unified conceptualization

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The global carbon cycle connects organic matter (OM) pools in soil, freshwater and marine ecosystems with the atmosphere, thereby regulating their size and reactivity. Due to the complexity of biogeochemical processes and historically compartmentalized disciplines, ecosystem-specific conceptualizations of OM degradation have emerged independently of developments in other ecosystems. Recent discussions regarding the relative importance of molecular composition and ecosystem properties on OM degradation have diverged in opposing directions across sub-disciplines leaving our understanding inconsistent.

In this talk, we argue that the underlying controls of OM degradation should be universal, with the relative importance of individual controls enhanced or masked depending on local ecosystem properties. We highlight the need to question why OM degradation 'appears' to be regulated differently across ecosystems. As the literature is currently full of stimulating discussions, we have a unique opportunity to consolidate newly acquired knowledge derived from one ecosystem to help explain outliers in adjacent ecosystems. Ultimately, we encourage moving towards the development of a more holistic perspective of OM degradation that is independent of the ecosystem.

ON041

Surviving heat waves: Dietary sterol supply modulates *Daphnia's* heat tolerance

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Summer heatwaves are pushing freshwater zooplankton towards its thermal tolerance limits. Higher temperatures and prolonged water column stratification can favor the dominance of cyanobacteria in phytoplankton. Even when not toxic or grazing resistant, these prokaryotes lack phytosterols as essential precursors for cholesterol, the main sterol in animal tissues. Cholesterol is crucial for the physiological adaptation of ectotherms to high temperature. Therefore, the shift to cyanobacteria-dominated systems may increase the vulnerability of zooplankton to heatwaves by intensifying cholesterol limitation. Here, we combine experimental and recent modelling approaches to predict the effects of cholesterol limitation on the cumulative mortality of the keystone species *Daphnia magna* that could occur in a fluctuating environment over several days of heatwave. We show that increasing cholesterol limitation decreases the maximal temperature that *Daphnia* can withstand by up to 0.74°C. This seemingly small difference is sufficient to halve the time individuals can survive heat stress. Our simulations predict that, when facing heatwaves over several days, the differences in survival caused by cholesterol limitation build up rapidly. Considering the anticipated intensity and duration of future (2070-2099) heatwaves, cholesterol limitation could increase mortality by up to 45% and 72% under low- and medium-greenhouse-gas-emission scenarios, respectively. These results suggest that the increasing risk of cholesterol limitation due to more frequent cyanobacterial blooms could compromise the resistance of zooplankton populations to future heatwaves. More generally, this study underscores the importance of considering the nutritional context in any attempt to predict ectotherm mortality with increasing temperatures in the field.

ON165

Projecting multi-dimensional habitats to year 2100 in Lake Constance

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Lakes are changing worldwide in response to human activity raising concerns about how lake organisms will respond to the resulting habitat changes. Species may cope with habitat change by shifting their seasonality or their depth to track suitable habitat, but these shifts may be constrained by ecological interactions, life histories, or limiting resources. Here we project a range of environmental conditions in Lake Constance to quantify habitat change (% non-overlap) to the year 2100 and assess how this change is exacerbated by potential habitat constraints, climate change scenarios, and invasive species trajectories. We expect that long-term temperature change will result in non-overlap between multi-dimensional habitats in baseline (1980-2015) and future (2090-2100) time periods, with non-overlap increasing on average when habitats are restricted and when humans fail to curb the global increase in greenhouse gas emissions. In the worst-case emissions scenario, future habitats may exhibit minimal overlap with those currently available, with important implications for the lake's biodiversity and the benefits that Lake Constance currently provides.

ON018

Predation increases multiple components of microbial diversity in activated sludge communities

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Protozoan predators form an essential component of activated sludge communities that is tightly linked to wastewater treatment efficiency. Nonetheless, very little is known how protozoan predation is channelled via bacterial communities to affect ecosystem functioning. Therefore, we experimentally manipulated protozoan predation pressure in activated-sludge communities to determine its impacts on microbial diversity, composition and putative functionality. Different components of bacterial diversity such as taxa richness, evenness, genetic diversity and beta diversity all responded strongly and positively to high protozoan predation pressure. These responses were non-linear and levelled off at higher levels of predation pressure, supporting predictions of hump-shaped relationships between predation pressure and prey diversity. In contrast to predation intensity, the impact of predator diversity had both positive (taxa richness) and negative (evenness and phylogenetic distinctiveness) effects on bacterial diversity. Furthermore, predation shaped the structure of bacterial communities. Reduction in top-down control negatively affected the majority of taxa that are generally associated with increased treatment efficiency, compromising particularly the potential for nitrogen removal. Consequently, ourfindings highlight responses of bacterial diversity and community composition as two distinct mechanisms linking protozoan predation with ecosystem functioning in activated sludge communities.

ON401

Iron as a precursor of aggregation and a vector of organic carbon to the sediment

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During the last decades, terrestrial loading of dissolved organic carbon (DOC) to northern freshwaters has increased dramatically, observed as a browning of the water, with consequences for the biogeochemical fate of OC. A more recent finding is that also iron (Fe) concentrations are on the rise. Fehas the capacity to influence key processes that are decisive to the fate of OC in aquatic systems. These processes include photochemical transformations, aggregation of dissolved OC into particles, and preservation of OC in sediments by means of a “rusty carbon sink”.Nevertheless, we are only beginning to understand the quantitative importance and the mechanisms by which Fe influences OC transformations and loss processes in freshwaters. The aim of this study is to investigate how interactions between Fe and OC affect their biogeochemical cycling in boreal lakes with a particular focus on understanding the role of Fe as a precursor of aggregation and a vector of OC to the sediments. We used Lake Bolmen in Sweden as a study system.The basic approach was to sample Fe and OC – in the water column, in sinking material and in sediments – along a gradient of increasing distance from the main inlet, corresponding to increasing water residence time.Aqueous Fe and OC concentrations, sinking and accumulation rates in sediments, and a detailed characterization of Fe speciation (XAS) and the composition of organic matter (IR and NMR)reveal how interactions with Fe affects the fate of OC within the lake.

ON403

Riverine dissolved organic matter responds differently to flow alterations in two hydrological regimes from Northern Spain

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Iberian rivers are characterized by flow regimes with high seasonal flow variation. They also host one fifth of Europe’s reservoirs for hydropower generation, irrigation or water supply needs, and thus many rivers have heavily altered flow regimes. Under such conditions, the natural dynamics of Dissolved Organic Matter (DOM), may also be affected by such alterations and cause disruptions in carbon cycling due to changed conditions for transformation, transportation and storage of carbon. Here we looked into the effects of flow alteration on the “DOM regime” i.e the variation of DOM quantity and quality throughout a year with bi-monthly sampling in 20 rivers belonging to 2 different hydrological classes (i.e., Mediterranean and Atlantic) in Northern Spain. To further investigate which flow regime components influence DOM properties, we linked variance of DOM composition to a range of hydrological flow indices. We found that naturally flowing Atlantic rivers have lower DOC concentration than their altered equivalents while there is no significant effect of flow alterations in Mediterranean rivers. Moreover, we observed no difference in average annual DOM quality due to flow alterations. However, the variance of DOM quality is higher in natural Atlantic rivers compared to altered ones (i.e., no differences in Mediterranean rivers). Our results suggest that the variation in DOM quality was linked to upstream reservoirs which created reversed seasonality and homogenized flow regimes .

ON082

Managing hypoxia and water quality using artificial aeration in a New Zealand reservoir

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New Zealand relies heavily on reservoirs for electricity generation and irrigation. Reservoirs must be carefully managed to avoid hypoxia and negative in-lake and downstream effects on water quality. Lake Opuha is a New Zealand reservoir that is primarily used for hydro-electricity generation and irrigation. Soon after the dam was built and fertile land was flooded in the late 1990s, sediment oxygen demand and thermal stratification were high. An artificial aeration system was installed in 2003 to mitigate water quality issues, specifically by preventing stratification and associated nutrient release from the sediments. Concerns about effective management increased when a large cyanobacteria (*Woronichinia*) bloom occurred in the summer of 2020–2021 and the presence of toxin-producing cyanobacteria mats (*Microcoleus*) increased in the downstream rivers. To determine if the aeration system was properly sized for the lake, we used continuous in-lake temperature and dissolved oxygen and downstream water quality data, and conducted two in-lake water quality surveys during a year with and a year without an algal bloom. Results showed that artificial aeration is effective in mixing the lake and that timing is important. We developed a real-time data visualisation platform and automated alerts to support effective operation of the artificial aeration system. Ongoing work includes the development of a hydrodynamic model to simulate and better understand the effects of artificial aeration and draw-induced mixing and the potential for use of a multi-level offtake to prevent the release of nutrient-rich water to receiving waters.

ON235

Spatial scale and dispersal modes of taxa modulate the relative contributions of environment, space and time in shaping rock-pool invertebrate communities

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Determining drivers of community organization is central to ecology. Patchily-distributed ephemeral habitats offer an ideal system to determine the relative roles of environment, space and time in structuring ecological communities, an aspect that is still poorly understood. We studied functionally-diverse communities of insects and crustaceans in 32 freshwater rock-pools in the Western Ghats biodiversity hotspot, sampling these pools over their hydroperiod (2-7 months).Using the Hierarchical Modeling of Species Communities approach, we assessed the relative influence of environment (water chemistry, habitat complexity), space (inter-pool distance) and time on species occurrence. Influence of species traits (dispersal mode, size, feeding modes etc.) and phylogenetic relationships on species responses to predictor variables was also assessed. Environmental factors (mainly hydroperiod, water chemistry) explained most of the variation at local (85.2%) and regional (63%) scales. The contribution of space increased (8-25%), whereas that of time remained similar across spatial scales (8.3-12%). Both dispersal groups were similarly influenced by environment at the local scale, but the influence of space was higher for passive dispersers at the regional scale. The contribution of temporal factors was similar for both dispersal groups. Closely-related taxa exhibited shared responses to predictor variables. This study highlights the influence of time in structuring ephemeral communities, and trait-based responses of species to the environmental and spatial factors. These underscore the importance of long-term observations in informing conservation of these threatened habitats in a fragile landscape.

ON452

Lake Biwa shows you the Earth breathing

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Watch the signals from Lake Biwa, the largest and oldest lake in Japan, and you will see the slow crustal motion of the Earth. This concept originated from the famous story presented by Zebrowski, who pointed out the relationship between perimeter increase and radius change of a circle. Shrinking distance rate (SDR) has a positive correlation with turbidity above the lake bottom near the maximum depth area of Lake Biwa. In 2009, the AUV “Tantan” first detected ebullition from the lake bed, a so called benthic vent. These ebullitions could be formed by deepening and compression of the lake bottom due to the lake shrinking and causing high turbidity in water. According to our recent observations, the turbidity above the lake bottom in Lake Biwa is still increasing as is the SDR. Lake Biwa is a hot spot for watching Earth’s crustal changes because it is surrounded by two large tectonic plates and is always being stretched or compressed. When we carefully watch the SDR between Hikone and Kutsuki, we can see the Earth breathing, and that probably we may expect a large earthquake occurrence in the not too distant future.

ON229

Species dominance does not predict species-specific contribution to ecological stability

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Ecosystems worldwide are experiencing an unprecedented reorganization of biological communities driven by multiple environmental changes acting in concert, many of which are characterized by local extinctions and changes in species dominance patterns. With proceeding global change, it is therefore essential to understand how single species contribute to the overall stability of an ecosystem (i.e. ecological stability).While recent research has focused on measuring species contribution to stability by e.g., removing keystone species from a particular environment, here we propose an analytical framework quantifying species-specific contributions to stability for communities experiencing multiple environmental disturbances. We used zooplankton communities as our model focal functional group, which were exposed either to a pulse disturbance treatment (fish addition), press disturbance (shading) or a combination of both (pulse and press) in a large mesocosm study. Experimental data were amended with simulations derived from a model community with known species properties. Specifically, we introduced the same disturbance types to a community model and compared which species contributed most to overall stability. While in our model community the most stabilizing species were the most resistant and competitive species, we found that in the experimental data stability did not simply arise from species identity. Instead, species-specific contributions to stability were multifaceted: Compositional stability relied mainly on dominant species whereas functional stability was provided also by less dominant species. We conclude that in the diversity-stability debate it is essential to understand species contributions to ecological stability, given its profound implications for conserving and managing ecosystems under global change.

ON244

Genomic distribution of mobile elements among the bloom-forming cyanobacteria Planktothrix spp

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It is generally assumed that insertion (IS) elements play a key role in genomic plasticity, i.e. by genomic rearrangement through homologous recombination in prokaryotes, eventually leading to the inactivation of cyanotoxin/bioactive peptide synthesis. Since harmful algal blooms formed by cyanobacteria have severe impacts on water quality, it is of interest to understand which of the IS elements would be effective in disrupting cyanotoxin/bioactive peptide synthesis. According to one hypothesis active IS elements have a tendency to cluster together in host genomes. Such clustering may affect the mutation rate in certain regions of the host genome including functional operons such as cyanotoxin/bioactive peptide synthesis gene clusters. Recently, we completed the genomes for 13 axenic strains of Planktothrix spp. which were selected out of a larger number of isolates collected from various continents and which were phylogenetically characterized previously. When comparing IS element net distance between the cyanotoxin/bioactive peptide synthesis gene clusters the majority of IS elements were found distributed nonrandomly, but typically the range in variation of net distance exceeded 1 Mbp. On the other hand IS elements may affect certain cyanotoxin/bioactive peptide synthesis gene clusters despite their genomic distance, for example directed by the presence of short repetitive sequences. Such repetitive sequences can form stem-loop hybridization during the DNA replication process and might direct transposases functioning as recognition sites for insertion. Notably, such recognition sites were found to have a rather unequal genomic distribution, i.e. regions not containing these re-occurring sequence motifs imply a potential protection from IS element disruption.

ON033

Developing future Copernicus inland water services

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Lake research and monitoring has been based predominantly on in situ and laboratory analysis during the first century of limnology. Other tools, like remote sensing, have been used to a certain extent. However, most of satellite remote sensing developments have been done using one-off scientific sensors not designed for inland waters. Meaning that the end of a satellite life cycle meant also loss of monitoring and research capabilities. The launch of Sentinel satellites in the frame of the Copernicus Programme opened a new era in satellite remote sensing – moving from one-off scientific missions to long-term monitoring. This allows to tackle problems like climate change, global carbon cycle etc. that require long data series and large spatial coverage (e.g. global). Inland water related services are currently split between six Copernicus Services – Atmosphere, Marine, Land, Climate Change, Security and Emergency. The European Commission has now funded the Water-ForCE project to develop a Roadmap that will propose a way forward how to optimise the water related services delivery, propose new products for the services (based on users needs) and suggest how to improve future Sentinel satellite network in order to make it more suitable for inland water research. With this presentation we will demonstrate our ideas about the future scenarios of Copernicus inland water services and invite SIL2022 participants to contribute to the Roadmap development.

ON431

Climate change impact on Estonian lakes

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Lakes store most of the carbon and nutrients originated from their catchment area and can become predominantly heterotrophic systems, emitting carbon dioxide and other greenhouse gases, and can therefore contribute to global warming. It is thus important to know their functional response to climate change.
Total number of lakes in Estonia is reaching around 2800, area ~ 4.9% of the state territory. Despite this abundance, our lakes are divided only into eight different types according to EU Water Framework Directive. Here we show the changes in six different lake types.
We modelled the changes in water regime, water temperature, ice cover, thermal stratification, dissolved oxygen and organic carbon according to the International Panel for Climate Change scenarios RCP4.5 and RCP8.5 using mechanistical and/or empirical models.
We found that the water temperature could increase up to 4.5 degrees Celsius in maximum, in the case of the worst scenario. Thermal stratification will shift earlier, and strong thermal stratification may also occur in shallow lakes during the summer months. Even under milder scenarios ice cover duration will decrease significantly already by the middle of this century. Warming would cause the increase in nitrogen and chlorophyll levels, which decrease the water transparency of lakes. In shallow-large lakes, the amount of dissolved oxygen in the water column will decrease, whereas it will increase in small-deep lakes. In lakes dominated by internal processes, climate warming will cause changes in respiration and sedimentation whereas in those dominated by external processes, changes will affect mostly exports and loads.

ON249

Oxygen depletion in lakes' hypolimnia: anoxic age is a new tool to predict anoxia's biogeochemical consequences

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Deoxygenation in aquatic ecosystems, particularly in lakes, threatens ecosystem services delivery and is of growing concerns due to its projected expansion and increased duration. Anoxia consequences include the production or release of nutrients, greenhouse gases and metals from the sediments. Many of these compounds' dynamics cannot be easily predicted thus hindering our capacity to forecast the ecological consequences of global changes on lakes. Here, we present a framework that uses monitoring data from two lakes in Germany and USA to develop a novel metric termed the "anoxic age" to characterize anoxia in lakes' hypolimnia. As a single predictor, anoxic age of hypolimnion samples explained between 44% and 74% of the variation for anaerobic metabolites, including ammonium, soluble reactive phosphorus and a dissolved organic matter fluorescent compound. Anoxic age could also be modelled using two oxygen profiles and lake bathymetry, making it widely applicable. This novel metric thus has the potential to transform commonly available oxygen data into an ecologically meaningful variable.

ON316

Letting Data estimate Turbulent Diffusive Transport: Boosting the performance of a 1D lake model through modular compositional learning

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Vertical one-dimensional hydrodynamic lake models are frequently used to assess and explore global change and management scenarios. State-of-the-art models vary in their respective physical formulations, i.e., either apply an integral energy balance approach or quantify vertical changes of turbulent kinetic energy. Recently, physics-guided deep learning (PGDL) models – a combination of process-based lake models with recurrent neural networks – have been shown to be superior in projecting water temperature and water quality changes. PGDL applies long short-term memory to account for time processes, pre-training from process-based lake models, physical constraints, and field data to achieve improved model fits. Nonetheless, a direct merger of process-based models and deep learning algorithms was not tested yet, although such a hybrid model could potentially achieve physically sound results while incorporating field data without risking over-calibration. In this study, we present a simplified, modularized lake model that accounts for the hydrodynamics iteratively: (1) heat addition from boundary conditions, (2) vertical turbulent transport, (3) energy balance approach to quantify mixed layer depth, (4) convective overturn, and (5) ice formation and cooling. We showcase the improved model performance by subsequently replacing individual modules with a multi-layer perceptron (MLP). Eventually, we only replace the vertical turbulent diffusion module by a MLP which estimates the vertical turbulent diffusion coefficient from high-frequency data while relying on the background process-based model for physical validity. The resulting hybrid model, although based on simplified 1D hydrodynamic equations, provides improved fits to observed data and is flexible for application to other study sites.

ORAL ONSITE

ON164

Individual trait and fitness variation in a phytoplankton population across eutrophic and re-oligotrophic periods

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Aquatic ecosystems underwent major changes in the last decades. Cultural eutrophication followed by periods of attempts to revere this are probably the most significant and prominent examples. The phytoplankton species composition tends to follow these changes with losses and gains of taxa as well as changes in the dominance of species depending on the environmental conditions. However, some species persist at similar frequencies independent of the environmental conditions. We hypothesize that the persistence of some species is mediated by evolutionary adaptation to different environments. To test for this, we resurrected and isolated multiple clonal lines of *Chlamydomonas* sp. from Lake Constance sediment, associated with either eutrophic or re-oligotrophic conditions in the lake. We characterized and compared competitiveness and defense as two major trophic traits of these isolates and linked these to fitness under controlled laboratory conditions. Specifically, we followed the growth and yield of 14 isolates from each period in low and high phosphate conditions in the presence and absence of predation by *Brachionus calyciflorus*. We found significant differences in traits between isolates and that the trait ranges differed when isolates from the different time periods were compared. In addition, isolates with similar trait combinations for defense and competitiveness differed in fitness when tested in the different environments (phosphate and predator). The observation of differences in heritable trait variation and differential translation into fitness responses suggests that adaptive evolution may play a role in the resilience of *Chlamydomonas* sp. to major environmental changes.

ON437

Cluster analysis reveals hidden community interests to inform a collaborative management plan for Blueskin Bay estuary in Aotearoa New Zealand

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Community participation has been increasingly embedded into environmental policy with the aim to accelerate transformative change towards sustainable management. When performed effectively, participatory processes integrate local preferences and knowledge with scientific evidence, which leads to more effective management powered by community buy-in. A common way of engaging the community is the collaboration with local stakeholders; a relatively cost-/time-efficient approach based on the often vaguely-met assumption that each stakeholder represents a shared interest of the respective key community group. The selection of representatives, despite well planned, also often ends up being done ad-hoc due to availability constraints of participation favorites. We tested a more analytical approach based on cluster analysis to identify community interests to feed into the development of a collaborative management plan for the Blueskin estuary in Otago, New Zealand. We interviewed a total of 36 community members to elicit their preferences of management objectives, which we had co-designed in previous workshops. We found distinct preference clusters comprising stakeholders with different backgrounds for the main and the more specific sub-objectives, with the defining objectives being catchment/estuary health and sustainable economic activities (main objectives) and recreational activities, and sustainable agriculture and forestry (sub-objectives). Our results indicate that the assumption that participants with certain economic interests are primarily concerned with objectives directly relating to their industry may not hold. Consequently, cluster analysis helps map community preferences more accurately, while likely facilitating collaborative decision making as stakeholders from diverging backgrounds could view themselves clustered with stakeholders previously assumed to have differing preferences.

ON422

Land use drives detritivore size structure and decomposition through changes in resource quality and quantity

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Land use change and nutrient pollution are two pervasive global changes that can modify detritus dynamics and carbon cycling. The availability and type of detritus can be greatly modified by land use conversion, whereas nutrient pollution typically stimulates the rate at which detritus can be consumed. Here we study the implications of changes in land use from deciduous forest to *Eucalyptus*plantations, and nutrient enrichment, on the size distribution (size spectrum) of stream detritivores. We also test how size spectra parameters (slopes and intercepts) are related to the decomposition rates of detritus. As expected, the quantity of detritus was positively related to size spectra intercepts, i.e. the carrying capacity of detritivores. Increases of the intercept were caused by an interspecific response based on a larger relative abundance of Amphipoda and Trichoptera, which added individuals in all size categories. In contrast, detritus quality modified size spectra slopes, i.e. the energy transfer efficiency, with shallow slopes (proportionately more large individuals) associated with mesotrophic sites and steeper slopes (proportionately fewer large individuals) associated with sites draining eucalypt plantations. Decomposition rates increased with increasing (shallower) size spectra slopes, highlighting the importance of large sized individuals for driving this ecosystem function. We demonstrate the link between detritus quantity and quality, and the transfer of energy through the 'brown' food web, by means of intra- and interspecific mechanisms. Our study reveals that global change projections that include further land use changes and nutrient pollution could greatly impair detrital dynamics and ecosystem functioning in headwater streams.

ON206

Insight into long-term ecological dynamics from the Lynn Brianne Observatory

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Understanding the erosion of freshwater biodiversity has become a global imperative, but consistent series of long-term data from which to appraise changes are rare. In central Wales (UK), the Lynn Brianne Stream Observatory has provided unique insight into the complexity of biodiversity dynamics over four decades, revealing how apparent stasis in alpha- and beta-diversity might mask non-random functional changes in macroinvertebrate assemblages.
Assessments of synchrony and stability at population and community levels reveal the effect of climatic variations in which warmer, wetter phases of the North Atlantic Oscillation (NAO) have been associated with large interannual changes in community composition. Moreover, these positive NAO periods have brought greater synchrony in species abundances within streams (community synchrony) and across streams (spatial population synchrony). Increasing synchrony can destabilise ecosystems with consequences for the persistence of populations. Preliminary analyses at Lynn Brianne suggest that species with greater spatial synchrony tend to decline in abundance over time. For instance, the abundance of cold-adapted species has declined by 40% since the 1980s reflecting the general increase in temperatures. Moreover, populations of these species displayed significantly higher spatial synchrony than warm-adapted species, which increased by 30% over the same time period. We suggest that both directional climate warming and the NAO contribute to the long-term reorganisation of benthic communities in temperate headwaters.

ON364

Towards a deeper understanding of hypolimnetic anoxia by integration of campaign-based and monitoring data

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Oxygen profiles are typically included in lake monitoring programs as oxygen is crucial for the health of aquatic ecosystems. When oxygen consumption exceeds renewal, anoxic conditions can develop. Anoxia in hypolimnetic waters promotes the accumulation of anaerobic metabolites like ammonium or methane. Upon lake turnover, the reduced substances mix with surface waters and therefore critically affect the lake and downstream ecosystems.
The spatiotemporal patterns of hypolimnetic water chemistry depend on the contributions of benthic and pelagic turnover processes which are hard to separate and forecast. Here, we paired observations from several instrumented lakes with more complex campaign-based sampling of hypolimnetic water chemistry. We present a modelling scheme based on widely available buoy O2 data that may be used as a deductive biogeochemical forecast tool and to study lake-scale metabolism. We discuss how such a scheme may help to better integrate the implications of anoxia into interdisciplinary lake studies and how it can be used to predict consequences of eutrophication, browning and climate change.

ON366

Establishment of an algal platform for the management of algal blooming areas

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In areas with high concentrations of algal blooms, the characteristics of algal blooms differ depending on wind, temperature, water level, and depth. In addition, in order to improve the effectiveness of decision-making for algae control and to increase the efficiency of operation of algae facilities, it is necessary to switch from point to surface-level and three-dimensional monitoring. Recently, with the increase of real-time measurement data, the need for big data analysis and its utilization are increasing, so data model development and field application are increasing.
It is necessary to establish an integrated algal management platform through the effective circulation and accumulation of information on algal blooms at each stage through technological convergence of algal management technology. And, by developing automation technology to improve the efficiency of algae reduction technology, automation of algae management can be completed through the convergence of “Monitoring-Prediction-Decision-making-Remote control” technology. A K-water type algae management platform was built and introduced on a trial basis in the intensive algal blooming zone upstream of Daecheong reservoir in Korea, and it was intended to be used for efficient algal management.

ON417

Sex, Death and Food: How *Daphnia* manage multiple threats in a landscape of fear

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Organisms are perpetually challenged by multiple threats in the environment, and such threats are rarely constant in either time or space. Therefore, organisms must utilise adaptations that maintain fitness across environments. As behaviour is a particularly labile trait, capable of mitigating risks from many environmental stressors, it is a prime candidate for studying the response to spatial and temporal variations of stressors. In terrestrial ecology, the landscape of fear has quickly become a concept that relates behaviour to the underlying source of stress and the physical landscape. Despite its prevalence in regards to predator-prey dynamics of large mammalian or avian systems, this concept is less reported in aquatic taxa. Furthermore, the original use of the term relates only to predator-prey interactions, however the core assumptions can apply to any spatially explicit threat. In other words, the landscape of fear may encompass far more than its current use. To demonstrate this, we used *Daphnia magna*and a 3-D tracking platform to investigate how sex factors into the spatial distribution of this species, and how the abiotic threat of ultraviolet radiation trades-off against spatially explicit foraging opportunities. We also investigated how the temporal variation in threat delivery has fitness consequences. This research shows how *Daphnia*experience a complex landscape of fear which can facilitates our understanding of the spatial variation in behaviours within populations, and the importance of considering the timing of threats not only the spatial dimension for the evolutionary trajectory of the species.

ON107

Burial of microplastics in freshwater sediments facilitated by limnic aggregates

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Microplastics are ubiquitous in limnic sediments, consequently lakes and reservoirs may be important sinks for these contaminants. However, the mechanisms transporting initially buoyant microplastics from the water phase into the profundal and the subsequent fate of these particles within the sediments are understudied.
We studied the role of limnic aggregates in facilitating the sinking and the infiltration of buoyant microplastics into freshwater reservoir sediments.
Aggregates consisting of iron (oxyhydr)oxides and lake water-derived organic compounds are formed during autumnal lake mixing events. In laboratory experiments buoyant polyethylene microplastics of various shapes and sizes were rapidly (1–4h) incorporated into these sinking iron-organic aggregates. In consequence, these aggregates also mediated the swift deposition of microplastics into limnic sediment cores. Ingression of microplastic bearing aggregates into the sediments was completed within 6days and led to stable deposition of the incorporated polyethylene particles for at least 2months. Inside of the sediments the aggregates' iron (oxyhydr)oxides were reduced to secondary sulfides by anaerobic bacteria . This mineral transformation did not affect the integrity of the aggregates. Subsequently, only small quantities of plastics were released from the buried aggregates or the sediments. Most aggregate-bound microplastics were deposited in the top 2cm of the sediments and few particles (5–15%) were re-released into the water phase. Our results show at least 85 % burial of microplastics transported in aggregates to the sediments, indicating the significant role of freshwaters in intermitting the riverine transport of microplastics from land to sea.

ON005

Community assembly of cladoceran zooplankton in relation to pond age: the interplay of dispersal and the establishment of macrophytes and fish

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A vast body of research has assessed the relative importance of local and regional factors shaping ecological communities, often using lakes and ponds as model systems. However, little is known about how age and history of habitat patches can help to explain current community characteristics. Here, we used a dataset of >100 morphologically similar farmland ponds constructed in three different time periods to analyse to what extent the diversity and composition of current zooplankton assemblages reflect variation in pond age. We hypothesized that young ponds will accumulate species over time, but that community assembly is also determined by the establishment of other organism groups (macrophytes and fish). Our results suggest that the lower species richness in recent ponds is partly the result of dispersal limitation and that regionally more abundant species colonize

new habitats faster than regionally less abundant species. We conclude that cladoceran richness gradually increases during pond maturation, but colonization by plants and fish will ultimately determine cladoceran community composition. Our findings illustrate that management interventions should not only try to compensate for the loss of small aquatic systems with the creation of new ponds, but should also aim the maintenance and restoration of older ponds to conserve aquatic biodiversity at a regional scale.

ON391

How is the temporal variability of stream methane regulated? – evidence from long term monitoring

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Streams are a significant source of methane (CH_4) to the atmosphere. However, stream CH_4 emissions can be extremely variable because the CH_4 concentration in streams changes greatly over time. The prediction of stream CH_4 is poorly constrained due to a lack of long-term data. Here, we explore a 7-year dataset of biweekly CH_4 concentrations and underlying drivers from two adjacent small German streams with contrasting riparian area characteristics. CH_4 concentrations were consistently supersaturated with high interannual and seasonal variability. Temporal dynamics were dominated by seasonal variability, which could be explained by discharge and temperature. Our findings suggest that the combination of seasonality and topography ultimately shaped considerable temporal variations of CH_4. Fluctuations in CH_4 concentrations may reflect a temporal pattern of CH_4 input from soils of the riparian zone. The discrepancy of the CH_4 flux between streams was likely triggered by different connectivity to riparian soils, with higher CH_4 emissions in the hydrologically more connected stream. CH_4, which was predominantly originating from the adjacent riparian area, was mainly emitted into the atmosphere, rather than being oxidized or transported downstream. Our interannual comparison of the two streams shows a crucial role of hydrology and riparian connectivity. Higher CH_4 emissions are predicted to occur in wetter years in streams that are closely connected to riparian soils.

ON372

Stream pollution impacts are transmitted to wintering insectivorous birds through increased aquatic emergence

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I investigated the effects of pollution due to a sewage treatment plant (STP) on benthic insect larvae, aquatic insect emergence, and wintering insectivorous birds in a stream in Switzerland during winter (January-February). At sites downstream of the STP, a combination of nutrient, organic, and thermal pollution led to greater aquatic emergence compared to upstream sites (6× higher). In turn, the greater emergence led to a strong aggregational response by wintering insectivorous birds (7× higher linear densities compared to upstream sites). Polluted sites also had a partly different bird assemblage, which included rare wintering species that feed largely on aerial insects. A comparison between the polluted (downstream) sites and a nearby unpolluted stream yielded similar differences. The magnitude and consistency of the effects through the larvae→emergence→birds pathway illustrate how strongly stream alterations can propagate to birds through changes in aquatic emergence. Moreover, they provide insights into the responses of linked stream-terrestrial food webs to other environmental issues that cause warming and/or pollution, including urbanization and climate change.

ON416

Stress response of populations and their ability to meet additional threats

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Global change is rapidly altering environmental conditions. As a result, an increasing number of species face environmental stressors. Targeted management of these environmental stressors requires assessing the combined effects of the stressors most important to population viability. The presentation will introduce approaches to identify patterns in the biological response to simultaneous and sequential exposure to multiple stressors. On this basis, a framework for predicting the synergistic effect of independent stressors will be presented. Further, however, environmental stresses lead individuals to adapt accordingly. However, trade-off processes lead to increased sensitivity of these individuals, which may lead to even stronger synergistic effects when exposed to multiple stressors. Overall, systematic patterns of the combined effect of stressors are presented on the basis of a large number of studies. However, it also becomes clear that the question of the effect of multiple stressors and the corresponding adaptation processes will continue to occupy limnologists for a relevant part of the next 100 years.

ON130

Ecosystem consequences of boreal lake browning and eutrophication – using mesocoms as tools for food web studies

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With increasing temperatures and precipitation, as well as land use changes in boreal regions, waterbodies are receiving larger inputs of coloured terrestrial humic substances. At the same time, nutrient inputs are increasing. This brownification in combination with increasing nutrient levels has consequences for the aquatic food web in terms of species composition and energy transfer efficiency. In Lake Bolmen, Sweden's 7ths largest lake, brownification additionally creates problems for drinking water production, since this lake is an important drinking water reservoir of southern Sweden. Lake monitoring data show a clear pattern of increasing brownification in Lake Bolmen over the preceding decades. To understand the consequences of increased browning and of increased nutrient inputs for Lake Bolmen's food web on bacterial production, and phytoplankton and zooplankton species community composition and abundance, we conducted a 6-week mesocosm experiment during summer 2021. Brownification and nutrient ratios were manipulated. Measures of algal pigment concentrations show that browning has strong effects on algal pigment composition and thus probably on algal taxonomic composition. Our results suggest that brownification affects basic producer community composition in lakes, thus possibly changing community composition and biomass of higher trophic levels of the aquatic food web in boreal regions.

ON320

Prediction of algal blooms in multiple lakes via a two-step hybrid process-based and machine learning model architecture

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With the expanding availability of lake monitoring data, data-driven machine learning (ML) models have the potential to represent complex and nonlinear algal bloom dynamics that are not completely captured in process-based (PB) models. We applied two ML models, Gradient Boost Regressor (GBR) and Long Short-term Memory (LSTM) network, and developed a two-step model approach based on a 17-year dataset from mesotrophic Lake Erken, in Sweden. The two-step approach estimates lake nutrients that have limited observations first, and in the second step predicts chlorophyll concentrations (*Chl*) using both directly environmental observations and the nutrient concentrations pre-generated in the first step. This modeling approach was further improved by supplying hydrodynamic features derived from a PB model into the ML model training processes. The

performance of the final hybrid workflow was superior to PB model in predicting magnitude of*Chl* concentrations and the timing of algal blooms in Lake Erken.
This two-step hybrid model architecture has also been applied to different types of lake systems with less monitoring data, and promising predictions were achieved in most lakes with consistent seasonal occurrences of algal blooms. We expect this hybrid model architecture to not only improve mechanistic explanations of algal dynamics in the natural lake systems, but will enable near-term and even longer-term algal bloom predictions.

ON414

Empirical modelling of longitudinal dispersion in German waterways

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Preparing effective models to predict dispersion in water bodies is one of several aims of the large-scale monitoring concept for federal waterways by the German Federal Institute of Hydrology. The parameter *dispersion* is key to predict the transport of water masses, and is applicable to describe the transport of dissolved matter such as pollutants, nutrients, carbon, or dissolved gases through connected aquatic systems. For reliable forecasts, solid knowledge of the parameters controlling dispersion is key, however challenging. The description of dispersion processes in rivers is highly complex and directly dependent on the respective river morphology and changing hydrological boundary conditions. In fact, the current dispersion coefficients based on empirical equations poorly represent these processes. The complexity and therefore urge for adaptable models to predict dispersion under varying conditions is intensified by climate change, as precipitation patterns shift and extreme weather events such as floods and draughts are gaining in frequency.
Underlying numerical models are therefore calibrated and validated by empirical field studies. In the presented study, a known concentration of the radioactive isotope tritium is released to the German waterways Moselle and Weser in discrete release events with the wastewater from resident nuclear power plants, and traced along the flow path of the rivers. Characteristic parameters such as discharge-dependent flow velocities, dispersion, and elimination constants are determined for individual river sections. On this basis, discharge-dependent flow times, expected impact times, concentration maxima and the duration of critical concentration increases can be well predicted within the framework of the dispersion models.

ON120

Mate-seeking behavior in the calanoid copepod *Eodiaptomus japonicus* from Lake Biwa, Japan

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Mate-seeking behaviors of the calanoid copepod *Eodiaptomus japonicus* from Lake Biwa are for the first time reported, and their implications for maintaining population structure in this lake are discussed. Mate-seeking behaviors are observed using a three-dimension (3D) optical system. Video analyses reveal males exhibit both homo- and heterosexual pursuit patterns, with no obvious increase in swimming speed during seeking. Males appear to use hydromechanical signals to seek female locations and can detect them from up to 5 mm away, mainly from below. Males always exhibit several small hops to adjust their position to one that is optimal for catching a mate. In homosexual encounters, the two individuals separate within 1 s, whereas the median copulation duration in heterosexual mating events persists for approximately 2.3 min. Females display a shaking-off male behavior in all heterosexual pursuit events, indicating the existence of mate choice, possibly to enhance the quality of offspring. Because mating partners would be exposed to high predation risk by visual predators during prolonged copulation, mate choice behavior in *E. japonicus* might limit extended pairing, thereby reducing predation risk and benefit to adult survival at the expense of frequent offspring production.

ON104

Effects of altered management practices on risks associated to pesticide use for small freshwaters

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Chemical pesticide use in agriculture contributes to water pollution and biodiversity loss. This serious problem is even more dramatic in the smallest of our aquatic ecosystems, and in those located directly on or adjacent to agricultural land. Small standing water bodies (SWBs), which occur in vast numbers in some European regions, are particularly prone to risks associated with the use of pesticides. Within the new European Green Deal, the EU recently affirmed its goal to reduce the use and risk of chemical pesticides by 50% by 2030. Effective actions to reach this goal may include the ban of pesticides containing critical substances or the rigorous implementation of on-site mitigation measures, such as buffer strips between fields and surface water bodies.
Based on a five year monitoring of nine SWBs in an agricultural landscape in North-East Germany, this study (I) identifies pesticides which occur in critical concentrations for different groups of freshwater organisms (using the Toxic Unit approach), and (II) models the risk to SWBs using the risk model SYNOPS aiming to achieve the 50% risk reduction goal. The initial risk model is parametrized with farmers' application data from 2014 to 2021 and validated by the monitoring data. The potential for risk reduction will be evaluated in model runs where vegetated buffer strips will be implemented at all SWBs, and where alternative products, (e.g. for which apply different application rules or that may contain other active ingredients with different environmental behaviour) will replace the products containing the critical pesticides identified above.

ON168

Does personality have an effect on bait selectivity of Northern Pike (*Esox lucius*)?

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Predatory fish with bolder personality traits have been proposed to experience greater angling mortality resulting in lower reproductive fitness than those that have shy personality traits. This study tested the basis of this proposition by investigating how pike of different personality (bold/shy) responded to simulated angling with three common hookless fishing baits (a soft plastic natural colored lure, a soft plastic bright colored lure and natural dead bait fish) under laboratory conditions. The personality of pike (N = 42) was assessed by measuring latency to forage under stressful conditions, i.e. exposure to challenging ambient light, in three trials over a period of 15 days. Additionally, predation trials with living prey were conducted to observe the hunting behavior on an individual level. In the simulated angling trials, bold pike showed significant more predation than shy pike. This effect was independent of bait type. Handling of the bait differed during successful attacks; the natural bait was swallowed more frequently than artificial lures, which were rejected after the attack. Both personalities showed similar learning capacities by developing bait avoidance during the angling trials. Bait exposure did not affect natural pike hunting behavior on living prey. These results set the basis that pike of different personality (bold/shy) have different susceptibility to angling and increase our understanding of potential effects of fisheries-induced evolution on biodiversity and may inform future management decisions in recreational fishing to protect biodiversity of pike stocks globally.

ON286

Functional ecology of planktonic ciliates. II. Thermal response

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Predicting the performance of aquatic organisms in a future warmer climate depends critically on understanding how current temperatures and their variations affect the organisms' specific growth rates. Planktonic ciliates play a central role in marine and freshwater food webs. Using a meta-analysis for published data from laboratory experiments, we calculated the activation energy (E_a; the energy needed to start a biochemical reaction) to parameterize the thermal sensitivity of marine and freshwater ciliates. We hypothesized that ciliate growth rates generally increase with temperature but that ciliates dwelling in the ocean, the largest, thermally stable environment on Earth, are closely adapted to their ambient temperature and have lower growth rates and relatively low E_a. In contrast, freshwater ciliates living in smaller, thermally more variable environments should be characterized by higher growth rates and E_a. We also postulated that mass-specific ciliate growth rates decline with cell volume, as predicted by the metabolic theory of ecology. We find that marine ciliates studied thus far are significantly larger than freshwater species. However, cell volume did not affect the ciliate specific growth rates and E_a for the available dataset. For both environments, the E_a was in the range known from other taxa but significantly lower for marine ciliates (0.390 ± 0.105 eV) than for freshwater ciliates (0.633 ± 0.060 eV). Accordingly, models aiming to predict the ciliate response to increasing water temperature cannot use a uniform E_a for all aquatic ciliates but should apply the environment-specific activation energies provided in this study.

ON326

Labile dissolved organic carbon influences in-stream ammonium uptake across biomes

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Headwater streams play a critical role in reducing the pervasive effects of excess nitrogen (N) by retaining a substantial amount of this nutrient. The magnitude of this retention depends on the interaction of several biological processes, most of which are mediated by dissolved organic carbon (DOC) availability. Yet our knowledge on how DOC affects in-stream dissolved inorganic N (DIN) processing is far from complete. To assess the role of DOC as a driver of in-stream DIN uptake, we performed constant-rate ammonium (NH_4) additions with and without a co-release of acetate, a labile source of DOC, in 15 headwater streams across the globe. The streams showed contrasting concentrations of DIN (from 0.006 to 2.5 mg N /L) and DOC (from 0.5 to 20 mg C/L), resulting in a wide range of molar DOC:DIN ratios (from 2 to 600). For each stream, we calculated gross NH_4uptake velocity (Vf) and also analyzed DOM character and microbial heterotrophic activity through florescence and resazurin releases. Vf of NH_4ranged from 0.7 to 16.5 mm/min, and always increased when acetate was added. The magnitude of this increase varied widely across streams (from 5% to 850%) and showed no relationship to either ambient DOC and DIN concentrations or DOC:DIN molar ratio. These results suggest that labile DOC, rather than bulk DOC concentrations, generally limits in-stream heterotrophic activity and associated DIN uptake in headwater streams. Overall, this study highlights the relevance of DOC in determining the cycling of other essential ecological elements in freshwaters.

ON461

Towards women-inclusive ecology: participation of women at an international conference

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Conferences are ideal platforms for studying gender gaps in science because they are important cultural and networking events that reflect barriers to women in academia. We evaluated women participation in ecology conferences by analyzing female representation, behavior, and personal experience at the 1st Meeting of the Iberian Society of Ecology (#SIBECOL2019), an international research event that gathered 722 researchers in Barcelona (Spain). While there was gender balance in attendance and presenters, less than 35% of last authors, keynote speakers and conveners were women. We also showed that, during the conference sessions, only 32% of the questions were asked by women. Yet the number of questions raised by women increased when the speaker or the convener was a woman. Finally, the post-conference survey indicated that women heard more stereotypical remarks and tended to have a worse experience than their male counterparts during the conference. Although our results indicated clear differences in participation between men and women, most participants declared not to be aware of gender biases during the conference. Overall, we highlight the challenge of increasing women's scientific leadership, visibility and interaction in scientific conferences; and we provide several recommendations for creating inclusive meetings that promote equal opportunities for all participants.

ON357

Eutrophication control: what does it take?

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Eutrophication – over enrichment of surface waters with nutrients – is the most important water quality issue often leading to nuisance cyanobacterial blooms. Some years ago a discussion was started whether focusing on P, N or both would be most successful in controlling eutrophication nuisance. In this discussion the argumentation was planted that "current nutrient limitation" determined through nutrient addition experiments would yield the insights needed for planning nutrient control measures. I will show that this reasoning is flawed and that it only indicates further enrichment with a specific element is not a clever thing to do. Such meaningless exercises distract from what should be done: for each eutrophication problem first a system analysis should be performed. This will yield insight in the water and nutrient fluxes, and will guide to the measures having highest chance for success. I will provide two

case studies where such diagnosis guided eutrophication control was implemented successfully. In one case internal load was the main issue, in the other one both external and internal load were problematic. The subsequent restoration measures improved water quality for many years until present. Nonetheless, diffuse nutrient pollution will eventually necessitate a repeated intervention in these lakes. Diffuse nutrient loads are getting problematic rapidly around the globe, as is the ongoing discharge of untreated sewage. This is nothing new, thus our approach to deliver the uncomfortable knowledge to decision makers should change. We need to muster the troops in a coalition of the willing and join the World Water Quality Alliance.

ON419

Advancing our understanding of the temporal dynamics of stressor pulses – when does the order of exposure matter?

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The recent proliferation in multiple stressor fully-factorial experiments, where two or more stressors are applied alone, in combination and are compared to a control, has mainly involved simultaneous exposures. However, stressors frequently occur as pulsed-exposures, and stressors occurring in the same space might not necessarily co-occur at the same time. The order in which stressors act on ecosystems is crucial in determining their outcome, since a subsequent stressor will be affecting an already disturbed ecosystem and its altered food web. However, the sequential exposure of different stressors has not been as well-studied as simultaneous exposures.
Here we present some results from a large-scale freshwater mesocosm experiment manipulating pulses of nutrient enrichment and pesticide contamination in a fully-factorial design with four temporal scenarios. The temporal treatments include individual, simultaneous, and sequential stressor exposures over two pulse periods to empirically quantify the effects of stressor sequence, with recovery periods between each pulse. During each pulse and recovery phase, we quantified effects on community composition and ecosystem functioning, and measured changes in gross primary production and respiration to assess the effect of stressor sequence on ecosystem metabolism.

ON309

A year in a river's life: Unveiling seasonal dynamics of fish, invertebrates, and diatoms using environmental DNA

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Freshwater biodiversity is declining at an alarming rate. While traditional biodiversity assessments of freshwater ecosystems offer comprehensive insights into ecosystem health, they remain cost- and time-consuming and are often limited in spatial-temporal resolution, struggling to efficiently depict ecosystem changes. Furthermore, assessing multiple taxonomic groups can render traditional biomonitoring even more cost- and time consuming. Environmental DNA (eDNA) metabarcoding, as a new complementary tool for biomonitoring, might help closing this gap, as it can efficiently explore patterns of species occurrences whilst retaining high resolution at comparably low efforts and costs.
To demonstrate the potential of eDNA metabarcoding, we collected 2 L of water every two weeks over the course of one year at the mouth of the river Lippe (Germany). We extracted eDNA from the filtered water and amplified the eDNA of vertebrates, invertebrates, and diatoms.
We successfully sequenced all three target groups from all collected samples and found compliant species occurrence patterns over the course of the year. For example, we detected various invasive species (e.g., the round goby *Neogobius melanostomus*), migratory activity (e.g., the greater white-fronted goose *Anser albifrons*) and indications of spawning events for the burbot (*Lota lota*) or pike (*Esox lucius*).
In conclusion, our results demonstrate that all three investigated target taxa can be efficiently monitored with eDNA over the course of a whole year, without extensive sampling efforts or costs. Our results helped to unveil seasonal dynamics of migratory species and even allowed for semi-quantitative analyses.

ON067

Near-surface Turbulence in Arctic, Temperate, and Tropical Inland Waters: Implications for Gas Fluxes

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Near-surface turbulence is a key determinant of gas exchange velocities (*k*) used to compute fluxes of climate forcing trace gases under light to moderate winds. Scaling approaches to accurately predict turbulence would enable modeling of fluxes from diverse water bodies over large spatial scales. While wind based models have been used, heating (buoyancy flux, β +) or cooling (β-) in the upper water column are likely to moderate turbulence relative to predictions from wind. Monin-Obukhov similarity theory (MOST) estimates turbulence, as rate of dissipation of turbulent kinetic energy (ε), taking into account the relative contributions of wind and β. We evaluated the accuracy of MOST in tropical floodplains, lakes, and reservoirs, in temperate, boreal and Arctic lakes, and in Arctic ponds and rivers using measurements of ε from temperature-gradient microstructure profilers and acoustic Doppler velocimeters. Dissipation rates were enhanced under heating relative to prior predictions from MOST due to low mixing efficiency. Under cooling and minimal wind, ε was predicted from β-, however, as winds increased, ε was at times lower than predictions from MOST. Merging variable mixing efficiency with MOST will lead to improved time series estimates of ε and *k* as needed for modeling fluxes of dissolved gases.

ON131

Effect of Brownification on the microbial food web of the oligotrophic Eastern Mediterranean Sea: A mesocosm experiment

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Terrestrial ecosystems export more dissolved organic carbon (DOC) to aquatic ecosystems than they did a few decades ago. This "brownification" phenomenon causes shading affecting primary production. Also, the increase in DOC concentration may affect heterotrophic organisms, with potential consequences on the whole food web. The present study is part of a series of similar experiments that investigated the effects of increasing DOC exports from terrestrial into aquatic systems along two gradients, a salinity and a latitude one and is one of few run in marine waters. Browinification was simulated in a mesocosm experiment by adding HuminFeed to seawater. It took place at the HCMR-CretaCosmos facility in Crete, in June 2021 and comprised 2 treatments: Control (C) and HuminFeed (HF). HuminFeed reduced light penetration causing a decrease in the abundance of strict autotrophs (*Synechococcus*and diatoms). However, no clear effect on nanoflagellates was recorded, possibly due to the mixotrophy observed in this group. In addition, HuminFeed was a source of DOC for the bacterial community. Although bacteria abundance was higher during the first days of the experiment, the abundance of HNA (High Nucleic Acid) bacteria was higher in HF during the whole experiment, which was reflected on the increased bacterial production. In the HF treatment, increased dinoflagellate abundance was observed, which was probably due to either a dominance of mixotrophic species or a decrease in their predators' abundance (copepods). However, ciliate abundance decreased immediately after the addition of HuminFeed. Finally, HuminFeed had a clear negative effect on copepods.

ON280

Zooplankton community composition in the White and Blue Niles near Khartoum: combining molecular and morphological approaches

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Zooplankton are a vital component of freshwater ecosystems and, in large rivers, are of critical importance to freshwater fisheries and can serve as bio-indicators of ecosystem health. Variation in flow, temperature and nutrients lead to natural (i.e., seasonal) and unnatural (i.e., human-induced) changes in zooplankton species composition and relative abundance. We studied zooplankton community composition in the White and Blue Niles near Khartoum, Sudan, combining morphological identification and counting (100/species methods) with DNA metabarcoding a fragment of the 18S rRNA gene. To date, metabarcoding has revealed ca. 2.5-fold more taxa compared to morphological analysis, as expected. A large proportion of genetic taxa could not be identified due to lack of close matches to existing reference databases. Nonetheless, 44% of amplicon sequence variants (ASVs) were assigned to genus and 24% to species level. We observed significant differences in the plankton community in the White and Blue Niles and attribute these differences to the physical nature of the two rivers in addition to the changing of temperatures with time.

ON075

Dietary changes in predators after application of the Bti-based mosquito control agent in a replicated pond mesocosm

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The mosquito biocide *Bacillus thuringiensis israelensis* (Bti) is considered to be environmentally friendly and to reduce only target-organisms in freshwater systems where it is applied. Recent studies, however, showed a reduction of the non-biting chironomids (Diptera: Chironomidae) after exposure to Bti. Chironomid larvae are an important food source in freshwater ecosystems, therefore their reduction due to Bti can cause a bottom-up effect for consumers. We used Bayesian stable isotope analyses of carbon and nitrogen to test whether the up to 40% observed reduction in chironomid larvae in ponds exposed to the maximum field rate of Bti, changed the diet of pond vertebrate (palmate newt larvae) predators. Bayesian mixing models for the palmate newt *Lissotriton helveticus* showed a reduction in chironomid intake in ponds exposed to Bti, while the intake of zooplankton increased. Also, palmate newts showed larger niche size in control ponds compared to Bti ponds, where they feed on zooplankton almost exclusively. We conclude that applications of Bti can affect the dietary composition of freshwater predators by decreasing chironomids. Because Bti is so widely applied on floodplain systems where chironomids are key organisms, Bti may have effects on structure and function of such ecosystems, affecting food web predatory-prey interactions and potentially threatening ecosystem stability.

ON137

Benthic diatoms community dynamics in the Savannah River estuary

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Human activities can influence significantly structure and functions of aquatic ecosystems. The Savannah River estuary has locations with temporal exposure of diatoms to diurnal desiccation at low tides. The objectives of this study were to: identify algal communities present within mud samples taken during low tide periods over 10 years, second to classify their physiological status and finally to infer algal ecological preferences. The monitored location is within the Savannah River Estuary at USGS site 02198920 and was sampled seasonally. Algal community indices were also examined and related to species alterations in the community. Algal species were classified as freshwater, marine, or brackish. Morphometric measurements for each taxon were collected. Only 56 percent of the documented 430 taxa were identified to species. Through time, live diatoms were replaced by filamentous cyanobacteria representatives like Phormidium. Species richness within the diatom communities decreased 26 percent. Epipelic or epipsammic diatoms were potentially moving upward in the sediment, but their salinity preference is unclear. Non-motile, planktonic diatoms like *Cymatosira belgica* Grunow maintained high relative abundance of 38%. Planktonic marine diatoms were potentially overlayed on the sediment with water retrieval. Taxonomic work on primary producers from the economically important Savannah River will remain relevant. Microscopic primary producers biomass shows remarkable resilience to large-scale changes in sedimentation, turbidity, and light availability, but smaller proportion on motile diatoms within the community can lead to dominance in cyanobacteria.

ON331

A social-ecological biogeography of Canadian Lakes

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Anthropogenic pressures including population growth, land use and climate changes can negatively influence a lake's capacity to provide aquatic ecosystem services (ES). However, an approach that integrates the ecological and social knowledge needed to identify lakes most at risk of losing their ES based on their current state and impending threats is currently lacking. Here, we provide a framework that integrates lake ecological state, global change threat, and demand for ES as recreational use at regional scales across Canada. Using data from over 660 lakes sampled across Canada, a lake regional classification based on baseline biophysical information of unaltered lakes was determined. The deviation from baseline with a series of impacted lakes identified total nitrogen and chloride concentrations as the strongest human indicators of altered lake ecological state in all five regions. Lake ecological state was integrated and mapped using an additive color model along with regional scores of threat levels (combining pollutants, invasive species, withdrawal, habitat loss and climate changes) and ES demand of four recreational uses. Vulnerable areas were largely linked to population. Lakes in Southern Ontario and Quebec were most concerning, being highly altered, under threat, and heavily used for these ES. Lakes near urban centers on both coasts were altered and used, but apparently less threatened, whereas those in the Prairies were altered and threatened, but less used. Our novel framework provides the first social-ecological biogeography of Canadian lakes and is a promising tool to assess lake state and vulnerability at relevant scales for management.

ON121

The effect of sediment gas storage on methane ebullition dynamics in a freshwater reservoir

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Freshwater reservoirs are important sources of the greenhouse gas methane to the atmosphere. Methane is mainly produced in the bottom sediment, from where bubble mediate transport is the most efficient way of transporting methane to the atmosphere. The sediment characteristics shape net methane production, gas mobility in the sediment matrix, and in combination with external forcings also the release of gas bubbles. We combine methane flux monitoring (diffusive, ebullitive, and oxidation) with measurements of potential methane production rates, vertical distributions of gas voids in the sediment, and sediment gas content, to investigate the effect of sediment gas storage on methane ebullition dynamics from a freshwater reservoir. The study site is the pre-dam of Wupper Reservoir located in the western region of Germany. The extensive data set allowed to establish a methane

balance for the pre-dam. The system is a methane source to the atmosphere in which ebullition was the main emission pathway (49.2% of methane emissions). Potential methane production was higher at the top 20 cm sediment layer and sediment freeze cores are being analysed to determine the vertical distribution of bubbles in the sediment. In a rough estimation, an equivalent of 8 – 28 days of potential methane production is stored as free gas in the sediment. The interplay between gas storage in the sediment and ebullition flux will be discussed.

ON021

A groundbreaking approach for the identification and documentation of aquatic fungal diversity

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Headwater streams functioning relies on energy supply from allochthonous sources, mostly leaf litter. Aquatic fungi are known to have a primary role in its decomposition, due to their ability to produce enzymes that degrade complex plant polysaccharides and to assimilate nutrients from stream water. The breakdown processes are enhanced by fungal diversity, with intraspecific variability and genetic diversity being pivotal to ecosystem functioning. Most of the diversity research efforts stem from early investigations using microscopic conidial identification, which does not always provide reliable, species-level identification. Nowadays, molecular barcoding of the ITS region is routinely used for fungal reference material. However, serious gaps remain in the databases for these taxonomic markers. This is evident when environmental sequencing turns up many unknown fungal lineages. The goal of our study was to assess fungal communities' diversity in naturally decomposing leaves from several freshwater ecosystems. To that end, we developed a novel methodology to microscopically identify and extract DNA from individual conidia using Laser Microdissection and Multiple Displacement Amplification and performed molecular identification by amplification of universal DNA barcode markers. Our results enable the expansion of the information currently available in databases and reflect the importance of combining molecular and microscopic identification methods to unambiguously identify aquatic fungi. We assessed genetic diversity within and between communities and investigated intraspecific divergences between communities. The developed approach also has potential to expand the current knowledge on aquatic fungal diversity and enzymatic functionalities by combining high throughput sequencing techniques targeting different marker genes.

ON008

Food web structure in Mediterranean streams: influences of invaders and habitat change

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Freshwaters are exposed to multiple anthropogenic stressors that may interact in complex ways to affect species, communities and ecosystem functions. Species invasion and habitat change are particularly concerning, but while their individual impacts are fairly well understood, little is known about their interactions. This may be especially important in strongly modified Mediterranean rivers harbouring unsaturated communities highly prone to invasion.
Here, we used a stable isotopes approach to examine the effects of fish invaders and habitat change on food webs in the Lower Guadiana River Basin (Portugal). We conducted our study in 34 dry-season pools along gradients of invasive fish richness and abundance, and habitat change. We quantified resource basis and trophic niches using stable isotope mixing models and analysed how the isotopic variance of basal resources, primary consumers and predators vary along the invasion and habitat gradients. We expect invasive species and habitat change to have interactive effects, leading to the alteration of trophic interactions and rewiring the flow of energy through food webs. Specifically, we expect the addition and removal of food web nodes in association with invasive species and habitat change, respectively. This would lead to a reorganization of food web configurations through novel interspecific interactions, propagating via bottom-up or top-down processes. Finally, we expect lower trophic redundancy through fewer species occupying similar niche positions.
Our findings will improve the understanding of interactive effects of anthropogenic stressors on the flow of energy through food webs and provide insights into the functioning of ecosystems in modified freshwater ecosystems.

ON126

Methane dynamics in sediments of freshwater ecosystems: from local to global scale

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Methane emission from freshwater sediments encompass production, oxidation and transport, which are all influenced by physical, chemical and biological processes. For instance, among many parameters, the organic matter content and temperature have been considered as dominant factors in methane production and release from the sediments. Due to the large number of processes and parameters involved, the net methane production from freshwater sediments that is transferred to the water column is highly heterogeneous, within and among ecosystems. Given this heterogeneity, the extrapolation of the methane emissions from the sediments to the water column may be biased. In addition, an important biological regulator of methane emissions from sediments is the anaerobic oxidation of methane, which is still not well understood and constrained, further increasing the inconsistency of methane budget. Based on a study from 15 lakes, we show that anaerobic methane oxidation is a ubiquitous process and that 29% to 34% % of the methane produced in lake sediments is oxidized anaerobically. Additionally, here it is proposed that despite the wide variability of methane dynamics in freshwater ecosystems, an overall trend among contrasting ecosystems can be observed. Nevertheless, the amount of data required for accurately extrapolating the methane flux of the sediments to the water column remains open and requires further consideration.

ON225

How can we distinguish species sorting and physiological plasticity in a multifactor environment?

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Phytoplankton communities can respond differently when facing alterations of abiotic factors in their environment, as these influence the individual cell directly or indirectly due to resource competition. Species sorting and phenotypic plasticity (here explicitly physiological plasticity) are two important mechanisms. The first results from a change in interspecific competitive pressure and the second is a species-specific physiological adjustment. These mechanisms are difficult to distinguish as a shift in species composition and physiological adjustments in species can both lead to changes in community fatty acid composition that determine the food quality for zooplankton consumers. We approached this challenge by evaluating the species and fatty acid composition of our laboratory phytoplankton communities using the Bray-Curtis similarity index. Our results suggest that the relevance of these two mechanisms in shaping the community response highly depends on which environmental factors influence the system.

ON380

Spit it out!? – Influence of invasive quagga mussels on cyanobacteria blooms during heat waves

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Quagga mussels (*Dreissena rostriformis bugensis*) are one of the world's most troublesome invaders, causing widespread ecological and economic damage. They form dense carpets and their high filter feeding activities strongly impact phytoplankton communities in lakes. Their effects on cyanobacteria, some of which form harmful algal blooms that impair water quality for bathing and drinking water production, are controversially debated. Both, a decline in total cyanobacteria, but also selective filtration with a spitting out of particular species such as *Microcystis* has been reported. In addition, the filtration activity is supposed to drop at higher temperatures which facilitate cyanobacteria blooms, but the range above 24°C is still insufficiently studied. We hypothesized 1) that selective feeding increases the share of "non-edible" cyanobacteria, but does not compensate negative mussel effects on total cyanobacteria biomass and 2) that strong cyanobacteria blooms can occur during heat waves when mussels stop feeding above a temperature threshold. To test these hypotheses, we analysed long-term data of urban eutrophic Lake Müggelsee (750 ha, 4.9 m mean depth, Germany) and compared cyanobacteria abundances and species composition during heat waves in the decade pre and post quagga mussel invasion in 2011. Heat waves with daily mean water temperatures above 24°C occurred each year and were dominated by "edible" and "non-edible" species before quagga invasion. Post invasion, total cyanobacteria biomass was significantly lower. The share of „edible" cyanobacteria was lower than pre-invasion, but seemed to increase with increasing temperatures, indicating a loss of mussel filtration impact.

ON095

Assessing climate change impacts on the water quality of standing waters in Scotland, UK

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Like the rest of the world and the UK as a whole, Scotland is facing an unprecedented climate change crisis. Amongst other impacts, this is affecting the quality of its standing waters. Here, we present evidence to evaluate climate-related risks and inform adaptation strategies to safeguard the integrity, biodiversity and sustainable use of Scotland's standing waters. We focus on identifying interactions between climate change and the drivers of eutrophication. We combine information from the literature, expert opinion and monitoring data, and use statistical analyses and visualisation (mainly mapping), to assess future sensitivities to climate change stressors. We found that 97% of Scottish lochs and reservoirs had experienced an increase in water temperature between 2015 and 2019, with most (88%) warming by between 0.25°C and 1.0°C per year and a small number (9%) increasing by 1.0°C to 1.3°C per year. Average April to September water temperatures were projected to rise by about 3°C in Scottish standing waters by 2080, and extreme drought events are likely to increase. As a result, algal blooms are expected to become more prevalent across all Scottish lochs by 2080 in response to warming, increased retention timed, and shifts in the seasonal timing of biological communities causing a mismatch between algal communities and their zooplankton grazers. We discuss the importance of a climate change risk assessment for standing waters and stress the need for a whole system approach to lake and reservoir management under a changing climate.

ON354

Internal nitrogen loading in eutrophic lakes: moving beyond nutrient concentration measurements and Liebig's Law

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Lakes impacted by anthropogenic eutrophication are often monitored intensively for evidence and mitigation of nutrient-related impacts, such as hypoxia and harmful algal blooms. 'Snapshot' nutrient concentration monitoring is common practice, but the most bioavailable nutrient forms (e.g., ammonium and reactive phosphorus) cycle rapidly within systems, limiting the usefulness of these discrete concentration measurements. Nutrient 'limitation' of primary productivity is dynamic in time and space, and the concept, based on Liebig's Law, is often insufficient to explain controls on cyanobacteria growth in lakes. For example, heterocyte differentiation and nitrogen fixation are energetically costly and require extreme nitrogen stress to be initiated and completed on a cellular level. For ammonium, and nitrogen in general, the result is underappreciation of its importance due to low in situ concentrations. Understanding internal nitrogen dynamics and its importance in contributing to eutrophication and cyanobacterial blooms requires quantification of rates at which various nitrogen forms are assimilated, recycled, and ultimately removed. In large lakes, internal nitrogen loading (e.g., ammonium regeneration, sediment release), driven by external nitrogen loading, help support cyanobacterial blooms and N-rich toxin production, especially when non-nitrogen-fixing taxa dominate. This internal nitrogen loading helps explain how these taxa thrive despite high denitrification rates and low in situ concentrations. As the limnological community more fully understands the importance of nitrogen in driving eutrophication and contemporary (non-N-fixing, N-rich toxin-producing) cyanobacteria blooms, resource regulators and managers are increasingly calling for much needed control of external nitrogen loading, in addition to existing controls on phosphorus loading.

ON190

Achieving chlorophyll-*a* concentration targets in Ireland's largest lake: N or P control

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The long-term trend in annual mean DIN:TP (natural log) ratio and chlorophyll-*a* (chl-*a*) was investigated in Lough Neagh, a large, hypereutrophic lake in Northern Ireland. The log N:P ratio was relatively stable over the first part of the 45 year data series (1974–1995) with a mean value of 1.42, while the annual mean chl-*a* concentration increased over this time period and peaked at 75 µg/L in 1993. After the mid 1990s there was a concomitant, highly significant decline in the log N:P ratio and chl-*a* concentration; mean values over the period (1996–2019) were 0.98 and 48 µg/L respectively. The observed decrease in annual mean ratio was driven by a 33 µg/L increase in TP and a 58 µg/L decrease of DIN in the second part of the time-series. P increase was largely due to internal loading of P whereas lake water concentration of DIN has decreased as a response to management measures in the catchment. TP and chl-*a* target concentrations are 24 and 10 µg/L but current lake concentrations (2009–2019 mean) are 130 and 44 µg/L respectively. Recent DIN:TP ratios indicate N limitation of phytoplankton for the entire growing season and this is likely to remain the case until P concentration is reduced. The target chl-*a* concentration is unlikely to be achieved in the medium term as the nutrient ratio and empirical chl-*a* models indicate that phytoplankton will remain N limited until concentrations of P reach approximately 30 µg/L. Internal loading will not reduce for 20 years.

ON055

Glaciofluvially-derived dust modifies benthic algal growth in West Greenland lakes

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Melting of the Greenland ice sheet is increasing meltwater discharge in the Kangerlussuaq area of West Greenland. Glaciofluvially-derived silts can be mobilized by winds and transported as dust; a potentially important geochemical subsidy to the nutrient-limited lakes in this region. To assess how dust influences the chemistry and biota of lakes around Kangerlussuaq, we conducted an in situ mesocosm experiment in three lakes located at different distances away from the ice sheet. We added dust to enclosures embedded in sediments to determine the effects on the water chemistry, phytoplankton and benthic phototrophs. We hypothesized that dust would supplement phosphorus to these lakes and stimulate phytoplankton production. However, there was no significant effect of dust on either the water chemistry or the phytoplankton. Instead, dust additions modified benthic algal communities in different ways among lakes. In lakes with lower natural dust supply, dust additions stimulated the production of siliceous and chlorophyte benthic phototrophs. In lakes with high natural dust supply, addition of further dust inhibited rather than stimulated production of cyanobacteria, suggesting that the sedimentary dust matrix was adsorbing nutrients and rendering them unavailable for algal uptake. Together our results indicate that the physical effects of dust rapidly settling onto the sediments and its physico-chemical properties that strongly bind phosphorus moderate how and where nutrients are supplied by dust to lake biota. These effects on benthic communities suggest that dust deposition could provide a mechanism for the observed "benthification" of lakes in the Kangerlussuaq area over recent decades.

ON092

Planning riparian restoration at a whole catchment scale: Navigating trade-offs among agricultural production, ecosystem functioning and biodiversity

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Stream-riparian networks are subject to multiple anthropogenic pressures that cause habitat and diversity losses, threaten ecosystem services, and drive stakeholder conflicts. The rehabilitation of woody riparian buffers along stream channels is frequently proposed as a management measure capable of addressing multiple goals, including enhancement of ecosystem functioning, and protection of biodiversity. However, the planning of riparian rehabilitation to simultaneously meet multiple goals requires a clear understanding of potential trade-offs, and a landscape-scale perspective on planning of reforestation measures. The BiodivERsA funded project CROSSLINK used data collected from spatially-explicit field sampling campaigns to develop a landscape optimization algorithm for allocating riparian forest management measures in the heavily agricultural catchment of the Zwalm River (Belgium). We optimized forest allocation to improve three target indicators, *viz.* stream ecological quality (EPT index), functional diversity (diatoms) and riparian carbon processing (cotton-strip assay), while minimizing losses in agricultural production potential. Regression models were developed to predict the target indicators for 489 segments of the Zwalm riparian corridor. For each riparian segment we evaluated alternative spatial allocations of different intensities of riparian reforestation to identify (1) trade-offs among the target indicators, (2) priority regions for reforestation, (3) required reforestation intensity. Riparian reforestation along the Zwalm could significantly improve biodiversity and ecosystem functioning indicators, but will result in a strong trade-off with agricultural production. Our optimization analyses resulted in identification of the headwaters of the Zwalm as priority areas for reforestation actions, with tradeoffs further minimized through modest expansion of and improved connectivity among existing forest patches.

ON430

Footprint concept largely disregards impacts of food production on fresh waters

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Land use change to produce food for people and domesticated animals is one of the world greatest anthropogenic transformations. The consequences for biodiversity, quantity and quality of fresh waters, and for the carbon cycle are enormous. Using the framework of environmental "footprints", we aim at highlighting impacts of food production on the functioning of freshwater ecosystems. We review footprints related to water quantity and quality and the greenhouse gas (GHG) footprint related to emissions from fresh waters used to support food production. Rice and cultured fish are evident examples of the importance of including aquatic GHG emissions to compute carbon footprint, but less evident are the GHG emissions from artificial water bodies used for terrestrial food production, such as drainage ditches and water reservoirs for cattle or irrigation. Aquatic GHG emissions are either largely underestimated or entirely neglected in the GHG footprint of food production. Moreover, eutrophication boosted by conventional agricultural practices strongly increases GHG and particularly CH_4 emissions from aquatic systems, besides its long-known negative impacts on biodiversity and water quality. We thus argue that many impacts on fresh waters are not captured by current estimations of footprints, as neither are interactive effects of eutrophication and climate change. Better estimations of multifold impacts are needed to better assess footprints and inform stakeholders including consumers, whereas better local practices are needed for impact mitigation. These steps can contribute to a more sustainable, fair, and ethical food system, while contributing to more biodiverse aquatic ecosystems with a lower carbon footprint.

ON408

Trophic transfer efficiency and land-water coupling – a conceptual contribution

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Trophic transfer efficiency (TTE) is an ecosystem function that is rarely estimated for lakes. Furthermore, it is not explored how reciprocal carbon flows between aquatic and terrestrial system may affect TTE. In our review, we elucidate the processes and structures that have to be understood for a proper lake TTE estimate. We briefly discuss how nutrients (N, P) and other compounds (fatty acids) constrain energy transfer between trophic levels and hence TTE. Subsequently, we explore temporal and spatial heterogeneity of production and TTE in lakes, with a particular focus on the links between benthic and pelagic habitats and between the lake and the terrestrial environment. Finally, we present two alternative approaches to estimating TTE. First, TTE can be seen as a mechanistic quantity informing about the energy and matter flow between producer and consumer groups. This approach is informative with respect to food-web structure, but requires enormous amounts of data. The greatest uncertainty comes from the proper consideration of basal production to estimate TTE of omnivorous organisms, in particular if the contribution of allochthonous carbon to lake metabolism is substantial. An alternative approach is estimating food-web efficiency, by comparing the total sum of all heterotrophic production including that of heterotrophic bacteria to the total sum of primary production. Again, allochthonous carbon may contribute to heterotrophic production, and hence estimates of food-web efficiency have to consider coupling of aquatic and terrestrial ecosystems.

ON123

Methane fluxes in Amazon floodplain lakes: measurements and modeling

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Floodplain lakes are abundant in the Amazon basin and are important methane sources to the atmosphere. Methane concentrations, diffusive and ebullitive fluxes, and environmental conditions in Lake Janauacá, a representative Amazon floodplain lake, measured for two years, revealed patterns in temporal and spatial variability related to water levels and other factors, including daily cycles of stratification and mixing. The contribution of ebullitive methane fluxes to total fluxes was variable (1 to 93%). Current biogeochemical models are not designed for conditions in floodplain systems. Hence, we modified a 1-D process-based, biogeochemical model combined with thermal structure and mixing derived from a 3-D hydrodynamic model. We evaluated the combined models' performance simulating conditions in Lake Janauacá. Parameters for calibration were selected through sensitivity tests using a machine learning-based algorithm, classification and regression trees. Overall, the model performed well for all water phases in the main lake and in a narrow embayment, simulating dissolved methane and oxygen concentrations, and methane emissions on diel to seasonal scales. Our results have important implications for the regionalization of methane fluxes for Amazon floodplains and inland waters elsewhere, and emphasize the inter-related temporal and spatial variations in habitats and fluxes especially in aquatic systems with large seasonal variations in extent.

ON460

Gender gap in Science – A small attempt to understand and tackle it

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As awareness on the JEDI (Justice, Equity, Diversity and Inclusivity) principles in research raises, we as researchers need to ask ourselves/themselves the question: which steps will lead to diverse representation and to practices in science that are just, equitable and inclusive? In the graduate research school Systemlink, studying terrestrial-aquatic interactions, we asked ourselves this question and started a series of seminars. We have realized how much we do not know and how much we need to learn. In this presentation we will talk about the process we did to organize the series and what we are (still) learning from it.

ON338

Population dynamics of native mixed phytoplankton communities exposed to the invasive cyanobacterium *Raphidiopsis raciborskii* along gradients of N:P and temperature

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The tropical invasive freshwater cyanobacterium *Raphidiopsis raciborskii*, first recorded in Central Europe about two decades ago, is now relatively widespread and expanding its geographic range. Currently, however, there are no records of this species in Scandinavia. As a bloom-forming, toxin-producing species, future population growths of *R. raciborskii* could negatively affect local biodiversity and ecosystem services. Hence, there is an urgent need to understand the factors controlling its range of expansion in Northern Europe in order to predict the probability of invasions. We performed a laboratory experiment to study the competitive success of *R. raciborskii* when interacting with other species typically found in Swedish lakes. The experiments consisted of three different temperatures ranging from minimum to optimal growth of *R. raciborskii* (17; 22; 26 °C) and three different nutrient conditions (N:P ratios: 8:1; 16:1; 32:1) to test if the N-fixing capabilities of *R. raciborskii*affects its competitive success. The results of the experiment will be presented and discussed with the aim to evaluate the possible success of the invasive *Raphidiopsis raciborskii* in northern boreal lakes.

ON146

SMARTLAGOON - Coupled catchment-physics-biogeochemical modelling in lakes and coastal lagoons

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SMARTLAGOON is an EU-funded Horizon2020 project that started in 2021. The primary aim of the project is to develop modelling approaches to understand and manage environmental problems in coastal lagoons. The primary case study of the project is the Mar Menor lagoon (Murcia, Spain), which is under increasing pressures due to eutrophication and urbanisation, and has experienced a recent shift to turbid and phytoplankton-dominated conditions. Our overarching goal is to create a modelling setup in the Mar Menor that can be used for short-term and long-term forecasting. To achieve this, the SWAT+ catchment model and the GOTM-WET aquatic ecosystem model are set up as a coupled modelling framework both in the Mar Menor, and in Lake Erken in Sweden, where extensive data are available for testing the two models. Ecosystem dynamics in these systems are controlled by interactions between thermal structure, oxygen, nutrients, macrophytes, and phytoplankton, so it is crucial to include these features in the modelling setup. Understanding the interactions among these and the interactions with factors regulating nutrients input from the catchment model is the major challenge undertaken in this study. In the Mar Menor, a lack of long-term and high-quality data poses additional challenges. We will present several ways to take on such uncertainty, including ensemble modelling and enabling future data assimilation. In this presentation, we report on the progress made so-far and the tasks ahead.

ON448

The „pre-SIL“ phase of August Thienemann

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From 1907 to 1917 AT hold his first workplace in Münster/Germany, heading the newly established „Hydrobiological Section for Fisheries and Wastewater“, which was part of an Agricultural Research Institution. Against the background of increasing pollution of surface waters, affecting – among others - fisheries, AT had to deal with problems emerging from the practice from the beginning. Accordingly, AT's early professional work contributed likewise to the applied sciences and to basic research making both of them an integrative part of limnology, which is still the case to date. The innovative approach AT pursued was in describing and understanding the environmental (abiotic and biotic) conditions of fish habitats, combining it with research on the specific demands of organisms which serve as food for fish farming. The model organisms on which AT focused were species of the taxon Chironomidae, which would remain his principal research object throughout. This taxonomic and ecological research became also important for his conceptual work on lake typology, production biology, biodiversity, and biogeography. That limnology goes far beyond pure hydrobiology has been stressed in many publications. AT's work demonstrates that a detailed focus on the species and community level implies the potential for an integrative perspective on freshwaters. This holistic view of inland waters marks a further milestone in AT's legacy. Which research lines have prevailed, and which have even been developed further? What concepts have moved the scientific community forward?

ON293

Has acid deposition reduced long-term carbon storage in northern forest lakes?

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Lake sediments are important carbon (C) sinks, removing C from the short-term C cycle; yet little is known about the sensitivity of this sink to anthropogenic disturbances. During the 20th century, atmospheric acid deposition disrupted terrestrial-aquatic C cycling by drastically lowering organic C loads in many lakes across NE North America and northern Europe. Recovery from acid deposition has, in turn, increased organic C loads (i.e., freshwater browning). To date, it remains unclear how acid deposition has affected long-term C accumulation rates (CAR). We present CAR, and other supporting infrared spectroscopic, isotopic and elemental geochemical proxies, for eight lakes around Sudbury, Ontario, Canada – an area that has been heavily affected by acid deposition in the past. Lakes with direct watershed disturbances (i.e., vegetation loss and soil erosion following acidification and metal contamination) showed short-lived CAR increases, but CAR changed little in remote lakes with minimal direct human disturbances. On a landscape scale, CAR did not change during the 20th century (median 1880–2018 CAR: 13.5±0.8 g/m^2/yr). This is in stark contrast to other northern forest lakes with minimal direct catchment disturbances that experienced significant CAR increases during the 20th century. In contrast to these lakes, Sudbury watersheds received considerably higher acid inputs in the past (~25 vs. ~13 kg/ha/yr in 1981–1983). We propose that acid deposition suppressed CAR increases during the 20th century and consequently there is a large potential for increased future C storage in lakes from formerly high acid deposition areas following complete acid-deposition recovery.

ON086

Controlling blooms of *Planktothrix rubescens* by optimized metalimnetic water withdrawal: a modelling study on adaptive reservoir operation

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Planktothrix rubescens (hereafter *P. rubescens*) is a filamentous cyanobacterium that potentially contains hepatotoxic peptides known as microcystins, and its occurrence in drinking water bodies poses a serious human health concern. Metalimnetic blooms of *P. rubescens*have apparently increased in frequency and severity in recent years so there is a strong need to identify reservoir management options against its growth. We hypothesized that *P. rubescens*blooms in reservoirs can be suppressed by selective withdrawal maximizing its export from the reservoir. We also expect that altering the light climate can affect the dynamics of this species. We tested our hypothesis in Rappbode Reservoir by establishing a series of withdrawal and light scenarios based on a calibrated water quality model (CE-QUAL-W2). Our scenarios demonstrated that the novel withdrawal strategy, in which its depth under the water surface is fixed at the metalimnion, effectively reduced *P. rubescens*biomass in the reservoir. According to the simulation results, we defined an optimal withdrawal volume to control *P. rubescens*blooms in the reservoir as approximately 10 million m^3. An unexpected outcome was that *P. rubescens* growth can be most effectively suppressed if the metalimnetic withdrawal is applied in the early stage of its rapid growth. Additionally, the results showed that *P. rubescens*biomass gradually decreased with increasing light extinction and nearly disappeared when the extinction coefficient exceeded 0.55 m^{-1}.Our results inform management strategies to minimize the harmful impacts of *P. rubescens* in water supplies and generate an adaptive response to offset the rise in *P. rubescens* populations.

ON386

Effects of high and low flows on population abundance of fish species in small Central European streams

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Hydrological variability is considered a major structuring factor of biotic and abiotic processes in freshwater ecosystems and is of particular importance for fish communities. We used hydrological indexes to investigate the short- intermediate- and long-term effects of high and low flow patterns on fish populations in small streams in Germany. Generalized linear models on average explained 54 % of the variability in fish abundances. Models based on long-term hydrologic indices best-explained fish abundances. Long-term models also had fewer variables with higher explanatory power per variable. Species response to low flow conditions revealed three clusters. Cold-stenotherm, demersal species were susceptible to high frequency and long duration but tolerant to the magnitude of low flow events. In contrast, species with a more benthopelagic habitat preference and tolerance of warmer water were susceptible to magnitude but tolerated larger frequencies of low flow events. Euryoecious chub (Squalius cephalus), tolerating both long durations and large magnitudes of low flow events, formed its own cluster. Species responses to high flows were more complex and five clusters of species were differentiated. Native salmonid species were negatively influenced by the frequency and magnitude of high flow events, due to constraints on reproduction and recruitment. Species with an equilibrium life history strategy were positively affected by longer durations of high flow conditions which may allow them to take advantage of the extended floodplain whereas opportunistic species significantly differed by thriving in frequent high flow conditions.

ON339

Should they stay or should they go: New insights on the removal of invasive macrophytes from a biodiversity perspective

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Mass developments of macrophytes increasingly cause problems in lakes and rivers worldwide. They can hinder commercial and leisure activities (i.e. navigation, fishing, swimming or other water sports), increase the risk of flooding adjacent land, clog hydropower plants, and repress native vegetation. However, positive effects of macrophytes like the provision of cleaner water (by sediment stabilization and nutrient removal) or habitats for other organisms are often overlooked. Based on this negatively biased perception, vast amounts of money are spent on removing macrophytes, often without success, as plants regrow quickly. For effective management of aquatic systems, a more balanced view is needed. We investigated the effects of macrophyte removal on the diversity of macroinvertebrates, zooplankton and phytoplankton at five sites in four countries in Europe and Africa, covering different climate types, trophic status and plant species. Three of our five sites are colonized by invasive plants, while dense mats of native macrophytes colonize the two other sites. Similar sampling methods and BACI design (Before-After-Control-Impact) applied in all sampling sites allow us to disentangle global from local effects. Macrophyte removal had significant, primarily adverse effects on the diversity of all investigated organism groups. These results imply that macrophyte management strategies should include effects on biodiversity to reach a more balanced answer to the question: “Should they stay or should they go?”.

ON116

Biogeography and beta-diversity patterns of reservoir protist communities in subtropical and tropical China

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Protists are not only important component of aquatic ecosystems, but also play key roles in nutrient cycling. However, how trophic interactions (i.e. biotic factors including bacteria, fungi and metazoa), together with environmental-climatic and spatial factors, shape the community structure of small (0.22 – 5 μm), large (5 – 64 μm) and all (0.22 – 200 μm) protists in natural freshwater ecosystems remains largely unknown. Here, we investigated biogeography and β-diversity patterns of protist functional groups (consumer, phototrophs and parasites) based on three size-fractions among 24 reservoirs in southeast China and quantified the relative contributions of biotic, environmental-climatic and spatial factors on their β-diversity. Our result showed that the composition of the protist functional communities (consumer, phototrophs and parasites taxa) differed significantly between small-, large-, and all- size-fractions. We observed significant negative distance-decay relationships in β-diversity of all protist functional groups. The biotic, environmental-climatic and spatial factors had significant impacts on β-diversity of small and large protist functional groups, whereas biotic factors were stronger in shaping β-diversity patterns than abiotic factors. Our study provides novel insights into the importance of biotic (trophic regulations) and abiotic factors in structuring β-diversity of small and large protist functional groups, and promotes our understanding of the community assembly and diversity of consumer, phototrophs and protists in the freshwater ecosystems.

ON015

The potential for using lanthanum modified bentonite to mitigate eutrophication of Lake Hålandsvatn, Norway

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Lake Hålandsvatn is heavily eutrofied and suffers from frequent and extensive cyanobacterial blooms.The lake and its surroundings are valued sites for recreation, but the blooms and associated cyanotoxins impair these activities.Restoring the lake is therefore a priority for the local authorities, and measures are undertaken to reduce the excessive input of nutrients from the watershed.But the lake sediment is rich in nutrients which is expected to be a major factor for the development of cyanobacterial blooms in years to come.Lake internal measures will most probably need to be applied to mitigate the situation on an acceptable time scale, and the use of lanthanum modified bentonite (LMB) to bind phosphorus in the sediments is proposed as the most relevant.Tests have been conducted to investigate how LMB will perform under conditions frequently observe in the lake (like anoxic hypolimnion and high pH in surface water) and how it could be best applied.This presentation outlines the situation in Lake Hålandsvatn, presents the results of the tests with LMB, and discusses possible and probable ways forward.

ON266

Methods used to set management objectives for nutrients – a comparison of European national approaches

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ECOSTAT is a working group of national experts supporting the Common Implementation Strategy of the European Union Water Framework Directive (WFD) regarding the ecological status of surface waters (rivers, lakes, transitional and coastal waters). One objective is to understand approaches taken by Member States and associated countries of the EU to manage nutrients in order to achieve “good ecological status” (WFD) and “good environmental status” (Marine Strategy Framework Directive) for all surface waters. For this purpose, a questionnaire was circulated to compare national approaches to setting and implementing management objectives for nutrients in river, lakes, transitional, coastal and marine waters. The questionnaire was divided into three sections: (1) management objectives for nutrients; (2) calculation of current nutrient loads; (3) achievement of management objectives for nutrients. A large number of replies were received from throughout the EU, enabling a comprehensive overview of nutrient management in Europe to be obtained. The outcome revealed that most countries have already set management objectives for all water bodies exposed to nutrient pollution. However, some countries reported that the derivation of management objectives set for nutrients are not linked to the nutrient thresholds set for ecological status. This raised the question how management objectives for nutrients can be set if the link to biology is not considered. This presentation will give a summary of the main outcomes of the questionnaire and discuss the challenges for nutrient management that it revealed. Finally, recommendations derived from the exercise to further improve nutrient management in Europe will be discussed.

ON277

Microplastics effect on microbial organic matter degradation in peat-forming wetlands

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Microplastics (MP), small easy to transport plastic particles (<5mm), are organic long-chain polymers of carbon (C) mixed with different additives that can add up to carbon pools and impact biota when entering to the environment. Thus, plastic and MP are new players in the C cycle with little known function and dynamics. This might be especially relevant in wetlands where C cycling is strongly driven by microorganisms and constrained environmental conditions, such as low pH and oxygen availability. In order to explore potential effects of microplastics on organic matter (OM) degradation by microbial communities in peat-forming wetlands, we conducted an experiment mixing peat with two MP concentrations (0.5% and, 5%) of ground sanitary polyvinyl chloride (PVC-<1mm). We monitored water physicochemical characteristics, microbial community composition and functions, and organic compounds in the peat-PVC matrix during 91 days. Results show that PVC-MP addition significantly changed the physicochemical peat-water conditions increasing pH, and the concentration of some ions (e.g. Ca, Mg) and total nitrogen (N, mainly as ammonium). PVC-MP decreased hydrolases activity but improved CO_2 and methane production, denitrification rate, and liberation of OM in water. Impacts increased with the PVC-MP concentration and time.Our results suggest a strong alteration of microbial processes due to MP or/and MP's additives that apparently promote OM decomposition affecting C and N cycling and potentially generating more greenhouse gas emissions from peat-forming wetlands.

ON294

Predicting methane formation rates in sediments of lakes in different northern climates

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Inland waters emit a large amount of methane (CH4) to the atmosphere, despite covering only a small fraction of Earth's landmass. CH4 is produced by microbial degradation of organic matter in the sediment but there is currently a limited understanding of the links between sediment characteristics and methane production. With a better understanding of such links, CH4 emission from inland waters could be better constrained at larger scales. A previous study in tropical reservoirs showed that the CH4 production rate can be well predicted from the age and total nitrogen content of the sediment. It is unclear, however, if this

empirical model can be applied to predict CH4 production in sediments of inland waters in other climate zones. To test this, we incubated sediment layers from 9 Swedish lakes differing in productivity, catchment area and climate. We compared the measured CH4 production rates to the existing model predictions for lakes in northern climates. The model was able to predict sediment methane production rates of nutrient-rich northern temperate lakes with reasonable accuracy, but it overestimated methane production in the sediments of boreal humic-rich lakes. Research is ongoing to assess whether other sediment or lake characteristics can improve model predictions of methane production rates across the studied lake types.

ON049

Antarctic lake phytoplankton and bacteria from near surface waters exhibit high sensitivity to climate-driven disturbance

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The McMurdo Dry Valleys (MDVs) of Southern Victoria Land, Antarctica, is a cold, desert ecosystem poised on the threshold of melting and freezing water. The MDVs have experienced dramatic signs of climatic change over recent decades, most notably a warm and sunny summer in 2002 that caused widespread flooding and triggered several years of ice cover loss and lake level rise. To further understand the impact of these environmental disturbances on lake microbial communities, we mimicked lake level rise and ice-cover loss by transplanting dialysis-bagged communities from varying depths to lower in the water column or to the open water moat. Bacteria and eukaryote communities residing in the surface waters (5 m) exhibited shifts in community composition when exposed to either disturbance, while microbial communities from below the surface were largely unaffected by the transplant. We also observed an accumulation of labile organic carbon in transplanted surface communities. In addition, there were taxa-specific sensitivity to disturbance: Cryptophytes and Actinobacteria were highly sensitive particularly to the moat transplant, while Chlorophytes and several other bacterial taxa increased in relative abundance or were unaffected. We conclude that location and community composition impact the sensitivity of Antarctic lake communities to climate-driven disturbance.

ON456

Daphnia in Lake Biwa and Water circulation

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Currently, Lake Biwa is facing problems with the lack of annual circulation cycles due to global warming. In summer, the surface layer of Lake Biwa warms up, and cold water accumulates at the bottom of the lake, stopping the water circulation. In winter, the surface layer cools down, and oxygen-rich water flows to the bottom of the lake. This phenomenon is also called „deep breathing of Lake Biwa. Then, oxygen does not reach the bottom of the lake, which has a great impact on the organisms living at the bottom of the lake. Daphnia at different depths in Lake Biwa seasonally, but it has become evident that this pattern is being affected by the lack of Water circulation. Because Daphnia,is located at the base of the food chain, this can affect organisms on a higher trophic level. In my research, I compared and discussed data on the dissolved oxygen concentration with the number of Daphnia at the bottom of the lake. In 2019, many endemic species were found dead at the bottom of the lake. Water circulation failure is a threat to organisms that live on the bottom of the lake, such as Isaza goby fish, *Jesogammarus annandalei*, *Bdellocephala annandalei*, and Daphnia. I believe that by continuously collecting data, I will understand the impact of water circulation failure.

ON241

Localization and duration of the synthesis of chemically-modified microcystins/bioactive peptides in the bloom-forming cyanobacteria *Microcystis aeruginosa* and *Planktothrix agardhii*

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Harmful algal blooms formed by colony-forming cyanobacteria threaten our water resources by the production of cyanotoxins. We aim to localize and measure the duration of synthesis of toxic microcystin (MC) and anabaenopeptin (AP) - peptides under noninvasive conditions on single cell level. This approach is enabled by the promiscuity of certain key enzymes during the respective nonribosomal peptide biosynthesis (NRPS) pathway. These key enzymes can use non-natural functional groups as precursors (e.g. amino acid-alkynes) enabling subsequent labeling by an azide-modified fluorophore through a copper-catalyzed click chemistry reaction (CuAAC). Cell cultures were grown under maximum-growth rate conditions in the presence of non-natural amino acid for 1, 12, 24 and 48 h and subsequently labeled using Alexa Fluor488 for visualizing the MC or AP peptides. In a second step, after 48 h for aliquots, the decline in peptide label versus the theoretical decline induced by cell division was observed to differentiate between active and passive MC or AP release. Compared with controls (cells grown and processed under identical conditions but without amino acid substrate) a statistically significant intracellular labeling of chemically modified MC was recorded after 12 h in *M. aeruginosa* and for modified AP after 24 h in *P. agardhii*. While the natural autofluorescence was found homogeneously distributed in the cell, the Alexa Fluor 488 signal appeared to be rather heterogeneously located during the entire observation period. This heterogeneous distribution might indicate the regions of MC or AP synthesis inside the cell.

ON059

Effects of temperature, light and nutrients on tropical *microcystis* growth and toxin production: broader lessons from individual laboratory experiments

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Cyanobacterial blooms (C-HABs) are a global problem for water resources in view of their potential to bloom and produce toxins. Most studies have focused on cyanobacterial bloom and toxin production in temperate regions with fewer carried out in the tropics. Thus, the main focus of this research was to elucidate the autecology of dominant toxin-producing tropical cyanobacterial bloom species in Singapore. Species of *Microcystis*(*M. ichthyoblabe*, *M. flos-aquae*, *M. aeruginosa*and *M. viridis*) were isolated from Singapore's reservoirs, with some found to produce microcystins (MC-RR and MC-LR). Laboratory-based temperature, nutrient and light experiments were conducted on these species and overall findings revealed that high nutrient concentrations increased *M. ichthyoblabe* and *M. flos-aquae* growth, while low phosphorus concentrations increased toxin cell quotas of both species. Temperature increases from 27°C–36°C did not increase the growth of most *Microcystis* species, while toxin cell quotas in most isolates increased significantly at a higher temperature (33°C) compared to those at ambient temperature (27°C). Low light intensity resulted in high growth rates for *M. ichthyoblabe* while high light intensity resulted in high growth rates of *M. aeruginosa,* while high light intensity increased *M. ichthyoblabe* and *M. flos-aquae* toxin cell quotas. Overall, these findings indicated that *Microcystis* toxin production may increase with impending climate warming while high nutrient concentrations (high nitrogen) are necessary for C-HAB proliferation with light intensity playing a smaller role in the tropics. These broader lessons can be applied to the management of future C-HABs in the region.

ON457

The art of mentorship: lessons learnt from undergraduate freshwater ecologists

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A large proportion of academic researchers mentor and supervise graduate students in ecological sciences, both to fulfil larger research goals and to cultivate future generations of scientists. However, often less time and attention can be afforded to the mentorship of undergraduate students given their typically short sojourns in research (typically on 9–12-month long projects during their tertiary education) and hence necessarily limited scopes. Irrespective of narrow timeframe or extent, effective mentoring of undergraduate students requires significant planning, time allocation, research structure and pedagogical thought. In this work, we share our insights, methods and experiences of productive undergraduate mentorship of students in short-term research projects, including opportunities for scientific publication as well as further scholarship in the field of undergraduate education and facilitating undergraduates towards graduate school or a research career in aquatic ecology. We will also discuss current challenges faced by undergraduate students and mentors alike and offer potential solutions on how to bridge any potential gaps in expectations, management and compatibility in Singapore- based institutions with some applicable generalities abroad. This work will be focused on mentorship of undergraduate students who have enrolled in their second, third or fourth year in research projects in aquatic ecological sciences. It concludes with suggestions for improvement within current systems in tertiary institutions and how these undergraduate research projects can instil undergraduate students with essential skills for their future careers in aquatic ecology research, environmental policy and governance.

ON269

Whole lake Phoslock application to manage eutrophication

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Kralingse Plas (The Netherlands, 114 ha, maximum depth 3m) is used by ~3 million people every year; however, cyanobacterial blooms occur often as a consequence of eutrophication. A system analysis revealed that most of the phosphorus (P) was coming from the sediment, after external load reduction did not improve water quality. To reduce sediment P-release, the lake was treated with a solid-phase phosphate sorbent - Phoslock®,in November 2021. The Phoslock dose was based on the releasable P in the sediment. The lake was divided into 42 sections, and Phoslock was applied proportionally to the releasable P in each zone, yielding 1064 tonnes applied. We have been monitoring the lake before, during, and after the application. Water samples were taken weekly during the application and monthly after the intervention. Sediment cores were also taken to evaluate P-flux before and one month after the intervention. Furthermore, sequential P extraction was done to assess how P species changed in the sediment. The results showed that phosphorus concentrations (mg P l^{-1}) in the water column decreased from 0.196 (±0.009) to 0.1 (±0.059) during application and kept down to 0.02 (±0.005) after one month of the application and 0.015 mg P l^{-1}after four months. P flux also reduced from an average of 6.3 mg P m^{-2} d^{-1} (±4.4) before the application to -0.93 (±3.2) after one month. The dose calculation and results of the monitoring will be presented in detail, shed light on the treatment›s efficacy.

ON016

Pilot study on the use of Fe-rich water treatment residuals for the remediation of internal P loading in a peaty freshwater system

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Globally, surface water quality and ecosystem functioning are challenged by increased P concentrations. While sterner legislation has led to lower external P loading, internal loading fed by legacy P accumulated in the sediment has become the controlling factor of surface water P concentrations in many European freshwater systems. Efforts to decrease internal P loading include addition of Fe. The chemical form of this added Fe can be pivotal for the effect on the geochemical system and hence the success of the treatment. While $FeCl_3$ has widely been used for surface water remediation, in this study we accompanied a field experiment, performed in peaty eutrophic ditches in a former agricultural area, using Fe-rich water treatment residuals (Fe-WTR, 420-520 mg Fe / g). Sediment geochemistry was investigated shortly before as well as 5 months and 14 months after addition of Fe-WTR to peaty eutrophic ditches in a former agricultural area. Sediment analysis including sequential extractions revealed that a substantial reservoir of reactive Fe was introduced to the top 10 cm of sediment that significantly affects the P and S dynamics of the sediment, while not affecting organic matter mineralization. Incubation experiments showed that P and sulfide release to the surface water is effectively suppressed over the monitored time period. Our results suggest that Fe-WTR is a viable additive for surface water remediation, even though the role of S for the longevity of the treatment needs further investigation.

ON311

Zooplankton functional groups as water quality indicators: application to reservoirs

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Water resources play an essential role inside ecosystems and in human development, thus, the strategies applied to monitoring and management of those resources increase their importance every year. In the European Union, the European Framework Directive (WFD) was established for water resources management. It includes as indicators several biological groups to determine waterbodies ecological potential; however, zooplankton was not included. Here, using data from more than 60 sampled reservoirs located in the Ebro basin (Spanish Mediterranean county) for ten years, we investigated the environmental variables related to zooplankton functional groups and the utility of these groups to differentiate among the categories inside the trophic status and ecological potential. Through several selected functional traits, we obtained a total of five functional groups: large filter copepods, raptorial copepods, cladocerans, microphagous rotifers and raptorial rotifers. The physicochemical variables that were more related to the functional groups were mainly chlorophyll-a, total phosphorus, temperature and dissolved oxygen. The most sensitive group to differentiate among categories were cladocerans followed by large filter copepods and raptorial copepods, while raptorial rotifers were the less sensitive. Using the functional approach, the presence and low densities of large filter-feeding groups such as calanoid copepods and large cladocerans can be used as indicators of good water quality (oligotrophy and good or superior ecological potential). While the high abundances of cyclopoid copepods are indicators of bad water quality (eutrophy and moderate-poor ecological potential). Thus, our results indicate that these functional groups could be useful as indicators.

ON297

Do *Gonyostomum semen* blooms counteract brownwater lake CO_2 emissions?

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Brownwater lakes are generally net emitters of CO_2 to the atmosphere, as bacterial respiration typically surpass autochthonous primary production. At the same time, blooms of flagellated phytoplankton, such as by the nuisance alga *Gonyostomum semen,* are expected to increase in such lakes due to global warming. Over the last decades, *G. semen* blooms have become more frequent in Northern brownwater lakes, where they have shown potential to decrease lake net CO_2 emission. It is unclear, however, whether such an increase in primary production and autochthonous organic matter would lead to a long-term decrease in CO_2 emissions. Increased primary production would counteract emissions only if the enhanced production of autochthonous organic matter to a significant extent results in a carbon sink, rather than being respired. To determine whether the sedimentation and burial of organic matter from *G. semen* blooms can affect the contribution of brownwater lakes to atmospheric CO_2, we captured organic material in sedimentation traps in two Swedish brownwater lakes in summer 2020, measured lake CO_2 concentrations and monitored *G. semen* biomass via quantitative PCR (qPCR). If *G. semen* blooms affect CO_2 in those lakes, we expect CO_2 concentrations to decrease during blooms and increase again once the blooms are over. Analyzing the trap contents for particulate organic carbon (POC), chlorophyll and ^{13}C will let us link organic matter sedimentation rates to*G. semen* blooms, providing insight into whether these blooms end up in the sediment or are respired by bacteria in the water column.

ON319

Integrating lake modeling and paleolimnological records for improving long-term simulations of water quality in a deep peri-alpine lake

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Numerical process-based lake models are powerful tools to simulate the dynamic of aquatic ecosystems and to investigate the future of lakes. In this regard, one-dimensional models have been widely implemented over the last years, but most of these models are calibrated and validated against short limnological records, potentially limiting the robustness in long-term reconstructions of future scenarios. The present study performs long-term simulations from 1850 to 2100 to investigate the temporal evolution of the ecological dynamic and water quality in a deep perialpine lake, Lake Annecy (France). The one-dimensional General Lake Model is coupled to the Aquatic EcoDynamics library (GLM-AED2) to simulate dissolved oxygen, nutrients, and chlorophyll-a concentrations along the water column. Pluri-decadal series of limnological data monthly collected by the French Observatoire des LAcs (OLA) are used to calibrate and validate the model. In addition, model outputs are further validated with published paleolimnological records of oxygen conditions and primary productivity for the past 300 years. The integration of one-dimensional lake model and paleolimnological records supports a deeper understanding of the temporal evolution of water quality in the lake by providing more robust long-term forecast simulations.

ON435

Solutions for existing and future challenges in water governance

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A multitude of human induced pressures lead to deterioration of surface water status through conditions of anoxia, eutrophication, pollution, resource depletion, among others. This limits availability of good quality water for both human use and ecosystem functioning. Elevated water scarcity leads to severe competition and potentially conflicts among water uses and users. Climatic and socioeconomic changes will most likely exacerbate the water crisis. Therefore, there is need to have proactive measures to counter the crisis. Effective water governance strategies can mitigate water crisis and guarantee sustainable water use and ecosystem health. Such strategies can be developed and implemented through effective resource monitoring and modelling. In this study, we aim at developing an adaptive water governance framework that can be used to support sustainable water-use and ecosystem health. The study is piloted at the Möhne reservoir and its catchment in the North Rhine-Westphalia state, Germany. This case study represents a multi-decadal time machine for hydro-climatic changes, socioeconomic dynamics and water governance by the Ruhrverband.
A multi-decadal trend analysis of the hydro-climatic and nutrient variables in the inflows and outflows of the reservoir enables us understand how the water quality and quantity has changed over time. Based on the trend analysis, we explore the main drivers and implications for effective management of the reservoir and its catchment.

ON300

Microalgal community in the plastisphere across an environmental gradient: results of a mesocosm experiment

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Plastic debris represents a new habitat for rafting organisms to the point that the term “plastisphere” was coined to define the diverse community growing on the surface of plastic debris. The presence of epiplastic microalgae within the plastispshere has been repeatedly documented, but data about this process are still scarce, especially for freshwater ecosystems. Here, our goal was to evaluate the biomass development of microalgae on microplastics and evaluate whether plastic surfaces exert a strong enough selection to drive species sorting, overcoming other niche-defining factors. We added microplastic pellets of high-density polyethylene (HDPE), polyethylene terephthalate (PET) and a mix of the two polymers in 15 mesocosms of 5 different locations of the Iberian Peninsula and after one month we evaluated species composition and biomass of microalgae developed on plastic surfaces. Our findings revealed that plastic colonization occurs across a broad geographical gradient and under a variety of environmental conditions. We found that microalgae biomass changed depending on the polymer considered, with PET substrate supporting more biomass than HDPE. Microplastics promoted the development of a diverse community of microalgae (242 species), with several cosmopolite species. However, we did not observe species-specificity in the colonization of the different plastic polymers. The determinant factor defying community diversity seems to be the local species pool and nutrient content rather than polymeric composition. We demonstrated that numerous species may persist on the surface of small plastic items, demonstrating how microplastics may have significant carrying capacity, with potential consequences for the wider ecological context.

ON136

AQUACOSM-plus: an open international network for aquatic mesocosm facilities supporting experimental ecosystem studies across the marine/freshwater divide

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Human impact on the environment manifests in rapidly changing the state of marine and freshwater ecosystems around the globe. We argue that to better understand the mechanisms underlying the observed trajectories, a combination of long-term data coupled with ecosystem-scale experiments, will yield more comprehensive data that enable us to gain mechanistic understanding and develop predictive concepts. While knowledge on ecosystem processes increases, the need for active mitigation increases faster. Thus, testing environmental engineering and nature-based solutions, is mandatory. Mesocosms are excellent tools for this. However, the access to such tools is still limited for most systems. One reason is the need for substantial technical investments and know-how to experimentally study ecosystems on adequate scales.
We therefore present open opportunities in the EU-funded research infrastructure project**AQUACOSM-plus** (**www.aquacosm.eu**, 2020-2024) that aims to mitigate that problem. **AQUACOSM-plus** offers >13.000 days of access to > 60 mesocosm facilities across the EU and UK and is linked to world-wide cooperation through the **MESOCOSM.EU** virtual network. This networkcomprises mesocosm facilities in rivers, ponds, lakes, estuaries and marine systems – offering unique opportunities to conduct ecosystem-scale experimental studies of relevance to a range of environmental forcing. The AQUACOSM-plus RI thus allows mechanistic studies to test models based on long-term observations as well as to test environmental engineering concepts and nature-based solutions - to enable active management of aquatic (eco)systems. Finally, we present how to access our facilities and technological solutions increasing opportunities for relevant scenario-testing by the scientific community at large.

ON255

Relief of phosphate limitation stimulates methane oxidation

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Aquatic ecosystems such as shallow lakes and wetlands are important emitters of the greenhouse gas methane (CH_4). Increased phosphorus (P) loading is expected to increase CH_4 production in these ecosystems. This increased CH_4 production can potentially be mitigated by increased CH_4 oxidation, but how P availability affects methane-oxidizing bacterial (MOB) community composition and potential CH_4 oxidation remains to be tested. Here, we incubated MOB from sediments of four subtropical lakes of different trophic states for seven days at different phosphate (PO_4^{3-}) concentrations to determine the effects of P on MOB community composition and potential CH_4 oxidation. We measured CH_4 consumption daily and compared CH_4 oxidation during the exponential growth phase. Furthermore, we determined MOB community composition at the end of the incubations using qPCR of the *pmoA* gene. To test for differences in N and P uptake, we determined bacterial biomass N and P content. We found that increases in PO_4^{3-} concentrations until 10 µM significantly increased CH_4 oxidation. PO_4^{3-} also increased bacterial biomass P content, while N content was not affected. MOB community composition was not affected by PO_4^{3-} but more strongly correlated to lake of origin, likely due to the short duration of the incubations. Our results show that PO_4^{3-} can not only stimulate CH_4 oxidation indirectly through increased CH_4 production, but also directly by increasing MOB growth. Importantly, these effects only occur at low PO_4^{3-} concentrations, indicating that at high nutrient loads the increased CH_4 oxidation will likely not mitigate the increased CH_4 production.

ON389

Wetlands in a future climate: How will drier summers affect wetland nitrogen removal?

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Wetland nitrogen (N) removal is temperature dependent and therefore generally highest during summer in the northern temperate zone. However, climate change scenarios predict more frequent summer droughts in these regions, resulting in lowered N transports during summer to wetlands created for interception of agricultural runoff. This may adversely affect annual wetland N removal, thus reducing the mitigative effects wetlands have on eutrophication. In this study, continuous flow-proportional sampling was performed in six agricultural wetlands located on the east coast, and three on the west coast, of southern Sweden. These two regions represent different climate conditions, where precipitation is lower and summer temperatures are higher on the east coast. Our results showed a pronounced no-flow period during summer in east coast wetlands, but not in west coast wetlands. No-flow periods only decreased N load and removal rate during summer but had no effect on annual N removal. Annual N removal was instead best explained by multiple regression with annual N load and hydraulic efficiency as predictors. This indicates that low wetland N removal during drier summers may be compensated by higher N removal during other seasons. A possible explanation is that annual N removal through denitrification is determined by the amount of organic carbon provided by wetland vegetation, and that organic carbon not utilized during summer, due to lack of nitrate and oxygen under no-flow conditions, will be available for denitrification during other seasons. In conclusion, climate change might not have the anticipated decreasing effect on wetland N removal.

ON144

Impact and monitoring of Land-based Salmon Aquaculture Effluents in North Patagonian streams of Southern Chile

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Chile has the second largest production of salmon worldwide (ca. 1.000.000 Ton/year & ca. 30% of global total).Early life stages are grown in land-based aquaculture facilities before smoltification and transport to marine sites. Although important in terms of provision of employment and wages in an area with low employment rates, these aquaculture facilities are typically located on pristine low order streams which they pollute through the discharge of large amounts of organic waste. This input of highly labile and mainly dissolved organic matter has a high potential to disturb stream metabolism, deteriorating water quality and generating stress in fluvial ecosystems. However, although impacts are likely significant, there has been little study of the fate and impacts of dissolved organic matter pollution from this key aspect of aquaculture in northern Patagonia. This presentation aims to give an overview on the impact of land-based salmon aquaculture facilities on receiving waters and explore potential monitoring improvements. We measured nutrient concentrations, discharge as well as DOM quantity and quality via fluorescence spectroscopy in natural and effluent waters associated with aquaculture facilities. Furthermore, results of isotopic analysis of dissolved organic matter (SPE-DOM) d13C and d15N, obtained from aquatic matrices coming from effluents of these fish farms. Protein-like fluorescence was a good predictor of N and P in effluents, We suggest that monitoring effluents for optical and physiochemical parameters using continuous in-situ sensors could improve estimates of aquaculture-derived nutrients delivered to Chile's inland waters.
Funding: Fondecyt 1200205, Fulbright Chile

ON245

Molecular analysis reveals changes in species composition, explaining a reduction in *Microcystis* bloom toxicity in response to an increase in lake water temperature

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Cyanobacteria are notorious for producing water blooms and for toxin formation. In many cases, such blooms are dominated by toxic *Microcystis* sp. that produce a family of structurally similar hepatotoxins, known as microcystins (MCs). Here we present a retrospective analysis of *Microcystis* seasonal blooms from Lake Kinneret (Sea of Galilee, Israel) using a combination of molecular tools and chemical analysis. We demonstrate that the *Microcystis* bloom episodes are composed of a population of at least 25 different genotypes and two different chemo-types, whose relative abundance changes over decades. Based on a long-term record of biotic and abiotic parameters and laboratory experiments we propose that minor increase in water temperature, but not in salinity, may affect *Microcystis* community structure by changing the relative abundance of species/strains from toxic to less or non-toxic species.

ON002

Decades of warming alters maturation and reproductive investment in fish

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How can warming affect maturation and reproductive investment in ectotherms? Here, we compare age- and size at maturation and reproductive investment between a heated Baltic Sea Eurasian perch (*Perca fluviatilis*) population and a control population in natural water temperature by estimating their probabilistic maturation reaction norms (PMRN) and gonado-somatic index (GSI) over an intergenerational timescale. We found that fish mature earlier and invest more in building up their gonads in the heated area than in the natural temperature area. Using the PMRN approach, we found that the effect of warming on these traits are likely to be independent from warming induced changes in growth and the differences over multi-generations of warming suggesting possibility of warming induced evolution. This calls for further investigation into such trait changes and underpinning mechanisms for better population dynamics forecast and management adaptation in face of climate change.

ON216

A simple model for predicting oxygen depletion of Lakes under Climate Change

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Climate change and its implications on the interactions between meteorological factors and freshwater resources is increasingly becoming a fundamental focus in global water studies. Aquatic systems and their ecological processes are largely influenced by meteorological characteristics of their regions. Thermal structures of lakes and reservoirs display the significance of meteorology, with projected increases in temperatures set to initiate chains of ecological processes that will negatively affect water quality in the long run. One major target variable of climate induced water quality changes is dissolved oxygen (DO) levels in stratifying lakes whose depletion leads to unwanted hypoxic and anoxic states. However, predicting oxygen dynamics is difficult, with in situ oxygen depletion rates showing considerable variability depending on the lake, but also due to there being different modes of action at play. For example, climate change induced warming leads to extended stratification periods but can also induce increasing hypolimnion temperatures, resulting in linear and exponential scales of DO depletion, respectively. By reviewing DO depletion rates from different empirical studies, we refine the range of typical DO depletion rates and analyse their sensitivity against temperature in order to broaden their usage to lakes in different climates or with differing morphologies. By exploring the effects from increases in water temperatures and the extension of stratification duration on DO depletion dynamics we develop a simple model for predicting anoxia risks. Furthermore, we explore oxygen dynamics in a coupled physical-ecological lake model in order to exemplify and test the predictions from the simple model.

ON220

Bulking phytoplankton: under-ice nutrient status

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Winter, historically a largely un-monitored season, is important and changing. Our ability to forecast climate change impacts is hindered by our limited understanding of what happens under the ice. For most, the bulking phase occurs in winter; ensuring optimum fitness at the peak of competition in the spring and early summer. Here, we evaluate if year-round phytoplankton populations are constrained by light, phosphorus (P), nitrogen (N), or a combination thereof. We assess proximate physiological deficiencies of phytoplankton communities in dimictic water bodies, paying particular attention to the under-ice communities. Our seven study systems range from hypereutrophic prairie potholes to mesotrophic large lakes and reservoirs, representing a range in trophic status. Phytoplankton light and nutrient status are assessed using a suite of deficiency indicators, including mixed layer irradiance, P and N stoichiometry and debts, alkaline phosphatase activity, P turnover time, and nutrient addition photosynthetic efficiency experiments. Our results demonstrate that nutrient deficiency of phytoplankton communities is uncommon during the winter and shoulder seasons. This study reveals further insights into the importance of under-ice nutrient status of phytoplankton communities on year-round processes in a changing climate.

ON358

Different nutrient and light scenarios in human impacted shallow lakes host persistent cyanobacterial harmful blooms

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Cyanobacteria Harmful Blooms impair the nutrient enriched, turbid and polymictic shallow lakes spread along the Central Plains of Argentina. A 3-year research indicated that the structure and dynamics of cyanobacterial assemblages driving to bloom prevalence were more prone to be affected by light conditions, nutrient concentrations and water level fluctuations, than by temperature variations. The effect of seasonal temperature was subordinated to the light conditions (highly affected by water level fluctuations) and nutrient concentrations. Species composition and biovolume changed across a gradient of resources and conditions determining unique scenarios in each individual lake. Even the high P lakes differed in the structure and dynamics of their assemblages due to the influence of water depth on inorganic turbidity. Anyhow, the saturating relationship between cyanobacterial biovolume and TP suggested limitation by nitrogen, as increased TKN:TP were related to lakes with highest cyanobacteria biovolume or to peaks of N-fixers and non-fixers in others. The overall responses of taxa to the main drivers responsible for CyanoHABs differed according to the scale used for the analysis: i) at a regional scale *Raphidiopsis, Sphaerospermopsis*and *Anabaenopsis*occurred at lower transparencies and in individual lakes growth was promoted after temporary decreases of inorganic seston; ii) despite pulses of pico-sized cell colonies were observed under poor light conditions in individual lakes, they bloomed in the more transparent waters from other water bodies. The relationship with TP was quite similar at the lake and regional scales, evidencing the preference of *P. agardhii, Microcystis*and *Anabaenopsis*for high P lakes.

ON036

Retrieval of Inherent Optical Properties from Multiple Aquatic Systems using a Quasi-Analytical Algorithm for Several Water Types

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The estimation of inherent optical properties (IOPs) from remote sensing measurements is important for the establishment of a physically meaningful relationship to retrieve water quality parameters. However, remote sensing algorithms for the retrieval of IOPs are only reliable at specific study sites. In this context, the primary goal of the present study is to evaluate the use of the proposed single algorithm formulation for the retrieval of IOPs in different inland waters. The secondary goal is to examine the performance of the proposed formulation for different optical water types. The proposed algorithm single algorithm formulation got a normalized Root Mean Square Error (nRMSE) ranging from 4 to 28% for the estimation of the absorption coefficient of colored dissolved matter (a_{CDM}). For the estimation of the absorption coefficient of phytoplankton (a_{phy}) the proposed algorithm got nRMSE values ranging from 10 to 42% for 487 sampling points from 7 different aquatic systems. These results indicate

the possibility of retrieving the absorption coefficients of phytoplankton and colored dissolved matter from different aquatic environments. Therefore, the proposed algorithm can be the first step for a global estimation of IOPs which is important for understanding biogeochemical processes on inland waters.

ON149

A calibrated, simple model for predicting pelagic primary production in lakes from inflow nutrient loads, lake size, and water residence time

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A recently proposed model (hereafter the GPP limitation model) describes variation in pelagic primary productivity based on the carbon-nutrient stoichiometry of the hydrologic inputs to the lake, the chromophoricity of organic matter inputs, and other factors that interact with water color to determine the light climate experienced by phytoplankton. Here, we confront this model with data on pelagic primary production (GPP) from 58 lakes in the Global Lake Ecological Observatory Network. Lakes span diverse hydrologic and landscape settings across 11 countries and 4 continents. We first compared empirical GPP estimates to predictions generated with the default parameterization of the GPP limitation model. We then calibrated the GPP limitation model using a subset of 18 lakes with measured nutrient loads via maximum likelihood estimation. We found moderate levels of agreement between the two approaches. Lake GPP was well predicted overall, but the predictive ability was strongest in lakes with total phosphorus (P) concentrations less than 50 ug L^{-1}, where underestimations may be related to internal P loading from anoxic sediments that are not represented in the GPP limitation model. Overall, we show the utility of this process-based model to predict GPP from a small number of easily measured variables (nutrient inflows, lake size, hydrologic residence time). The validation and calibration of this GPP limitation model will enable limnologists to dig deeper into the mechanisms underpinning variation in lake production across broad spatial scales.

ON369

Changes in the quality of subsidies affect the functions of riparian ecosystem

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Empirical researches demonstrate that cross-ecosystem subsidies can have consequences for recipient ecosystems. These subsidies often vary in quality relative to local resources. Ecological theories have been proposed as a tool to identify the mechanisms of the effects of subsidies on recipient ecosystems. However, existing theories implicitly assumed equal quality of subsidies and local resources. In this study, we derive a novel ecosystem model that incorporates differential quality of subsidies and local resources. We applied our model to study how changes in the quality of subsidies affect transient dynamics and functions of the recipient ecosystem using a riparian ecosystem subsidized by emergent aquatic insects as a case study. We predict that an increase in the quality (long-chain omega-3 PUFA) of emergent aquatic insects had a positive impact on the stock of riparian plants and predators but a negative impact on the stock of riparian nutrients and herbivores. The positive effects on plants and predators are due to an increase in production and ecological efficiency of the plants and predators, while the negative effect on herbivores is due to a reduction in production and ecological efficiency of herbivores. Overall, the production, ecological efficiency, and recycling of the riparian ecosystem increase with the increasing quality of emergent aquatic insects. In an attempt to parameterize our model, we identified that the quantitative relationship between consumer fitness and long-chain omega-3 PUFA is missing. Empiricists can also use our theories by; testing the predictions, adopting the framework, or using the mathematical equations.

ON398

Kairomone diversity in fish-induced phenotypic plasticity of *Daphnia lumholtzi*

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The zooplankton species *Daphnia lumholtzi* is notoriously famous for spectacular morphological structures featuring very long head and tail spines, and for having a strong potential to invade new habitats. Originating from tropical and subtropical lakes of Africa, Asia, and Australia, *D. lumholtzi*successfully invaded lakes in North and South America. One important factor for the invasion success of *D. lumholtzi* is their effective defence against fish predation based on phenotypically plastic morphological changes. In response to chemical cues released by fish predators, animals can extend their head and tail spines, which serve as an effective protection against fish predation. A recently identified kairomone, the fish bile salt 5α-cyprinol sulfate, is also able to induce morphological defences in *D. lumholtzi*. 5α-cyprinol sulfate is an evolutionary old component of the fish digestive system and present in e.g., cyprinid fish. In contrast, fish species of the group Perciformes do not synthesize 5α-cyprinol sulfate.
As *D. lumholtzi*is known to coexist with perciform fishin natural habitats we studied if chemical cues released by these fish are also able to induce morphological defences in *D. lumholtzi* and if this defence is related to bile salts. When exposed to fish incubation water containing chemical cues of perch, *D. lumholtzi* indeed showed pronounced morphological defences, similar to the defences induced by 5α-cyprinol sulfate. However, exposing *D. lumholtzi* to perch bile did not induce the defensive response, indicating that a different, yet unknown kairomone is responsible for the defence against perch.

ON195

Freshwater salinisation induces biodiversity loss and cyanobacteria dominance in periphyton: a salinity gradient experiment in shallow lake mesocosms

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Climate- and human-driven salinisation have drastic impacts on biodiversity, functioning and services of freshwater ecosystems, particularly in (semi)arid regions. Despite the key role of primary producers, the effects of salinisation on their community thresholds remain scarcely addressed. Here, we experimentally analysed the salinity effects on periphyton (photosynthetic biofilm) in outdoor lake mesocosms (5000 L) along a gradient of 16 salinities (0-50 g/L) and identical nutrient conditions in two climatic regions in Turkey: dry-arid (Ankara) and warmer Mediterranean semi-arid (Erdemli). Each mesocosm included sediment, plankton, benthos and plants taken from lakes with different salinities and four small-sized omnivorous fish. We analysed the periphyton biomass and composition from artificial plants (similar to Elodea) placed at 20 cm-depth, for 25 days. Periphyton biomass was higher at intermediate salinities and ca. 5 times higher in colder conditions (Ankara). The composition drastically changed along the salinity gradient in both climates. At low salinities (0.5-2 g/L), desmids and filamentous green algae dominated, but rapidly decreased towards intermediate salinities, being replaced by pennate diatoms, along with an increase in Chroococcales cyanobacteria. The relative biomass of cyanobacteria increased with salinity, and filamentous cyanobacteria (*Leptolyngbya* sp. and*Lyngbya* sp.) largely dominated the periphyton at high salinities (> 30 g/L), thus decreasing the taxonomic richness. Our

results suggest that salinisation drives profound compositional changes in the periphyton and cyanobacteria dominance, with potentially drastic consequences on higher trophic levels (e.g., lower diversity of food items, toxicity), among various other ecosystem functions and services.

ON359

Session concluding discussion: Questions for research and management to develop criteria for site-specific nutrient-based mitigation of eutrophication

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Concepts differentiating nutrient limitation by uptake rates, growth rates and carrying capacity for phytoplankton biomass were developed in the 1970's and 1980's, and since then, these have guided lake and reservoir management. Do new approaches such as ecological stoichiometry and the recognition of co-limitation change this understanding? If so, what are the consequences for management? Where is restoration more effective if we focus on P, or on N, or on both? What do we need to know to set nutrient concentration targets for effective mitigation of eutrophication? Furthermore, although in some regions nutrient concentrations have declined in response to regulations and load control measures, for many waterbodies results remain far from satisfactory, in part because loads did not decline sufficiently to reduce concentrations to levels that limit phytoplankton biomass and control cyanobacterial blooms. Also however, because internal loading retards or even compromises success. What roles do nutrient loading legacies play in system responses to N and P reductions? What are the key knowledge gaps for more effective management of internal loads? During the session we intend to collect input to these questions and to use this last slot of the session to present and discuss this. Depending on the outcome we target a joint publication with conclusions that give some guidance for planning management measures to control eutrophication.

ON439

Raising the standards of limnological research and monitoring in the Philippines: The UST ZESL experience

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The unique characteristics of tropical lakes does not necessarily translate to increased studies on them. As such, initiatives to conduct long-term ecological research and monitoring are usually lacking. In the Philippines – one of the most lake-rich countries in SEA, very little is known on its lakes due to the inability of the country to keep its data gathering, management and analysis at par with other countries. Since 2016, the University of Santo Tomas has formed a group focused on the routine monitoring seven maar lakes and one dual-basin caldera lake located in the main island of Luzon. We collect monthly vertical profiles of various water quality parameters, quantify methane concentrations and document impacts of natural and human-induced limnological phenomena such as massive fish die offs and upwelling events. Results showed three mixing regimes among lakes which have similar surface areas but differing depths (shallow – polymictic; intermediate – monomictic; deep – meromictic), and identified air temperature and wind speed as key factors facilitating thermal stratification. Methane production and emission were also shown to be driven by mixing events which are in turn affected by the changing seasons. By 2018, vertical profiling of Lake Taal – was initiated, and results showed similarities between its two basins based on mixing regimes – classifying it as monomictic despite its surface area and depth. All this information contributes novel understanding to Philippine limnology. This, together with the integration of globally-accepted monitoring techniques may help in lake management and conservation, and contribute to the global understanding of tropical lakes.

ON373

Anthropogenic modifications and riparian vegetation responses in East Mediterranean rivers

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River floodplains and riparian zone are among the most sensitive ecosystems in the Mediterranean as they are significantly altered by human disturbances at basin and corridor scales, where high population densities and water scarcity aggravate pressures around water bodies. However, human manipulations and fluvial geomorphological processes led to the loss of structure and the extent of riparian habitats. Alterations in flow regime and hydromorphology are often responsible for changes in the riparian community, habitat loss, narrowing of the riparian buffer zone and loss of longitudinal connectivity. Not surprisingly, river scientists have shown increased interest in new tools and methods for quantifying the relationships between hydromorphological alteration, land cover changes, and the status of the riparian habitats. Hydromorphological modifications were assessed with the implementation of the indices of Riparian Quality and Habitat Provision, in a lowland river catchment. The riparian zone was mapped in a fixed buffer zone of 200 m and multi-temporal maps created, help to assess land cover changes occurring in the second half of 20th century. The results from the spatiotemporal analysis show that the land cover changes were associated with human interference and major socioeconomic processes occurring in the area during the study period. Moreover, human interventions have changed the riverbeds, the structural quality of riverine and alluvial habitats, increased landscape fragmentation and led to the degradation and loss of the riparian communities. Overall, the findings of this study can provide useful information towards the development of an effective management plan for the rivers of east Mediterranean.

ON428

Quantification and mitigation of greenhouse gas emissions from dredged sediments: effects of inundation and zeolite additions

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Dredging entails the physical removal of sediment from the bottom of aquatic systems to improve water quality. After dredging, the dredged material (sludge) is deposited on land for storage and possible reuse (e.g., agricultural field depots). Drying sludge may represent a substantial source of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) to the atmosphere, however little information is available on the emission intensity and the drivers of these emissions. Moreover it is increasingly necessary to develop measures capable of reducing greenhouse gas (GHG) emissions from sludge depots. Potential measures include inundation and zeolite addition. Inundation creates a barrier between sludge and the atmosphere, potentially preventing CO2 and CH4 emission, whereas zeolite has high affinity to bind cations like ammonium, reducing substrate for denitrification and, therefore, preventing N2O production. We incubated sludge in 40 aquariums, in dark and controlled room conditions. Aquariums were randomly selected to be inundated (or not) with 2cm of rainwater and different doses of zeolite (0, 1.25, 2.5, 5, and 10 kg zeolite m-3). Preliminary results indicate that, on average, drying sludge emits respectively 3, 40, and 2.5 times more CO2, CH4 and N2O compared to inundated sludge, likely due to high availability of oxygen and the venting of previously trapped gas as the sludge cracks. So far, we did not observe any effect of zeolite on N2O emissions. Our preliminary results show that emissions from sludge are substantial and that insights in drivers of emissions can contribute to the development of mitigation approaches.

ON077

The Penetration of Essential Aquatic Nutrients into Adjacent Terrestrial Habitats

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Emergent insects represent a key vector for aquatic-based nutrients to penetrate adjacent terrestrial food webs. Long-chain polyunsaturated fatty acids (LC-PUFA) have been a recent interest when quantifying the cross-ecosystem transfer of dietary nutrients. Aquatic insects contain higher LC-PUFA, such as eicosapentaenoic acid (EPA), arachidonic acid (ARA), and docosahexaenoic acid (DHA), than terrestrial insects. The importance of LC-PUFA has been demonstrated for several riparian predators (e.g., birds, bats, and spiders), thus the penetration of aquatic insects into terrestrial habitats strongly dictates the availability of these LC-PUFA in terrestrial food webs. We deployed Malaise/window hybrid traps at 8 different distances (ranging from 1 to 1000 m) from the lake shore in two different terrestrial habitats (i.e., forest and meadows) to estimate the terrestrial penetration of aquatic biomass and LC-PUFA (i.e., EPA, ARA, DHA). Terrestrial insect biomass did not differ with distance from the lake, but aquatic biomass decreased with distance from lake shore in both habitats at differing rates with the majority of aquatic biomass diminishing by 10 m from the shoreline. Our dataset provides order-level aquatic and terrestrial insect abundance along a distance gradient and demonstrates that physiologically-important aquatic-derived LC-PUFA are only available for terrestrial predators within a few meters of a lakeshore, highlighting the importance of riparian zones for terrestrial food webs.

ON343

Impacts of an invasive omnivore shrimp on plankton communities: a mesocosm experiment from a food web perspective

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Limnomysis benedeni (Mysida) is a widespread aquatic invasive species in Europe, yet little information is known about its trophic role in the aquatic community. For Mysida species, short-term experimental and field studies have reported selective zooplanktivory with a preference towards Cladocera, especially herbivore *Daphnia* species. This suggests that Mysida species may alter food web structure resulting in trophic cascades. We conducted a mesocosm experiment to test the community impact of *L. benedeni*in Copepoda-dominated vs Cladocera-dominated natural communities obtained from Lake Balaton, Hungary. The mesocosms were monitored for two weeks for abiotic and biotic variables (including temperature, nutrients, chl-*a* concentration, biomass of main zooplankton functional groups). We found that predation by *L. benedeni* reduced Cladocera biomass in the Cladocera-dominated mesocosms, but had no effect on the Copepoda-dominated zooplankton communities. We did not find any evidence of *L. benedeni* grazing on phytoplankton. We also found that after depleting Cladocera biomass, *L. benedeni* reduced Rotifera biomass in the Cladocera-dominated treatments, indicating switching between prey resources. We conclude that the trophic impact of *L. benedeni* depends on the community composition and can alter planktonic food web structure, but only in Cladocera-dominated communities. We will also discuss the relevance of our results in a theoretical food web context, specifically why the probability of trophic cascades is reduced through omnivory.

ON083

Modelling the dynamics of phytoplankton and zooplankton in a temperate stratified reservoir

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Modelling phytoplankton and zooplankton in temperate freshwater ecosystems is challenging because their biomass depends on complex and seasonally changing environmental variables, such as light, temperature, mixing conditions and nutrients. In this study, CE-QUAL-W2, a two-dimensional hydrodynamic-water quality model, was used to simulate four fluorometrically defined phytoplankton groups (chlorophytes, cryptophytes, cyanophytes and diatoms) and two groups of zooplankton (herbivorous cladocerans, partially carnivorous copepods) in the meso-eutrophic Římov Reservoir (Czech Republic) over a 20-year period. The sensitivity analysis of the model showed that the most sensitive parameters include growth rates, temperature preferences, nutrient uptake and stoichiometry of phytoplankton and zooplankton grazing. The manually calibrated model achieved satisfactory agreement of chemical (nutrients, dissolved oxygen) and physical (temperature) variables with observed data and reasonable agreement of seasonal dynamics of phyto- and zooplankton. A scenario analysis for testing increased phosphorus loading, elevated temperature, or zooplankton grazing effects revealed that: (1) the modelled total phytoplankton increased in proportionally to the increased phosphorus loading; (2) phytoplankton biomass increased at elevated temperature due to better nutrient utilization and a longer growing season; (3) increased zooplankton grazing slightly reduced total phytoplankton biomass due to a large reduction in grazable cryptophytes, which was mostly compensated for by increase of diatoms and cyanophytes. Overall, this study provides insight into the response of phytoplankton to environmental change and zooplankton grazing and may help in management strategies to reduce phytoplankton biomass and improve water quality under the ongoing climate change.

ON424

The full carbon balance of an urban pond

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It is well established that small, constructed ponds can be large sources of greenhouse gas (GHG) emissions, and that they can simultaneously accumulate sediment carbon at high rates. However, few studies have measured both processes to calculate the net carbon/GHG balance of constructed ponds. This information is key to understanding whether these waterbodies are “good” or “bad” for the climate. Furthermore, the spatial variability in GHGs, and what drives them, remains unclear. Here, we present the findings from a study of a small (1300m^2), eutrophic, urban pond in hemi-boreal Sweden. Carbon burial was 62 g m^{-2} yr^{-1}, whilst diffusive GHG emissions measured during the ice-free season were 33 g CH_4-C m^{-2} yr^{-1} and 150 g CO_2-C m^{-2} yr^{-1} – thus, the pond is a carbon and GHG source. Ongoing measurements of ebullition at 18 points within the pond show that this is the dominant pathway for CH_4 release and comprised 80% + of total CH_4 emission during autumn 2021. Thus, diffusive flux measurements alone will lead to large underestimates of annual emissions. During winter 2021/2022 the pond was ice-covered for five months, but under-ice CH_4 accumulation was low, likely because high phosphorus concentrations stimulated high rates of methanotrophy. Concentrations of total nitrogen are high, but inorganic nitrogen concentrations are low, and so the pond is undersaturated in N_2O. Analyses of sediment and water samples for microbial activity and potential extracellular enzyme activities are underway, and will provide detailed information into the processes driving the pond's biogeochemistry.

ON396

Climatic features or vegetation structure? Which of these factors is more decisive for phytoplankton communities in temperate lakes?

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This study compares the composition and biomass of phytoplankton assemblages in two types of lakes with abundant vegetation dominated by charophytes (*Chara*-lakes) and angiosperms (*Potamogeton*-lakes). These two groups of submerged macrophytes effectively control the phytoplankton abundance and composition in lakes but differ in the feedback mechanisms of the macrophyte-phytoplankton interplay. Despite increasing interest, the phytoplankton development in charophyte- and angiosperm-dominated lakes under different climatic circumstances remains poorly recognized. Therefore, each type of lakes was studied in two distant (> 500 km apart) western (warmer) and north-eastern (cooler), regions of Poland, characterized by distinctly different climatic influences, with temperature differences corresponding to the predicted magnitude of the global warming-related temperature rise. In addition to the seasonal dynamics of phytoplankton, macrophytes and climatic conditions, water chemistry and the use of land in the catchment area were analyzed. Twelve lakes were selected for this study, three *Chara*- and three *Potamogeton*-lakes in each region. Although we expected that climatic differences would have a greater impact on the structure of phytoplankton assemblage than that expected due to higher macrophyte biomass and lower nutrient availability in *Chara*- than in *Potamogeton*-lakes, multidimensional statistical analyses clearly distinguished between the two macrophyte types of lakes. Significantly lower values of the total phytoplankton biomass and the biomass of diatoms and cyanobacteria occurred in *Chara*- vs.*Potamogeton*-lakes. The taxonomic richness of phytoplankton assemblages, however, was higher in cooler NE than warmer W Polish lakes.
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ON093

A Bayesian network model to support river management for improved ecosystem services

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Rivers are a key part of the global hydrological cycle and a vital conduit of water resources, but anthropogenic pressures can diminish this resource. Linking pressures with ecosystem services is challenging because the processes interconnecting the physico-chemical, biological and social elements are usually captured using different methods. We modelled a diverse set of aquatic ecosystem services against human pressures using a Bayesian belief network (BBN) model based on weighted evidence from an expert workshop, non-linear data analyses, legislation and literature. We then applied the BBN to three case study catchments in Ireland to demonstrate the implications of changes in stressor levels for ecosystem services in different settings. Deficiency of riparian shading was identified as a prevalent and strong influence, which should be addressed to benefit a broad range of societal benefits. Sediment load interacted synergistically with organic matter and phosphate; tackling them simultaneously can yield additional societal benefits compared to the sum of their individual influences, which highlights the value of integrated management. The prevalence and ecosystem-service impacts of the individual land-use-related stressors varied among the three case study catchments, which emphasises the importance of considering context-dependencies in environmental management. Four out of the seven significant relationships were non-linear, highlighting that non-linearity is common in ecosystems, but frequently oversimplified in environmental modelling. Our BBN forms the 'backbone' of a decision support tool for integration of ecosystem services considerations into river management.

ON400

Cations as promoters of the self-assembly of dissolved organic matter into particles in lakes

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Spontaneous self-assembly of dissolved organic matter (DOM) polymers increases its size, eventually forming particulate organic matter (POM). This conversion has consequences for the carbon transfer through microbial food webs and export to sediments. Polymeric assembly occurs when the inter-polymer or inter-colloid distances allow chemical (covalent) or physical (e.g., electrostatic, hydrogen) bonds. Polymer and colloid networks depend on pH, ionic composition, and dielectric properties of the solvent. Here we performed sequential experiments to explore the underlying mechanisms of self-assembly using lake waters with different DOM and cation concentrations. We also manipulated the solvent conditions by the chelation and addition of calcium and iron. To determine polymer size, we used homodyne dynamic laser scattering. First, we tested if lake DOM polymers self-assemble spontaneously. Subsequently, we provoked polymer disaggregation by cation chelation, providing evidence that polymeric matrices were electrostatic-bond-stabilized. The cations calcium and iron were promoters of DOM self-assembly, and their chelation disaggregates POM into DOM. The dissolved-particulate interchanges mediated by iron were less dynamics than those mediated by calcium. A fact possibly related to different iron species. These findings improve our understanding of the DOM-POM dynamics, their interactions with iron and calcium, and potential role in carbon export and further long-term sequestration in the lake sediments.

ON203

Shedding light on zooplankton diversity from the Congo River Basin

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The Congo River Basin is the second largest in the world, and its plankton biota remains completely unknown. We studied the zooplankton diversity across 1700 km of the main channel (from the cities of Kisangani to Kinshasa) and subsequently in the mouths of the 25 largest tributaries during 2013 (N=39), and across 500 km of Kasai-Kwa River and tributaries in 2015 (N=25). We recorded 135 zooplankton species (26 for Testate Amoebae, 56 for Rotifera, 27 for Cladocera and 26 for Copepoda). At least five cladoceran and four copepod species are new. A non-metric multidimensional statistical analysis with Bray Curtis dissimilarity revealed that the zooplankton composition within Congo main channel was more similar than within the mouths of several tributaries and the Kasai-Kwa River basin. In the later, the tributaries were distinct from each other and from the main channel of Kasai River. A distance-based redundancy analysis using Bray-Curtis dissimilarity on abundance data revealed two main groups of species and limnological variables, one comprising sites with high total suspended matter, conductivity, chlorophyll, phytoplankton

abundance (white water rivers), and other with sites with high transparency and dissolved organic carbon concentration (black water rivers). Zooplankton diversity was uniform in the Congo main channel and in the Kasai-Kwa River, with low difference among sites. There was also a distinct third group, unrelated to variables. This study reveals a high diverse zooplankton community in the Congo basin, with new species and distinct community between the studied rivers, but homogeneous along each one.

ON412

The effect of riparian forest on landscape connectivity for the EPT community across European biogeographical regions

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EPTs (Ephemeroptera, Plecoptera and Trichoptera) are three orders of freshwater insects with a short terrestrial adult life-stage that they use to disperse by flying upstream. This aerial dispersion can be assisted by riparian vegetation through different mechanisms (by increasing humidity and refuge availability or changing light polarization). In temperate regions native deciduous riparian forest can increase connectivity for EPTs, while coniferous and non-native forest can act as a dispersion barrier (Peredo Arce et al. unpublished). While the role of riparian forest on EPT dispersion is still not deeply studied, differences between regions have never been explored.
In this study we compare ~200 sites located in the Continental (Middle-Rhine, Germany), Alpine (Tirol, Austria and Italy) and Mediterranean (Mondego, Portugal) biogeographical European regions. In each site we use EPT surveys to calculate the dispersion capacity of the EPT community using the Species Flying Propensity (Sarremejane et al. 2017). The predictors for the dispersion capacity are the percentage of riparian woody vegetation (10 km long by 10 m wide riparian buffer) and several environmental stressors as saprobic pollution, site naturalness or catchment degradation. Finally, we compare the significance, sign and magnitude of the effect of riparian forest on the dispersion capacity across the three regions.
In the Continental region we found that riparian forest enhances EPT dispersion in mountain but not in lowland streams. We expect to find a positive effect of the forest in the other regions, but of different magnitude given their particularities and their different pool of EPT species.

ON069

From alkalinity to CO_2: the forgotten half of lakes' carbon cycle

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Alkalinity supplied by catchment weathering is seen as a primary reason lakes might end up supersaturated with CO_2. Yet the underlying mechanisms tying alkalinity to surface CO_2 concentrations remain unclear. A blatant illustration is the inaccuracy of the current generation of water quality models in reproducing the surface CO_2 concentrations of Lake Geneva, a moderately alkaline lake in which >95% of the carbon is present as bicarbonates. Indeed, Lake Geneva, the largest lake in Western Europe, emits annually as much CO_2 to the atmosphere as all the cars circulating in the second biggest city on its shore (Lausanne). However, SIMSTRAT-AED2 simulates the lake as a CO_2 sink rather than a CO_2 source to the atmosphere.
Combining remote sensing observations with in-situ data, we show that the carbon cycle of Lake Geneva is dominated by the bicarbonate biogeochemistry, including calcite precipitation and dissolution, a mechanism unaccounted for in most lake carbon models. We use high-frequency measurements of carbonate species to constrain and parametrise the calcite cycle in lake Geneva. Implementing the calcite module within the biogeochemical model succeeds in shifting simulations from a carbon sink to a carbon source, enabling to clear out the chain of processes by which alkalinity brought by the catchment supports the lake's CO_2 emissions.

ON174

Bet-hedging strategies determine daily choices in effort allocation for Nile perch fishers of Lake Victoria

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Within a resource area constrained by operational restrictions, small-scale fishers encounter substantial variability in their daily catches. This study aims to uncover biophysical factors that influence daily choices in the spatial effort allocation of Nile perch fishers in the south-eastern part of Lake Victoria, Tanzania. Questions focus on the consequences of the resource area's size and fisher's options to handle risk because of daily catch variability through a catch portfolio of sizes and species within that resource space. Gillnet and longline fishers were given a GPS and asked to log their location along with the daily catch. Three distinct gillnet and longline fishing methods were identified, all of which exhibited bet-hedging characteristics: various resource area sizes, fishing distance from the coast, and a focus on a mix of Nile perch and other species captured. The daily fishing site has no bearing on the previous day's catch success. Despite this, fishers chose mesh and hook sizes based on the usual inshore-to-offshore distributional trends of small and large Nile perch. Due to a portfolio effect, the mix of sizes and species ranges collected reduced the daily fluctuation in catch. Current mesh and landing size limits obstruct these strategies, resulting in increased individual catch variability, uncertainty, and risk, as well as recurring management disputes. Portfolio management of fished resources by compromising on mesh size regulations would make sense by allowing fishers to utilize a certain proportion of smaller mesh or hook sizes that are now illegal as part of their fishing strategies.

ON027

Species abundance models in freshwaters: Developments for fish and macroinvertebrates in a large catchment

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To preserve freshwater biodiversity, understanding how the environment shapes aquatic communities and drives the spatial distribution of species occurrences and abundances is mandatory. While current species distribution models are mainly based on presence-absence data, information on species abundances appears to be much more indicative of the status of a population (*e.g.* extinction risk, resistance and resilience to disturbances). The increasing number of studies on species abundance models shows the interest and challenge of developing such methodological approaches. However, while large datasets on a broad geographic scale with abundance data on many taxa become increasingly available, abundance models remain explored on a few species and relatively small geographic areas. We developed species abundance models for >60 taxa of fish and macroinvertebrates in the Loire catchment in France ($10^5 km^2$). We used extensive biological monitoring (>1000 sampling stations) and high-resolution environmental data (water temperature, hydraulic variables) available across the entire hydrographic network thanks to thermal and hydrological physical-based models. To overcome the difficulties classically encountered when developing species abundance models (zero-inflated distribution, data overdispersion, ...), we propose an ordinal forest approach combined with an automatic delineation of abundance classes. Abundance models for several fish species and macroinvertebrate genera on the Loire catchment will be presented. Insights and limitations of these methods will be discussed and opportunities to project species abundance distributions under different climate change scenarios will be explored to address challenges regarding potential biotic homogenization of aquatic communities and species range shifts.

ON349

Out of the Blue Comes Green: Reconstructing 1000 years of lake multi-trophic responses to anthropogenic and natural disturbances

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Understanding how lake communities have changed in response to historical disturbances, both anthropogenic and natural, is challenging as most monitoring records are short and many organisms do not leave fossil traces, thus limiting the application of traditional paleolimnological techniques. However, sedimentary ancient DNA (sedaDNA) now provides a unique opportunity to study diverse organisms from lake sediment cores. Lake Pounui is one of only a few lowland lakes in New Zealand whose catchment is still mostly in native forest. Despite this, the water quality of the lake has deteriorated markedly in the last decade, and it now experiences cyanobacterial blooms every summer. Using sedaDNA in concert with multiple metabarcoding markers (16S rRNA, 18S rRNA, rbcL/trnL) and traditional approaches such as pollen, hyperspectral and XRF scanning, we reconstructed lake biological communities and geochemical elements over the past ~1000 years, pre-dating human presence in New Zealand. The most pronounced changes in the in-lake communities occurred after European arrival (~1840s) following the partial clearing of the southern catchment and lakeshore, and introduction of European perch. Our results indicate a switch from macrophyte-dominated (*Potamogeton* and green algae) to a phytoplankton-dominated (diatom and cyanobacteria) state. Potentially toxic cyanobacterial taxa (*Dolichospermum* and *Microcystis*) arrived in the lake and gradually increased in abundance over this period. The transition from a clear, macrophyte-dominated lake to one with cyanobacterial blooms in the absence of substantial land-use changes challenges prevailing paradigms for lake water quality degradation in New Zealand.

ON066

CO_2 fluxes in a large perialpine lake: the role of near-surface stratification, circulation and biological activity disentangled by microstructure profiles

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Carbon dioxide (CO_2) fluxes between inland water bodies and the atmosphere largely contribute to the global carbon budget, hence influencing the climate system. Stimulated by ongoing climate change, in the last decades large efforts have been dedicated to i) the direct measurement of such fluxes and ii) the definition of empirical parameterizations for their quantification. Several of the existing parameterizations were traditionally based on wind speed but more recently surface renewal models based on turbulent kinetic energy dissipation rate have been proposed to account for other relevant processes (e.g., cooling-induced convection at night). Despite the advancements on this topic, understanding the interplay between the physical and biochemical processes governing CO_2 fluxes between lakes and the atmosphere still poses scientific challenges. This is particularly true in large water bodies, where complex three-dimensional processes interact at various temporal and spatial scales, questioning the assumptions underpinning gas exchange models. Here, we contribute to the understanding of such interactions with a high-resolution CO_2 flux and microstructure dataset acquired nearly weekly at the floating platform LéXPLORE (https://lexplore.info/) on a large deep lake, Lake Geneva (Switzerland-France) for one year. The dataset shows that both fine-scale near-surface stratification and persistent large-scale motions influence the rate of CO_2 exchange at the lake-atmosphere interface, thus challenging the application of existing gas flux models, which typically do not consider these aspects. The results also show the significant benefits of having access to microstructure measurements to disentangle the complex interplay between physics, biology, and gas exchanges.

ON076

Effects of aquatic micropollutants on the fatty acid transport via hemi- and holometabolous aquatic insects

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Emerging aquatic insects are important vectors for dietary nutrients such as long-chain polyunsaturated fatty acids (LC-PUFA) for riparian consumers. Aquatic micropollutants may affect the transport of these nutrients by impairing development and emergence or interfering with the fatty acid metabolism of emerging aquatic insects. Therefore, we examined effects of aquatic micropollutants (i.e., organic pesticides, metals or a biocontrol agent) on the emergence and the fatty acid (FA) profile of *Chironomus riparius* and *Cloeon dipterum*. We observed a significant reduction of emergence by up to 95%. Furthermore, we found evidence that exposure to aquatic micropollutants directly affects the FA profile of *C. riparius* with cadmium increasing saturated fatty acids (SAFA) and omega-3 PUFA by up to 35% and 55% in females and males, respectivley. In additon, our results indicate that FA profiles significantly differ with sex in *C. riparius*. Females have a higher FA content and are predominately associated with (SAFA), while males are predominately associated with PUFA. Sex-specific differences in the sensitivity towards micropollutants, as observed for copper, may thus have a meaningful impact in FA transfer. As samples of *C. dipterum* and *C. riparius* are currently being analysed, our results are preliminary, but already indicate profound direct and indirect effects of aquatic micropollutants on the transport of FA with emerging aquatic insects. Given that micropollutants become ubiquitous in the environment and LC-PUFA are mostly synthesized in the aquatic environment but are required for many physiological processes, riparian consumers appear to be particularly vulnerable to such changes.

ON152

Amazonian flood plain thermal structure stability over hydrological periods and spatial diversity: first appraisal

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Floodplains are common wetlands features of the tropical Amazon Low Basin. To assess the vertical processes occurring in their water column, we collected vertical temperature profiles at different locations for all hydrologic periods through several field missions and crossed these data with simulated hydrodynamics and meteorological datasets. Model-derived data (2D-averaged velocity, flood extend) are derived from a previously published work (Pinel et al., 2020) work which integrated remote sensing for the simulation. The analyses evidence the existence of thermal stratification and its spatio-temporal specificities. Besides the absence of permanent thermal stratification, the studied floodplain can be split: i) the “South Stream” with a seasonal deep thermocline (up to 12.04 m depth) and homogenized vertical profile during rising water, ii) the “Lake” with an upper thermocline (up to 2.10 m depth) and homogenized vertical profile during high water. For both zones, the subsurface layer is sensitive to the diurnal heating process (up to 6°C during high water in the lake). This process can modify the water column up to 2.4 m depth. Regarding the controls, seasonal detected stratification is associated with lateral contribution (cooler local tributaries). The water floodplain circulation likely remains the main key driver for explaining spatio-temporal heterogeneity of full vertical mixing. In addition, other hydrodynamics-derived parameters, such as flood extent, water depth, morphometry and fetch, also impact the diurnal heating processes. This work should have large consequences on phytoplankton bloom in the upper layer.

ON061

Planktonic blooms and fish kills as hydrodynamics proxies of Lake Tanganyika limnological cycle

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Recent phytoplanktonic blooms were detected from remote-sensing images during a 12 years period (2003-2014) at the south-east of Lake Tanganyika in April-May with interannually variable intensity. Their timing and location suggest that those are related to the relaxation of NE trade winds. Those planktonic blooms in addition to a recent bloom at the north of the lake in September 2018 (Cocquyt et al.,2021) and various recent and historical observations support the regular occurrence of Kelvin waves traveling in a clockwise direction along the shores of Lake Tanganyika. Fish kills are also observed in relation to Kelvin waves at various sites. Trade winds direction are largely unidirectional and have a cumulative impact on piling up epilimnion waters at the lake ends. In addition to the main SE trade winds that are known to be strong drivers of the limnological cycle at Lake Tanganyika (Plisnier et al, 1999), the NE trade winds appear also to have a significant impact on the limnology of this lake. An updated summary of Lake Tanganyika limnological cycle is thus proposed.

ON450

Rivalry, competition, peaceful coexistence, or ignorance: drinking water and the relationship between limnology and chemical analysis

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Since the time of Greek and Roman antiquity conceptions for the quality of water existed. Drinking water had to be clear, cold, odorless, palatable, and sometimes calcareous.
These criteria underwent some significant changes in the process of industrialization and urbanization. The question arose where and under which circumstances the quality of the water should be proofed, e.g. as raw water, in the waterworks, or streaming out of the water faucet in the households. The scientists Kolkwitz and Marsson established at the beginning of the 20th century their saprobic system, useful instrument and guideline for the evaluation of water quality in rivers, ponds, reservoirs and dams. Nevertheless, in daily practice of water control the method of chemical analysis became more and more important, and during the 20th century the possible methods became more and more precise.
To question this history of progress is the subject of the presentation. The sensory evaluation of the water sample played a major role even in the middle of the 20th century. Since that time opinions about the way to proof water quality changed and include now an assessment of water as an environmental medium. It seems that limnological methods become more important in the present tense when the regulations and conditions of the EU Water Framework directive must be satisfied. That major change has to be characterized before the background of the responsibility of several German authorities and the research work of scientists working for these, like August Friedrich Thienemann, Richard Kolkwitz and Maximilian Marsson.

ON264

Defining water quality targets for UN Sustainable Development Goals and European water policy

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Target setting is fundamental for long-term sustainable water management. The 2030 Agenda for Sustainable Development includes a goal on water and sanitation (SDG 6) with indicator 6.3.2 focusing on ambient water quality. In Europe, countries set targets (i.e. good-moderate status class thresholds) both for biological and supporting physico-chemical and hydromorphological quality elements, according to the European Water Framework Directive (WFD). In this study, we review the targets set for physico-chemical quality elements including nutrients, oxygenation, organic pollution, salinity and acidification. We first look at which parameters are used by the different countries for lakes and rivers. Then, we compare target values for the most commonly-used parameters (total phosphorus, total nitrogen, dissolved oxygen, BOD, pH, conductivity) between countries and between broad water body types. Here, we found significant variation between both types and countries. In order to test whether or not the reported target values set for these parameters are likely to support good ecological status for sensitive biological quality elements, we compile ambient concentrations for the same parameters at monitoring sites where sensitive biological quality elements are reported to be in good or high status. We show that several national target values seem too relaxed to protect good status and will need further consideration. This work provides a useful guide for countries still developing good quality targets for SDG implementation. Therefore, we finish with some thoughts on how this work on WFD targets can be linked to water quality assessment under the SDG framework.

ON048

Extreme climatic events impacts on trophic network complexity and community multidimensional stability of freshwater ecosystems

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Untangling the relationship between network complexity and ecological stability under climate change is an arduous challenge for theoretical and empirical ecology. Even more so, when considering extreme climatic events. Here, using the results of an outdoor pond mesocosm experiment, we studied the effects of extreme events (heatwaves) on the complexity of realistic freshwater ecosystems using topological and quantitative trophic network metrics. Next, we linked changes in network complexity with the investigation of four stability components (temporal stability, resistance, resilience, and recovery) of community's functional, compositional, and energy fluxes stability. We found reduction in topological network complexity to be correlated with reduction of functional and compositional resistance. However, temperature-driven increase in link-weighted network complexity increased functional and energy fluxes recovery and resilience, but at the cost of increased compositional instability. Overall, we propose an overarching approach to eviscerate the effects of climate change on multidimensional stability through the lens of network complexity, providing helpful insights for preserving ecosystems stability under climate change.

ON237

Resistance and resilience traits to drying from rivers in Europe

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Climate change is an increasingly pervasive environmental stressor, especially on freshwater habitats. Among them, intermittent rivers and ephemeral streams (IRES) are one of the most reactive and vulnerable ecosystems to climate change. The durations of dry and wet periods in IRES are being altered, which cascades onto biodiversity, ecological functions and ecosystem services provided by river networks. To concentrate efforts to understand and mitigate the effects of climate change on IRES, the DRYvER project was initiated (www.dryver.eu). Among multiple efforts, experts from 4 continents are developing a comprehensive meta-system framework to enhance our understanding of the effects of drying on river network biodiversity and ecological integrity. This includes using existing knowledge of experts, published literature and existing databases for creating a database of resistance (capacity to tolerate) and resilience (capacity to avoid and or recover) traits to cope with drying across European IRES communities. This database includes traits of bacteria, fungi, diatoms, macroinvertebrates and fish. So far, we have created a list of potential traits for all five of the mentioned biota. The approach for determining the traits between biota varies greatly, so all of the traits have their attributed explanation or rationale, as well as the coding method. While there are some shared traits between bacteria, fungi, end diatoms (e.g. biofilm production), individual approach enables us to determine the traits that have the most coverage of the group and which ones give us the most precise information on the groups ability to survive drying events.

ON147

A coupled physical-biogeochemical model of GHG dynamics for reservoirs

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We have developed a 1-D coupled physical-biogeochemical model that describes the production, transport, consumption and emission of O_2, $CO_2$and $CH_4$for reservoirs. The physical dynamics is driven by SIMSTRAT while the biogeochemical model integrates the decay of the flooded soil organic matter, its processing within the water column and its ultimate release as $CO_2$and CH_4at the reservoir surface. In addition, it estimates the partitioning of the CH4 flux between diffusive and ebullitive components, as well as the maximum depth at which bubble flux occurs. Depending on the bathymetry, geographical location and thermal stratification regime of the reservoir, our results show that the fate of the flooded organic matter can vary considerably, from CO_2 to CH_4. For hydropower reservoirs, our modelling approach also provide the optimal depth at which water should be drawn to power the turbines so as to minimize the GHG footprint of the system.

ON204

Trait dynamics reveal functional changes of a phytoplankton community during the resilient states of a regime shift

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Phytoplankton biomass shows considerable resilience to changes in phosphate concentrations in both eutrophic and oligotrophic systems. Typically, the response of phytoplankton biomass to a reduction in phosphate is delayed, and in some lakes, e.g. Lake Constance, annual mean biovolume exhibits a regime shift characterized by a resilient high biomass state at high phosphate concentrations and a rapid transition to a resilient low biomass state when phosphate concentrations decrease significantly. These observations suggest that the functional character of the phytoplankton community changes with trophic change, supporting resilience of biomass to nutrient change, whereby this adjustment to trophic change may break down during short transition times, resulting in a regime shift.
We investigate the long-term changes in phytoplankton community composition and annual mean community traits and compare these to changes in phosphate concentration and phytoplankton biomass. We show that the community mean traits are largely determined by sorting on high taxonomic levels and that this restructuring is strongly associated with the temporal phosphate gradient. Furthermore, we show that changes in community composition and mean traits exhibit compensatory dynamics in the resilient high biomass period and that the regime shift in phytoplankton biomass is associated with a synchronous change in all traits.

ON178

Non-biting midges at risk in high altitude streams of the Pyrenees

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The larvae of non-biting midges (Diptera, Chironomidae) are common in the cold stenothermic streams around the globe, with several species being associated to streams originating in glaciers and with higher abundances in the melting zone. In this study, we sampled 17 streams in the southern slope of the Pyrenees (from 1310 to 2405 m.a.s.l.) from east to west during the summer and spring. In each stream, We took samples at three sites, the first one close to the stream source and the next ones after the incorporation of a tributary. We found up to 114 larval morphotypes of Chironomidae from 5299 larvae analysed. Midges of the subfamily Orthocladiinae were the most diverse (67 taxa) and abundant (50% of the individuals). In contrast, the subfamilies Tanypodinae and Chironominae were less abundant and diverse, being *Nylotanypus dubius* and *Paracladoplema* sp. the taxa most associated with glacial streams. Finally, Diamesinae and specially the genus *Diamesa* are the larvae of Chironomidae most associated to the studied glacial streams with 40% of the individuals found in these streams. Most of the larvae from this subfamily are abundant in the sites close to the stream source, and for this reason seem the group more at risk for the rise of temperatures in the Pyrenees. We hypothesize that for some of the most common taxa (e.g. *Tvetenia calvescens*) different haplotypes may be present along the gradient west-east. Some taxa are more abundant and frequent in spring than in summer especially those of the subfamily Diamesinae.

ON050

The influence of stream and internal diffusive nutrient loads on trophogenic zone primary productivity in Lake Fryxell, Antarctica

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Permanently ice-covered Antarctic lakes are sensitive indicators of climate change. The relative role of internal diffusive and intermittent stream nutrient loads to phytoplankton demand was investigated over an 18 y period in chemically stratified Lake Fryxell as part of the McMurdo Dry Valleys Long-Term Ecological Research program. Upward diffusion of dissolved inorganic nitrogen (DIN) and soluble reactive phosphorus (SRP) across the chemocline to the trophogenic zone were relatively constant during the study period with average values of 211.17 kg DIN y^{-1} (SD = 57.01) and 38.69 kg SRP y^{-1} (SD = 9.99) yielding a mean diffusive DIN:SRP ratio of 5.5 (g:g). In contrast, annual stream DIN and SRP nutrient loads fluctuated greatly over this period owing to climate driven glacial melt rates. The mean stream DIN load was 43.59 kg DIN y^{-1} (SD = 75.87) whereas the mean stream SRP load was 14.61 kg SRP y^{-1} (SD = 16.20) yielding a mean stream DIN:SRP loading ratio of 3.0 (g:g). These results reveal the importance of upward nutrient diffusion to phytoplankton in the trophogenic zone. Phytoplankton demand for DIN and SRP within

the trophogenic zone was on average 4.8 and 3.1 times greater than combined diffusive and stream nutrient supply highlighting the importance of internal nutrient regeneration. As the McMurdo Dry Valleys continue to warm, climate driven nutrient pulses associated with elevated glacially fed stream flow will likely drive the phytoplankton towards a more N-deficient state and reduce the relative influence of internal nutrient regeneration.

ON314

Warming of surface temperature in alpine lakes and consequence for productivity

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Due to their pristine nature alpine lakes are considered most valuable. Lakes are affected by climate warming on a global scale, however compared with lakes at lower altitudes, lakes located in the alpine climatic zone are not monitored on a regular basis. In this study, plankton community composition was analyzed in 20 alpine lakes of the Niedere Tauern region (1700-2300 m a.s.l.) during 2019-2021 using metabarcoding to describe the genetic diversity of phytoplankton and to follow the (im)migration of indicative taxa. The limnological parameters were compared to measurements of lake surface water temperature (LST) which have been recorded two decades ago (1998-2003). In general lakes located at an altitude below 2000 m a.s.l. show more pronounced increases in ice-free periods (12 d (-1 – 24) <2000 m a.s.l.; 7 d (-0.5 – 13) >2000 m a.s.l). In order to determine the relationship between atmospheric variables (incl. temperature and precipitation), near-lake snow depth and observed LST, general additive models were trained with a daily temporal resolution. The model with highest fit was then used to estimate LST until 2100 under the RCP8.5 (business as usual) scenario. The average ice-free period is predicted to increase 1-1.2-fold in the near future (2030-2060) and 1-1.5-fold in the distant future (2070-2100). Primary productivity is indicated by chlorophyll a which is extrapolated via the Q10 rule during a prolonged growth period. From this estimate it is predicted that at least some of these alpine lakes currently classified as oligotrophic will become mesotrophic until the end of this century.

ON333

Stable carbon and nitrogen isotopes composition of soft-water lakes vegetation along pH gradient

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The variation in stable isotopes composition of aquatic vegetation is related to 1) pH of water for carbon ($\delta^{13}C$) (HCO_3^-enrichedby 7-12‰ compared to CO_2); 2) a source of origin for nitrogen ($\delta^{15}N$) (organic nitrogen from wastewater enriched ~5-15‰ compared to inorganic nitrogen). Aquatic vegetation has developed different uptake ways of carbon and other nutrients, including nitrogen, necessary for development. Isoetids, take up nutrients only through root systems, while elodeids through the entire body surface. To check whether the $\delta^{13}C$ in organic matter of plants growing in a pH gradient can be used to identify the carbon source they use during the process of photosynthesis, in July 2020, we sampled 10 plant species on 14 soft-water lobelia lakes (pH gradient from 4.78 to 9.21). Furthermore, the study aimed to check if and how $\delta^{15}N$ of organic matter differs in relation to the water pH. The obtained results showed high positive relationships with $\delta^{13}C$ for elodeids: *Elodea canadensis* and *Myriophyllum alterniflorum*, which indicates that elodeids use two forms of carbon in photosynthesis ($\delta^{13}C$ along pH gradient from -9.93‰ to -21.95‰). Surprisingly, we got divergent results for isoetids: high positive relationships with $\delta^{13}C$ for *Isoëtes lacustris*andnegative moderate for *Littorella uniflora.* Furthermore, we found strong negative correlations between pH and $\delta^{13}C$ for *Fontinalis antipyretica* and no relationships for other species. In the case of $\delta^{15}N$ results, we found only positive relationships with pH for *F. antipyretica*. The studies were financed by the Polish National Science Centre, project No 2019/32/C/NZ8/00147.

ON159

Lake Lunz: First Bottom Anoxia in more than a Century of Observations

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Lake Lunz an oligotrophic, pre-alpine lake has been extensively studied since the establishment of a limnological field station on its shore in 1905. A large number of limnological studies along with continuously recorded data (surface temperature, ice-cover, water level) over a period greater than a century provide an exceptional opportunity for ecological long-term studies. Over the recent decade some profound changes could be observed in Lake Lunz. This includes changes in nutrient concentrations, fish community, macrophytes, surface temperature, ice-cover, and hypolimnetic oxygen depletion. The first oxygen profiles available in literature date back to 1912. For a whole century thereafter hypolimnetic oxygen depletion was described to be moderate with no case of bottom anoxia being reported ever. Even in the years before the installation of a sewage treatment system when the lake received domestic waste water, autumnal oxygen levels never dropped below 2mg/L. The lake has not been receiving waste water for four decades, still in recent years hypoxia was found to extend from the sediment at 33m up to 25m depth in autumn. This corresponds to 10% of the water volume and 33% of sediment surface being hypoxic.

ON242

A monitoring system for cyanobacteria in Austrian bathing waters via amplicon sequencing

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Cyanobacterial blooms are a major problem in freshwater systems as they have an impact on whole ecosystems and can cause serious health problems in humans and animals. Nevertheless, environmental factors influencing the development of cyanobacterial harmful algal blooms are not well understood. According to Article 8 of the Bathing Waters Directive (2006/7/EC), a monitoring system should be applied, to evaluate and predict potential toxin producing cyanobacteria to identify health risks at an early state. The aim of this presentation is to introduce a workflow for the surveillance of cyanobacteria in Austrian bathing waters based on Amplicon Sequencing. During the summer season of 2020 planktonic samples from 20 bathing waters were obtained and DNA was sequenced by the use of general bacterial and specific cyanobacterial 16S primers. From the sequencing data correlations between cyanobacterial read numbers, toxin concentration as well as abiotic and biotic factors were applied. The results indicate that the number of cyanobacterial reads and cyanotoxin presence were correlated mostly with water surface temperature. Furthermore, it could be demonstrated that amplicon sequencing offers great insight into the cyanobacterial community composition, evaluation of the toxin producing potential and prediction of the development of potential cyanobacterial harmful algal blooms.

ON410

Landscape determinants of benthic and pelagic primary production in northern lakes

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Global change affects key environmental drivers for gross primary production (GPP) in benthic and pelagic habitats of northern lakes by impacting catchment characteristics and lake water biogeochemistry. However, how these changes manifest and impact total (benthic+pelagic) GPP and the partitioning of GPP between these habitats („autotrophic structuring“) is unclear. Using a dataset with total GPP and autotrophic structuring of 26 shallow lakes measured in midsummer, located in Arctic, subarctic and

boreal northern Sweden, we investigate how landscape (air temperature, land cover and hydrology) properties of catchments affect aquatic biogeochemistry and GPP. We find that total GPP is mostly light limited, due to high dissolved organic carbon (DOC) concentrations originating from coniferous vegetation and wetlands, promoted by high catchment runoff. Contrarily, autotrophic structuring relates mostly to the relative size of the benthic habitat, and is further modified by CO_2 fertilization of pelagic GPP, especially in low DOC lakes. Moreover, lake CO_2 concentrations are modified by pH and the total inorganic carbon (DIC) pool, and both DIC and CO_2 are unrelated to DOC in the (sub)Arctic. This indicates high inputs of groundwater or catchment-derived DIC or CO_2, that combined with low pH in the wetland-rich subarctic results in high CO_2 concentrations. In the boreal, DOC and CO_2 are correlated, indicating that mineralization of DOC drives CO_2concentrations. Our results underline that GPP as a resource is regulated by landscape properties, and sensitive to large scale global changes (warming, hydrological intensification, recovery of acidification) that promote changes in catchment characteristics and aquatic biogeochemistry.

ON284

Infection by a eukaryotic gut parasite in wild zooplankton associates with a distinct bacterial community

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Host-associated bacterial communities (or microbiomes) play an integral role in response to environmental stressors, such as tolerance of parasites. Yet, few studies investigate tripartite interaction between a host, a parasite and host microbiomes, particularly in natural settings. We investigated such interactions using the zooplankter water flea belonging to the *Daphnia longispina* species complex and its gut parasite *Caullerya mesnili. C. mesnili* is a highly virulent, eukaryotic gut parasite that causes seasonal epidemics in*Daphnia* populations in the Swiss eutrophic lake Greifensee.
We performed two experiments using 16S amplicon sequencing to compare microbiomes associated with infected and uninfected hosts in lake Greifensee during (1) a recent natural epidemic in 2020, in the host gut and body tissue and (2) six past natural epidemics spanning 13 years (2007, 2011, 2013, 2014, 2017 and 2020), in whole individuals. Overall, our sequence data represents the microbiomes of 250 infected and 214 uninfected animals. The gut microbiomes of infected hosts showed classic community-level changes consistent with dysbiosis (decreased alpha-diversity and increased beta diversity) compared to those of uninfected hosts; and some bacterial abundance shifts also occurred in the body tissue with gut infection. Changes in host microbiomes with disease status were inconsistent, but some bacterial taxa specifically associated with infected hosts across epidemics, suggesting that diseased zooplankton offer distinct niches for aquatic microbes.
Our results show that the microbiomes of a dominant zooplankton species change during natural epidemics of a gut parasite and raise questions about the functional role of bacteria associated with infected hosts.

ON445

Interactive effects of global change and potential adaptation in freshwater zooplankton

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Freshwater zooplankton communities of ponds and lakes are essential to control phytoplankton growth and as a food source for higher trophic levels such as fish. Recent experiments have shown that several zooplankton species as well as phytoplankton communities can be variably affected by raising temperatures, reduced pH and higher dissolved pCO_2 associated with global change. However, to understand how freshwater ecosystems may respond to the combined effect of these stressors, more realistic multi-stressor tests are needed that document population and community level responses. In addition, while many species have the capability to adapt to changing environments, the adaptive potential to cope with elevated pCO_2 in freshwater organisms remains poorly understood. We investigated the responses of a natural zooplankton community to combinations of elevated pCO_2 (300 vs. 12,500 ppm) and warming (20 vs. 24 °C) in indoor microcosms. In addition, the adaptive capacity of a water flea species to deal with elevated pCO_2 was studied. We show that both elevated pCO_2 and warming can result in strong shifts in zooplankton communities and the importance of each stressor changed over time. We also found indications of adaptation to elevated pCO_2 in the studied water flea. Overall we conclude that zooplankton community composition will likely change under simultaneous warming and elevated pCO_2 which, in turn, will result in changed food-web interactions at multiple trophic levels. Although our results suggest potential for adaptation to the tested global change components, consequences for long-term demographics and trade-offs with key life-history traits remain to be explored.

ON306

Long-term acclimation might enhance the growth and competitive ability of *Microcystis aeruginosa* in warm environments

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It is frequently predicted that there is a positive effect of global warming on the growth of cyanobacteria which can have severe impacts on aquatic ecosystems. However, long-term studies targeting the potential of adaptation to higher temperatures are missing, making existing predictions of the magnitude of future cyanobacterial blooms questionable. Do cyanobacteria thrive even more in warmer environments when they are able to adapt to them? Here we examined the effect of exposing three freshwater *Microcystis aeruginosa* strains to ambient (22 °C) and increased (26 °C) temperature for six months. Then, the competitive ability of the strains was evaluated by inoculating them into a natural lake plankton community in mesocosms (one set at ambient temperatures, one set 4 °C above ambient) and analysing their impact on community composition. According to chlorophyll-*a* concentration measurement and DNA metabarcoding, the structure of eukaryotic communities was impacted by both inoculated cyanobacteria and temperature. Cyanobacterial abundance significantly increased in the cultures inoculated with one of the heat-acclimated strains as compared to the ambient-acclimated version. This strain also displayed significantly higher growth rates when heat-acclimated than when ambient-acclimated. The results of this study emphasise the high potential of cyanobacteria to adapt to stressors, and highlight the fact that previous acclimation to warming is a critical factor in shaping the overall structure of plankton communities. Our results therefore strongly advocate for including a step of culture acclimation to future experimental conditions in studies addressing effects of climate change to allow for a realistic understanding of long-term developments.

ON148

An individual-based model of *Microcystis* bloom dynamics in a shallow lake

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The cyanobacterial genus *Microcystis* commonly forms surface blooms that adversely impact aquatic ecosystems. Many modelling studies have attempted to simulate the vertical and temporal distributions of *Microcystis* colonies by using a fixed colony size whilst acknowledging that colony size has a significant effect on buoyancy and vertical distributions of populations. The aim of this study was to examine how colony size changes under different environmental conditions and how colony size impacts *Microcystis* bloom formation and collapse using a novel individual-based model (IBM). To simulate transport and mixing processes, the IBM was coupled to a three-dimensional hydrodynamic model. Based on relevant relationships from the literature,

aggregation and disaggregation of colonies influenced by turbulent dissipation, and growth rate were incorporated into the IBM. The model was applied to Forest Lake (Queensland, Australia) in the summer of 2020, when *Microcystis* concentrations calculated from phycocyanin fluorescence measurements exceeded 3.5×10^5 cells mL^{-1}. The model results were compared with in situ high-frequency observations of phycocyanin. The hydrodynamic model accurately reproduced the observed variation in water temperature and current speed. As a result, the IBM was able to capture the observed *Microcystis* colony accumulation at the water surface during diel stratification and redistribution during mixing events. It was found that including dynamic variations in colony size yielded more accurate predictions of the cyanobacteria blooms and could improve current models of colony-forming cyanobacteria.

ON296

Flow Velocity Influences Methane Emissions From Aquatic Sediments

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Inland waters are a globally important source of the greenhouse gas methane, with reservoir surfaces considered as hotspots of methane emissions. Flow velocity has been indirectly related to these higher emissions by influencing the supply and trapping of fresh sediments. However, the near-bed flow velocity also has the potential to directly affect methane production and oxidation in the sediment by controlling oxygen and methane transport into/from the sediment-water interface. The direct dependence of methane emissions from aquatic sediments on flow velocity has not been studied so far. We developed a novel experimental mesocosm system consisting of six annular flumes to fill up this knowledge gap through targeted laboratory experiments. The system allows to measure the production, consumption and transport of methane, carbon dioxide and oxygen simultaneously in the pore space, surface water and headspace for a gradient of flow velocities. We will present and discuss the novel mesocosm system and provide first insights into the importance of flow velocity for methane emissions from aquatic sediments. In particular, we will discuss the flow regimes in which methane release is dominated by diffusion or bubble-mediated transport, respectively.

ON163

Decadal water quality trends in the Finger Lakes, New York, USA

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The Finger Lakes of New York, USA, are a series of eleven glacial lakes oriented north-south in the Lake Ontario watershed. These glacial lakes are mostly deep (mean maximum depth = 63.5 m, range = 9 – 186 m) and support considerable agricultural activities, though some lakes are also largely or entirely forested in their watersheds (i.e., Honeoye Lake). All lakes have experienced aquatic invasions including by dreissenid mussels. In recent years, the frequency and intensity of harmful algal blooms (HABs) has caused widespread concern from residents to state and federal agencies. Here, we analyze a 12-year (2005-2017) dataset that investigates the changes in water quality on a monthly basis (May – September) for 8 Finger Lakes spanning oligotrophic to eutrophic conditions. We ask: (i) how do water quality parameters (e.g., Secchi depth, total phosphorus, soluble reactive phosphorus, total nitrogen, chlorophyll-a, total suspended solids, and silica) change through time? (ii) are oligotrophic lakes showing a more rapid rate of change compared to mesotrophic and eutrophic lakes? (iii) do trends mirror water quality changes in Lake Ontario over the same time period? We find dramatic decreases in water clarity across all trophic lake types, and the highest number of significant changes in epiliminetic and hypolimnetic total phosphorus, which increased across all lakes. August and September showed the greatest changes in water quality conditions compared to other months. Trends presented here provide important historical context for research investigating drivers of HABs in deep lakes.

ON397

How nitrogen and phosphorus supply to nutrient-limited phytoplankton communities affects zooplankton growth: testing stoichiometric and co-limitation theory across trophic levels

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Autotroph communities are often growth-limited by essential nutrients such as nitrogen (N) and phosphorus (P). The magnitude of limitation and whether N, P, or both are limiting growth depends on their supply and ratios. Previous studies identified single, serial or co-limitation as predominant limitation outcomes in phytoplankton communities. Little is known about consequences of such scenarios for herbivorous zooplankton and whether their growth is primarily affected by changes in phytoplankton quantity or nutritional quality. We grew a community of phytoplankton species of various food quality aspects at varying N and P concentrations resulting in three N:P ratios. At carrying capacity, N, P, both or none were added to reveal what was limiting. The rotifer *Brachionus calyciflorus* was fed the nutrient-supplied communities to investigate how changing phytoplankton biomass and community composition affect zooplankton abundance. We found phytoplankton growth being limited either singly or serially by N, altering food available for rotifers. Rotifer growth showed a different response pattern compared to phytoplankton, suggesting an effect of food quality aspects apart from food quantity. While the combined addition of N and P to phytoplankton had generally a positive effect on rotifer growth, adding non-limiting nutrients had a rather detrimental effect probably due to stoichiometrically imbalanced food in terms of nutrient excess. Our experiment shows that adding nutrients to phytoplankton communities will not always lead to increased phytoplankton and zooplankton growth, and that differences between phytoplankton and zooplankton responses under co-limiting conditions can be partly well explained by concepts of ecological stoichiometry.

ON150

Using high level validation and ensemble modelling to increase lake ecosystem model reliability

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Lake ecosystem models are an essential tool for capturing ecosystem response to climate change. However, benefits of model prediction come with considerable challenges often resulting in model inaccuracy. Our confidence in a model's ability to capture ecosystem dynamics is limited for various reasons. The current study aims to increase confidence in future scenario simulations by rigorous validation and by using a model ensemble.
A recently established four level validation framework, CSPS (Conceptual, State, Process and System validation) was adapted. The lake ecosystem model QWET was calibrated for Lake Kinneret and validated using the CSPS framework, inspecting 18 state variables, 11 processes and 15 emergent properties. Validation showed that most processes and emergent properties inspected were correctly simulated. Modifying the model to overcome weaknesses resulted in increased model reliability. This conclusion would not have been possible without the process validation.
Applying an ensemble modelling approach to a given lake system can reduce some of the inherent uncertainties in the individual model projections by conveying the mean and range of the projections. A two-model ensemble was run on 30 years of historical data, and two climate scenarios of a gradual increase in air temperature and an increase in heat wave frequencies. The use of an ensemble on the historical data resulted in improved performance for some variables and increased confidence in the scenario testing. We conclude that higher validation levels and the use of ensemble modelling are necessary to receive reliable results when running process-based lake models on future scenarios.

ON253

Aerobic methanotrophy in lakes: significance to whole-lake microbial metabolism and fluxes

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Up to the totality of the methane produced in the anoxic sediment of lakes is not emitted to the atmosphere due to the activity of methane-oxidizing bacteria (methanotrophs) in overlaying oxic waters. Methanotrophic activity and abundance are mainly controlled by methane and oxygen concentrations and water column stratification. While extensive methane oxidation happens below the thermocline in stratified lakes, lower methane oxidation rates are observed in well-oxygenated epilimnetic waters. Nevertheless, methane produced within oxic surface waters is also susceptible to microbial oxidation, and the dispute between biological and physical processes within these open waters may determine the efficiency of the microbial methane filter and subsequent methane fluxes to the atmosphere. In this talk, I will discuss the mechanisms allowing methanotrophy to be the main microbial carbon metabolism in many stratified lakes, potentially leading to a methane-centered microbial loop in these ecosystems; and how methanotrophic activity in the epilimnia of lakes can offset or not the production of methane in oxic aquatic environments. I will also explore the controls on the isotopic fractionation during methane oxidation, which is a critical term in the calculation of the extent of methane oxidation in situ and, consequently, in the estimation of oxic methane production through whole-lake methane budgets.

ON019

It more than adds up: interaction of antibiotic mixing and temperature

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Use of antibiotics for treatment and prevention of bacterial infections in human, agri- and aquaculture as well as livestock rearing leads to antibiotic pollution of fresh waters and these anti-biotics have an impact on free-living bacteria. While we know which antibiotics are most common in natural environments like rivers and streams, there is considerable uncertainty regarding antibi-otics' interactions with one another and the effect of abiotic factors like temperature. Here, we used an experimental approach to explore the effects of antibiotic identity, concentration, mixing and water temperature on the growth of Pseudomonas fluorescens, a common, ubiquitous bacterium. We exposed P. fluorescens to the four antibiotics most commonly found in surface waters (ciprofloxacin, ofloxacin, sulfamethoxazole and sulfapyridine) and investigated antibiotic interactions for single and mixed treatments at different, field-realistic temperatures. We observed an overall dependence of antibiotic potency on temperature, as temperature increased efficacy of ciprofloxacin and ofloxa-cin with their EC50 lowered by >75% with a 10˚C temperature increase. Further, we show that mix-tures of ciprofloxacin and ofloxacin, despite both belonging to the fluoroquinolone class, exhibit low-temperature-dependent synergistic effects in inhibiting bacterial growth. These findings high-light context-dependence of antibiotic efficacy. They further suggest antibiotic-specific off-target ef-fects that only affect the bacteria once they enter a certain temperature range. This has important implications as freshwater systems already contain multi-drug antibiotic cocktails and are changing temperature due to environmental warming.

ON240

Loss and erosion of microcystin genes in non-microcystin producing Microcystis botrys

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Cyanobacterial blooms in freshwater systems are often dominated by species within the genus*Microcystis*, which produce the algal toxin microcystin. Microcystin is biosynthesized by the mcy gene cluster consisting of ten modular genes (*mcy*A-J). *Microcystis*populations consist of both microcystin-producing and non microcystin-producing strains. The proportion of the two types of strains in natural populations is determined using quantitative PCR targeting one of the genes in the microcystin gene cluster (typically*mcy*A,B, D or E). However, proportions vary both temporally and spatially, and are not always correlated with microcystin levels. To better understand the underlying genotypes of producers and non-producers we sequenced the genomes of 23 strains of*Microcystis botrys*isolated from a single occasion during a bloom. At the same time, the strains were phenotyped based on microcystin variants using LC-MS/MS.As expected, the microcystin-producing strains had the full*mcy*gene cluster with all ten genes present, although some variations were found among strains. The non microcystin-producing strains displayed a range of genotypes yet with a common pattern of mostly lacking*mcy*F, G, and J. Other genes in the complex were either present or had partial hits against our custom-made microcystin gene database. We hypothesize that non microcystin-producing*Microcystis*are genotypically diverse and that genotypes vary from population to population. This implies that qPCR to quantify microcystin-producers must be custom-targeted for the population of interest.

ON278

Effect of temperature on the survivorship and fecundity of*Moina macrocopa*(Cladocera) exposed to microplastics

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Since the 1950's the production of plastics has doubled, resulting in large proportions as residues in water bodies. The effects of microplastics on aquatic organisms can be diverse, from intoxication from adsorbed chemicals to mechanical damage by direct ingestion of the fragments. These effects, combined with temperature changes, can be strong stressors to aquatic biota. The cladoceran,*Moina macrocopa*is common in tropical freshwaters. It is a generalist filter feeder, capable of consuming particles from 20 to 100 µm, which allows small particles of microplastics between 0.05 to 50 µm to be easily ingested resulting in adverse effects on the survival or reproduction. Here we evaluated the effect of 30 µm beads of polystyrene microplastics on the life cycle of*Moina macrocopa*. We exposed the neonates (<24 hours old) to a medium containing beads of polystyrene microplastics (SIGMA-ALDRICH) at 40 mg/L together with algal food (*Chlorella vulgaris*) at a density of 0.5 x 10^6cells, offered at two temperatures 20 and 25º C. Everyday data on the survivorship and reproduction were noted and test medium was replaced. In the treatments with microplastics at 20º C we observed a decrease in survivorship from the second day of the experiment. Fecundity increased in the presence of microplastics at 20ºC. At 25ºC we did not observe significant differences among treatments with the presence of microplastics and food availability. The data have been discussed with emphasis on the species specific responses of cladocerans to exposure to microplastics.

ON158

Catching up climate- and land use changes by paleolimnological methods

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Changes in climate and land-use will frequently impact loss of particles, where fine particulate matter ends up at the deeper parts of lakes. These consecutive sediment layers can provide long term trends in the sediment loads to lakes.
The current study is based on dated sediment cores from 14 lakes in south-eastern Norway, all located below the highest marine level. The lakes show a great variability in depth, size and lake to catchment ratio. They are generally surrounded by forest (28-94 %) and some mires (0,1-11,5 %), although agricultural activities also represent a significant share of the land use (0-40 %).
In the period 1900- 2020, there was great variability in the sedimentation rate between the lakes, with single lake averages varying

from 0,0009-0,1127 g $cm^{-2}yr^{-1}$. Especially, in marine clay dominated catchment with high agricultural activity, the sedimentation rates were high.
Based on Mann-Kendall trend analysis, there has been a general increase in sedimentation rate the latest 100 years (1920-2020). Especially, for the period 1920-1939 and since 2000, there has been a general increase in sedimentation rate for several lakes. However, for the period in between (1940-1980), episodic events have been more frequent, probably reflecting changes in areal use impacting the hydrological connectivity, e.g. lowering of water level to gain extra agricultural land or drainage of areas used for peat extraction.
Sediment core analyses have proven valuable for disentangling long term drivers for sediment loads, and determine links between landscapes and lakes.

ON094

New management strategies that make reservoirs more resilient against climate change

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The various consequences of climate change are meanwhile well documented for lakes and reservoirs. This includes evidence from long-term empirical data as well as impact modelling studies from single case study levels to global scales. In these studies, negative effects on water quality and ecosystem services have been well documented. This knowledge on the impacts of climate change calls for action by managers in developing and implementing adequate adaptation strategies. Limnologists often concluded that climate change has similar effects to eutrophication and that both stressors often synergistically interact. From a management perspective this implies that any strategy against eutrophication will also increase climate resilience. This talk takes up this thought and focuses on reservoir operation and management strategies that can be integrated into current practice in order to strengthen resilience against climate change. We identified the water outtake management tool for buffering heating rates and removing water of unwanted quality. With respect to external inputs, the bypassing of inflows can fulfil similar purposes. In addition to specific applications of clever withdrawal and/or bypass management, we review a list of classical lake restoration measures against eutrophication and analyse how they can contribute to increasing climate resilience of reservoirs. Particularly difficult situations will arise when there are competing interests or conflicts between the services provided by reservoirs, e.g. drinking water supply, irrigation, environmental flows or hydropower used. Therefore, water governance has to include fast reaction plans for (foreseeable) emergency situations to enable adaptive decision-making.

ON451

Aquatic ecosystem ecology: from „lake respiration“ to carbocentric limnology

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R. Lindeman's famous trophodynamics and his paper of 1942 is known to be a starting point for the development of the modern concept of ecosystem. However, at the end of the 1930s similar theoretical systems have been proposed in the USSR: Georgiy G. Vinberg's concept of biotic balance and Vladimir I. Zhadin's theory of biological productivity of water bodies. My study shows that both Lindeman's trophodynamics and Vinberg's concept of biotic balance relied on an energy-based approach in considering the wholeness of a water body. The two scientists, however, differed in several important aspects concerning the interpretation of the role of living organisms. The holistic interpretation of ecosystem by Lindeman and Vinberg can be seen as part of the dilemma between physicalism and organicism. The organismocentric approach in limnology at the turn of the 20th century was actively promoted by E. Birge and E. Naumann in his regional limnology. All early limnologists stressed the role of plankton as the original source of organic substances. For example, the Hungarian aquatic chemist R. Maucha saw a clue to solving the problem of unity between living organisms in the water body and inorganic environment in the photosynthesis of planktonic algae. Attempts to measure metabolism of water masses (by R. Maucha, A. Putter, P. Jenkin, G. Vinberg, G. Riley, and some others) have led naturally to very productive concepts of production ecology. Modern perspectives of limnology are connected with much deeper evaluation of physiological basis of production and destruction.

ON425

Greenhouse gas exchange from artificial water bodies that dominate Central Germany

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Natural lakes are largely absent from Central Germany. There, drinking water reservoirs and artificial lakes in former open-pit lignite mines dominate water bodies and vary considerably in age, morphometry, trophic state, hydrology and local climate. Artificial water bodies are susceptible to eutrophication, promoting pelagic primary production. Simultaneously, they experience large water-level fluctuations, resulting in enhanced greenhouse-gas emissions from temporary water-level decrease and drying of littoral areas. To estimate the role of these ecosystems as greenhouse gas sinks or sources, we selected five summer-stratified artificial water bodies, both reservoirs and open-pit mining lakes, to represent the major classes of regional water bodies with respect to type and trophic conditions.
We measured aquatic greenhouse gas concentrations and fluxes of CO_2, CH_4 and N_2O, using an automated floating chamber in multiple campaigns over 2 years. We have paired our observations of relevant physical and chemical water parameters with long-term (10 years) monthly monitoring data to identify dynamics and drivers of greenhouse gas accumulation and emissions.
Our preliminary results show that trophic state and redox conditions are controlling factors of greenhouse-gas production irrespective of water body class. Furthermore, our results suggest that autumn overturn dominates annual diffusive gas evasion from all study sites (medians: 1.68 mmol CO_2 m^{-2} h^{-1}, 4.86 µmol CH_4 m^{-2} h^{-1}). We will discuss, how monitoring data may be used to understand the role of these artificial water bodies in the carbon cycle and under rapidly changing conditions in regional climate.

ON199

Cell molecular bases of freshwater diatoms segregation along pH gradients: an experimental approach

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Diatoms are widely used as water quality and ecological status indicators due to their remarkable species segregation along some environmental gradients. They have been particularly successful in identifying acidification changes, both as present indicators and as proxies for past reconstructions. However, the molecular cell bases for such segregation along pH gradients in freshwater ecosystems are poorly known. Our goal was to unravel cell functions and mechanisms that may be relevant from an eco-evolutionary perspective for freshwater diatom colonization. Epilithic biofilm samples from acidic, neutral, and alkaline Pyrenean mountain lakes were cultured in artificial media, and single-cell isolations were performed to obtain diatom monocultures. Twelve strains were each cultured at pH 4.7, 7, and 8.2 independently for two weeks, monitoring their growth by measuring fluorescence. At the end, RNA was extracted and sequenced. For each strain, the transcriptome was assembled, and protein-coding transcripts were functionally annotated. After removing potential contaminants, differential expression and gene set enrichment analyses were performed. All strains grew in at least two out of the three pH conditions during the experiment. Alkalophilic strains could not thrive at acidic pH, while some circumneutral and acidophilic strains grew under alkaline conditions. Transcriptomic responses to suboptimal pH conditions showed a considerable variation among strains depending on their optimal growth pH and their phylogenetic relationships. These results may reflect the complex history of invasions from the sea and radiation in continental waters.

ON124

High temporal resolution of greenhouse gas fluxes in a eutrophic reservoir

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Global estimations of greenhouse gas (GHG) emissions from reservoirs are highly uncertain since data are restricted to favorable weather conditions. These limitations are even larger in the case of CH_4, because there are multiple processes that control its fluxes. The Mediterranean biome is characterized by hydrological and thermal regimes with extreme seasonal fluctuations. CH_4 ebullition rates increase during water drawdowns linked to droughts, particularly in shallow reservoirs. During the stratification, the hypolimnion in anoxic conditions accumulates significant quantities of GHG that can be partly released during mixing. We determined the GHG fluxes in a eutrophic reservoir and explored their drivers. We selected Cubillas reservoir, a small and shallow reservoir located in Granada (Spain). The fluxes of CO_2, CH_4 and N_2O were measured simultaneously using a PICARRO G2508 laser-based cavity ring down spectrometer (CRDS) coupled to a floating chamber. We sampled 4-6 measurements once a week from March 2021 to July 2022. The CO_2 emissions ranged from 69.36 mg C m^{-2} d^{-1} to 448.78 mg C m^{-2} d^{-1}.The diffusive CH_4 emissions ranged from 1.5 mg C m^{-2} d^{-1} to 279.06 mg C m^{-2} d^{-1} and for N_2O fluxes ranged from 0 µg N m^{-2} d^{-1} to 261.49 µg N m^{-2} d^{-1}. During the period of maximum primary production we observed a reduction in the CO_2 emissions. The best predictors of CH_4 diffusive fluxes were the chlorophyll-a concentration and the temperature.

ON377

Respiring cities: Carbon dioxide fluxes from an urban aquatic network

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Carbon dioxide (CO_2) emissions from freshwaters constitute a significant flux of carbon to the atmosphere. However, despite rapid urbanization trends, there is a large knowledge gap on the magnitude and seasonal timing of CO_2 fluxes from urban surface waters. This hampers reliable upscaling to the landscape scale and exploration of global change scenarios, especially in light of the diversity of urban water bodies. Using floating chambers, we measured CO_2 fluxes from 32 randomly chosen streams, rivers, ponds and lakes across the city of Berlin, Germany, in 4 seasons. Additionally, we assessed potential drivers of CO_2 emissions such as land cover, nutrient availability, dissolved organic matter composition, and concentrations of chlorophyll *a* and micropollutants. Ponds and lakes were almost invariably CO_2 emitters, with fluxes ranging from -22 to 585 g C m^{-2} y^{-1}, similar to rates recorded in other studies. In contrast, rivers and streams showed lower fluxes than observed elsewhere (22 to 809 g C m^{-2} y^{-1}). Likely reasons include the lowland character and heavy channelization of running waters in the city of Berlin, which limit turbulent flow and gas exchange with the atmosphere. The first axis of a principal component analysis of the measured physico-chemical variables was significantly related to CO_2 fluxes and suggested a notable influence of anthropogenic drivers on emissions. Extrapolation to Berlin´s aquatic network results in an annual carbon emission estimate of 9.01 Gg as CO_2, which accounts for only 0.17% of the total estimated emissions from the city.

ON162

Environmental conditions and dynamics of a *Limnoraphis* cyanobacterial bloom in lake Atitlán, Guatemala and tools for its potential early detection

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Algae blooms have increased in water bodies and their potential to become harmful in regions where water is used for human purposes raises concern. To better understand yearly dynamics of algal blooms, a monthly monitoring during 2018 was conducted in Lake Atitlán, Guatemala. Preliminary results showed that bloom formations depended on sampling locations (WP, SA and CWG). Sites close to urban settlements (WP and SA) showed highest diversity in phytoplankton communities with cyanobacterial peaks mainly of *Limnoraphis robusta* occurring on September and November (3.4 and 1.5 x 10^6 cells L^{-1}respectively). In contrast, lake center (CWG) displayed constant cyanobacterial presence with higher peaks on September and December (4.7 x 10^6 and 5.1 x 10^6 cells L^{-1}, respectively). Brief bloom concentrations of *Microcystis* spp. and *Dolicospermum* spp. were also detected. Total phosphorus in WP (R^2=92.34) and ammonia in SA (R^2=84.64), consistently influenced phytoplankton communities, whereas pH in CWG (R^2=88.00) was influential according to ordination technique (NMDS). During the occurrence of cyanobacterial blooms three cyanotoxins were detected in CWG and WP: microcystins-MC (0.26 and 0.30 µg.L^{-1}, respectively), cylindospermopsins-CYN (0.23 and 0.15 µg L^{-1}, respectively) and saxitoxins-STX (0.075 and 0.025 µg.L^{-1}, respectively). The detection and sequencing of gene *mcyE* suggested that toxicity of the blooms could be associated to *Microcystis* rather than *Limnoraphis*. Our results show that ongoing monitoring activities (determination of physicochemical, chemical and phytoplankton values), could be combined with other methodologies (phytoplankton genetics) to shed light on the dynamics of cyanobacterial blooms and their harmful potential in Lake Atitlán, Guatemala.

ON370

Current-use organic pesticides in freshwater ecosystems: effects on emerging aquatic insects propagating to terrestrial predators

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Contamination of freshwater ecosystems with pesticides can potentially impact adjacent terrestrial food webs by changing the availability of emerging aquatic insect subsidies or by direct dietary exposure of terrestrial predators to pesticides accumulated by these insects. Currently, there is a lack of information on the relevance of pesticide- and organism-specific parameters, such as pesticide class and sex-specific life history of emerging insects, as well as the extent of dietary exposure of terrestrial predators for many current-use pesticides. We performed microcosm experiments in which emerging insects were exposed to sublethal concentrations of single insecticides or a mixture of fungicides and herbicides during their aquatic development phase. We measured effects on larval development time, emergence success and emergent biomass as well as pesticide concentrations in the aquatic and terrestrial life stages. Furthermore, we sampled riparian spiders, their prey and the adjacent aquatic ecosystems from river sites along a gradient of agricultural land use to assess the trophic transport for many current-use pesticides. At the microcosm scale, exposure to insecticides negatively impacted insect development duration and emergence success. Exposure to a mixture of fungicides and herbicides resulted in the majority of pesticides being retained after emergence. Furthermore, we observed sex-specific differences for larval development duration and

pesticide concentrations in the adult emerging insects over the full terrestrial life stage. Additionally, a broad range of current-use pesticides were found in riparian spiders, including several neonicotinoid insecticides. Exposure to current-use pesticides during aquatic insect development can therefore result in potential negative effects for terrestrial consumers.

ON251

Methane production by Cyanobacteria isolated from soda lakes in the Brazilian Pantanal

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Oxic methane production has been reported as a significant contributor to methane emissions from oxic surface waters. Cyanobacteria are often correlated with methane accumulation and emission in freshwater, marine, and saline systems. While some mechanisms of oxic methane production related to demethylation have been recently resolved, photosynthesis-associated methane production remains enigmatic. The Brazilian Pantanal is the world's largest wetland system with approximately 600 shallow lakes, most of which are highly alkaline and saline extreme environments. In this study, we used two filamentous and one unicellular bloom-forming cyanobacteria from the Pantanal lakes to assess their ability to produce methane under in vitro conditions. The gas concentrations were measured in a dark/light photoperiod, using membrane-inlet mass spectrometry. All strains produced methane during the photoperiod, with a rapid decrease in rates with the onset of dark. Methane production rate by the two filamentous Cyanobacteria, *Anabaenopsis* sp. and, *Arthrospira* sp., was significantly higher than that of the unicellular *Geminocystis* sp. strain. Long-term experiments in which the photoperiodicity was inverted revealed that methane production continues for ca. 24 h following the previous light regime, till it adjusts to the new one. This suggests a link between methane production and the cyanobacterial circadian clock. Furthermore, this indicates that photosynthesis-associated methane production may be linked to the dark rather than light reactions of photosynthesis. While not resolving the mechanism of photosynthesis-associated methane production, our results support the notion that cyanobacteria as a phylum produce substantial amounts of methane under oxic conditions, in a light-fueled mechanism.

ON105

Microplastic variability in subsurface waters of a deep perialpine lake (Lake Lugano, CH-IT)

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Plastics are ubiquitous in aquatic environments, but data on the abundance, distribution and biological impact of microplastics in lakes are still scarce. In addition, the majority of microplastics research in lakes has focused on microplastics floating on the surface, while only few studies have investigated their concentration in deep waters or sediments. Due to this lack of information the full extent of the problem cannot be evaluated.
In Lake Lugano, a deep lake that stretches across the border between Switzerland and Italy, microplastics are one of the major emerging pollutants. According to recent research, the lake has a mean surface concentration of 0.27 microplastics m^{-2}, a value approximately twice as high as the average of other Swiss lakes. In comparison, no data are available regarding microplastic abundance in subsurface waters. To fill this gap, we surveyed microplastics throughout the water column of Lake Lugano using a seasonal sampling scheme. The water column was divided into an upper (0 – 10 m, epilimnion), middle (10 – 20 m, metalimnion) and deeper layer (20 – 80 m, hypolimnion), which were sampled with a 100 µm mesh size net to include smallest microplastics not considered in previous research. Our preliminary results show that the distribution of microplastics in the water column is highly dynamic, depending e.g. on thermal stratification and microplastic shape. The results will help understand the environmental risks connected to microplastics and improve strategies to manage microplastic contamination in deep lakes.

ON063

Depletion of dissolved silicon as a precursor to cyanobacterial blooms in a nutrient rich river

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Phosphorus (P) and nitrogen (N) loading are the ultimate drivers of cyanobacterial blooms, but questions remain about proximate conditions that facilitate blooms. The silicon (Si) depletion hypothesis suggests phytoplankton communities dominated by diatoms can be displaced by blooms of cyanobacteria when diatoms become silica limited. Testing this hypothesis requires concurrent and co-located data on dissolved silica and the relative abundance of diatoms vs. non-siliceous phytoplankton before and during a bloom. Such data are rare, particularly in rivers. In this talk, I use data from several sources to explore the relationship between dissolved silica depletion and cyanobacterial blooms. I focus primarily on the Ohio River, the second largest river in the U.S. Depletion of dissolved silica during late summer has occurred annually in the Ohio River for the past 40 years. Harmful cyanobacterial blooms have been documented throughout the Ohio River, with total microcystin concentrations occasionally exceeding 5,000 micrograms/L, far above the common recreational threshold of 10-20 micrograms/L. These events in the Ohio River tend to be preceded by silica depletion, and a presumptive cause-and-effect relationship will be examined using the Indicator of Freshwater Eutrophication Potential, a stoichiometric index that expresses N:Si and P:Si imbalances in terms of the potential for non-siliceous algal production. There is a strong need for comprehensive, high-frequency data collection to fully resolve the role of silica in facilitating harmful cyanobacterial blooms in the Ohio River and elsewhere. In future, declining concentrations of dissolved silica might provide an early warning of cyanobacterial blooms.

ON288

Can invasive round goby control invasive quagga mussels?

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Invasive mussels dominate the benthic community of a large shallow lake in New York State that has long-term data on both benthic and pelagic components of the ecosystem. After 2008, the mussel biomass increased as quagga mussels became the dominant mussel species, replacing zebra mussels. This caused further declines in open water chlorophyll and increased water clarity, However, mussels declined by a factor 5 from 2014 to 2020 following the arrival and subsequent increase of the round goby, a specialist mussel feeding fish native to the Ponto Caspian region, the region of origin of both mussel species. Associated with this decline of mussels was an increase in veliger production, but few young mussel recruited to the population between 2014 and 2020.Gobies prefer small mussels and cannot handle larger individuals in laboratory experiments. Larger mussels present in 2014 increased in size each year through 2021, indicating that quagga mussel can live for at least 8 years even in a warm, eutrophic lake. However, in the fall of 2021, a large number of mussels less than 5 mm were again present in the lake.These mussels settled late summer and fall of 2021 and September fish catches indicate a decline in round goby at that time. This suggest that a decline in goby densities will allow for a large mussel recruitment event and highlights the highly dynamic nature of the goby-mussel predator-prey system.We expect this dynamic to result in more variable mussel effects on the lake ecosystem in coming years than in previous decades.

ON325

Brownification impacts on dissolved organic phosphorus bioavailability – a mesocosm study

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Nutrient enrichment of surface waters caused by anthropogenic activities is changing the functioning and structure of coastal ecosystems. Eutrophication is often a consequence of excessive loads of nitrogen (N) and phosphorus (P), which are then carried out to the sea. Concurrently, terrestrial DOM containing coloured DOC that is transported to surface waters is causing brownification. The extent to which inorganic nutrient enrichment, changes in water colour (browning) and variation in labile carbon (C) concentrations interact with the DOP pool, and consequently changes its size and bioavailability to coastal heterotrophic bacterial communities, is unclear and could be a contributing factor causing of eutrophication. To address this issue, we conducted a fully factorial mesocosm experiment with treatments manipulating nutrient supply, C concentration and water colour (light availability) and carried out bioassay experiments to estimate changes in concentrations of bioavailable DOP (BDOP). We hypothesized (H1) higher BDOP in clear but not in dark water when both are enriched with inorganic nutrients; (H2) initial negative effects on phytoplankton due to increased competition for nutrients by bacteria but, as the DOP is eventually processed and mineralized over time, this may change in favour of phytoplankton. Overall, we observed that inorganic nutrient enrichment, as well as the interaction of nutrient additions and browning, positively affected DOP bioavailability, while labile C additions increased BDOP in light and decreased in dark treatments.

ON421

Land-use changes systematically alter the size structure of tropical aquatic communities

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Changes in land use have altered the structure and functioning of ecosystems, including trophic interactions that control the flow of energy and matter. We investigated the differences between the relationship of log10-biomass and log10-body size classes in macroinvertebrates communities along a land use gradient. We used data from 30 streams, located in southeastern Brazil. We mainly expected a higher energetic cost in impacted streams, sustaining less biomass in large size classes (i.e. steeper size spectra slope). We also expected more deviations in the model in impacted streams (lower regression R^2), due to the high energy demand and low energy efficiency transfer, causing organisms to feed outside their ideal predator-prey mass ratio. Our results demonstrated that impacted streams have fewer small organisms available at lower trophic levels (lower intercepts) than preserved streams, but with a more efficient energy transfer (shallower slopes). This may be due to few strong interaction links related to communities with low abundances and the simplification of the food web in impacted environments, which tends to decrease stability and enhance vulnerability to stochastic events. Preserved streams are more complex and have more energy pathways possible, resulting in weaker interaction strengths, which leads to higher community stability. We also demonstrated that deviations in the model do not vary systematically across the land use gradient. Our study represents a step forward to understanding how anthropogenic impacts affect trophic interactions and ecosystem functioning in tropical streams.

ON337

Successful invasions to freshwater systems increase with climate warming

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Although invasive species are recognised as a major threat to freshwaters, little is known about how future climate warming will affect the success of invaders. To quantify invader success, we performed an outdoor experiment mimicking present and future temperatures (IPCC RPC 8.5) combined with a multispecies invasion of planktonic organisms collected from a region with 3-4°C higher mean temperature. eDNA metabarcoding (16S and 18S) was used to track invaders and their impacts over 60 weeks. We show that invasion success doubled with climate warming compared to at present, implying a substantial increase in the successful establishment of invaders in the future. Moreover, community composition was also affected by both climate warming and invasion treatments, and species richness increased at warming, but not at present, climate conditions following the invasion. Our quantification of the establishment of invaders in a climate warming scenario, using eDNA metabarcoding, provides a novel step in understanding and predicting how climate warming may affect the success of invasive species in the future, thereby allowing for more informed management recommendations in adapting society to climate change.

ON375

Macroinvertebrate assemblages and functional traits in ashfall-impacted littoral zones of Lake Taal after the Taal volcano eruption in January 2020

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The recent major eruption of Taal Volcano last January 2020 released large volumes of tephra and gases in the atmosphere and the lake that were concentrated mostly north of Taal volcano. Limited limnological post-eruption studies have been done in the tropics. Thus, this study on Lake Taal will provide information on the response of tropical lentic biota to natural disturbance. The study assessed Lake Taal's macroinvertebrate assemblages, functional traits, and environmental variables across 10 littoral (i.e., five HAS – high ashfall; five LAS – low ashfall) sites in October-November 2021. NMDS and ANOSIM revealed no distinct difference in the overall assemblage structure. Conversely, RLQ and fourth-corner analyses showed significant differences (p<0.05) between taxonomic structure to environmental variables and functional traits. HAS and LAS sites were differentiated between RLQ axes 1 and 2. Macroinvertebrate associated-traits with HAS, silica, and phosphate were piercer, terrestrial oviposition, hydrostatic vesicle, swimmer, and climber. While clinger, ovoviviparity, parasite, crawler, hermaphroditism, and hard-shell traits were linked to LAS and were associated with pH. Independent sample t-test (p<0.05) revealed markedly higher ammonia, nitrate, turbidity, silica, color, Simpson's diversity index, and (%) Chironomidae levels in HAS. LAS have significantly higher pH, macroinvertebrate abundance, and (%) Crustacea. Taxa with ovoviviparity and parasite traits were statistically higher in LAS. Despite having the most diverse macroinvertebrate assemblage, abundance and trait diversity were affected by tephra and possibly by land use stressors in HAS. The findings also suggest the need for continued monitoring in tephra-impacted Lake Taal to elucidate the lake's post-eruption recovery.

ON434

Nature contributions to people and their values as a tool to implement participatory water monitoring

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Participatory monitoring of water quality is receiving increasing attention worldwide, as it can complement institutional monitoring. One of the obstacles towards implementation is to maintain a well capacitated group of people involved that can provide the necessary time and resources to participate on a longer term. We exemplify how the relational values of a set of nature contributions to people (NCP) can be used to evaluate the level of disposition of local actors to participate monitoring activities. NCP were valued through interviews with local stakeholders in 3 communities in the Río Hondo watershed in southern Mexico, using 3 categories (monetary, health, cultural) and additional criteria to establish the disposition to participate in long term monitoring activities. The results show that in general cane fields have the highest monetary values and wells the highest health values, while water bodies show the highest cultural values, with high values for health. It was possible to identify 3 types of local actors with a broad range of available time and resources for water monitoring. This makes it possible to improve the efficiency and long-term success of participatory monitoring groups, as in the implementation phase less people will desert from the program and thus less people need to be trained to be able to maintain the monitoring groups. Additionally, exploring the relational values of NCP of local actors can help to focus the effort of implementing participatory monitoring activities, because potential leverage points for more sustainability in water management can be identified.

ON281

The pico powerhouse: exploring the diverse and dynamic communities of picocyanobacteria in New Zealand lakes across the trophic spectrum

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Picocyanobacteria (< 3 µm) play a vital role at the base of aquatic microbial foodwebs, yet little is known about their diversity, dynamics, and drivers in freshwater systems. Most previous studies sought to understand picocyanobacterial drivers by measuring shifts in cell abundances as a response to environmental change. However, these results were often conflicting, suggesting that differential responses may be occurring within the picocyanobacteria group. To test this and explore the temporal diversity, dynamics, distribution and potential drivers of picocyanobacterial taxa across contrasting lakes, my thesis used a combination of molecular (environmental DNA metabarcoding and genomics) and traditional (epifluorescence microscopy and culturing) approaches. Here I present insights into the temporal dynamics and distribution of picocyanobacterial communities across contrasting New Zealand lakes.
Lacustrine picocyanobacteria were extremely abundant (up to $4.5x10^7$ cells/mL) and highly diverse across all trophic states, with up to 76 amplicon sequence variants (ASVs) found per lake. This diversity was heavily weighted towards rare, lake-specific ASVs. No ASVs were found to inhabit all 128 study lakes or all lakes of a certain trophic state, illustrating a strongly unimodal occupancy distribution. Temporally, cell abundances within lakes were not consistently related to environmental shifts. However, metabarcoding data revealed significant temporal shifts in community structure with specific ASVs strongly associated with certain environmental drivers. These results suggest that freshwater picocyanobacteria are abundant and diverse across the trophic spectrum, with this diversity likely to play a key role in their response to pressures such as eutrophication and climate change.

ON205

Investigating spatial and anthropogenic drivers to explain river water temperature trend variability – a comprehensive German-wide approach

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Temperature is a critical variable in river ecosystems at all organisational levels, from molecular processes to species community composition. Several studies report warming trends in river water temperatures (RWT), sometimes exceeding climate change-related air temperature trends. Apart from the air temperature, numerous other parameters influence the RWTs, so cooling tendencies are also regularly reported. Therefore, high trend variability is expected on a large spatial scale, depending on the spatial boundary conditions and anthropogenic changes. In addition to the magnitude of RWT change, its timing is also decisive for its effect, for example, on the success of a species. Despite the importance of temperature and the expected spatial variability in its change, comprehensive spatial studies of RWTs are scarce due to the demands on the data needed. Based on a German-wide dataset, we examine RWT trends (annual, seasonal) at over 500 locations distributed across Strahler orders 1 to 8 and analyse how much of the trend variability can be explained by topographical and geographical features and the degree of anthropogenic change. In our preliminary analysis, 64% of the time series showed a significantly positive and 8% a significantly negative trend. The estimated annual median temperature increase for the significant positive trends was 0.35 (0.04 – 0.83) °C/decade and was greatest on average in autumn. The mean temperature rise for the significant negative trends was -0.368 (-0.96 - -0.1) °C/decade. Knowing how spatial boundary conditions interact with anthropogenic changes is key to identifying and protecting the river ecosystems most vulnerable to climate change.

ON004

Post-mining effects on fish communities and food web dynamics

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The production of fish communities in streams and rivers might substantially be subsidized by terrestrial insects that fall into the water. Although such animal-mediated fluxes between adjacent ecosystems are increasingly recognized, little is known on how anthropogenic perturbations may influence the strength of such exchanges. Here, we present how lignite mining may impact a river ecosystem due to the flocculation of iron (II) oxides, and thus altering food web dynamics with profound effects on fish communities. We compared sections of the River Spree in Brandenburg that were greatly influences by iron oxides with sections located below a dam where passive remediation technologies are applied. Compared to locations below the dam, the abundance of benthic macroinvertebrates at locations of high iron concentrations was significantly reduced. Similarly, CPUE of all fishes was significantly higher in locations below the dam compared to locations above the dam. Bleak (*Alburnus alburnus),* a fish species known to specialize on terrestrial insects was found in high abundances at locations of high iron concentrations. Using hydrogen stable isotopes, we could demonstrate that the three most abundant fish species (perch, roach, and bleak) received higher contributions of terrestrial insects to their diet at locations of high iron concentration. Thus, we illustrate that iron flocculation resulting from open-cast lignite mining has the ability to restructure the lotic food web, including the species composition of the fish community and the strength of the linkage to the adjacent terrestrial ecosystem.

ON362

Monitoring primary production in a shallow polymictic lake: methods and uncertainty, compartments and drivers

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Lake Müggelsee is a temperate polymictic lake with a seasonal floating research platform. Müggelsee, as a GLEON member, is often included in larger lake aggregate analyses, but its morphology and frequent mixing deviate from assumptions and therefore reliable fit using standard modeling approaches. We use a range of profiling and stationary sensors at up to ten depths over ten years to examine primary production as a function of frequent mixing, quagga mussel invasion, and the subsequent response of dynamics among primary producers. This led us to methods questions associated with long-term and cross-system study, relevant across usage of research platforms and buoys. We evaluate differences in, error associated with, and exchange among production by zone (pelagic vs littoral), resolution (single fixed point vs. depth-integrated estimate), and photosynthesizer (including macrophytes, periphyton, and phytoplankton). We quantify dimensions of uncertainty associated with primary production estimates as a result of gap filling and mismatched data resolution, and prioritize protocol modifications. We evaluate how different modeling approaches apply in a rarely stratified lake to track shifting carbon dynamics. The relationship among open channel primary productivity and biochemical metrics of photosynthesis was neither as predicted nor monotonic with depth, supporting further investigation of lake physics with regard to shifting parcels of variably oxygenated water. We are eager to refine methods for more valuable, accessible, and comparable usage of monitoring platforms in the age of Big Data, and identify how this approach can flexibly respond to changing questions, systems, and environmental conditions.

ON365

Pilot project for continuous monitoring of the thermal structure of Swiss lakes

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Climate change is expected to be one of the major challenges for lake ecosytems in the next decades. The most direct impact of climate change on lakes is the modification of the seasonal thermal dynamics, including changes in surface and deepwater temperature, duration and timing of thermal stratification as well as depth and intensity of seasonal mixing. Long-term high-resolution temperature observations are an indispensable base for assessing the extent of these changes and their potential impacts on lake ecology. The Federal Office for the Environment (FOEN) is therefore considering to establish a representative network for continuous temperature monitoring in Swiss lakes to complement the existing cantonal long-term water quality measurement programs. FOEN has mandated Eawag to deploy pilot stations in three larger lakes and in a group of smaller lakes covering an altitude range from 461 to 2216 m a.s.l. Here, we will present the setup of these pilot monitoring stations as well as first observational results, and discuss options to combine both the historical and the newly acquired in-situ monitoring data with our operational one-dimensional lake model Simstrat in order to hindcast reliable long-term time series of lake temperatures and to estimate the thermal structure of lakes without or with only very limited observational data.

ON197

Disconnected effects of oscillating light and frequent mechanical stress on the microbial community structure and activity in river migrating ripples

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Due to changing land use and extreme weather, increased sand load to rivers will severely expand the phenomenon of migrating bedforms (sand ripples). Biofilms inhabiting migrating ripples undergo high-frequent moving-resting cycles, likely acting as a filter to microbial communities. The grain moving at the ripple surface exposes associated biofilms to light and mechanical stress by grain collisions, while the alternating resting in the ripple buries the biofilms in darkness. We hypothesized that the effect of oscillating light on the microbial community structure and activity is stronger than the effect of mechanical stress. We implemented a microcosm experiment for eight days exposing river sediment to (i) stationary treatment at constant light (14h light and 10h dark), (ii) a typical migrating ripple treatment with oscillating light (14h light period consisting of a cycle of 3.3 min light and 9.7 min dark), and (iii) stationary treatment with oscillating light (same as ii). Light oscillation had a stronger effect on sediment microbial activity and abundance than mechanical stress. Net ecosystem production (NEP) of stationary sediments under constant light was 15times higher than under oscillating light. Besides, under oscillating light, NEP of stationary sediments was consistently positive and doubled those observed in migrating sediments with negative NEP. Only mechanical stress affected the bacteria β-diversity, while phototroph β-diversity was unaffected by light oscillation and mechanical stress. Our findings contribute to a better understanding of migrating bedforms‘ role in the river's sediment microbial community structure and functions, which is essential for future management of lowland rivers.

ON172

Genetic monitoring of the Atlantic salmon conservation and restocking program in the river Rhine catchment area

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With its anadromous migration behaviour the Atlantic salmon (*Salmo salar*) is a good indicator species for ecological vitality continuously connected river systems.
However, the species has almost become extinct in the entire Rhine-system in the 20th century.
Although Atlantic salmon from different origins has been stocked for several decades in the German Rhine system, it has still not established a self-sustaining population within the river system.
In the restocking of the German part of the Rhine system, 6 hatcheries are involved (3 in North Rhine-Westphalia breeding a Swedish strain, 1 in Baden-Württemberg and 2 in France which are breeding a French strain) for the stocking. Each hatchery is managed differently.
The reasons for the low number of returners from the ocean into the Rhine system are manifold and complex. With this project we answer some questions that are relevant for the management of salmon. Genetic samples have been taken from all salmon in the hatcheries (parents) and from fish caught in the wild (smolt, returners). We apply the international SALSEA-Merge microsatellite panel to enable comparisons of our data to Atlantic salmon data from the entire Rhine catchment and even to samples taken in the Atlantic Ocean.
We have assessed the genetic diversity in the hatcheries over the years, assigned the returners to their original strains, identified the parents of the returners in the hatcheries, detected stray fish from other European river systems and have searched for evidence from the results of natural spawning of salmon in the Rhine system.

ON182

GloBios – Global Observatory Network for Freshwater Biodiversity in High Mountain Streams: First Results from the European Alps

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While global climate change is affecting all limnic environments, the effects are especially pronounced in high-altitude mountain streams. The disappearance of alpine glaciers and the shifting of ecosystems to higher altitudes is projected to disturb and fragment benthic invertebrate communities in this vulnerable environment. GloBios is an international project aiming to assess taxonomy and functional biodiversity of chironomids (non-biting midges), trichopterans (caddisflies) and plecopterans (stoneflies) of high-altitude streams of South American, Central American and European mountain ranges. Using barcoding, metabarcoding and species distribution modelling approaches, we aim to identify species that are especially vulnerable to climate change due to low genetic diversity, habitat specificity and small distribution ranges. Here we present first results of the benthic community data from 2020 and 2021 in the European Alps. The long term goal of our project is establishing a global observatory network for the biodiversity of high mountain streams.

ON270

Lake Runstedt – an artificial lake for treating polluted water and protecting groundwater

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Lake Runstedt (near Merseburg, Germany; area 2.3 km^2, volume $53x10^6$ m^3, max. depth 32.8 m) is an artificial lake resulting from lignite mining. The lower part of the former mine void was filled by industrial wastes consisting mainly of ashes but also containing waste from nitrogen fertilizer production rich in ammonium. The concentrations of ammonium exceed 360 mgL^{-1} in the pore water in the deposited wastes and constitute a threat for the regional groundwater resources. In order to protect the groundwater, Lake Runstedt was created by filling the remaining space above the waste with water from Saale River. The neighbouring pit lakes are managed in a way that groundwater flows into Lake Runstedt from all directions and that there is no outflow except evaporation. Hypolimnetic aerators provide the hypolimnion with oxygen needed for nitrification and reed was established in the littoral as habitat for denitrification. Since completion of the filling in 2002, the system has worked well as documented by monitoring. Usually, limnologists look at lakes as valuable ecosystems that have to be protected. Lake Runstedt is used as a reactor. This unusual approach is sometimes the best option to minimize the overall environmental impact of human activities. Therefore, this approach should be not the preference but an option in applied limnology and lake management. The presentation will report on the development of Lake Runstedt and discuss the potential use of lakes as reactors for treating contaminated water and protecting other compartments of the environment.

ON047

Two sides of the same coin? Effects of fluctuating light spectrum and intensity on phytoplankton growth and community structure

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Light is one of the basic resources used by autotrophic organisms, but its quality (spectrum) and quantity are not constant and fluctuate over different spatio-temporal scales. While the effects of light intensity and its fluctuations on phytoplankton were investigated, the effects of light quality, especially its variation, are rarely considered. We disentangled the effects of light quality and quantity on a natural phytoplankton lake community by exposing it to different constant and fluctuating light intensity and quality conditions: Treatments followed a two-factorial design combining an intensity gradient with different spectral regimes, based on underwater light attenuation conditions.We found that under constant conditions (1) phytoplankton biomass was mainly influenced by light intensity, while (2) the spectral composition was a good predictor for the ratio between chlorophytes and cyanobacteria, representing the two dominant groups. Our results demonstrate that changes in light intensity and shifts in the light spectrum within natural systems will likely affect phytoplankton growth and community composition, depending on the species' light-harvesting strategies. Results from the constant conditions were used to calculate predicted outcomes under fluctuating conditions and compared to measured results. These findings may be the first step to improving knowledge about the importance of fluctuating light conditions for phytoplankton growth and competition, not only in intensity but also in the quality of light.

ON449

The legacy of Einar Naumann(1891-1934): Following the material and immaterial traces

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Naumann's innovative research and the way he consistently tried to integrate the development of scientific research with economic and societal interests such as the development of aquaculture and effects of wastewater on lakes, makes him a fascinating scientist in several respects. Naumann's comprehensive archive material, including lab journals, instruments, photos and films, manuscripts, correspondence and microscopic material, has been re-discovered at the Division of Aquatic Ecology at Lund University. Astrid Schwarz has started an inventory of the archive material and digitized some of the visual material, demonstrating its potential https://www.b-tu.de/fg-technikwissenschaft/bildkulturen. The Naumann legacy is of anunusual intactness of the material, it contains work-in-progress of a kind that is virtuallyunique in archives, a fact that, in itself, implies that the Naumann material possesses an unusually high research potential.
A special focus is on the collection of glass photos (about 3500 plates).It is discussed to what extent Einar Naumann treated photographic images as epistemic tools. He became one of the main proponents of depicting lakes and in particular planktonic organisms with photography and film. Naumann was a pioneer in the production and use of visual material, and much remains to be explored regarding his use of visualization in scientific practice and communication. For example, in what ways did he use photos and images to generate hypotheses? And has this influenced the emergence of limnology as a new field of science? What can we learn from Naumann's experimental attitude in his scientific work?

ON252

Simulating natural ebullition patterns and bubble-mediated transport of solutes and particles in the lab

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Inland waters are known to be hotspots for methane release.In shallow waters, the main emission pathways to the atmosphere is via ebullition. Bubbles can transport more than their gas volume though. This is a well known and studied phenomenon for industrial applications, for example microbubble floatation in waste water treatment. The unintended remobilization of contaminants for example PAHs from sediment is the focus of this work. In a joint campaign at the Wupper pre-dam we monitored ebullition for one year. We evaluated the bubble spectra to identify realistic size spectra and volumes for our laboratory experiments. In the lab, we used transparent columns of 1 m depth. In these columns we measured the spectra of yeast bubbling in sediments of different grain sizes. This serves to assess the possibility to control the bubble size spectrum by the substrate the yeast was growing in.

Yeast was chosen as a model since it is readily available, fast growing, forms a biofilm and produces the greenhouse gas CO2 through respiration and fermentation. Additionally, we used peristaltic pumps as a source of bubbles to observe the transport of surfactants, fluorescing particles and natural sediment with fixed volumes. To suppress thermal convection and diffusion we employed a density stratification by layering saltwater with different concentrations. Bubble-mediated transport encompasses a variety of transport modes. The turbulent flow caused by rising bubbles appeared to be the dominant path of transportation in our experiments. Direct transport via attachment onto the gas liquid interface seemed of minor importance.

ON363

Estimating the impact of climate change on German lakes using high-frequency monitoring data and modelling

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Climate change is one of the major global concerns of the 21st century and will potentially affect lake ecosystems. In Germany, lake surface temperatures increased by 0.3-0.6°C per decade during the last ~50 years. However, changes vary significantly between lakes. In order to monitor this variability and to assess the impact of climate change on lakes in Germany, we combined data from (1) automated measuring stations in Lake Arendsee, Lake Müggelsee, and Lake Stechlin, (2) continuously measuring moorings including oxygen, temperature and pressure sensors in ~10 lakes and (3) low-resolution monitoring data taken several times per year in >100 waterbodies. These data were used to identify the dependency of lake warming or stratification on geographical location or lake morphometry and for model calibration.

The results show that temperature differences in lakes can be explained by latitude, altitude, and averaged air temperatures. However, low- resolution data were not sufficient to explain data satisfactory. The duration of stratification was determined by temperatures during spring and fall/winter. In addition, end of stratification was strongly dependent on lake depth. Numerical modelling (using the 1D-models SIMSTRAT and FLake) shows a significant increase in temperature and stratification for the most extreme climate scenario (RCP8.5) but only weak changes for the most optimistic scenario RCP2.6. Our study shows that high-resolution measurements in various representative lakes are crucial to cover the full range of responses to climate change. Measurements of additional parameters such as Chl-A or Turbidity are desirable to calibrate more complex biogeochemical models.

ON065

Creating high Temperature Noble Gas Solubility Functions to analyse missing Noble Gases in Lake Kivu's deep Water

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Noble gas concentrations in natural waters are widely used to determine ambient temperature conditions during the last intensive contact with the atmosphere (equilibration). This approach—called n*oble gas thermometry*—is widely used to track groundwater recharge temperatures and to analyse past temperature variations. Thus far, only conditions up to 35°C have been considered, and hence solubility functions do not exceed 35°C, even though environmental scenarios that generate higher surface-water temperatures (such as volcanism) exist. We therefore conducted new noble gas solubility measurements for higher temperatures and combined them with previous data taken from literature to determine new functions valid from 0°C to 80°C. These were used to analyse published field measurements of noble gas concentrations in Lake Kivu that found a strong depletion in the deep waters. Lake Kivu sits at the base of the Nyiragongo volcano and stores vast amounts of carbon dioxide and methane that would be deadly for the surrounding population if a large scale outgassing event were to occur. Ratios of noble gases and least squares fitting of individual concentrations indicate that groundwater formation temperatures of approximately 60°C can entirely account for the observed depletion, showing that the current noble gas concentrations in the lake's deep water do not necessarily indicate past catastrophic ebullition events. The recent 2021 Nyiragongo eruption and the commercial exploitation of the lake's vast methane deposit render this conclusion immensely important since it can contribute to the understanding of Lake Kivu's past and future dynamics.

ON355

Ecosystem stoichiometry constraints on nitrogen fixation and toxin production by cyanobacteria

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Cyanobacteria have a global cosmopolitan distribution and many species also have the ability to produce a variety of nitrogen-rich toxins that are of growing concern. Moreover, N-fixing species may cause pattens in seasonal succession by providing 'new' nitrogen to other phytoplankton and/or baterioplankton. Although the competitive growth dynamics of various phytoplankton groups are reasonably well-known, the fitness advantages associated with heterocystous N fixation and toxin production, and their potential interaction, remain poorly understood. Here we present recent developments in modeling N fixation, growth, and toxin production by heterocystous cyanobacteria using resource ratio theory and apply this framework to a variety of cyanobacteria populations and phytoplankton communities. Monoculture experiments reveal that some species (e.g. *Dolichospermum flos-aquae*) use N fixation to maintain stoichiometric homeostasis in which N cell quota is balanced proportionally with phosphorus and carbon cell quotas. However, other species (e.g. *Aphanizomenon flos-aquae*) respond differently by modifying their stoichiometry in order to maximize growth and thereby alter their N cell quota relative to C and P. Interestingly, these differences in N fixation efficiency and growth tradeoff dynamics create large differences in toxin production. Cellular stoichiometry of all species, regardless of N fixation strategy, is directly linked to the rate toxin production per cell. Predicting competitive outcomes of N-fixing cyanobacteria versus non-N-fixers is complicated by food web structure but may explain experimental observations across a large N:P supply gradient in a long-term fertilization experiment using limnocorrals.

ON262

On endangered turtles and "ghost ponds" and how to bring them back to life

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Connectivity is a key landscape property affecting the persistence of populations occupying patchy habitats. When individuals need to cross hostile matrix among suitable habitats, landscape connectivity may be a critical limiting factor by influencing survival rates. This was shown to be the case with a pond-dwelling turtle, the European pond turtle, *Emys orbicularis*, inhabiting the pondscapes of SW coastal plateau of Portugal. Two main turtle population cores exist in the region which coincide with two major temporary pond clusters where extensive livestock fields dominate the landscape. These areas contrast with the agricultural intensification to which the region has been subjected to in the last 30 years, which led to the destruction or strong alteration of more than half of the ponds since the early 1990s, with severe consequences in pondscape connectivity. Many, likely became "ghost ponds", filled in for agricultural demands, though with good recovery potential. A long term turtle capture-recapture programme has been carried out since 2003 in one of the main population cores. The data collected so far allowed to model the effects of pond connectivity and hydrological conditions on survival rates as well as the decay of inter-pond movement probabilities with distance. We show how these results, coupled with least-cost path analysis, remote sensing and graph theory, may be useful as inputs for a multi-criteria prioritization framework to guide the conservation of existing ponds as well as the restoration of "ghost ponds" or the naturalization of artificially deepened ponds that remain in the landscape.

ON276

Effects of biofilm growth on microplastic settling velocity, and implications for microplastic transport in lakes

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Microplastic transport in lakes is heavily dependent on the physical properties of microplastic particle density and shape, but both properties can change due to superficial growth of microbial communities (biofilms). Biofilm-induced changes of microplastic rising and sinking rates were investigated and quantified through laboratory experiments on irregularly-shaped buoyant polypropylene virgin microplastics (~125-2000 µm size) in an ex-situ freshwater lake environment. Biofilm growth affected microplastic particle density, shape, size, terminal rise and settling velocity, and settling onset times of microplastics. The biofouled microplastics were compared to their non-biofouled microplastic constituents to identify or quantify the effects of biofilm formation on microplastic pollution transport. Results showed that biofilm growth can cause initially buoyant microplastics to become denser and sink; biofilm growth induced sinking of small microplastics (125-212 µm) at 18 days, 6 days sooner than for large microplastics (1000-2000 µm). Because of the size-dependence of settling onset times, it is expected that a size-fractionation of microplastics deposition would occur where smaller particles are deposited closer to their sources relative to larger particles. Using a simple mathematical model for microplastic sedimentation, it is estimated that microplastic particles become lost to sediments in 2-3 weeks in large lakes on the order of 50 km long. This investigation into the effects of biofilm growth on microplastics improves the understanding of the potential distribution and accumulation of microplastics in lakes or other aquatic systems.

ON186

Internal ammonium dynamics in the water column of a eutrophic lake: how non-nitrogen-fixing cyanobacteria thrive despite severe nitrogen stress

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Eutrophication is widespread in lakes and associated with harmful cyanobacterial blooms. Potentially toxic cyanobacterial blooms are increasingly caused by non-nitrogen-fixing taxa. Cyanobacterial blooms often rely on recycling of chemically reduced nitrogen forms, mainly ammonium (NH_4^+). Due to its high bioreactivity, NH_4^+ rarely accumulates in lake water, and its importance is therefore often overlooked, despite the continuous supply from regeneration (i.e., internal nitrogen loading). This bioreactivity and rapid cycling means that NH_4^+ concentration measurements do not accurately reflect its availability; thus, NH_4^+ turnover rates (uptake and regeneration) must be measured to determine actual NH_4^+ availability for primary producers. The study objective was to quantify water column NH_4^+ dynamics in large (270 km^2), shallow (mean depth 2.8 m), eutrophic Lake Võrtsjärv (Estonia) for comparison with those from other large eutrophic lakes (e.g., Lake Erie, USA). Stable isotope ($^{15}NH_4^+$) incubations have been conducted monthly since summer 2019, and preliminary results show that NH_4^+ turnover rates in summer were much higher than those in other seasons. Potential NH_4^+ uptake rates (0.33 and 0.16 µmol L^{-1} h^{-1} in light and dark, respectively) and actual regeneration rates (0.16 µmol L^{-1} h^{-1}) in summer in Lake Võrtsjärv are similar to those reported previously for non-peak bloom periods in Lake Erie. Quantification of NH_4^+ dynamics improves our understanding of non-nitrogen-fixing cyanobacteria bloom maintenance (including nitrogen-rich toxin production) during summer nitrogen stress in eutrophic lakes; and results show that cyanobacterial NH_4^+ demand can be largely met by internal nitrogen loading from the water column.

ON427

Assessing the effects of climate warming on an urban tropical reservoir

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The hydro-ecological dynamic of a well-designed Putrajaya Lake in Malaysia was investigated with reference to the predicted impact of climatic change during the 21st century. The climate impacts study in this urban and well-managed artificial lake were based on numerical simulations using coupled hydrodynamic-ecosystem model, developed as part of the assessment of the management measures. Output from a regional hydroclimate model was used to modify the temperature data to represent an increase in air temperature. The maximum model error for the simulated temperature was 0.23°C, while for current measurement was 0.049 ms-1. The model predicts that thermal stratification is expected to persist with a sharp decline in dissolved oxygen near the lake bottom, which has potential effects on the overall surface water quality. Our results showed that understanding of the lake's eco-hydrological dynamic may be assessed by modelling, which could be used as a management tool to manage the lake basin system sustainably under a changing environment.

ON352

Can nutrient – biomass relationships in lakes infer nutrient limitation and help manage eutrophication?

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Using the relationship between phytoplankton biomass and total nutrient concentrations to infer nutrient limitation in lakes has been rightly criticized as a tautology: nitrogen and phosphorus are integral components of biomass, so they will always correlate with biomass regardless of whether they are limiting. Here we examine whether regressions of biomass against total nitrogen (TN) and total phosphorus (TP) can still provide useful information for lake managers. We performed model simulations of a simplified phytoplankton community competing for nitrogen and phosphorus under a range of nutrient loading and mortality rates and chemostatic conditions using Droop-type growth. We also examined regressions from 4 decades of data from German lake Müggelsee. The model simulations and lake data displayed the well-known tautology, and showed that the slope of the biomass vs total nutrient regression is upper bounded by the $1/Q_{min}$ line, where Q_{min} is the minimum cellular nutrient quota. Results also demonstrated that a steeper regression slope and lower variance generally indicates stronger limitation, but could still give no definitive indication of limitation status. We propose that a biomass-normalized nutrient ratio (Q_N/Q_P), given by the ratio of reciprocal regression slopes for TN and TP, gives a better indication of cellular nutrient stoichiometry and is more useful than conventional TN:TP ratios. We argue that the actual limitation status is not ascertainable and not necessarily important for managers because steep regression slopes with low variance imply that reduction of the respective nutrient may still help control phytoplankton biomass.

ON122

The impact of extreme hydrological events on reservoir methane emissions

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Cotter reservoir is a drinking water reservoir near Canberra, Australia. Following the driest 3 years on record and bushfires (2003) in the catchment, upstream heavy rainfall events between Dec 2010 and Mar 2012 led to the largest annual runoff in 26 years. The multiple runoff events delivered exceptionally large loads of soil and vegetation from upstream: profoundly changing the water column thermal structure and the spatial distribution and magnitude of methane emissions. The hypolimnetic temperature was raised by 10 °C after the first event (spring-summer 2010-2011), and by 5 °C after the second event (autumn 2012). Periodic floating chamber measurements of CH_4 fluxes at 8 sites before and after the flood events showed an increase in mean areal emission from 4.3 mg-CH_4 m^{-2} d^{-1} (pre-flood) to 99 mg-CH_4 m^{-2} d^{-1} post-first event, which declined to ~ 30 mg-CH_4 m^{-2} d^{-1} post-second event. The pre-flood, spatially uniform, pattern of CH_4 emissions was replaced by a 100-fold difference along the reservoir following the first event, and a weaker gradient after the second. We interpret these results in terms of thermal enhancement of methanogenesis, and the pulse loading of organic matter to reservoirs.

ON318

Ensemble projections of climate change impacts on Lake Sevan using latest climate products and a lake model ensemble

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Lake Sevan is the largest lake in the North Caucasus and the most important surface water resource in the whole Caucasus region. The lake has been shown to be vulnerable to climate change, but concrete predictions based on state-of-the-art climate projections are missing. We applied a large set of regionalized climate projections from the CORDEX dataset that reflect different climate models and geographic domains. These high-resolution projections were applied to force an ensemble of 5 hydrodynamic lake models using the LakeEnsembleR modeling framework. While the use of the ensemble approach is standard in climate research, the usage of multiple lake models in such a setting is a new feature that allows separating model uncertainties from the climate drivers from uncertainties in lake models. ERA5 reanalysis data were used to calibrate the lake models and to bias-correct the historical and long-term projection of CORDEX data for three Radiative Concentration Pathway scenarios (RCP2.6, RCP4.5, and RCP8.5). The resulting ensemble showed a rapid response of the lake's surface temperature under all scenarios, as well as prolongation of stratification times and changing ice dynamics. Deep water temperature resisted warming in RCP2.6 and RCP4.5 but underwent hypolimnetic warming under RCP 8.5 in the second half of this century. When comparing optimistic and pessimistic scenarios, uncertainty bands were smaller than differences in ensemble means.

ON181

Are mountain passes higher in Ecuador line than in southern limit of the tropic? A trend for hygropetric insects

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Tropical species tend to show narrower altitudinal ranges than temperate species. One hypothesis argues that species in the tropical region are adapted to stable climatic conditions and therefore mountain gradients are effective barriers to them. We investigated the variation in species composition of hygropetric insects' communities in two mountain chains ranging from 90 to 3000 m a.s.l., one at the Amazon Forest (AM), at latitude zero, and other at the Atlantic Forest (AF), at latitude 23S. We expected to find: 1. higher dissimilarities within AM compared to AF; and 2. stronger influence of environmental factors on AM communities. In total, 109 sites were analyzed. Predictor's variables were separated into environmental, spatial and elevational. We calculated the abundance-based dissimilarity. Additionally, db-RDA and variation partitioning analyses were used to detect the relationships and relative contribution of predictor variables and communities' dissimilarity. Contrary to expected, higher dissimilarity was observed in AF (0.98), although similar to the one in AM (0.97). The spatial predictors were the most relevant for communities in both mountain chains, meaning that the dispersal limitation precludes species to cross the geographic and elevational space. Although environmental factors had secondary relevance for AM communities, it was comparatively higher in this mountain chain than in AF, as expected. Notably, the dispersion of hygropetric insects is limited to the adult phase, what explains the strong effect of spatial factors over hygropetric communities. Additionally, the coastal influence on AF may also contribute to the large beta diversity observed in these mountains.

ON415

Different forms of carbon, nitrogen, and phosphorus influence ecosystem stoichiometry in a north temperate river across seasons and land uses

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Natural and human features on land result in differential loadings of carbon (C), nitrogen (N), and phosphorus (P) to rivers that influence within ecosystem processing. However, little is known about how land use, together with seasonal changes in climate and hydrology, influence the relative proportions and types of C, N, and P in rivers. We quantified the spatial and temporal patterns in DOM components and nutrient forms along the mainstem of a 5th order river through sequential forested, urban, and agricultural reaches during low flow moments in summer and winter, and two contrasting springs, one with a historically rare flooding event. Flow-weighted C: N: P ecosystem stoichiometry ranged from 2319: 119: 1 in the most upstream site to 368: 60: 1 at the outlet, driven by rapidly increasing N and P downstream due to urban and agricultural land uses, and rather stable C concentrations along the continuum. There were widespread abrupt shifts in the composition of DOM in low flow seasons that coincided with changes in land use. Major shifts were observed during the extreme flood year, pointing to unusual loadings. Winter stoichiometry was enriched in bio- and photolabile DOM, inorganic N and dissolved P forms. The spatial and temporal variation in stoichiometry in this north temperate river covered much of the range previously observed between litter ratios and the Redfield ratio. This suggests that even moderate human impacts can have profound effects on riverine ecosystem stoichiometry, and that these effects are modulated by seasonal trends in temperature and hydrology.

ON420

Adaptation to pesticides and associated fitness costs under single and multi-stress conditions

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Under global change scenarios, multi-stress conditions may occur regularly and requires adaptation. However, the adaptation to one stressor may reduce performance due to fitness costs and long-term effects of adaptation. Here we investigated the ecological consequences of adaptation under multiple stress and long-term consequences of pesticide exposure to ultra-low concentrations in the widespread crustacean *Gammarus pulex*. Under optimum temperature, *G.pulex* from agricultural streams were considerably more tolerant to pesticides as compared to the reference populations. Here we assume that the increased tolerance in agricultural populations is the combination of acclimation, epigenetic effect and genetic evolution. After experimental

pre-exposure to very low concentration (LC_{50}/1000), reference populations showed increased pesticide tolerance. In contrast, pre-exposure did not further increase the tolerance of agricultural populations. Moreover, these populations were more sensitive to elevated temperature alone due to the hypothesized fitness costs adaptation. However, both reference and agricultural populations showed a similar tolerance to the combined stress of pesticides and warming due to stronger synergistic effects in adapted populations. As a result pesticide adaptation loses its advantage. The combined effect was predicted well by the Stress Addition Model (SAM), developed for predicting the synergistic interaction of independent stressors. Long-term consequences of increased insecticide tolerance were characterized by significantly reduced survival, per capita growth and mating when organisms were cultured under pesticide-free conditions in the laboratory for three months. We conclude that under multi-stress conditions, adaptation to pesticides reduces the general stress capacity of individuals and trade-off processes reduce the general fitness of adapted populations.

ON153

Differential trends in iron concentrations of boreal streams linked to catchment characteristics

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Increasing iron (Fe) concentrations have been reported for freshwaters across northern Europe over the last decades. This increase, together with elevated concentrations of dissolved organic carbon (DOC), leads to browning of freshwaters, which affects aquatic organisms, ecosystem functioning, biogeochemical cycles, and brings challenges to drinking water production. Here we aimed to increased our understanding of the contribution from different catchment sources to temporal stream Fe dynamics and identify drivers behind long-term trends. For this we investigated Fe dynamics in a network of 13 boreal streams with varying contribution of the two major catchment sources: mires and coniferous soils. We determined Fe speciation in riparian soils and a mire, and studied temporal Fe dynamics in soil-water and stream-water over a span of 18 years. Positive Fe trends were found in solution of the riparian soil, while no long-term trend was observed in the mire. These differences were reflected in stream-water, where three headwater streams with coniferous catchment cover displayed positive Fe trends, whereas the mire dominated stream showed no trend. Surprisingly, the majority of higher order streams showed declining Fe trends, despite long-term increases in DOC. In addition, we found that an extreme drought event led to a prolonged release of Fe and DOC from the riparian soil, likely due to the oxidation of organic matter and the release of associated Fe. Results show that riparian forest soils can be major contributors to ongoing increases in freshwater Fe concentrations and that drought can further promote release of Fe from organic soils.

ON344

Recent ecological changes in Canada's "Northern Great Lakes": a comparative paleolimnological perspective

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While limnological and paleolimnological research on Arctic lakes and ponds has accelerated over recent decades, relatively little data are available for the "Northern Great Lakes". In fact, the late David Schindler noted that the dearth of scientific information available for "Canada's Northern Great Lakes" was a "a national disgrace". Given the paucity of direct limnological studies, we have been employing paleolimnological approaches to reconstruct how these ecosystems have been responding to climatic and other stressors. Here, we compare lake trajectories, over the last ca. 200 years, for Lake Hazen (Ellesmere Island, Nunavut), Great Bear Lake (NWT), and Great Slave Lake (NWT), and compare these changes to those available for medium and small-sized lakes in the region. Using primarily diatom-based paleolimnology, we address fundamental questions such as: What were the baseline limnological states for these large, understudied lakes? Has recent warming affected the algal communities of these large, deep Arctic lakes? How do trends compare among sampling locations within and between lakes? Major diatom compositional shifts and changes in sedimentary chlorophyll *a* (which includes its diagenetic products) concentrations were recorded in recent decades, reflecting rapidly declining ice covers and fundamental changes in lake thermal structure. By comparing the nature and timing of these ecosystem changes to those recorded in nearby medium and small-sized lakes, a clear continuum of changes is discerned, reflecting climate and changing ice covers. Our data track striking changes that will undoubtedly cascade throughout the ecosystems of these iconic lakes.

ON426

The carbon footprint of tropical hydropower is related to reservoir productivity and flooded land area

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The carbon footprint of hydropower has been shown to vary over a wide range, and tropical reservoirs in particular have been reported to be strong sources of greenhouse gases (GHG). However, evidence is not unequivocal, and some tropical reservoirs might have low GHG emission. A part of the conflicting evidence might arise from differences in measurement methods and limnological properties. We used a consistent methodology to measure GHG emission in three contrasting hydropower reservoirs and one drinking water reservoir in Brazil across hydrological seasons. We focused particularly on covering the spatial variability in emission from these often large reservoirs, and we also measured the carbon sink in the sediments. All reservoirs were strong net sources of GHG to the atmosphere, and emission was dominated by methane ebullition and carbon dioxide emission from drawdown areas (sediments that temporarily fall dry). Carbon burial in sediments accounted for only 6-13 % of GHG emission and could therefore not offset GHG emission. Emission of CO_2-equivalents per reservoir area was high in the eutrophic and Amazonian reservoirs, but low in the oligotrophic reservoir. The carbon footprint of hydropower (kg CO_2-equivalents MWh^{-1}) was strongly dependent on size of the reservoir: a very large and meso-to eutrophic reservoir had a carbon footprint similar to fossil fuel combustion, while the footprint of a highly eutrophic but comparatively small reservoir was 7 times lower. New hydropower projects should minimize the area of flooded land, and both existing and projected hydropower installations can minimize their carbon footprint by controlling eutrophication.

ON187

Phosphorus is most often the limiting nutrient in eutrophied Norwegian lakes, but nitrogen-limitation or co-limitation is likely in one third of the lakes

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A recent eutrophication survey of 364 Norwegian lakes based on data available in a national database shows moderate, poor or bad ecological status for nutrients, phytoplankton and/or macrophytes in half of the lakes. Severe cyanobacterial blooms were found in 29 lakes, but may be more widespread, as data on such blooms are missing in half of the lakes. Most of the eutrophied lakes are located in Southern Norway in river basins affected by agricultural runoff and/or urban wastewater. Only a few lakes show significant trends after 2008 when the WDF was implemented in Norway. Improvements were found in ca. 20 lakes where nutrient loads have been largely reduced, while deterioration was found in ca. 15 lakes, indicating a further need for nutrient reduction measures. Climate change with warmer water and increased frequency and intensity of flash floods is likely to counteract and delay recovery. Cyanobacterial blooms in nearshore areas of otherwise oligotrophic large, deep lakes in recent years are of increasing concern in this context. Indicative nitrogen limitation was found in 30% of the lakes with moderate or worse

ecological status based on a weight-ratio below 20 between total nitrogen and total phosphorus. Nutrient reduction measures to decrease the loads of both nitrogen and phosphorus are therefore important to improve the ecological status and reduce the risk for harmful algal blooms. Reduction of both nutrients will also contribute to control eutrophication of downstream coastal water bodies, which is often considered to be nitrogen limited.

ON214

Machine learning models for suspended particulate matter estimates: a global inland waters perspective

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Suspended particulate matter (SPM) in lakes exerts strong impact on light propagation by strong absorption and backscattering and aquatic ecosystem productivity, which ultimately affects water leaving radiance that can be detected by satellite optical remote sensors. In this study, we assembled more than 16400 *in situ* measured SPM over lakes from six continents (excluding the Antarctica continent), in which 9640 samples were matched with Landsat surface reflectance. Seven machine learning algorithms and two regression methods were compated. The results showed that random forest (RF), gradient boosting decision tree (GBDT), and extreme gradient boosting (XGBoost) models demonstrated good spatiotemporal transferability, and have potential to map SPM. The GBDT model has accurate calibration (n = 6428, R^2 = 0.95, MAPE = 29.8%) from SPM collected in 2235 lakes across the world, and the validation (n = 3214, R^2 = 0.84, MAPE = 38.8%) also exhibited stable performance. Further, RF model also exhibited good performances with respect to both calibration (R^2 = 0.93) and validation (R^2=0.86, MAPE = 24.2%) datasets. We applied GBDT and RF models to map SPM of typical lakes, and satisfactory result was obtained from GBDT modeling. In addition, the GBDT model was evaluated by historical SPM measurements coincident with different Landsat sensors (L5-TM, L7-ETM+, and L8-OLI), thus the model has the potential to map SPM of lakes for monitoring temporal variations, and tracks lake water SPM dynamics in approximately the past four decades (1984-2021) since Landsat-5/TM was launched in 1984.

ON166

Do invasive species change ecosystem functions in Lake Constance in an irreversible way?

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Lake Constance, one of the largest Alpine lakes on the border between Germany, Austria and Switzerland, has undergone extensive changes in the past century. In the 1950-1980s, Lake Constance experienced a phase of severe eutrophication caused by untreated sewage and intensive agriculture, resulting in significantly increased nutrient-levels. Although the natural trophic state of the lake has been almost completely restored, there have been irreversible changes to the communities of aquatic organisms.
In addition to eutrophication, climate change and especially the invasion of non-native plant and animal species are endangering natural biodiversity. This leads to changes in the food webs and affect ecosystem functioning in Lake Constance. Specifically the three-spined stickleback (*Gasterosteus aculeatus*) and Quagga mussel (*Dreissena bugensis*) cause major problems.
The three-spined stickleback and Quagga mussel populations have exploded in the last years, with sticklebacks becoming the most abundant pelagic fish species of the lake. The Quagga mussel is able to settle in all water-depths, which causes problems with water intake pipes and other structures. Furthermore, the Quagga mussel is an important competitor for zooplankton-species feeding on phytoplankton. We hypothesize that the decline in catch yields and fisheries in Lake Constance is caused, at least partly, by these two invasive species.
We present a large EU funded project (www.seewandel.org) that i.a. investigates causes and consequences of such invasions for Lake Constance and its ecosystem functions, and that aims to develop methods to mitigate the consequences. We present latest results about those invasive species and its consequences for the lake.

ON271

A report on the global survey of lake restoration in practice

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The UNEP coordinated World Water Quality Alliance (WWQA) Ecosystem Workstream is an open membership body which aims to assess and improve water quality with a focus on freshwater restoration. In 2021, WWQA Ecosystems initiated a Global Survey of Lake Restoration. By, April 2022, the survey had returned >150 responses from >30 countries across six continents, representing a deep global context on the past, present and future of sustainable lake management. The Global Survey provides evidence on the scope of human-induced pressures, lake uses, target setting, management measures and their effectiveness, and on the importance of considering contemporary and future stressors in management plans. In this presentation, we will provide an overview of the results of the Global Survey, exploring variation in the responses across countries and regions. Responses indicate that although nutrient emissions remain the primary pressure on lakes globally; climate change impacts, invasive species and hydrological modifications are also globally pervasive. However, some novel or emerging pressures (e.g., plastics, eWastes) appear to be more 'visible' in management responses in more developed economies, whereas, monitoring capacity remains a challenge in less developed economies. Strong governance, stakeholder engagement, knowledge, and resources, were most important for restoration success, while insufficient support for cross-sector working and policy, poor understanding of the problems and weak governance were the most common reasons behind failure. We will present draft priority messages for policy makers and the public, to be communicated by the WWQA to raise awareness of the multiple benefits of effective management of lakes.

ON043

Effects of different fluctuation regimes at high temperatures on the performance of *Daphnia magna* clones differing in thermal sensitivity

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Depending on their geographical distribution ectothermic species may be adapted genetically to local temperature conditions. Climate change, however, leads to rising mean temperatures, more frequent thermal extremes, and increasing amplitudes of daily temperature fluctuations, which may push aquatic ectotherms closer to their thermal tolerance limits. Understanding the effects of high and fluctuating temperatures on the performance of key aquatic ectotherms is important to assess potential changes in trophic transfer and functioning of freshwater food webs. Using the cladoceran *Daphnia magna* as ectotherm model organism, we measured life history traits of clonal lineages originating from different latitudes in response to high mean temperatures and different fluctuating regimes. Our aim was to assess whether fluctuations at high temperatures have detrimental effects on performance and if so, how this is depending on differences in fluctuation regime and the thermal sensitivity of the clones. As expected from theory, detrimental effects of temperature fluctuations on growth rate were more pronounced at higher mean temperatures. We observed strong clone dependent effects related to the thermal sensitivity of the clones. Northern clones, locally adapted to lower temperatures, showed larger negative effects of fluctuations at high mean temperature compared to southern clones. We also observed complementary effects of high and fluctuating temperatures on reproductive outcomes and ingestion rates. Overall, our results support theory on fluctuation effects based on non-linear thermal performance curves and may deliver a baseline for predicting impacts of climate change on aquatic ectotherm performance under fluctuating, more natural conditions.

ORAL ONSITE

ON127

Global patterns in the methane to carbon dioxide ratio of running waters

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The ratio of methane (CH_4) to carbon dioxide (CO_2) concentrations or fluxes can serve as a metric for assessing the relative importance of methanogenesis in ecosystems. Yet, to date, the usefulness of this proxy has hinged on having relatively constrained CH_4:CO_2 ratios, which often holds for wetlands, but may not for running waters, where concentrations of both gases reflect contributions from internal production and external inputs. We leveraged a new global database (GRiMeDB), including nearly 16000 observations from 2800 streams and rivers, to assess scaling relationships between $CH_4$and CO_2, evaluate variation in CH_4:CO_2 ratios, and explore the physical, chemical, and land-use drivers that shape these patterns. Globally, CH_4 and CO_2 concentrations were positively correlated (r = 0.55), but considerable variance in this relationship underscores a wide range in CH_4:CO_2. The overall average ratio was 0.008, but observations spanned eight orders of magnitude, with 5th and 95th percentile values of 0.0001 and 0.028, respectively. In general, CH_4:CO_2 increased with dissolved organic carbon (r = 0.32), but also decreased with discharge for most sites that had sufficiently long records. Across biomes, average CH_4:CO_2 was notably high in the Arctic tundra (0.025), highlighting the importance of methanogenesis in these permafrost-dominated, carbon-rich landscapes. Based on our findings, we suggest a conceptual model for understanding the controls over the CH_4:CO_2 ratio and the corresponding implications for carbon cycling in fluvial ecosystems.

ON108

Fate, uptake and effects of plastic nanoparticles when entering wetland mesocosms

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The alarming increase of plastic waste has led to a research focus on effects of micro- and nano-sized plastic particles. Previous studies have shown negative effects of nano-sized plastic particles (NPP) on freshwater biota. Since most studies have been carried out at the lab-scale, there is an urgent need to assess the fate and environmental effects of NPP in natural ecosystems. Therefore, we evaluated the transport, fate, uptake and effects of polystyrene nanoparticles (88±11 nm) using constructed freshwater wetland mesocosms. Quantifying NPP in complex environmental matrices is, however, analytically challenging; hence, we used gold-cored NPP, allowing us to assess their transport and fate in the wetlands. Twelve wetland mesocosms were set up and inoculated with *Asellus aquaticus* and *Daphnia magna*. NPP were added weekly to the treatment wetlands (N=6). At the end of the experiment (week 10), animals, sediment and macrophytes were sampled. We show that NPP moved through the wetlands and a considerable part of them were retained in sediment and macrophyte roots. NPP were taken up by both *D. magna* and *A. aquaticus*, with *D. magna* showing a significantly higher uptake, which may explain why NPP-exposed *D. magna* showed altered behaviour compared to controls. However, neither *D. magna* nor *A. aquaticus* population sizes were affected by NPP´s at the end of the experiment. On the other hand, algae biomass was significantly reduced in the presence of NPP. Overall, our study provides needed understanding regarding the fate and effects of NPP when entering natural freshwater ecosystems.

ON257

Linking spatial patterns of DOM molecules and microbial taxa along a boreal terrestrial-aquatic continuum

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Microorganisms and dissolved organic matter form the bridge between the abiotic and biotic realms across ecosystems. Recent advances in analytical approaches have allowed us to study both pools with extremely high resolution, however, the overwhelming amount of data often yield more challenges than decisive answers. Both pools have been shown to be composed of a seemingly unreactive fraction (i.e., dormant microorganisms and persistent DOM molecules), thus, identifying the reactive moieties may aid us in disentangling the complex interactions between DOM and microbes. To distinguish the reactive members within both microbial communities (16S rRNA) as well as DOM molecular formulae (MF) assemblages (FT-ICR-MS), we followed their individual spatial patterns along a boreal terrestrial-aquatic continuum in Eastern Québec, Canada (i.e., soils, streams, rivers, reservoir) over two years and two seasons. This framework allowed us to categorize the individual microbes and MF into four distinct categories: relatively unreactive (‚stable'), various degrees of ecosystem specificity peaking at one or multiple locations along the continuum (‘dynamic'), and those that either consistently ‘increase' or ‘decay' as they travel downstream. These spatial units potentially indicate similarity in reactivity to environmental changes, passive persistence, or loss along the continuum. Preliminary results show that this novel approach using spatio-temporal dynamics can be useful when trying to effectively link the dynamics of microbial and molecular assemblages within aquatic networks. It enables us to distinguish between passive patterns that are mainly caused by changes in hydrology and those that may be actively involved in microbial and DOM interactions.

ON234

The terrestrial and semi-aquatic invertebrates of intermittent rivers and ephemeral streams

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Intermittent rivers and ephemeral streams (IRES) are the most abundant waterways worldwide. They can support a diverse and often abundant terrestrial and semi-aquatic invertebrate (TSAI) fauna. TSAIs can be found in a variety of habitats, including floodplains, riparian zones, dry riverbeds, unsaturated gravels, the surface of exposed gravel bars, and the shoreline. Much less is known about the species composition and ecological roles of TSAIs of IRES than their aquatic counterparts, with TSAIs being largely overlooked in conceptual models, policy, legislation, and ecological monitoring. Here we introduce TSAIs, and present conceptual models describing how they respond to hydrological changes in IRES. We then test these models with data collected from IRES in Australia and France during wet and dry phases. These generic models can be utilised by policy makers and water managers, ensuring that both wet and dry phases are considered in the management and protection of IRES. IRES should be viewed as a habitat continuum through time, with aquatic, semi-aquatic and terrestrial invertebrate taxa inhabiting at any hydrological stage. We call for collaboration among terrestrial and aquatic ecologists to further explore these invertebrates and ecosystems.

ON395

Predator mediated feedback effects in natural plankton communities

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Biodiversity loss due to climate change is unquestionable and, in some areas, irreversible. While some species cope less well with higher water temperatures, others benefit. A well-known predator in plankton systems is *Chaoborus* sp.. While this predator normally occurs in cycles, its presence is more and more constant throughout all seasons. As a very efficient but also selective predator in zooplankton, increased abundance can lead to shifts in the composition and diversity of the zooplankton community. These changes in the zooplankton can have lasting effects on nutrient recycling in the food web. For example, resources such as nitrogen and phosphorus are used differently by the respective zooplankton genera and are thus less or more available to the primary producers. This in turn can lead to changes in the composition of the primary producer communities, resulting in a shift in traits of the primary producers. The presence or absence of a predator can thus have a major impact on feedback mechanisms in plankton communities. While direct predator-prey effects are well known, there is a lack of knowledge about the above-mentioned feedback effects in natural plankton communities. Here, we present experimental data from eight different lakes that mainly show the changes in nutrient availability for phytoplankton caused by predator-mediated shifts in zooplankton communities. We discuss the resulting community compositions as well as phytoplankton biodiversity and possible implications for the food web.

ON228

Can space-for-time-substitution surveys represent zooplankton biodiversity patterns and their relationship to environmental drivers?

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Space-for-Time-Substitution surveys (SFTS) are commonly used to describe zooplankton community dynamics and to determine lake ecosystem health. SFTS surveys typically combine single point observations from many lakes to evaluate the response of zooplankton community structure and dynamics (e.g., species abundance and biomass, diversity, demographics and modeled rate processes) to spatial gradients in hypothesized environmental drivers (e.g., temperature, nutrients, predation), in lieu of tracking such responses over long time scales. However, the reliability and reproducibility of SFTS zooplankton surveys have not yet been comprehensively tested against empirically-based community dynamics from long-term monitoring efforts distributed worldwide. We use a recently compiled global data set of more than 100 lake zooplankton time series to test whether SFTS surveys can accurately capture zooplankton diversity, and the hypothesized relationship with temperature, using simulated SFTS surveys of the time series data. Specifically, we asked: (1) to what degree can SFTS surveys capture observed biodiversity dynamics; (2) how does timing and duration of sampling affect detected biodiversity patterns; (3) does biodiversity ubiquitously increase with temperature across lakes, or vary by climate zone or lake type; and (4) do results from SFTS surveys produce comparable biodiversity-temperature relationship(s) to empirical data within and among lakes? Testing biodiversity-ecosystem function (BEF) relationships, and the drivers of such relationships, requires a solid data basis. Our work provides a global perspective on the design and usefulness of (long-term) zooplankton monitoring programs and how much confidence we can place in the zooplankton biodiversity patterns observed from SFTS surveys.

ON353

What nutrient enrichment experiments (don’t) tell us about underlying co-limitation mechanisms

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Harmful algal blooms (HABs) are increasing in frequency and extent globally, in part due to cultural eutrophication supplying algae with ample nutrients. Nutrient enrichment experiments (NEEs) are widely used to characterize nutrient limitation in aquatic ecosystems. While NEEs provide information about what nutrient(s) are limiting a system from further growth, the underlying mechanisms of co-limitation are not thoroughly explored in most NEEs. Theoretical underlying mechanisms of co-limitation include community composition shifts, heterotrophic-autotrophic mutualistic relationships and metabolic efficiency associated with multiple nutrients in replete supply. We hypothesize that NEEs that measure additional endpoints alongside growth are more capable of discerning what underlying metabolic or community level pathways are leading to two nutrients stimulating a community additively, and that these experiments have the power to advance co-limitation theory. To assess this hypothesis, we conducted a literature review of all ~2500 papers that cite the landmark co-limitation paper, Elser et al. 2007, to determine what proportion of aquatic NEE papers are investigating underlying mechanisms of co-limitation. We also analyzed these citing papers for consistent co-limitation language use based on Harpole et al., 2011 and Morris and Lewis, 1988. While most aquatic ecology researchers are using consistent co-limitation language, preliminary results indicate that <20% of NEE papers report on the underlying mechanism of co-limitation, or measure endpoints other than growth. To more holistically understand and protect our aquatic resources from HABs, researchers conducting NEEs should consider investigating the specific metabolic or community pathways resulting in co-limitation of algal growth.

ORAL ONSITE

ON218

Zooplankton dynamics in lakes of different trophic state, depth and climatic region - a test of the PEG model

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The SIL Plankton Ecology group (PEG) conceptual model describes the patterns, and proposes the driving factors of seasonal phyto- and zooplankton succession in oligotrophic and eutrophic lakes. However, tests of the highly cited PEG model that address differences in zooplankton biomass dynamics across gradients of lake trophic state, depths and climatic regions are rare. Here, we use high-temporal (at least twice/month) resolution monitoring data from 25 lakes assembled within the GLEON ZOOPEG project to analyze 1) the degree to which the timing and the biomass of the zooplankton peak during spring are temperature versus food controlled; 2) whether this control changes with lake depth, trophic status or climatic zone; 3) whether zooplankton phenology and maximum biomass depend on phytoplankton phenology. We found complex patterns across lakes showing that the timing of the zooplankton maximum was strongly temperature and hence climatically controlled, whereas the maximum biomass depended strongly on trophic state. Relative to temperature forcing, phytoplankton phenology was only of secondary importance for spring zooplankton dynamics.

ON328

LIFE-Goodstream: a holistic approach to reach good ecological status of an agricultural stream

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The agricultural stream Trönningeån (drainage area: 31 km^2) in Southwest Sweden suffers from eutrophication, restricted fish migration, low biodiversity in and adjacent to the stream and repeated floods in downstream areas and was classified as moderate ecological status. In LIFE-Goodstream (2016-2022) we aimed at solving all problems simultaneously by a combination of close co-operation with landowners and the application of multifunctional measures. We have designed and located 21 constructed wetlands (CW), 13 Integrated Buffer Zones (IBZ), ca 30 amphibian ponds, ca 30 other creotopes, removed 2 migration barriers, constructed 3 new stream bed parts (previously piped), widened the cross section of the stream for ca 1 km in the downstream areas and deployed 570 nest boxes for birds, bats and solitary bees. The results show an improved nutrient status (phosphorus) for 80 % of the drainage area, and now the agricultural area is below the nutrient threshold for good ecological status. It is only in and downstream of urban areas that still has high nutrient levels. Interestingly it is in the downstream parts the monitoring station (run by the County Administrative Board) for status classification is located. The widening of the cross section of the stream seems to have reduced floods in urban areas and on arable fields. The biodiversity in the area has responded with major increase in species number for several organism groups (e.g. birds, amphibians, mammals, dragonflies, pollinators). The project has also been valuable for co-creation, citizen science and public recreation, and generated several research projects.

ON079

Diet- and temperature-controlled modifications of polyunsaturated fatty acids in Chironomidae larvae

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Chironomidae larvae often dominate benthic communities and thus, are important vectors for the transfer of nutrients, such as polyunsaturated fatty acids (PUFA), from the aquatic to the terrestrial environment. We conducted a set of experiments to investigate the effects of diet and warming on the proportions of eicosapentaenoic acid (EPA) and arachidonic acid (ARA) in *Chironomus riparius*. The experimental diets consisted of a nontoxic cyanobacterium, two chlorophyte taxa, and a diatom. We used TetraMin® fish flakes as a control treatment. Diet manipulation experiments indicated that *Chironomus* can desaturate PUFA precursors (C_{18} and C_{20} PUFA) to EPA and ARA. Dietary C_{20} precursors appear to be converted to EPA and ARA at a higher rate than C_{18} precursors. Warming decreased bioconversion of the precursors to EPA and ARA, while warming did not affect the levels of EPA and ARA in *Chironomus* if these fatty acids were directly availably in the diet. This indicates that warming-induced remodeling of PUFA may occur via downregulated desaturase activity. The results also showed that *Chironomus* did not accumulate docosahexaenoic acid (DHA) into the tissues, even if it was abundant in the diet. Most likely DHA was retroconverted to EPA. Overall, our results suggest that the cross-ecosystem transfer of PUFA via emerging chironomids may vary across waterbodies due the differences in biotic and abiotic factors, i.e., diet and temperature. Therefore, the analysis of PUFA in emerging chironomids may be a useful addition for monitoring purposes, such as the ecological status of lakes.

ON227

Environmental stoichiometry mediates phytoplankton diversity effects on communities' resource use efficiency and biomass

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Positive biodiversity-ecosystem functioning (BEF) relationships are predicted to increase in strength when high environmental variability allows for complementarity between resource use strategies in diverse communities. This environmental variability can be represented by spatial or temporal variation in nutrient ratios, but resource use efficiency (RUE) and therefore biomass build-up might be restricted when nutrient ratios are highly imbalanced (i.e., limitation by one nutrient and beyond optimal ratios for growth). Whereas the linkages between ecosystem functioning, diversity, and nutrient availability are theoretically well understood, we lack experimental evidence on how phytoplankton diversity affects resource use and biomass under variable nutrient ratios (N:P ratios). Combining a mesocosm and a microcosm experiment we tested diversity effects on ecosystem functioning by exposing a species diversity gradient generated by the loss of rare species in a natural community to different N:P ratios (uniform vs a gradient). The N:P supply ratio gradient also allowed us to evaluate responses across balanced and imbalanced ratios. We found that increased species diversity led to increased community RUE (and biomass) when supplied a gradient of N:P ratios. However, diversity did not affect RUE under uniform nutrient ratios. Thus, our results suggest that the effect of rare phytoplankton species losses on community RUE and biomass can be compensated by the persistent species when nutrient ratios are uniform, but leads to decreases in ecosystem functioning under variable nutrient ratios.

ON143

Towards better biomonitoring of temporary aquatic ecosystems: insights from dry streams in wet places

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Temporary streams are widespread and diverse in cool, wet countries such as the UK. Here, the chalk streams of south and east England are among the UK's most iconic rivers, and their 'winterbourne' reaches naturally dry in response to fluctuating groundwater levels. Chalk streams are celebrated for their international rarity, high water quality, biodiversity, and provision of recreational ecosystem services, but are also subject to a breadth of human impacts including eutrophication and geomorphological degradation. In addition, climate change and water abstraction are increasing the spatial and temporal extent of their dry phases. River managers thus need tools to assess the ecological health of winterbourne chalk streams regardless of whether they are wet or dry. This presentation will introduce winterbourne chalk streams and explore research done by academic and stakeholder collaborators to improve their biomonitoring. We will discuss research guiding the adaptation of current biomonitoring methods for use during flowing phases, then will focus on our use of newly collected field data to evaluate plant and invertebrate communities (including both their terrestrial and aquatic species) as biomonitors that enable ecological health assessments during dry phases. We call for testing, adaptation and use of our approaches to promote dry-phase biomonitoring which informs conservation of temporary waterbodies from winterbourne streams in cool, wet England to dryland ponds in arid zones.

ON407

Dendritic network location mediates detritivore community structure and associated processing of leaf litter in a riverine ecosystem

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Historically, studies have examined how local habitat, resources and species interactions influence community structure in stream ecosystems. Increasingly, though, attention has turned to understanding how regional factors (e.g. dispersal) interact with local conditions to influence communities. Often dispersal of organisms occurs in spatially-constrained habitats, which can drastically influence community assembly. Dendritic networks are an example, and have a branching spatial configuration with some branches of the system more connected to others, making dispersal easier, while other locations are more isolated. As interest in multi-scale community assembly mechanisms has increased, less work has focused on the relationship between community assembly and ecosystem processes. Here, we sought to understand how consumer-resource interactions unfold in river networks. We predicted that stream network location would mediate detritivore (shredder) richness and abundance, and in turn would be associated with a shift in decomposition of organic matter (leaf litter). To examine this, we manipulated leaf litter species in isolated (headwaters) and connected (mainstem) stream reaches. We found that shredder richness and abundance were influenced by both leaf litter quality and network location. Headwater environments supported a stronger consumer-resource relationship, and shredder communities were further richer and more abundant. This was not the case in mainstem locations. In these relatively harsher environments, we offer that shredders did not appear to be actively feeding on the resources, but rather utilizing leaf litter more for habitat. Our results suggest river network position has important implications for how ecosystem function changes across spatially-constrained environments.

ON332

Tracking the biochemical fate of terrestrial and plastic carbon using compound-specific isotopes

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Autotrophic primary production is the ultimate source of energy and biomolecules in aquatic food webs. However, freshwater receives also terrestrial loadings and plastic materials. The ^{13}C-labeled materials and compound-specific isotopes can be used to track the biochemical fate of different organic particles. Here we used ^{13}C-labelled leaves, lignin/hemicellulose, and polystyrene to track their biochemical fate (fatty and amino acids) at four different trophic levels. Our results show that freshwater microbes are able to decompose also recalcitrant organic carbon sources and synthesize some fatty acids and amino acids. These simple organic biomolecules are nutritionally upgraded by mixotrophic algae to support their growth and synthesis of biomolecules which become an inseparable part of food components for zooplankton and up to fish. Our study shows that ^{13}C-labeling together with compound-specific isotopes is a great tool in the studying processes of the aquatic food webs.

ON184

Spatio-temporal variations in sediment P dynamics in large shallow Lake Peipsi

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In the current study, we aimed at elucidating the mechanisms involved in sediment P release in large shallow Lake Peipsi. For that, we calculated diffusive P flux, fractional P and organic matter composition, measured redox potential and pore water concentrations of soluble reactive P and dissolved iron (Fe) in surface sediments (0-3 cm) in two subbasins of the lake with different trophy. Dissolved oxygen concentration in the water layer overlying lake bottom remained well above 2 mg/l, but redox potential at the sediment-water interface was close to 200 mV during the whole study period (in May, August, October). The importance of classic redox-related release was supported by two findings: a) increase in both soluble reactive P and dissolved P in the porewater with a decrease in redox potential; b) P release rate resembled mainly changes in the concentration of P adsorbed to iron-oxyhydroxides. Coprecipitation with calcium appeared to be an important mechanism of P settling at one site due to geochemistry in the watershed. At the southernmost site with higher trophic state, the TP in sediments increased from June to October, being replenished by increased inflow from the south in autumn. An internal P load for the summer 2021 (504 mg/m^2, as a product of the approximate extent and duration of sediment anoxia and mean summer release rate) was 1.5 fold of the long-term mean value for 1997-2018 (Tammeorg et al., 2020). Recent increases in water temperature and declines in water level could have considerable implications for lake water quality.

ON307

CO_2 and O_2 dynamics in Closed Ecological Systems of algae, *Daphnia*, and microbes

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More precise CO_2 and O_2 changes were measured by eliminating gaseous diffusion with the open atmosphere. Closed Ecological Systems consisting of 3 species of green algae, with or without the grazers *Daphnia magna*, and associated microbes have been studied in an instrumented Manta 2™ chamber containing probes for O_2, pH, conductivity, temperature, chlorophyll, and turbidity whose output was recorded and stored every 5 minutes during alternating dark and light conditions. Gentle mixing was necessary to provide transfer between the 850 ml aquatic and 60 ml atmospheric components. Alkalinity measurement and the CO2sys model were used to estimate forms of inorganic carbon. Replicated experiments have been conducted in non-instrumented sealed bottles. Among our findings in the instrumented chamber is that much more CO_2 was removed than suggested by the Redfield

ratio, given different amounts of nitrate as the limiting factor. This is consistent with C:N uncoupling and C overconsumption studies reported for natural phytoplankton assemblages. Given a small initial biota and a new nutrient supply, the ecosystems underwent a series of phase changes from gain, retain, and loss as net production changed from positive to zero, and eventually to negative. The grazers reduced the standing crop of phytoplankton to very low levels and persisted for months. High concentrations of nitrate resulted in CO_2 depletion, high pH, high O_2, and *Daphnia* declines. Our research objectives include learning the requirements for a self-sustaining ecosystem.

ON215

Assessment of phytoplankton dynamics and algal bloom events in an anthropised eutrophic tropical system using Sentinel-2 MSI time series

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Anthropogenic activities can heavily impact estuarine systems, and remote sensing is increasingly used to provide data to assess the function of these systems. This study used a time series of atmospheric and sunglint corrected Sentinel-2 MSI imagery from 2016 to 2021 to assess phytoplankton dynamics and frequency and timing of algal bloom events in a eutrophic tropical coastal system, the Mundaú-Manguaba Estuarine-Lagoon System (MMELS).
A previously validated chlorophyll-a (chla) semi-empirical algorithm (r^2 = 0.81, %RMSE = 34.0%) was employed, along with a locally-validated empirical algorithm (r^2 = 0.68, %RMSE = 12.6%) to retrieve the absorption coefficient of coloured dissolved organic matter (aCDOM(400 nm)).
There was a slight interannual variation in the system's chla and CDOM, concentrated on the bloom-forming areas, and seasonally, the lagoons exhibited mostly spatial variation, with the wet season being slightly less productive due to inorganic inputs, except for the more anthropised areas where higher flow increases nutrient availability.
The Manguaba lagoon showed a much higher correlation between chla and CDOM than Mundaú, confirming that most of the carbon in the lagoon has an autochthonous source, which indicates that hydrodynamics and the residence time in this lagoon are of major importance.
About 40% of the images analysed showed algal blooms, which are spread throughout the year and affected the entire Manguaba lagoon, but mostly the margins of the Mundaú lagoon. Further research will explore the driving forces of algal blooms in the system.

ON099

The impact of consecutive heat wave and pesticide exposure on two congeneric damselfly species and their gut microbiome

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To understand when and how stressors interact, we need better mechanistic insights and contrast combined stressor effects between species differing in tolerance. One understudied mechanism that may underlie responses to single and combined stressors are changes in the gut microbiome. We examined the effect of consecutive exposure to a heat wave and the pesticide chlorpyrifos, two frequent stressors in aquatic ecosystems that may reinforce each other's negative effects. We did so in two congeneric *Ischnura* damselfly species with special focus on changes in their gut microbiome. The heat wave, but not the pesticide, negatively impacted larval life history, whereas both stressors altered the physiological variables. *I. pumilio* had a higher energy budget than *I. elegans* allowing them to better cope with the increased energetic demands under stressor exposure. For example, *I. pumilio* did not suffer a pesticide-reduced growth rate, while *I. elegans* did. No evidence of higher negative effects of the pesticide after exposure to a heat wave was found for both species. Considering the gut microbiome, we found a different community composition between the two species and after the heat wave exposure but not after the pesticide exposure. We discuss how patterns at the level of the damselfly phenotype are associated with stressor-induced changes in the gut microbiome. Our results highlight that life history traits may not always show the combined impact of stressors on organisms, and that physiological variables may be more sensitive biomarkers.

ON392

Theoretical implications on the energetic role of parasites and its benefits for the ecosystem

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Parasites play an important, yet often neglected role in plankton community dynamics via direct control of host species as well as indirect effects through community feedbacks. So far, only a few studies have investigated host-parasite interactions in a community context with most food web studies solely focusing at predator-prey interactions. Consumption of parasites can create additional energy pathways to consumers from otherwise inedible host species. One well-known example from aquatic systems is the consumption of the infectious stage of parasitic fungi, i.e. zoospores, by zooplankton following the infection of otherwise inedible phytoplankton hosts (mycoloop pathway). Therefore, we theoretically investigated the influence of parasite-mediated trophic interactions on energy flow and community dynamics in a simplified food web consisting of parasitic fungi, host and non-host phytoplankton species, and zooplankton feeding on non-host phytoplankton and parasitic fungi. The results show an increasing importance of energy flow through the mycoloop with increasing nutrient availability. In accordance with empirical observations, the model predicts that fungi can contribute up to 50% to total zooplankton diet. Differentiating susceptible and infected host cells in our dynamic model increases the abundances of species involved in the mycoloop and the possibility of boom-bust dynamics, where long periods of a quasi-stable community state with dominance of non-host phytoplankton are interrupted by abrupt changes in community composition. The results highlight the critical role of parasites for community dynamics with important implications for energy flow and species coexistence in eutrophying ecosystems.

ON404

Carbon and microbial dynamics along the salinity gradient of the Elbe Estuary

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Estuaries are key components of the global carbon cycle and disproportionally contribute to carbon exchanges between aquatic, atmospheric, and terrestrial environments. In particular, they represent important loci for blue carbon storage and greenhouse gas emissions. To better understand the underlying mechanisms and organismic responses to current climate and anthropogenic changes, the DFG-funded graduate school BiCEst has been established. Our subproject focuses on the role of microbial organic matter colonization and remineralization in the open water column of the River Elbe. Thereby, evaluating both particulate and dissolved carbon exchanges that have previously shown strong seasonal trends. Aquatic CO_2 uptake has been mainly attributed to phytoplankton primary production and thus bloom dynamics, and aquatic CO_2 release to microbial degradation of dissolved and particulate carbon.

To better understand the interplay between both carbon pools and microbial communities we analysed carbon pool concentrations and chemical features. We identified a seasonal switch in DOM where winter shows increased proportions of marine humic-like matter, and summer increased inland organic matter sources. Particle characteristics affect microbial remineralization and particle fate; therefore, we separated suspended and sinking particles as particle density determines sinking velocity even in

highly turbulent systems. We identified significant particulate carbon concentration differences between suspended and sinking particles, as well as between seasons and locations. Here we show that the assessment of both dissolved and particulate carbon sources enables a better understanding of microbial community dynamics and functions, and thus the role of estuaries for blue carbon sequestration.

ON453

The end of nature?

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We will have to say goodbye to the romantic idea of an intact nature. The global interventions of mankind are too massive, many changes irreversible and the social challenges enormous. Yet we are only at the beginning of the „Great Acceleration" in the age of the Anthropocene. Thus, most habitats have been "domesticated", i.e. modified for the greatest possible benefit for us humans. For this, we engage in immense, irresponsible overexploitation of our nature - floods, heat waves and forest fires are, after all, not necessarily natural disasters; they are primarily man-made disasters. We are fully responsible for this damage through our actions. To solve the problem, we are increasingly relying on large-scale technical measures: building dams, diverting entire rivers and desalinating seawater. However, we need a fundamental rethinking of our relationship with nature, because sustainable solutions can only be found with and not against nature. And we have less and less time to take countermeasures.

ON361

The promising example of the LéXPLORE platform to promote interdisciplinary research on a large lake

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Understanding changing lakes in times of climate change requires novel and multidisciplinary measurements taken at high temporal resolution independent of the weather conditions. To bridge this data gap, the LéXPLORE platform was installed on Lake Geneva in 2019 and allows measurements in the surface layer that were impossible before due to drifting nets. This floating laboratory greatly facilitates the working conditions of the scientists, and brings researchers from diverse fields together, which promotes interdisciplinarity. The platform has further enhanced collaborations across disciplines through a strong partnership between five research institutions in Switzerland and France. This infrastructure allows collecting physical, chemical and biological data at high-frequency to model lake processes at appropriate time scales. A core dataset with background information is available openly and in real-time on the online data portal www.datalakes-eawag.ch. In addition, remote sensing products and simulations from a 3D-hydrodynamic model are openly available to extrapolate the local conditions over the entire lake. This presentation will give an overview of the key projects among the 40 projects that use the platform. Some projects concentrate on the ecosystem functioning including viruses, bacteria, mussels, phytoplankton to fishes, while others focus on key physical and biogeochemical processes or on evaluating pollution such as microplastics. A significant number of projects develop and test new technologies. Finally, the lessons learnt to develop such a platform will be discussed, to hopefully help other scientists to build such valuable infrastructure elsewhere. Any international researcher is welcome to benefit from the LéXPLORE platform and its active collaborations.

ON256

Ignorance of the connectivity between inland waters and surrounding landscapes results in overestimated continental carbon sink and failed climate mitigation

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Inland waters are highly connected to surrounding landscapes, making them important components of the continental carbon balance, and thereby crucial regulators of the land carbon sink. The Paris agreement identifies the importance of the conservation, or better, increase of the land carbon sink. The carbon sink is monitored via national reports to the United Nations Framework Convention on Climate Change, where the continental carbon balance is handled within Land Use, Land-Use Change, and Forestry (LULUCF), according to IPCC Guidelines for National Greenhouse Gas Inventories. However, in current inventories the coverage of all territorial carbon sinks and sources is incomplete, with important gaps concerning wetlands and inland waters. Here we demonstrate, using Sweden as example, that the land sink, which is critical in order to achieve national and international climate goals, is reduced to less than half of current estimates when emissions from wetlands, lakes and running waters are considered. This should have implications for the development of mitigation policy. We also show that current and future global emissions of methane and carbon dioxide from inland waters may radically offset continental greenhouse gas sinks. National as well as global inventories of sources and sinks need to consider the entire territory, including inland waters, to allow accurate guidance of future mitigation of climate change.

ON102

How do the structural characteristics of benthic invertebrate communities respond to agricultural stressors in small water bodies?

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Small standing water bodies (SWBs), such as kettle holes, are abundant in the northeast German lowlands and can often be found on agricultural fields. Due to their size and location, they are especially susceptible to external impacts and affected by multiple stressors such as nutrient and pesticide loads. Yet, SWBs are biodiversity hotspots and stepping stone elements, which contribute considerably to aquatic species richness and are important refuges of rare species, in a landscape where agriculture is prevailing. However, some agricultural practices can lead to habitat losses or water quality degradation, which leads to biodiversity declines. This study is based on a comprehensive dataset from more than 100 SWBs sampled for benthic invertebrate diversity and for parameters describing the water quality. We modelled the response of benthic invertebrate communities to stressors such as toxicity and nutrient concentrations.
The results show that biodiversity response variables, e.g. the Shannon-index or the EPT-taxa index, react differently and do not necessarily respond to stressors, as we would expect. Therefore, response variables other than structural biodiversity metrics (e.g. functional metrics) need to be selected to disentangle multiple stressor effects.
Furthermore, we suspect that due to ubiquitous and long-time occurrences of stressors, resulting from agricultural practices in the examined landscapes, the structural community composition does not show a strong response. Analyzing the response of functional diversity to stressors could improve predictions on ecosystem degradation or vulnerability, which can lead to more informed conservation measures.

ON302

Effects of flow reduction and biodiversity decline on periphyton characteristics and carbon cycling

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Climate change induces changes in riverine flow that affects biodiversity and stream functioning. In this work, we disentangle the effects of both low flow and presence of macroinvertebrates on periphyton characteristics. We grew periphyton on tiles placed in 8 identical experimental flow channels at the German Environment Agency (UBA, Berlin), as part of the EU Horizon project Aquacosm-Plus. We tested for the effects of two flow velocities: a normal flow of 0.25 m/s and an extreme low flow of 0.05 m/s. The effect of primary consumers was tested by placing a diverse macroinvertebrate community from a nearby stream in four of the channels. Periphyton tiles exposed to the different treatments were placed in sealed-flow chambers to measure primary production (GPP), ecosystem respiration (ER), and dissolved oxygen isotope ratios (expressed in ‰ as $\delta^{18}O_{DO}$). Moreover, we measured organic matter (AFDM), chlorophyll-a, and taxonomic biodiversity. Flow reduction (i) decreased GPP and increased ER resulting in a more heterotrophic biofilm, and (ii) led to more positive $\delta^{18}O_{DO}$signals (i.e more enriched in ^{18}O). These changes potentially alter biofilm isotopic composition. The presence of macroinvertebrates contributed to a decrease in AFDM but shifted biofilm composition, so it was dominated by autotrophic production. Moreover, the presence of macroinvertebrates partially buffered the effect of low flow on periphyton metabolic activity. Our results suggest that extreme low flow impact stream functioning, and that a diverse macroinvertebrate community could contribute to increase the resilience of freshwater ecosystems to these changing climate effects.

ON282

Seasonal variation of symbiotic bacterial community in three dominant crustacean zooplankton in Lake Biwa, Japan

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Three dominant zooplankton, i.e., *Eodiaptomus japonicus*, *Daphnia pulicaria*, and Cyclopoida spp., play a vital role in the Lake Biwa food web. Symbiotic bacteria are an integral part of these hosts, promoting their fitness. To determine dominant and stable symbiotic bacteria in the digestive tracts and other body parts, we used 16S rDNA gene sequencing. We collected zooplankton and water samples from the epilimnion (0-20 m) at a pelagic site in the north basin of Lake Biwa in March, June, and September 2021. We dissected gut from the animals sorted from the samples and made metagenomic analyses with the gut, body other than the gut, and suspended particles in ambient waters. The lake water was vertically mixed in March while stagnant in June and September. Symbiotic bacterial communities in both gut and body other than gut were more diverse than those in the ambient waters. Nine bacterial families were always dominant in the three hosts during the study period. Firmicutes were common in the gut of all three hosts but absent in the ambient lake waters. The bacterial compositions in the gut were similar to those in the body other than the gut while different among the three hosts and seasons. The dominant family in both gut and body other than gut were relatively similar in the stagnation period. This may be attributed to the different feeding habits of the three hosts; *E. japonicus* is omnivore, *D. pulicaria* is herbivore, Cyclopoida spp. is carnivore, and vertical structure of the water column.

ON368

Arthropod biodiversity increases energy and nutrient availability across terrestrial and aquatic food webs

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Global biodiversity loss in the Anthropocene is occurring at unprecedented rates across both aquatic and terrestrial ecosystems. Past studies have demonstrated that primary producer diversity increases the stability and magnitude of key ecosystem functions like productivity and elemental nutrient uptake. However, the consequences of consumer diversity loss for food webs and ecosystems are remain poorly understood. While growing number of recent studies provide evidence of dramatic shifts in arthropod diversity, it remains unclear how arthropod diversity is related to ecosystem services, such as energy and nutrient availability for higher trophic level consumers. Here, we asked how arthropod diversity in both aquatic and terrestrial ecosystems was related to the availability of both energy (biomass) and nutrients, specifically omega-3 and omega-6 polyunsaturated fatty acids (PUFA) and how such relationships varied with land use. To answer these questions, we used data on arthropod abundance from two large-scale surveys conducted within Switzerland in streams and in terrestrial habitats. First, we assessed arthropod diversity at each site using Hill numbers. We then converted arthropod abundance into dry mass using length-weight regressions at the species to family-level and then into PUFA at the family to order-level and related these to diversity. Finally, we separated these relationships by land use using classifications from the Swiss federal land use database. We found that fluxes of energy and nutrients from arthropods in both aquatic and terrestrial ecosystems were positively related to biodiversity, but that biodiversity and its benefits varied with land use and ecosystem type.

ON032

How contingent are clusters of freshwater habitats on spatial scale?

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For the adequate protection of freshwater habitats, the information of the predominant environmental conditions and their spatial distribution are needed. Available large scale characterizations of freshwater habitats are based on a coarse spatial data resolution and only provide large and general habitat groups. Small unique habitats, which may play a key role in the establishment of conservation strategies are not characterized by coarse classifications. We developed a data driven approach implementing a k-means cluster analysis, to identify fine scale patterns of freshwater habitats over large spatial domains. We tested different clustering designs to analyze i) the choice of environmental variables and ii) the impact of within-basin vs. across-basin clustering on the resulting clusters. We tested our approach in six river basins based on the Hydrography90m across different continents and climatic zones. We split the basins into sub-catchments and aggregated environmental variables for each, describing land cover, geomorphological and climatic characteristics. First, we used all non-correlated variables in the clustering routine and evaluated their importance using Random Forest. The clustering was then repeated with the most relevant variables for individual basins and across all six basins, and we analyzed the resulting patterns for similarities. Our results show that patterns of large cluster remained regardless of the clustering design, yet small clusters emerged in the within-basin clustering. Our findings provide guidance in assessing freshwater habitat patterns and lay out the basis for a global high-resolution freshwater regionalization analyses.

ON342

Feeding efficiency of the exotic copepod *Mesocyclops pehpeiensis* in the presence of the native species *Mesocyclops longisetus curvatus*

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The introduction of invasive species is one of the four main causes of biodiversity loss. In Mexico the exotic species of copepods include *Thermocyclops crassus*, *Mesocyclops aspericornis*, *Mesocyclops thermocyclopoides* and *Mesocyclops pehpeiensis*. Here we tested the presence of the invasive *Mesocyclops pehpeiensis*on the feeding behavior of an analogous native species, *M. longisetus*. We hypothesized that the invasive species would use the food resources more efficiently than the native species. Food preferences and consumption rates of *M. pehpeiensis* and *M. longisetus curvatus* were determined, separately and together in the same environment, prey items consisting of five cladocerans and five rotifers. The copepod predators were pre-starved for different periods (2 h, 4 h, and 10 h) prior to offering prey items. When tested alone, after a 2h starvation, *M. pehpeiensis* consumed prey biomass of 8.55 µg/ind. and after 4h starvation *M. longisetus curvatus* consumed 17.3 µg/ind. However, in mixed culture, after 4h starvation, both the predator species consumed 9.0 µg/ind. For the copepod species, optimal feeding rates were observed following two or four hours of starvation. Results have been discussed with emphasis on factors promoting the widespread distribution of the invasive *M. pehpeiensis* in Mexico.

ON042

Diet modulates ectotherm responses to temperature variance

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According to theory, thermal variance effects on performance are explained by Jensen's inequality (JI) and the non-linearity of the ectotherm thermal performance curves (TPC). However, using TPC imply an instantaneous acclimation of the organisms whatever the temporal scale at which environmental temperature fluctuates or the dietary context.
We analysed how the temporal scale of thermal variance interacts with the nutritional context of *Daphnia magna*. We fed *Daphnia magna* with three food treatments differing in terms of polyunsatured fatty acid (PUFA) and sterol supply (molecules known for their importance in temperature acclimation) and measured their growth and fecundity rates under constant and fluctuating temperatures at three different frequencies.
We show that except for the lowest PUFA and sterol supply, fluctuation consistently decreased growth rate relative to that under constant conditions. However, the decrease was stronger than expected from JI predictions, indicating that acclimation might lag behind the environment. Furthermore, in the intermediated supply, the decrease in growth was stronger for lower fluctuation frequencies. Fecundity also strongly decreased under lower fluctuation frequencies but only in the higher PUFA and sterol supply. We argue that the nutritional context and its effects on temperature acclimation need to be considered in any attempt to predict the performance of aquatic ectotherms in thermally fluctuating environments.

ON090

Quantifying river continuity for the EU Biodiversity Strategy

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The EU Biodiversity Strategy for 2030 has a target to restore 25.000 km of rivers to free-flowing rivers by 2030 through the removal of longitudinal and lateral barriers, addressing one of the key pressures preventing the achievement of good ecological status in European rivers. To monitor progress towards this target the length of free-flowing river stretches needs to be quantified. Earlier studies have shown that there is considerable variability between European countries in the availability and quality of barrier data. Especially for lateral barriers data is lacking. A method is proposed using existing and new monitoring data for river managers to show that a length of river is free-flowing. Key elements are (1) a simple typology of both longitudinal and lateral barriers of all sizes; (2) full inventories of all barriers along a river stretch; (3) the length of river stretches free of barriers; (4) consideration of any barriers up- or downstream the river stretch blocking fish, other organisms or sediments in a significant way.

ON100

A heat spike overrules pesticide tolerance: a case study in the water flea *Daphnia magna*

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Pesticides and warming are anthropogenic stressors causing biodiversity loss in aquatic ecosystems. Pesticide exposure causes severe (sub)lethal effects and therefore poses a strong selection pressure, which can lead to the evolution of pesticide tolerance. However, tolerance comes with costs, mostly due to energetic constraints. One such proposed, but poorly documented cost is a lowered heat tolerance. Building on an experimental evolution trial during which tolerance towards the insecticide chlorpyrifos evolved in the water flea *Daphnia magna*, we compared the heat tolerance of chlorpyrifos-tolerant and non-tolerant clones. Clones of each type were exposed for four days to chlorpyrifos (0, 0.50 or 0.65 µg/L) followed by a four days heat spike treatment (20°C or 30°C). We observed a strong cost of chlorpyrifos tolerance in terms of a lower heat tolerance: when exposed to the heat spike, chlorpyrifos-tolerant clones had a lower survival and reduced brood sizes compared to the non-tolerant clones. Notably, these heat-induced costs paid by the chlorpyrifos-tolerant clones did not disappear in the presence of chlorpyrifos. Intriguingly, the opposite was true: when combined with chlorpyrifos exposure, the heat spike caused the highest mortality (at the highest pesticide concentration), and delayed reproduction and reduced the number of offspring the most in the chlorpyrifos-tolerant clones. This indicates that heat spikes may offset pesticide tolerance. Our results suggest that in a warming world where heat spikes will become more frequent, pesticide-tolerant clones will suffer more, possibly leading to shifts in pesticide tolerance levels in natural populations.

ON299

Greenhouse gas emissions from dredged material and potential mitigation measures: an experimental approach

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World-wide, billions of cubic meters of material are dredged from aquatic systems annually. Dredged material is either repurposed, relocated within the system, disposed, or spread over land. While greenhouse gas (GHG) emission of dredging activities is receiving increasing attention, surprisingly little is known about the emissions from the dredged material itself. We investigated carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions from dredged material with different chemical compositions collected at four locations and subjected them to different treatments to investigate potential mitigation measures. For 85 days, the material was either subjected to drying, kept inundated, or subjected to drying with zeolite addition. We found

that drying material emitted significantly more CO_2 than inundated material (averages: 2513 and 1558 mg $m^{-2}day^{-1}$, respectively) and total GHG emissions in CO_2-equivalents were on average 1.8 times higher in drying material. Moreover, dredged material with high ammonium concentrations emitted more N_2O compared to material low in ammonium. N_2O emissions could be reduced considerably (up to 4.4 times) by the addition of zeolite in freshwater material. Our findings indicate that emissions from dredged materials can be substantial and that differences in composition influence GHG emissions and determine which mitigating measure is most effective.

ON003

Can size distributions of European lake fish communities be predicted by trophic positions of their fish species?

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Body size plays an important role in ecological interactions like predator-prey relationships, especially in aquatic ecosystems. As predators are typically larger than their prey, this often leads to a strong positive relationship between body size and trophic position. The distribution of body sizes in a community can thus be an indicator of the strengths of predator-prey interactions. But are these assumptions always true? In this study we intended to gain more insight in the relationship between fish body size distribution and trophic position in a wide range of European lakes. We used quantile regression to examine the relationship between fish species' trophic position and their log-transformed maximum body mass for 49 fish species found in 235 European lakes. Subsequently, we examined whether the slopes of the continuous community size distributions, estimated by maximum likelihood, were predicted by trophic position, predator-prey mass ratio (PPMR) or abundance of fish communities in these lakes. In contrast to our expectation that species' trophic position systematically increases with maximum body mass, we found a positive linear relationship between species' maximum body mass and average trophic position only for the higher quantiles for fish species included in our study. Consequently, the lake fish community size spectrum slope was not related to the average trophic position, but there were negative effects of community PPMR and abundance on the size spectrum slope. We conclude that, unexpectedly, predator-prey interactions likely do not contribute strongly to shaping fish community size distributions in these lakes.

ON267

Smart Nutrient Retention Networks: a 21st Century approach for nutrient conservation through water quality management

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With ongoing world population growth and unsustainable resource use, a shortage of resources is more and more threatening in the 21st Century. Nutrients are a special case because they are essential resources for food production but also seem to inevitably pollute inland waters. Moreover, they are transported through catchments and eventually lost into the oceans where they become unavailable for human use. Nutrient conservation by retention in surface waters and consecutive harvest and reuse would prevent nutrient losses to the atmosphere and downstream ecosystems. We present Smart Nutrient Retention Networks (SNRNs) as a novel management approach to achieve nutrient conservation across networks of connected waterbodies through strategic water quality management. In this approach, we focus on the self-reinforcing feedback loop of ecological water quality, nutrient retention, and nutrient loading in hydrological networks whilst considering socio-economic conditions and goals. We believe that Smart Nutrient Retention Networks can be one component of a sustainable and just future as they are designed around biogeochemical nutrient cycling processes and contribute directly to at least 3 UN Sustainable Development Goals (SDGs): zero hunger (SDG 2), clean water and sanitation (SDG 6), and responsible consumption and production (SDG 12).

ON265

Congruence in types specific anthropogenic thresholds for riverine ecosystems

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Rivers are one of the most essential natural resources for living beings, with cultural, social, economic, and historical significance. The water quality evaluation and monitoring are crucial for water resource management programs that need regulation and monitoring. As a result of this, it is necessary to assess the quality of the water as part of the ecosystem such as analyzing the enrichment of nutrients in the water bodies (based on category, type and geographical location), considering the influence of confounding factors on the nutrient-biology interaction. The main objective of this study was to compare the EQR (Ecological Quality Ratio) values obtained in rivers in Hungary with the limit values of nutrients stipulated by the Water Framework Directive (WFD) for freshwaters and observe the main taxonomic and ecological communities associated with conditions of good condition for their future preservation. We used macroinvertebrates, diatoms, fish, macrophytes and phytoplankton as ecological communities for the interaction with the nutrients (parameters). We performed a comprehensive review of Hungary's physico -chemical boundaries based on EQR evaluations using a tool-kit approach that suggests good/moderate thresholds to support good ecological status. Some efforts must be made to improve water safety and promote environmental awareness, which would necessitate a collaborative approach including researchers and stakeholders (from the water industry and government representatives).

ON071

Long-term epilimnetic CO_2 dynamics in a temperate polymictic eutrophic lake and its relationship with (a)biotic variation

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Inland waters are sources of CO_2 to the atmosphere, though the internal CO_2 dynamics within a lake can vary strongly over time. Long-term datasets on CO_2 concentrations can aid us in better understanding (and potentially predicting) inter- and intra-annual patterns in lake source/sink CO_2 dynamics. In the eutrophic, polymictic Lake Müggelsee (Germany), CO_2 concentrations have been monitored on a weekly basis alongside biotic and abiotic factors. Using this dataset, we investigated interannual patterns in epilimnetic CO_2 concentrations in Lake Müggelsee and how these have changed over time. Additionally, we addressed whether the potential variation in CO_2 concentrations was related to abiotic and biotic factors in the lake, such as phytoplankton and zooplankton biomass, invasive quagga mussel abundance, nutrient concentrations, and stratification periods. Our analysis showed no significant changes in annual mean CO_2 concentrations (46 ± 38 µmol/L, mean ± SD) between 1992 and 2019. Nonetheless, strong intra-annual variation was observed, with low CO_2 concentrations during the growing season and higher values throughout the fall and winter period. Within the growing season, CO_2 concentrations decreased, coinciding with the phytoplankton spring bloom. During the clear-water phase, these CO_2 concentrations increased again, which could be attributed to top-down control

by zooplankton grazing. Overall, CO_2 concentrations were significantly correlated with zooplankton and phytoplankton biomass across the dataset. Furthermore, CO_2 concentrations were significantly lower in periods when the lake was stratified. During the conference, we will discuss these preliminary findings within the context of CO_2 source/sink dynamics.

ON098

Shrinking body size and physiology contribute to geographic variation and the higher toxicity of pesticides in a warming world

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To improve current and future risk assessment of pesticides under global warming, mechanistic insights and consideration of daily temperature fluctuations (DTFs) are needed. One overlooked mechanism how both higher mean temperatures and DTFs may increase toxicity is by reducing body size (temperature-size-rule). We studied whether a higher mean temperature and DTF magnified chlorpyrifos toxicity in *Ischnura elegans* damselfly larvae, and whether this was mediated by temperature-induced reductions in body size and/or physiological changes. The lethal effects of chlorpyrifos were magnified at the high mean temperature (up to ~15%) and under DTF (up to ~33%), and especially at their combination (up to ~46%), indicating synergisms. This highlights that not only considering DTFs, but also their interaction with higher mean temperatures is pivotal for realistic predictions of pesticide toxicity. Both higher mean temperatures and DTFs resulted in smaller larvae, which were more sensitive to chlorpyrifos. Notably, the DTF-induced smaller body sizes, as well as the higher oxidative damage to lipids, contributed to the higher chlorpyrifos toxicity under DTF. By integrating the temperature-size rule and size-pesticide sensitivity pattern we provide proof-of-principle for a novel, likely general mechanism contributing to geographic variation and the higher toxicity of pesticides in a warming world.

ON056

Arctic sentinel lakes at the coastal margin of the Last Ice Area

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The coastal zone along the northern edge of Greenland and the Canadian Arctic Archipelago contains the oldest, thickest sea ice in the Arctic Ocean. This area of around 1 million km2 has been named the 'Last Ice Area' (LIA) because it is expected to remain ice-covered even once the Arctic Ocean becomes largely ice-free, and it is considered the ultimate refuge for ice-dependent species in the rapidly warming North. The coastal margin of the LIA contains many cryospheric features including alpine and piedmont glaciers, remnant ice shelves, permafrost soils, and perennial snowbanks that feed water tracks across the polar desert landscape. It also contains diverse ice-capped lakes that are sentinels of ongoing climate change, encompassing a spectrum of sensitivities to Arctic warming. Proglacial Thores Lake and its associated glacier at an inland site demonstrate relative stability at present, and the lake remains mostly ice-covered in even the warmest years to date. Further north, meromictic Lake A demonstrates parallels to Lake Bonney in the McMurdo Dry Valleys, Antarctica, and its strong density stratification is partially resisting the increased wind exposure and mixing due to ice cover loss. Coastal freshwater Ward Hunt Lake lost its perennial 4m ice cap in 2011 and is now intermittently wind-exposed and mixed in years of extreme warming, while Milne Fiord epishelf lake is on the brink of complete loss through ice shelf break up. This spectrum of sentinel lakes provides a set of indicators to track the ongoing effects of Arctic amplification of global climate change.

ON236

How do macroinvertebrates use aquatic refuges when the flow disappears?

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Intermittent rivers and ephemeral streams (IRES)are freshwater ecosystems characterized by periods of surface flow interruption and they are widely distributed around the world. IRES show great variability in the duration, frequency and occurrence of flow interruption across the river network. Surface flow cessation interrupts hydrological connectivity in all three spatial dimensions (longitudinally, laterally and vertically) promoting its spatiotemporal dynamism. The biodiversity of IRES is driven by flow regime and varies according to this dynamic. However, IRES biodiversity presents different adaptations to flow cessation combining distinct traits that promote resistance and/or resilience strategies. The aim of this study is to analyse the use of refuges (hyporheic zone and dry sediment) by invertebrates during dry period and its relation to flow intermittence intensity. Six reaches of different river basins across Catalonia (NE Iberian Peninsula) were selected. Temperature loggers were installed before dry period to register the duration and frequency of flow intermittence. During flow interruption, dry sediments were collected and hyporheic zone sampled at each reach. After dry period, benthic samples were collected. In the laboratory, dry sediments were rehydrated during 32 days and all macroinvertebrates individuals were identified. Our results showed that in all reaches resilience traits were more abundant than resistant ones. Taxonomical and functional diversity in hyporheic zone and dry sediments were subsets of benthic assemblages, but only between 20 and 56% of the benthic taxa were found in these habitats. In addition, any functional or taxonomical metric showed significant differences related to the duration of flow interruption.

ON433

Pesticides in surface waters: A European perspective

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The European Green Deal with its Farm-to-Fork and Biodiversity Strategies sets targets to reduce the risk and use of pesticides by 50 percent to protect and restore the environment, including aquatic ecosystems.
In the EU, pesticides are regulated and approved on the basis of high protection targets and risk assessments for the environment and human health. However, pesticides still end up in surface waters, but a Europe-wide overview of this input has not yet been quantified. It was just noticeable that pollution with pesticides under the Water Framework Directive 2016 was reported only for 0.5 percent of rivers and lakes. This seemed too low and was the trigger for a detailed evaluation for pesticide pollution in European waters.
Results of the evaluation show that in 2019 at a quarter of all reported monitoring sites in European surface waters concentrations of at least one pesticide exceed thresholds or environmental standards. From 2013 to 2019 this proportion ranged from 13 to 30 percent.
For the evaluation, approximately ten thousand monitoring sites of the annual 'State of the Environment' reporting delivered to the European Environment Agency were used. These data represent one of the most comprehensive datasets in Europe. Yet, existing data gaps lead to uncertainties in the interpretation of the results, including high variability in reported monitoring sites or number of substances, and missing effect thresholds. Despite these uncertainties, the evaluation very clearly shows the pesticide load and potential ecotoxicological risks in European surface waters.

ON119

Induction of diel vertical migration in zooplankton by an identified fish infochemical

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Daphnia is an important trophic link between primary producers and higher trophic levels in lakes and ponds and has become a textbook example for inducible anti-predator responses. A behavioral defense against fish is diel vertical migration (DVM) of *Daphnia* which is characterized by daytime residence in the dark hypolimnion and migration to the upper layers during nighttime. DVM is induced by an infochemical released by fish. Using a small-scale indoor bioassay, this infochemical from cyprinid fish has recently been identified as the bile salt 5-alpha-cyprinolsulfate (5-alpha-CPS) which induces DVM already at concentrations >100 pg/L. Here we performed mesocosm experiments to test if this infochemical induces DVM in natural zooplankton communities and to determine the threshold concentration needed for DVM-induction. We report that 5-alpha-CPS induces DVM in natural zooplankton. We successfully quantified *in-situ*concentrations of CPS in the lake (outside experimental mesocosms) which were five times higher than those needed for DVM induction under laboratory conditions. The results confirm that 5-alpha-CPS is inducing DVM also under natural conditions.

ON013

Can a living fossil save our soils?

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Wetlands provide important services including carbon sequestration and water retention and purification. To restore these functions, formerly drained agricultural areas are rewetted to recreate wetlands. Since these agricultural soils often have a substantial nutrient legacy, rewetting typically leads to soil and water quality issues and low biodiversity.
To overcome this challenge in a novel, cost-effective way, *Azolla filiculoides*(water fern) could be cultivated to simultaneously extract P, sequester carbon, and provide a commercial product. *A. filiculoides*is excellent at accumulating P due to its nitrogen fixating capacity and high growth rates. To characterize the potential of this approach, we cultivated *A. filiculoides* in a mesocosm experiment on 15 inundated agricultural soils which were high in Olsen-P. We measured soil, water, and plant nutrient dynamics and methane emissions in three treatments: no vegetation, *A. filiculoides* that was harvested weekly or *A. filiculoides*that accumulated during the experiment (2 months).
We found that Azolla cultivation was successful when soil NaCl-extractable P was sufficiently high (>50 µmol P kg FW^{-1}) and surface water pH was sufficiently low (<6). *A. filiculoides* effectively extracted P, and a weekly harvest resulted in high surface water O_2 concentrations and low CH_4 emissions. We conclude that cultivating *A. filiculoides*shows potential in the transition of agriculture to nature, while recovering P from former agricultural soils. Harvested *A. filiculoides* can be used as a biofertiliser or for human nutrition.

ON390

Spatial and temporal variability of greenhouse gases ebullition from fish ponds

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Fish ponds with their typically high carbon and nutrient inputs, are known to be relevant sources of greenhouse gases (GHG). However, not much is known about gas bubble emissions (ebullition) and their spatiotemporal variability. To improve estimates of GHG emissions, we studied diurnal and spatial variability of bubble gas composition and diffusive and ebullitive GHG fluxes in 11 fish ponds near Bautzen, Germany.Emissions differed greatly between different ponds. Feeding stations appeared to be hotspots with one order of magnitude higher ebullition rates compared to other parts of the ponds. At these hotspots, ebullitive fluxes of up to 38 l m^{-2} d^{-1} were measured with a mean bubble methane content of 79%, corresponding to a flux of 1.34mol CH_4 m^{-2} d^{-1}. Methane was the predominant GHG and ebullition the main pathway, but carbon dioxide also played a role near the feeding station. Bubble gas composition changed along a transect from a feeding station into the pond, with decreasing methane and carbon dioxide levels and increasing nitrogen and oxygen levels in the collected bubble gas. GHG emissions showed some diurnal fluctuations. Highest diffusive fluxes were observed in association with nighttime mixing of the pond, while ebullition rates were higher in the morning, presumably caused by higher fish activity.These results highlight the potential of ponds as significant sources of GHG in the atmosphere and show that ebullition is a major pathway of emissions from fish ponds. For robust quantification, both small scale spatial and temporal variability have to be considered.

ON154

Long-term changes in dissolved inorganic carbon (DIC) across boreal streams caused by altered hydrology

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A major challenge for predicting future landscape carbon (C) balances is to understand how environmental changes affect the transfer of C from soils to surface waters. Here we evaluated 14 years (2006-2019) of stream dissolved inorganic carbon (DIC) concentration and export data for 14 nested boreal catchments that are subject to climatic changes, and compared long-term patterns in DIC with patterns in dissolved organic carbon (DOC). Few streams displayed significant concentration or export trends at annual time scales. However, a clear majority of streams showed decreasing DIC concentrations during spring flood over this 14-year period, and about half showed declines during summer. Although annual runoff has generally not changed during this period, intra-annual redistribution in runoff explained much of the seasonal changes in DIC concentration. We observed negative DIC-discharge relationships in most streams, suggesting supply limitation of DIC with increasing discharge. This was in contrast to DOC, which mostly showed a chemostatic behaviour. The distinct trend patterns observed for DIC and DOC underpin intra-annual changes in the composition of the total C pool (DIC/DOC ratio) and reflect differences in how these C forms are produced and stored, are mobilized by hydrological events, and are responding to long-term environmental changes. Collectively, our results provide mechanistic insights into how total C transfer from boreal systems might respond to a changing climate. Based on our findings we predict that future DIC export from boreal soils is likely to change in amount and timing, with chemical as well as biological consequences for aquatic systems.

ON062

Does flow and thermal stratification induce cyanobacterial blooms in the large regulated Murray River, Australia?

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Low flow rates and persistent thermal stratification can be key factors promoting cyanobacterial blooms. Australia's largest river, the iconic Murray River, is highly regulated through a series of weirs and dams. In these riverine weir pools, flow is reduced, and conditions may more closely resemble those of lentic systems where persistent thermal stratification is more common. Potentially toxic cyanobacterial blooms are occurring at an increasing rate in the Murray River, however, the role of river flow rates and thermal stratification is not well understood. To test this, we measured hydrodynamics, climatic conditions, and vertical temperature profiles in weir pools of the Murray River and linked these data to cyanobacterial abundances. Site-specific threshold flow rates for the establishment of persistent stratification were determined, for example, discharges of <4000 ML day^{-1} at the

Kulnine weir pool and ambient maximal air temperatures >30°C. The data collected was used to model thermal stratification over the past two decades for comparison to historical algal data over this period. The analysis of historical algal data showed a positive correlation between increased thermal stratification and reduced flow and certain cyanobacterial genera including *Aphanizomenon* and *Dolichospermum*. However, many other bloom-forming cyanobacteria were not strongly related to flow, and other factors may be important for their growth. These results may be useful in informing flow management to reduce the environmental and economic costs of some blooms.

ON348

Ecosystem changes of Lake Constance and its surroundings in the past 14000 years

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The large perialpine Lake Constance (German: *Bodensee*) has gone through significant changes since the end of the Last Glacial under the influence of variable climate and human impact. To characterize the long-term change of its ecosystem and its surrounding area, we utilise the natural archiving property of sediment cores and are extracting multiple sediment DNA data series starting from the end of the Pleistocene, not long after the present lake came into being. Specifically, DNA metabarcoding, which generates data through amplifying specific marker regions, showed successions of plants around the lake corresponding to the start of the Holocene and later to increased human occupation, likely associated with agricultural activities. We are currently generating a series of sediment DNA shotgun data and anticipate a more comprehensive representation of biological community and its changes over time. Shotgun DNA sequencing technique directly sequences all DNA fragments in samples and enables researchers to identify all taxa as long as they are registered in reference databases. Through integrating multiple datasets, we aim to not only characterize changes and infer their causes, but also address questions of how lake ecosystems maintain their resilience under an ever-changing environment.

ON327

Can riparian forests improve water and sediment quality in agricultural headwater streams?

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Streams in agricultural regions have shown to be highly loaded with nitrogen and phosphorus, leading to the saturation of the systems and the eutrophication of receiving water bodies. Riparian forests have been discussed already for some decades as measures to mitigate nutrient inputs and improve the self-purification capacity of streams through the input of high-quality organic matter.
Our project aimed at analyzing whether and how riparian buffers can improve the water and sediment quality as well as biogeochemical processes in small headwater streams impacted by agriculture. We sampled 20 headwater streams in agricultural catchments with and without riparian forest buffers regarding water and sediment quality. We analyzed grain sizes, nutrient and organic matter concentrations, phosphorus uptake and release, and microbial respiration under in-situ conditions and increased water temperatures, simulating also sediment resuspension during floods. Inputs of eroded soils proved to be the largest impacts on the freshwater systems through clogging the interstices and thus uncoupling nutrient uptake sites in the sediments from the nutrient supply in the water column. Increased water temperatures reduced the capacity of stream sediments to store phosphorus. The effects of riparian buffers were restricted by preferential flow paths circumventing the buffer zones.

ON442

Connection to nature as a motivator to participation in citizen science within the communities of an Irish river catchment

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Water quality in Ireland's rivers is in decline due to pressures from human activities. In response, community groups, state agencies and non-governmental organisations are developing citizen science programmes to activate bottom-up engagement in catchment management. This talk will examine the sociological and psychological underpinnings associated with volunteerism and participation in nature-based citizen science to understand the factors that can influence participation in river water quality monitoring programmes. The themes provide context for responses to a regional questionnaire survey and focus groups with Ireland-based citizen scientists. The questionnaire survey targeted the residents of a river catchment that is characterised as 'at risk' of not meeting European Union Water Framework Directive water quality objectives. The results highlight levels of connectedness people feel towards nature and their concerns for their local rivers, and outlines factors that influence respondents' actions in relation to river environmental stewardship. Motivations and barriers to environmental volunteerism are summarised as well as the values, attachments and connections that people feel towards their local communities and catchment. These results will informthe design and development ofcitizen science projects to monitor benthic macroinvertebrates, nutrients, biodiversity and abiotic factors in small streams and waterbodies within an Irish river catchment. The integration of the sociological with the limnological disciplines will make citizen science projects more effective in increasing uptake and long-term community engagement, with the ultimate goal of improving freshwater quality.

ON285

Functional ecology of planktonic ciliates. I. Response to predators

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Planktonic ciliates are major components of the pelagic food web in the ocean and freshwater (FW). Their population dynamics and diversity are controlled 'bottom-up' by food supply and temperature and 'top-down' through feeding by microcrustacean predators. The efficacy by which the functionally different predators control ciliate population dynamics is debated. To this end, we investigated the grazing of three microcrustacean predators with different feeding modes (i.e., *Daphnia*, a calanoid and a cyclopoid copepod) on five freshwater ciliates in laboratory experiments. We then performed a meta-analysis to detect if our findings can be generalised for aquatic ecosystems. Mainly due to the presence of *Daphnia*in many lakes and the higher microcrustacean diversity in FW, we hypothesized that top-down control is overall stronger in lakes than in the ocean. We find that (*i*) the average ingestion rates of marine and FW microcrustaceans do not differ; (*ii*) all FW microcrustaceans have comparable ingestion rates and (*iii*) marine calanoids have the highest and marine cyclopoids the lowest ciliate-specific ingestion and clearance rates; (*iv*) clearance rates in FW cladocerans decrease with ciliate size but increase with ciliate size in FW copepods; (*v*) clearance rates of the marine microcrustaceans appear unrelated to ciliate cell size. Our findings have important implications for the functioning of FW and marine food webs. The ciliate – microcrustacean link is stronger in lakes than in the ocean. On the global average, top-down control of ciliate population dynamics is highly unlikely in the ocean.

ON064

Transfer and accumulation of microcystin from cyanobacteria to insect larvae is consistent between years despite the extent of the cyanoHAB

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In our study we investigated the transfer and the accumulation of the cyanobacterial toxin microcystin (MC) from *Planktothrix rubescens* via different planktonic organisms to chaoborid larvae and their different developmental stages in different years in a small mesotrophic lake (Illmensee, Germany).
Water samples and zooplankton was collected in four consecutive years. MC concentrations of filtered water samples and zooplankton were analysed via a microcystin enzyme-linked immunosorbent assay (ELISA). Monitoring of the cyanoHAB was conducted by in-situ measurement with a multispectral FluoroProbe (bbe Moldaenke) and traditional phytoplankton counts.
In all years MC was abundant in filtered phytoplankton samples, daphnids and chaoborids. MC was not detected in copepods, most likely due to selective feeding behaviour, thus avoiding preying on *P. rubescens* whereas filter-feeding daphnids apparently ingest the toxic *P. rubescens*. The amount of MC accumulated per biomass in daphnids and chaoborids did not differ between years even though *P. rubescens* bloom intensities vary strongly among years. The transfer of MC to the different larval instars of *Chaoborus flavicans* also differed between instars. Smaller instars I and II did not contain MC while the bigger instars III and IV did. This can be explained by changing feeding habits, as the smaller instars do not yet prey on daphnids. Additionally, the migrational depth of the smaller instars does not yet reach the depth of the *P. rubescens* stratum in that lake. Further investigations will address the extent and the effect of interannual transfer of MC through winter by overwintering larvae instars of *C. flavicans*.

ON040

Evaluating the skill of hydrodynamic simulations in two stratified lakes by Principal Component Analysis

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What statistics should be considered to validate hydrodynamic simulations of a stratified lake? Typically, low-order moments or spectra of simulated quantities are compared with observations at selected locations, while ignoring spatial correlations. Principal Component Analysis (PCA) offers an interesting complementary tool to validate simulation results, thanks to its inclusion of spatial correlations and optimally*compressive* character. Such validation has not been applied in limnology.
Consider timeseries of an "observation vector",*e.g.*the temperatures measured by a thermistor chain. The PCA expansion is a weighted sum of mutually-orthogonal spatial functions, evaluated in this example at each thermistor's depth, wherein the weights evolve temporally. The mean-squared error at any order of truncation is minimized by computing spatial modes from a certain eigenvalue problem. The shape of low-order modes can often be identified with physical "modes" such as internal waves.
We consider applications to Lakes Biwa (Japan) and Kinneret (Israel), including currents when observations are available, and compare the first spatial modes of the simulation *versus* observation together with the variance in each mode.For example, in a ten-day simulation of spring stratification in L. Biwa in 2020, the percent variance in the first two "temperature modes" of the simulation are respectively 87.9% and 8.6% , *versus* 71.6% and 23.0% from observations, indicating lower entropy in the simulations than in reality.To validate the time-varying weights requires a common basis, taken herein as the spatial modes from the observations.Comparative wavelet analysis of the time-varying weights will also be discussed.

ON272

Microplastics mass distribution in German dams and reservoirs

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Microplastics is nowadays detected everywhere in the environment, even in remote locations. Most studies build on particle numbers, so little mass-based information is available. Moreover, reservoirs and dams are understudied, but important for water management. Within the project MikroPlaTaS, we conducted a one-time survey of water and sediment from six water bodies in 2018. Samples were sieved, and sediment fractions were also density-separated using sodium polytungstate. Plastic polymers were analyzed by TED-GC/MS, and polyethylene, polypropylene, polystyrene, polyethylene terephthalate, styrene-butadiene rubber, acrylates and polyamide 6 were considered. We focused on the 100-500 µm size fraction and the top 5 cm of sediments. In surface water samples, polystyrene was most frequently detected, followed by polypropylene. Regarding microplastic concentrations in waters, main reservoirs with a pre-dam had the lowest values, and only one site had a concentration >1 mg per cubic meter. This suggests that pre-dams may efficiently retain inflow-borne microplastics, and microplastic concentrations in the waters were generally moderate. Sediments were very fine-grained except one dammed river, and polyethylene was detected in all sediment samples. Polystyrene and polypropylene were the next frequently detected polymers. Microplastic concentrations in the analyzed size fraction exceeded 1 g/kg in some cases. However, the varying contribution of the 100-500 µm fraction to the total sediment must be considered. Including other fractions may result in decreased or increased total concentrations. We therefore recommend a detailed physical characterization of sediments studied for microplastics, and a mass-based analysis of polymers in all fractions.

ON322

Combining modelling and chemostat experiments to analyse non-linear dynamics that drive single-species populations

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The importance of oscillations and deterministic chaos in natural biological systems which was originally based on discrete-time models of population growth has been discussed since the 1970s. Later, dynamics considering interspecific and trophic interactions such as predator-prey, parasitism and cannibalism have shown all aspects of non-linear dynamics in more realistic continuous models. However, continuous-time models and experimental systems of single-species without trophic interactions characterized by non-linear dynamics are still missing, even though multiple non-linear processes are already active on the cellular level. Here we show, that dynamics of single-species systems of protists in continuous experimental chemostat systems and corresponding continuous-time models reveal typical characteristics of deterministic chaos. A new automatic video registration enabled a nearly continuous undisturbed observation of abundances with a high measuring resolution allowing for a detailed analysis of the dynamic behavior. Our simple general continuous-time model simulating the cell cycle can exhibit a remarkable spectrum of dynamical behavior and is providing explanations for the experimental results as a principle of proof with estimated parameter values. For the first time, experimental and model data demonstrate the importance of non-linear dynamics already on the level of a single type of cells without any external forcing, showing the necessity of high temporal resolution measuring methods. In future, more detailed single-species population measurements are necessary to determine parameter values exactly for being able to provide reliable models predicting the dynamical behavior in this still sparsely investigated field of research.

ON438

Heavy Metals in the Crocodile River (West) System, South Africa following acid mine drainage

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The upper reaches of the Crocodile River (West) system are located in the Western Basin of the Witwatersrand mountain chain, an area heavily influenced by gold mining. In 2002, highly acidic and contaminated mine influenced water started to spill from an abandoned borehole of a gold mine and directly entered the Tweelopiespruit, a tributary to the Crocodile River. The initial monitoring suggested extremely poor water quality and water treatment was implemented to increase the pH and substantially compensate the consequences of acid mine drainage. Our study investigated water and sediments monthly in the river system at seven sampling sites especially considering confluences, during a 13 month's period. In addition to physico-chemical parameters like T, pH and electrical conductivity a multi element analysis was conducted. We used graphite furnace atomic absorption spectroscopy (GF-AAS), cold vapor atomic absorption spectroscopy (CV-AAS), total reflection x-ray fluorescence spectroscopy (TXRF) and inductively coupled-plasma mass spectrometry (ICP-MS) in filtered and acidified water samples as well as freeze dried sediment samples. Concentrations of Ni, Zn, As, Ag, Au, Cd and U in the sediment clearly appeared elevated at the Tweelopiespruit site, some of them by far exceeding quality guidelines. Additionally, we could detect dissolved Mn, Ni, Zn and U in the water phase, occurring irregularly in concentrations of concern, posing a major risk for the aquatic environment in this study site. Our findings imply a potential risk of further and chronic mobilization of toxic elements from this site and a possible threat to the connected river system.

ON345

Recent environmental transformation of Tatra lake ecosystem reflected in the stable carbon and nitrogen isotope composition of two *Daphnia* color morphs: paleolimnological approach

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The Tatra lakes have been changed intensively during the last centuries due to, e.g., climate changes, acid rain, and tourism. These environmental factors have influenced aquatic biota and food web structure in different ways. To address the question of *how(if any)recent environmental changes affect on zooplankton of the Tatra lake*, we analyzed $\delta^{13}C$ and $\delta^{15}N$ in ephippia of two *Daphnia* color morphs (orange, transparent) that differ in their life strategies. Analysis was done for a 21.5 cm-long sediment core from an oligotrophic lake, Czarny Staw pod Rysami, and combined with results of elemental analyses of C and N in lake sediments. Stable isotope records displayed similar trends of $\delta^{13}C$ and $\delta^{15}N$ in both types of *Daphnia* throughout the sediment profile. *Daphnia* ephippia had an average $\delta^{13}C$ and $\delta^{15}N$ values of 31.4‰(s.d. ± 0.61‰) and 1.76‰(s.d. ± 1.22‰), respectively. Reported $\delta^{13}C$ values were close to those noted for algae, and varied insignificantly suggesting persisting stable conditions, likely characterized by well-oxygenated water column and low methane concentrations. More clear alterations were revealed in the $\delta^{15}N$ profiles with a shift into lower values at the 14 cm depth. More negative $\delta^{15}N$ values(mean -2.74‰) in the upper portion of the core likely reflected changes in the food source (higher share of nitrogen-fixing bacteria). Interestingly, there was observed a peak of $\delta^{15}N$(-0.54‰) in the transparent *Daphnia* ephippia at the 11 cm depth which coincided with higher input of terrigenous organic matter (peak of C/N) presumably caused by a landslide.

ON112

Nanoplastics modulate the outcome of plankton-microparasite interactions

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Widely abundant micro- and nanoplastics pose a threat for aquatic ecosystems. However, despite mounting evidence for the adverse effects of micro- or nanoplastics (NPs) on single organisms/species, the way these pollutants affect interactions between species remains largely unknown. We studied the effects of NP pollution on host-parasite interactions in three model systems: a common planktonic cyanobacterium infected with its fungal parasite, water fleas (*Daphnia)*infected with a parasitic yeast and*Daphnia*infected with a microsporidium. NP exposure substantially altered the outcome of infection, by affecting both the parasite's infectivity and its reproductive output. These results demonstrate that the consequences of NP pollution go well beyond toxic effects at the individual level and modulate the intensity of species interactions, thereby potentially eliciting diverse cascading effects on ecosystem functioning. This further highlights the importance of including species interactions as ecotoxicological endpoints for a better understanding of the ecological consequences of plastic pollution.

ON259

Transport of nutrients and phytoplankton biomass along river-connected lake systems

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Worldwide, freshwater ecosystems are impacted by anthropogenic forcing including global warming-induced alteration of hydrological regimes and land use changes. For river systems, these changes might have far-reaching consequences as nutrients received from the terrestrial surrounding upstream may unfold both short and long-term effects downstream through system-wide changes of water residence time. River-connected lakes may modulate the spatial spread of eutrophication events throughout an aquatic network. However, studies on river-connected lake systems are scarce and limited by low temporal and spatial resolution. We investigated how local nutrient loading affects phytoplankton development along river-connected lake chains on a regional-scale by linking theoretical models with experimental and observational field studies. We specifically studied how local nutrient inputs drive phytoplankton growth and how nutrients and phytoplankton propagate along the aquatic network modulated by flow regime and lake size, both influencing water residence time. In a mesocosm experiment we manipulated connectivity, simulating short and long residence time in lake chains. Our field study encompassed 19 lakes in NE-Germany, contrasting strongly river-connected lakes along the Upper Havel with weakly connected lakes. High temporal and spatial resolution was achieved by combining water constituent measurements and automated *in-situ* probes with ground-based, space- and airborne reflectance measurements. Our results suggest that - depending on flow regime, lake characteristics and residence time - similar point sources lead to profoundly different maximum intensity, spatial range and regional-scale magnitude of eutrophication events in lake chains. We also highlight the potential of combining *in-situ* measurements with remote sensing to improve lake meta-ecosystem monitoring.

ON057

Increasing diversity of Planktothrix rubescens populations as a consequence of eutrophication and climate change

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Planktothrix rubescens forms dense blooms in the metalimnion of oligo- and mesotrophic lakes. This vertical position represents a compromise between the limited light penetrating through the epilimnion and the high nutrient concentrations associated with the hypolimnion. In recent years phosphorous release from sediments has fertilized Lake Stechlin, to a state where light in the metalimnion is extremely limited. Rather than decreasing, *Planktothrix* blooms have intensified and taken advantage of milder winters, dominating the nutrient enriched upper mixed water column. We sought to understand through metagenome sequencing how *Planktothrix* populations in Lake Stechlin have developed over the last decade. We compared monthly samples taken from the epilimnion and hypolimnion, commencing in 2011, with fortnightly epilimnic and metalimnic samples taken during the Planktothrix bloom of 2020. We identified a single Planktothrix species within the lake over the 10 year period, however identified sub-populations that vary over time. Interestingly, initial nucleotide diversity of the Planktothrix populations in the epi- and hypolimnion was low and increased during and was sustained in the years following two bloom events in 2016 and 2020. These findings show a link between environmental change and the diversity of cyanobacterial populations, and suggest that cyanobacteria may continue to expand their spatio-temporal range as climate change intensifies.

ON367

Primary production in the Great Lakes measured from autonomous underwater vehicles

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Autonomous underwater vehicles (AUV; *a.k.a.* gliders) have been widely used in marine environments to collect high-resolution oceanographic data across large spatial (i.e., horizonal and vertical) and temporal scales. Yet more recently, these technologies have been leveraged to better understand the ecology and biogeochemistry of large lake ecosystems. Through a multi-institutional collaboration, the Consortium of Great Lakes Gliders has directed both research and development, and observational AUV missions in the Great Lakes. Here, we took advantage of the 2021 Cooperative Science Monitoring Initiative to deploy 4 gliders simultaneously in Lake Superior for 3-4 week missions in August and September 2021. Flight paths were designed to capture spatial variation in primary production in deep and shallow areas of Lake Superior. Several zones were surveyed that were anecdotally expected to differ in primary production due to differences in nearshore proximities. Within each zone, continuous chlorophyll *a* and dissolved oxygen measurements will be used to estimate daily rates of epilimnetic gross primary production and respiration. Limnological variables will then be compared between zones with potential temporal variation being accounted for by directly assessing differences in chlorophyll *a* along adjacent transects. To contrast, we will also present results from a 3-week AUV mission (Sept – Oct 2021) with a flight path designed to capture summer-to-fall turnover in the central basin of Lake Erie during a hypoxic period. Our results will provide insights on the assumption that through primary production nearshore areas contribute more energy to pelagic food webs than those farther offshore.

ON305

Double trouble: Warming and Dissolved Organic Carbon (DOC) disturbance on Microbial Loop

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Climate change globally affects hydrological and thermal regimes of freshwater ecosystems which in turn change nutrient inputs and trophic interactions (Jeppesen *et al.,* 2010). Climate models predict an **increase in temperature** between 1,1 - 6,4°C during the 21st century in global air temperatures (IPCC 2013) and changes in precipitation patterns (Knutti and Sedláček, 2013) with **flush floods** in Mediterranean climate regions (Polade *et al.* 2017) such as Turkey (Oktay Akkoyunlu *et al.* 2019). Flush floods are expected to increase nutrient runoff, especially in the form of **DOC** (HELCOM, 2007). In flood receiving lakes, DOC stimulates heterotrophic bacterial production at the expense of primary production (Farjalla *et al.* 2006) causing **microbial loop (ML) to dominate the traditional food web**. Warming can potentially have synergistic effects which might exacerbate the impacts (Zingel *et al.*2018). Considering little is known in terms of consequences of these impacts for future conservation of biodiversity and ecosystem functioning, an ***in situ*mesocosm experiment was conducted at METU Mesocosm System**, Turkey between 05 July-05 August 2021. Experiment had 16 mesocosms with full factorial design having dissolved organic carbon (8ppm *local* DOC), 4 °C heating (H), heating + DOC (HD) treatments and controls (C). We hypothesized high temperature and DOC levels, (i) will have synergistic effect on bacterial biomass causing "**bacteria madness",**(ii) will effect metabolism with**"shift to heterotrophy"**and (iii) will effect ML through**"trophic interactions"**with changing zooplankton predation.Initial results imply synergistic impacts including significant oxygen reduction and shift in ciliate community.

ON432

Evaluation of European wastewater treatment plants' effluents under the future global changes : Towards minimizing ecological risks for river aquatic ecosystems

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Implementation of the EU Urban Waste Water Treatment Directive has remarkably reduced adverse impacts of effluents from municipal wastewater treatment plants (WWTPs) on European river water quality and aquatic ecosystems health. Nevertheless, the regulations focused on end-of-pipe treatments do not always ensure desirable conditions for healthy aquatic ecosystems in receiving rivers. This limitation dilutes efforts to achieve the goal of the EU Water Framework Directive, which is to reach at least "Good ecological status" or "Good ecological potential" for all European water bodies by 2027. In addition, global warming, population change, and urbanization which will further evolve over the upcoming decades can be likely to augment the future ecological risks of WWTP-discharges over rivers.

In this study, by sharing the spirit of the EU Zero Pollution Vision for 2050, we evaluate the required reduction magnitude of European WWTP-effluents to reach levels no longer considered harmful to aquatic ecosystems by the legally binding deadlines, under projected hydro-climatic and socio-economic conditions. To this end, we synthesize the dataset for river networks and WWTPs, the projected total population and urbanization level, and the flow simulation results of the mesoscale hydrologic model under different climate change scenarios. We identify ecological risks by employing four proxy indicators: the urban discharge fraction and the local-scale concentrations of each total phosphorous, ammonium-nitrogen, and diclofenac discharged from WWTPs. Our results provide a compass to prioritize WWTPs that needs to be managed under the expected future changes, preventing river water pollution from WWTP-effluents.

ON317

Lake Ice Thickness Patterns identified by Machine Learning

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Ice on lakes has recently received a lot of attention due to its rapid and direct response to global warming. Several models are available for the prediction of lake ice cover duration but a reliable simulation of lake ice thickness is more challenging. Here we used machine learning, specifically artificial neural networks, to model the thickness of ice on a Swedish lake from 1980 to 2007. We applied an artificial recurrent neural network with a long short-term memory (LSTM), which has the advantage to keep the information of the previous state of the system. We examined the impact of various forcing variables from the Swedish Meteorological and Hydrological Institute (SMHI) and the ERA5 reanalysis dataset i.e. air temperature (AT), snowfall, rainfall, wind speed, specific humidity, shortwave and longwave radiations, on model performance. We also used the day of the year (DOY) as additional input. We found that DOY had a great influence on lake ice thickness, as it accounts for the seasonality, but cannot explain the inter-annual variability nor possible long-term trends. Additional consideration of single meteorological input variables (including AT that is commonly used as a predictor), from the present date and preceding days (15 days), yielded only a slight model improvement. However, further work is required to include the effect of the history of the system. Being able to model ice thickness has important implications for the under-ice light regime because of its influence on under-ice ecology now and under ongoing climate change.

ON170

Experimental study on the effect of vegetation in flowing water on dissipation of supersaturated total dissolved gas

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When a high dam discharges, a mass of air is entrained in the water and dissolves in the plunge pool at an extremely high pressure, leading to the supersaturation of total dissolved gas (TDG). Fishes live downstream of dams would suffer from gas bubbles disease even death if they were prolonged exposure to supersaturated TDG water. It is necessary to explore measures to mitigate the damage caused by TDG supersaturation to fishes. Generally, due to the blocking effect of vegetation in floodplain, the nutrient substances and sediment will deposit at the region of floodplain, and attract fish to be there for feeding and spawning. Such behavior makes the vegetated floodplain an important habitat for fish. So, it is of great significance to investigate the dissipation regular of TDG under the blocking effect of vegetation. In this paper, a series of experiments were conducted in a 15m-long flume with PVC columns which were used to represent rigid vegetation. Several factors were considered in the experiment, including water flow intensity, surface appearance and cross-sectional shape of columns. The TDG variation between the inflow and outflow of the flume and the dissipation coefficient of TDG was discussed for different variables. The results showed that planting the vegetation can obviously promote the TDG dissipation coefficient, which increases with the increasing of water flow, surface roughness and unit blocking area. This research provides scientific basis for exploration of accelerating the dissipation of TDG, and reference for fish protection in rivers.

ON096

What climate change brings to a warm monomictic lake: mechanisms of tipping to thermal meromictic

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The mixing regime of lakes is generally considered invariant or slowly changing over time. However, climate change provides the possibility of rapid regime transition – a tipping point, which occurs when a gradual change leads to some critical feedback effect, rapidly altering the successive behavior of the lake's thermal regime. We hypothesize that a warm monomictic lake under climate change can evolve with nonlinear thermal effects dominated by warming of the epilimnion, such that the ensuing stronger stratification leads ultimately to permanent stratification. Studied was the Maroon reservoir, a large warm monomictic lake in southwest Iran. Ensemble means of three CMIP5 GCMs (RCP4.5 and 8.5) were bias-corrected to the local conditions and used as input data for the AEM3D hydrodynamic model to predict the thermal state until the end of 21st century. The results, quantified by analyzing limnological parameters, indicate, under RCP4.5, a continuous reduction in winter mixing and eventually a complete suppression of mixing by the end of the 21st century, which implies a switch from monomictic to weakly oligomictic behavior. For the more extreme RCP8.5, such a transition occurs abruptly in the late 2050s in the form of a tipping point, followed by an intermittent oligomictic behavior, after which transition to permanent stratification (thermal meromixis) occurs within a decade. This change happens because of the nonlinear warming of water column, namely a significant increase in the surface and mixing temperatures, with a less affected hypolimnion, owing to a milder warming of cold winter river underflow and strengthening stratification.

ON070

Carbon dioxide dynamics in a boreal forest ditch affected by clear-cut forestry

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Boreal streams are large emitters of carbon dioxide (CO_2). In Sweden, many of these streams are man-made ditches, created to improve drainage and increase forest productivity. Previous studies suggested that terrestrial sources sustain CO_2 in these ditches, with variability in hydrology as the main temporal control. However, few studies have quantified ditch CO_2-dynamics in harvested catchments. An altered hydrology, increased nutrient export and light availability upon harvesting can change the main source control. Thus, it is critical to understand how clear-cut forestry affects the ditch CO_2-dynamics in boreal regions. Here, high-frequency CO_2-dynamics and other hydro-chemical variables were studied in a forest ditch draining a fully harvested catchment in northern Sweden during the snow-free season. CO_2 concentrations displayed a seasonal pattern with higher values during summer. Concentrations were ranging from 0.4 to 3.9 mg C/L (median: 1.6 mg C/L). Strong diel CO_2cycles were developed during early summer, with daily CO_2 amplitudes reaching up to 2.2 mg C/L. These CO_2cycles were likely driven by aquatic primary production consuming CO_2 during daytime. Moreover, individual high-flow events following rainfall had a major influence on ditch CO_2-dynamics with generally a diluting effect, but the strength in the CO_2-discharge relationship varied among seasons and events. The study showed that growing season CO_2-dynamics in forest ditches affected by clear-cut forestry are high and controlled by a combination of hydrological and biological factors. These high dynamics and the associated controls need to be considered when scaling ditch CO_2 emissions across boreal landscapes affected by clear-cut forestry.

ON291

Mussels can facilitate the restoration of eutrophic waters by improving water clarity, enhancing macrophyte growth and changing plankton community

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As ecosystem engineers, mussels play an important role for structure and function of freshwater ecosystem, and they are attracting much attention in relation to restoration of eutrophic waters. We conducted mesocosm experiments to investigate the effect of mussels on water clarity, macrophyte growth and plankton community structure. Results showed that: water column nutrients and phytoplankton biomass (as measured by chlorophyll *a*i.e., Chl *a*) were lower and the light intensity at the sediment surface were higher in the mussel (*Anodonta woodiana*) treatments than in the controls.In another experiment, the dry biomass and height of *Vallisnerianatans*were larger in the mussel treatments than in the controls. Furthermore, the biomass of nanoplankton (2–20 µm) and picoplankton (<2 µm) in mussel (*Cristaria plicata*) treatment were reduced significantly by 65% and 68%, respectively, compared to controls. Conversely, the proportion of microplankton (>20 µm) in total phytoplankton biomass increased from 28% in the control group to 68% in the mussel treatment. *C. plicata*also decreased the total abundance of zooplankton and the abundance of rotifer by 81% and 87%, respectively, while the proportion of Cladocera in zooplankton increased ~10 times. Thus, these mussels changed plankton community structure, decreased phytoplankton biomass and nutrients concentrations, increased transparency and enhanced the macrophyte growth. The native mussel species can be useful players in restoring eutrophic waters.

ON011

Historical anthropogenic inputs dominate modern sedimentary phosphorus dynamics in eutrophic lakes in southern Finland

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Internal Phosphorus (P) loading has retarded the recovery from eutrophication in lakes worldwide. Organic matter remineralization and iron-bound P remobilization from reductive dissolution are two major diagenetic pathways of P regeneration from sediments. These processes drive a flux of P from sediments to the water column that may be sustained for decades following external loading reductions. However, various factors, including the content and composition of deposited organic matter, sedimentation rate and electron acceptor availability may regulate P diagenesis and therefore control the evolution of internal loading on longer timescales. In this study, we investigate the biogeochemical dynamics dominating modern internal P regeneration and burial in a set of human-impacted lakes located in southern Finland. Pore water profiles in lakes affected by past intervals of intense but transient nutrient loading show evidence for deep reactive sediment layers rich in organic matter, which sustain long-term P diffusion towards the surface sediment. Lakes with more stable external loading histories show convex porewater P profiles, consistent with recycling of P in the upper sediments during early diagenesis. Accordingly, in these lakes the solid-phase profiles show a strong accumulation of P at the sediment surface. The magnitudes of P concentrations and diffusive fluxes vary significantly between the lakes. We discuss how historical anthropogenic P inputs, environmental factors associated with catchment development, and diagenetic processes including authigenic mineral formation may cause the differences in internal P loading between lakes.

ON247

Identification of potential neuro-toxins and development of adverse outcome pathways associated with cyanobacterial exudates

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The release of toxic cyanobacterial secondary metabolites seriously threatens biosecurity and public health, and neurotoxicity has attracted much attention as one of its toxic effects. *Microcystis aeruginosa* (Ma), the dominant species in global freshwater algal blooms, produces exudates (MaE) that caused nerve damage. However, as MaE is a complex mixture of various chemicals, understanding of MaE's neurotoxicity mechanism and prioritizing potential neurotoxins remains limited. In this study, to reveal MaE's neurotoxicity mechanism and find potential neurotoxins, we screened out ToxCast assays which intended targets related to function of nervous system, machine learning supervised gradient boosting classifier models were further developed based on assays. Using machine learning models based on ToxCast assays, active chemicals from MaE on each ToxCast assays were identified. We systematically identified mechanism(s) to understand neurotoxicity of MaE. We predicted that MaE affected cholinergic, dopaminergic and serotonergic neurotransmitter systems, and may cause neuroinflammation and even neurodegenerative diseases like Parkinson's disease. Based on the relationship of active targets, we have proposed potential adverse outcome pathway (AOP) relevant to neurotoxicity of MaE. We further identified 13 potential neurotoxins combined with molecular docking for 13 targets based on machine learning. We found that these chemicals have high affinity for action of targets, such as Phytosphingosine, LysoPC(16:0), 2-acetyl-1-alkyl-sn-glycero-3-phosphocholine, LysoPC(18:1(9Z)), Sphinganine, Egonol glucoside, Nummularine B, etc. We propose that these chemicals be monitored in water management. Our study helps to understand neurotoxicity mechanism(s) and identify important neurotoxins of cyanobacterial blooms.

ON238

Inundated dense*Tamarix*forests: a unique lake habitat

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Inundated*Tamarix*forests around lake shores is a new phenomenon at Lake Kinneret, Israel, resulting from increased amplitude of water level fluctuations due to climate change driven multi-annual droughts alternating with high-precipitation winters. *Tamarix*establishes dense populations in exposed shores during consecutive years of declining water levels, then survives few years of inundation. These forests pose a conflict of interests between shore owners who want their removal, and ecologists who claim that this unique habitat must be studied before making management decisions on tree removal. Our objective was to explore and characterize the inundated*Tamarix*forest environment in Lake Kinneret, in order to understand whether it is a nuisance or a blessing to lake ecology. We sampled monthly, over two years, at two inundated forest sites and one control site with no vegetation. Sampling for physical, chemical and biological parameters was conducted from a boat, through boat-width channels pruned through the dense forests. Limited water exchange, low light conditions and high organic content characterized both*Tamarix*sites. The site with the older, larger and denser trees was continuously near-anoxic, with a completely different phytoplankton and zooplankton species composition from that known from the lake. The inundated vegetation comprised a preferred habitat for fish spawning and nursery for their fingerlings. Over time, the differences between the forest and control sites declined as the trees gradually died during the third year of inundation. Our study highlights the need to further study the understudied eulittoral zone of lakes with fluctuating water levels.

ORAL RECORDED

OR040

Human – environment interaction during the last millennium: A multi-proxy sediment record from Lake Höglwörth, Bavaria

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Today's rapid environmental changes pose serious threats to ecosystems worldwide. High population density and intensive land-use in the pre-alpine forelands of Bavaria, Southern Germany, since the medieval period make this region an interesting research area to investigate human impact on the environment. In this study, we present a multi-proxy record from Lake Höglwörth, Bavaria, Germany, based on sedimentological, geochemical, biomarker, and paleontological analyses of a 2.7 m long sediment core covering the past millennium. Peat deposits at the bottom of the core suggests, a lower water level (ca. 6 m below recent) at some point during or just before construction of the Höglwörth monastery around 1125 CE. The lacustrine deposited above the peat document the continuous existence of the lake, albeit with varying environmental conditions and evidence of significant human impacts as shown by fluctuation in lithology and proxy records. Anthropogenic activities in the catchment were probably responsible for enhanced sedimentation of allochthonous materials from 1275 to 1375 CE and for high aquatic productivity and anoxic conditions from 1375 to 1450 CE. Environmental conditions were relatively stable from 1450 to 1700 CE. Increased allochthonous input and a substantial shift in the composition of the aquatic community in 1701 CE coincides with the construction of a mill at the lake shore and the related rerouting of a small creek. Anoxic conditions from 1800 to 1870 CE and from 1950 to 2019 CE correspond to the industrial revolution and the acceleration in anthropogenic activities, respectively.

OR038

Study of invasive exotic aquatic plants in the Cedillo and Alcántara reservoirs with Sentinel-1 and Sentinel-2 images.*First results.*

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The proliferation of invasive aquatic plants can have serious impact on epicontinental water ecosystems, as has happened in some reservoirs of the Tagus basin, where large blooms of water fern (*Azolla filiculoides*) and duckweed (*Lemna minor*) have appeared in recent years. The use of products obtained through remote sensing, both optical and radar images, allows estimating the surface occupied by floating macrophytes and evaluating the impacts they produce on all the water bodies of a hydrographic basin. In this work, some spectral indices of vegetation used in continental studies have been used, which allow the areas occupied by macrophytes to be quantified. The optical images of Sentinel-2 provide spectral information that allows obtaining the vegetation indices, which allow knowing the temporal evolution of the invasive exotic species in the Cedillo reservoir area. Despite the fact that all the index used allow the detection of plant masses, the NDVI index turns out to be the most appropriate when it comes to discriminating between areas with abundant plant cover, areas with less coverage and water. Likewise, synaptic aperture radar (SAR) images, sensitive to surface roughness, are also presented as a possible tool for detecting invasive species in the Tagus River and reservoirs.

OR033

How often a monomictic subtropical lake will remain stratified throughout the year under expected climate changes?

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Located in the highly sensitive subtropical climate area, according to the IPCC reports, Lake Kinneret is exposed to extreme changes in the next few decades. Lake Kinneret is a warm monomictic lake, which is thermally stratified throughout most of the year and mixes thoroughly each winter when the epilimnion water temperature reaches equilibrium with the hypolimnion water temperature by surface cooling and turbulence. Using high-resolution atmospheric projections obtained from CORDEX RCP4.5 simulation to force a 3D limnological model, we show significant changes in the stratification and the circulation of the lake over the next 50 years. As air temperature is expected to rise by up to 2.5°C in winter by 2070, the water column full mixing is expected to be suppressed. Unmixed years are expected to appear more often and full mixing will be re-activated just when cold enough winter conditions will allow a full water column turnover. The lack of mixing between the epilimnion and the hypolimnion will create an extreme depleted in oxygen environment in which very few organisms can live in, hence, will strongly affect the lake's present ecological system, its sustainability and its water quality.

Elevational patterns of trait composition and functional diversity of stream macroinvertebrates in the Hengduan Mountains region, Southwest China

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Stream ecosystems in high-mountain regions are susceptible to rapid environmental change including warming and increased human activities. Understanding of elevational patterns of stream communities and underlying drivers can facilitate the development of efficient conservation and management strategies to mitigate the impacts of these changes. Our study investigated elevational patterns of macroinvertebrate trait composition and functional diversity in six streams located in the Hengduan Mountains region, Southwest China. The effects of regional and local habitat indicators representing habitat heterogeneity, as well as water temperature and primary productivity on elevation patterns were explored. Our results showed clear elevational patterns in both macroinvertebrate trait composition and functional diversity. The RLQ analysis indicated that trait composition was influenced by both local and regional environments: with decreasing elevation and associated increase in landscape fragmentation, farmland, nutrient concentration and water temperature, abundances of macroinvertebrate taxa with less movement and attachment ability, collector-gather, and sprawler tend to increase. Functional richness increased significantly with elevation, whereas functional divergence had the opposite trend. No significant elevational pattern was detected in functional evenness and RaoQ. We found that human disturbance at the regional scale was the most important driver shaping trait composition of macroinvertebrates while temperature, primary productivity, and local habitat heterogeneity also played considerable roles. Our study emphasizes the influence of regional human disturbance on altitudinal patterns of macroinvertebrates in high-mountain streams. It also highlights the potential of trait composition and function diversity of macroinvertebrates as indicators for monitoring the ecological status of high-altitude streams.

ORAL RECORDED

OR069

Spatiotemporal dynamics of stream fish size spectra under global changes

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The size spectrum is a universal and negative relationship between abundance and body size in communities that can provide unique insight into our understanding of the responses of communities to global changes including climate warming, eutrophication, and biological invasions. In this study, we quantified the temporal and spatial changes in the size spectrum of stream fish communities in response to global changes. We used a large biomonitoring dataset documenting nearly five million of individual fish body size across several decades in France. Overall, the size spectrum slopes decreased during the three decades toward steeper slopes, indicating that fish communities shifted toward a larger proportion of small-bodied individuals. These temporal changes were primarily driven by climate warming and this effect was observed consistently across the river network. Across France, we found that global change effects interacted with the natural drivers of the size spectra. Specifically, biological invasions and eutrophication alleviated the negative effects of climatic conditions: size spectra in warmer locations had flatter slopes in stream locations with high-nutrient conditions and a high proportion of non-native individuals. These results demonstrate that global changes have strongly re-organized the structure of natural communities in space and time and potentially alter the fluxes of energy and nutrients across trophic levels and further analyses are needed to understand the implications for food webs and ecosystem functioning.

OR092

Evidence of methane transformations near oxic/anoxic interface of Georgian Bay's embayment, Lake Huron

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Methane (CH_4) is present in significant quantities in freshwater ecosystems, where CH_4 can escape to the atmosphere. The growing evidence of chemical and microbiological studies demonstrates that active methanogenesis occurs in many freshwater environments in oxic and anoxic waters. The depths concentration profiles near the oxic/anoxic interface can present some evidence of biogeochemical reactions between CH_4 and redox-sensitive elements. Therefore, this study aims to elucidate an interplay between redox processes near the oxic/anoxic interface and CH_4 abundance; and link the geochemical processes with the development of microbial communities.
We carried out four samplings at the water column of Honey Harbor in Georgian Bay, Lake Huron, between July to October 2021. The thermal stratification was stable during August-September and characterized by anoxia below six to nine meters of water depths. Our results demonstrate that CH_4 is accumulated above the oxic/anoxic interface in oxic waters.
The CH_4 concentration increases in the surface waters compared with those in the deep water, consistent with high photosynthetic light intensity. Concentrations of iron (Fe) and manganese (Mn) increase with a depth in the hypolimnion up to 22.4 and 35 µM, respectively. We propose that CH_4 is oxidized in the vicinity of the oxic/anoxic interface and below through an anaerobic pathway. Depth profiles of Fe, Mn, and sulfate suggest that anaerobic methane oxidation (AOM) may be coupled with the reduction of Fe and Mn (hydro)oxides. We conclude that the methane dynamics at the oxic-anoxic interface is a product of both methanogenesis and redox-driven processes.

OR113

Internal nutrient cycling promotes net autotrophy in small and shallow lakes of the Canadian Arctic

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Arctic lakes surrounded by thawing permafrost have often been categorized as sites of net organic matter mineralization and greenhouse gas (GHG) emissions. However, in areas that are not yet affected by permafrost thaw, the metabolic balance of Arctic lakes is not well defined and may vary with diverse landscape features including: catchment characteristics, hydrological connectivity, and other factors. We sampled 35 water bodies from the Greiner Lake watershed in Cambridge Bay, Nunavut, in an area where permafrost thaw has not yet been observed to evaluate whether they were net autotrophic or heterotrophic during the open water period. Using isotopic ($\delta^{18}O$) measurements of water and dissolved oxygen and a mass balance approach, we show that most of these water bodies were autotrophic and sites of net organic matter production over the timescale of measurement. Autotrophy was associated with a combination of efficient internal nutrient cycling and a low effect of catchment area on the input of nutrients and dissolved organic carbon (DOC). However, the DOC and nutrient concentrations were higher in isolated water bodies due to evapoconcentration of solutes, with additional effects potentially resulting from the abundant geese feces surrounding the ponds. Although lakes on Victoria Island are now highly productive and the food web acts as a source, not a sink, of organic matter during ice free periods, future changes in precipitation patterns, temperature and permafrost thaw might eventually shift the metabolic state of these lakes.

OR049

How does the Raphidiopsis raciborskii adapt to environmental phosphorus?

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Raphidiopsis raciborskii is regarded as an invasive cyanobacterial species, and demonstrates prevalence in temperate regions in the last 20 years. Numerous factors may have facilitated the successful spread and expands of R. raciborskii. Thereinto, our results indicated that the strategic flexibility to environmental phosphorus might play an important role in the domination of R. raciborskii. First, for P-deficiency, R. raciborskii could synthesize APase and acquire the P sources from organic P-molecules with hydrolyzing ester bonds to overcome P-stress conditions, and once the P was resupplied, R. raciborskii can recover rapidly to grow. Secondly, R. raciborskii could survived in low-P conditions via a decrease in growth rate and photosynthetic activity and an increase in CAT and APA activities. Thirdly, R. raciborskii could use different organic P types when experiencing P scarcity, and the availability to phosphate was higher (C-O-P) than phosphonate (C-P). The significantly increased expression of genes involved in organic P utilization, the urea cycle, and genetic information in the β-glycerol phosphate group (C-O-P), and carbon-phosphorus lyase, genetic information and environmental information in the 2-aminoethylphosphonic acid group (C-P) may prompting the utilization of organic P sources. In addition, owing to the higher P utilization, R. raciborskii could outcompete Microcystis aeruginosa, when both were treated with P-free, DIP, β-glycerol-phosphate and 2-aminoethylphosphonic acid. Hence, even if the P is reduced in natural lakes and reservoirs, there is a risk of R. raciborskii bloom occurrence, and alternative methods of R. raciborskii control need to be studied.

ORAL RECORDED

OR100

Factors controlling zooplankton communities in temporary rock pools

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Temporary rock pools include all types of depressions occurring in inselbergs around the world, in all major biomes. These ecosystems show different degrees of isolation and connectivity, being mostly temporary habitats that occur in semi-arid or temperate regions. The objective of this study was to evaluate the effects of hydroperiod and biotic (phytoplankton) and abiotic factors on the zooplankton community in Brazilian semiarid rock pools. Twelve rock pools were selected for a sampling of water, phytoplankton, and zooplankton over the spatial gradient in a drying period. The hydrological regime was extremely irregular over the months promoting a drastic reduction in the water level during the drying period. In flood month all pools were small (≤ 150.9 m2) and shallow (≤ 1.0 m), with alkaline and warm waters. As expected, rock pools connected registered more similarity between zooplankton groups, while the rock pools more isolated in the landscape showed a greater diversity of zooplankton groups. In contrast, during the drying period, the area and volume of the rock pools decreased, worsening the water transparency. A similar result was identified for phytoplankton species, however, the influence of the phytoplankton on the zooplankton composition was not observed. In conclusion, the drying of the rock pools promoted the reduction of water level and, consequently the water quality. Besides it, was identified the increase of the herbivorous group with an intensification of the interactions between phyto and zooplankton communities.

OR005

Novel view on a framework of *Microcystis* spp. blooms: imaging flow cytometry analysis of bloom development in a mesocosm experiment

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Background: Frequent blooms of *Microcystis* spp. in freshwater systems lead to major disruptions in ecosystems on many levels. The high phenotypical plasticity of colonial *Microcystis* rises an active dispute about mechanisms for such successful expansion. The aim of this work was to provide a comprehensive picture of the seasonal development of *Microcystis* spp. community by using imaging flow cytometry (IFC) for samples from the LMWE-2019 mesocosm modeling climate change scenarios.
Methods: We analyzed samples from the mesocosm with three contrasting temperature scenarios and different nutrient loadings. The samples were collected from May to September 2019, resulting in 119,135 images of *Microcystis* spp. Samples were analyzed on FlowCAM (Yokogawa Fluid Imaging Technologies) cytometer and using a molecular biology approach (RT-PCR and Sanger sequencing).
Results: IFC analysis of samples showed recurring fluctuations in the abundance of *Microcystis* morphospecies. For once, non-colonial small clusters of *Microcystis* cells and gas-filled sheaths were shown to participate in the complex mosaic of a *Microcystis* bloom. We propose functional specialization of some of the morphospecies according to our findings. Two hypothetical models of transitional pathways of *Microcystis* morphospecies were constructed according to the findings.
Conclusion: To our knowledge, it is the first study using IFC to portray a *Microcystis* spp. bloom. The results of this study may add to the understanding of *Microcystis* sp. bloom development and its management.

OR108

Carrion subsidies of inland waters

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Decomposition of both plant and animal biomass is increasingly recognized as important to most ecosystems. While the importance of plant and algal detritus decomposition is recognized to lakes, wetlands and pond ecosystems, the functional role of carrion is often underappreciated. However, recent evidence suggests that carrion in all forms plays a fundamental role in aquatic ecosystem networks and energy flow. In this presentation, I review what is understood about the importance of both invertebrate and vertebrate carrion to inland waters focusing on sources from natural senescence, disease related non-consumptive mortality, phenology-based programmed death (e.g., salmon spawning and death) and stochastic and episodic events (e.g., mass fish die-offs). For instance, mass emergence and subsequent death and decomposition of several groups of aquatic insects (e.g., Ephemeroptera and Diptera) produce thousands of tons of biomass during emergence events; e.g, mayflies have been estimated to provide over 87 billion insects releasing 3,070 mT biomass over hours and spread over lake surfaces and riparian zones, and some provide subsidies to local indigenous human populations. Mass mortalities of invasive clams can result in 100 million carcasses with an estimated 751 kg C, 180 kg N, and 45 kg P to a stream over several days. Salmon carrion subsidies can exceed molar stoichiometry of 113:28:1 C:N:P inputs within one season. Using synthesized data from the literature that goes beyond lake snow (e.g., zooplankton carrion), I present how ubiquitous carrion subsidies impact energy and nutrient flow and foodweb structure in lakes, wetlands, ponds, rivers and streams.

OR066

Effects of urbanization-induced local alterations on the diversity and assemblage structure of macroinvertebrates in low-order streams

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Urbanization is one of the largest threats of stream ecosystems worldwide. It is crucial to understand its effects on stream organisms as a prerequisite for treating the damage caused by urban development. The aim of the present study was to investigate the general effects of urbanization in a moderately urbanized landscape and to assess the relationship between local environmental variables and biotic attributes of macroinvertebrate assemblages. Multiple sites at low-order streams flowing from natural forested area to moderately urbanized landscape were surveyed. We found that local habitat properties of natural and urban sites were different. Urbanization had a negative effect on the richness and Shannon diversity of macroinvertebrate assemblages, and caused an altered assemblage composition at urban sites. Biotic assemblage parameters showed negative, neutral or positive relationships with local physical parameters. Concrete cover was one of the most important variables, which explained a decreasing richness and diversity of macroinvertebrates. Our analyses revealed that beside microhabitat- and site-level environmental variables, stream identity explained a remarkable amount of community variation. This finding suggests that individual streams show considerable variability under natural condition, as well as in response to urban effects. It follows that the treatment of damage caused by urbanization might also show considerable variability.

ORAL RECORDED

OR095

Antibiotics increase methane production in freshwater sediments: Potential for climate change feedback, adaptation, and resistance

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The increasing concentration of atmospheric greenhouse gases is the main driver of climate change and a serious concern for human health and the environment. Microbial anaerobic methane (CH_4) production in freshwater sediments is the largest and most uncertain source of atmospheric CH_4. Since natural CH_4emissions are rising, researchers have been investigating environmental controls and climate change feedbacks for decades. Despite their ubiquity, the impact of anthropogenic chemical stressors (e.g., antibiotics) on methanogenesis in freshwater systems is still largely unknown. Against this background, we first incubated natural pond sediment at four levels of an antibiotic mixture. Second, three temperatures (i.e., 10, 15, and 20 °C) were employed as additional stressor to assess climate change effects on the toxicokinetics and -dynamics of antibiotics. Third, the adaptability of a pristine and a pre-exposed microbial community was investigated. Both communities were pre-treated with antibiotics for three weeks and consecutively incubated at three concentrations of the same antibiotics. In every experiment, the effect of antibiotics was decisive with the production rates almost doubling at the highest treatment (i.e., 5000 µg L^{-1}). Furthermore, preliminary results indicated that temperature altered effect patterns and sizes. Both communities also showed effects of antibiotics on methanogenesis after the pre-treatment phase. Compound-specific isotope signatures indicated that the same synthesis pathways (i.e., mainly acetate and H_2/CO_2as substrates) were utilized and metabarcoding of the 16S rRNA gene indicated changes in the community composition of microorganisms relevant for methanogenesis.

OR048

Cyanobacterial biomass in freshwaters of the Americas: revisiting the main predicting factors

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Cyanobacterial blooms and their toxins may compromise drinking water supplies, as well as other water-related economic and recreational human activities, in many freshwaters worldwide. High temperatures and eutrophication explain this phenomenon, although the roles of nitrogen and phosphorus have long been debated. Data was analyzed from 464 lakes covering a 14,000 km north-south gradient in the Americas and three lake depth categories (< 3m, 3 to 15 m, and > 15m). Phosphorus was the primary resource explaining cyanobacterial biomass in the Americas, while nitrogen became significant only under high nutrient conditions, particularly in shallow lakes (< 3 m depth). Water temperature was only weakly related to cyanobacterial biomass, suggesting its overemphasis in the literature. Depth was also critical for predicting cyanobacterial biomass, and shallow lakes are more vulnerable to eutrophication. Solutions toward managing harmful cyanobacteria should thus emphasize nutrient control, independent of temperature gradients, since local factors are more critical – and more feasible to control – than global external forces.

OR063

Geological determinants of cholera outbreaks along the African Rift

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The African Great Lakes have been an endemic area for cholera since the late 1970s. We focused on the Katana health zone, bordering Lake Kivu, as during outbreaks, this is, (together with the Kalemie health zone located along the west coast of the Tanganyika lake) the health zone in which the first cases of Cholera are usually observed, and the highest number of cases are also usually reached in this area. The persistence of this aquatic bacillus, usually associated with warm and salty waters, led us to formulate the hypothesis that the geothermal springs supplying Lake Kivu, mainly from the Nyiragongo volcano, should control the physico-chemical characteristics of the lake and promote the persistence of the bacillus. The lake would thus be a reservoir of the pathogen, which could contaminate local residents through the consumption of water and fish. Over the 2007-2012 period, we demonstrated a long-term unidirectional relationship between volcanic activity and cholera cases in the Katana health Zone. Contamination of the lake's water and fish was also correlated to the lake characteristics. The activity of the volcano can thus be used for predicting epidemic risks. A more comprehensive approach to the Kivu-Tanganiyka chain of lakes is underway to determine how the volcano tectonic and hydrogeological functioning of the area governs the epidemic dynamics on both sides of the Rift. The question of the role of food webs in the survival of the bacillus during inter-epidemic periods is also a problem that we would like to address.

OR109

Field experiments increase benthic densities of plant detritus and dependent organisms in small and large rivers

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Coarse plant detritus (CPOM) is a base resource of food and habitat for many small organisms in rivers. CPOM enters rivers from surrounding vegetation (supply) and drifts until it is caught and retained by hydraulic and structural features within the channel (retention). In human-altered landscapes, channels have often lost retentiveness via channel simplification, removal of large wood and clearing of riparian vegetation that contributes wood and detritus to the channel. In southeast (temperate) Australia, recent experiments have augmented in-channel structure by the simple method of driving hardwood garden stakes into the riverbed. Stakes trap drifting CPOM from the water column and retain it on the riverbed where it is available to invertebrates and other organisms. In small (≤ 10 m wide) upland streams the method yields variable results. Some streams attain order of magnitude increases in stocks of detritus and invertebrate abundance, with significant increases in species diversity of invertebrates. Other streams show little or no treatment effect. In a large (~ 40 m wide) regulated river, treatment effects vary in strength through time as detritus is periodically removed by large flows and restored by seasonal supply from riparian zones. Lessons learned from the success and failure of these experiments shed light on litter dynamics in small and large rivers. We discuss how stakes may be used for research and management objectives, particularly as a rapid and inexpensive method to identify systems where stocks of CPOM are limited by retentiveness vs supply from riparian vegetation.

ORAL RECORDED

OR067

Flow intermittency and light pollution: the effect of multiple interacting stressors on freshwater invertebrates

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Human activities have increased the diversity and spread of stressors that affect freshwater ecosystems. When stressors co-occur in space and time, their local effect may trigger unpredictable cascading effects to downstream sections via changes in the flux of material and organisms. However, few studies tested how local co-occurring stressors influence the downstream dynamics. The *Disconnected project* aims to disentangle the single and combined effects of flow intermittency and light pollution in different spatial contexts. Here, we evaluated impacts on freshwater invertebrates (both for drifting and benthic communities), using mesocosm experimental units organised in a simplified river network. The mesocosm system was designed with 18 flumes, each composed of two separated upstream sections that merged into a single downstream one.Stressors were applied upstream in a full factorial design, measuring weekly changes in the downstream drift over 24 hours. Benthos was sampled in both upstream and downstream sections at the end of the experiment, after 3 weeks of treatment. Preliminary results show changes in drift rates and composition, with flow intermittency reducing the drift of most taxa (except for good dispersers) and light pollution increasing drift through stressor avoidance mechanisms. Benthos composition was also affected, with changes both in upstream and downstream sections. Responses of drifting and benthic organisms were different whether stressors co-occurred or were spatially separated. Finally, unimpacted reaches (both upstream and downstream ones) seemed to act as in-stream refuge area. These outcomes provide valuable information for understanding the spatial dimension of multiple stressors and their mitigation.

OR126

An evolutionary ecological mechanism of CyanoHABs: unavoidable consequences when low nutrient requirements meet eutrophication

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Cyanobacterial harmful algal blooms (CyanoHABs) are longstanding global environmental hazards. Its mechanism has been recently established as the outcome of the synergistic interactions between superior ecophysiology and elevated nutrient supply. But is there positive evolution toward water eutrophication? Why the algae co-existing with cyanobacteria do not form blooms in the same waters? Here we provide our perspectives into these questions and propose a community-level mechanism of CyanoHABs.
To address the adaptive evolution to water eutrophication, comparative genomics and phylogenetics were used on all strains of a top bloomer*Microcystis aeruginosa*. To probe why coexisting algae do not bloom, we formulated a hypothesis cyanobacteria are simpler life than coexisting algae requiring less energy and mass input. To test this hypothesis, we compared them with cyanobacteria in adaptive radiation in early and current Earth, cell size and structure, nutrient demand, genome sizes and the complexity of metabolic networks, and finally field manipulation of nutrients. Both literature search and computational analyses were used.
Strong negative selection is found for all*M. aeruginosa* strains and no adaptation to local environment is identified. Cyanobacteria are simple life forms in cell structure and size, genome size, metabolic network size, per capita weight, and nutrient requirement approved by field studies.
In summary, the mechanisms of CyanoHABs have two components, a necessary component that coexisting algae have higher nutrient demand than cyanobacteria, which cannot be met by current eutrophic levels, and sufficient component cyanobacteria can readily saturate their growth and form blooms under current eutrophic regimes.

OR060

Physico-chemical characterisation of protected oligotrophic lakes in Ireland

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Permanent oligotrophic (code 3110) and dystrophic (code 3160) lakes are widespread freshwater habitats in Ireland. Despite being protected under Annex I of the EU Habitat Directive their conservation status is bad across all the Atlantic region. This is partially due to an under-characterisation of their reference conditions, preventing an accurate definition, clear mapping and specific conservation efforts. We tested water chemistry analysis as an assessment and monitoring method for these lakes, to distinguish key parameters and explore the range in which these habitat types exist in Ireland. A survey of more than ten water chemistry parameters was carried out monthly for one year in 24 lakes and ponds across County Galway and Mayo. Consistently with historical data, preliminary findings indicate that the surveyed lakes are acidic with very low levels of conductivity and alkalinity, while levels of total Phosphorus, Orthophosphates and Ammonium confirm their overall low nutrient status. By comparing the two potential habitat types we revealed significant differences in colour, organic matter, Silica, pH and alkalinity annual averages. Although a principal component analysis was able to confirm these as key parameters, it also highlighted major differences among the surveyed sites, indicating a strong regional influence on the water chemistry. Further analysis is required to explain these patterns, but this is a necessary step to better understand these protected lake habitats and design monitoring methods and assessment tools which will enhance their conservation status.

OR046

How do we manage our lakes to reduce blooms of cyanobacteria?

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Catchment nutrient management over the last 30 years has principally focused on the management of phosphorus sources to freshwaters. There is, however, growing evidence that nitrogen-limitation of primary production is much more widespread in freshwater lakes than previously thought. Nitrogen-limitation may be particularly important during summer when denitrification rates are high and this has been hypothesised to favour summer blooms of toxic cyanobacteria. This study presents results from a comprehensive analysis of nutrient limitation in over 700 European lakes. It examines the seasonal availability of nitrogen and phosphorus to identify lakes that are nitrogen-limited, phosphorus-limited, co-limited, or where both these nutrients are in excess. The abundance of potentially toxic cyanobacteria during summer is examined between nitrogen- and phosphorus-limited lakes to examine if there are any consequences for the provision of safe, clean water. The analysis reveals that co-limitation, of primary production is widespread in European lakes in summer, particularly in Northern Europe. N-limitation is more widespread in Central Europe. Higher levels of cyanobacterial abundance are most associated with an excess of phosphorus, not explicitly N-limitation, indicating management focused on reducing levels of P is key to reduce blooms of cyanobacteria. The story is, however, not all nutrients, citizen science data will be presented to illustrate that blooms can occur in almost any lake in any season, highlighting some other key factors that can lead to increased risks of bloom events.

OR039

Why we need broader monitoring for more successful freshwater restoration

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ORAL RECORDED

Large-scale ecosystem restoration, based around nature-based solutions, lies at the heart of strategies to tackle the climate and biodiversity crises. Progress has been slow and there is a need for wide-scale upscaling of restoration measures, particularly to restore much threatened freshwater biodiversity. Strong evidence is needed of successful restoration projects that demonstrate the benefits to society and the economy, alongside the environmental benefits of freshwater restoration projects. Here we outline elements of a monitoring framework aimed at maximising restoration success and widening the benefits from ecosystem restoration. It focuses on two elements: firstly, monitoring the processes in implementing restoration projects based on eight criteria within the IUCN Gold Standard for Nature-based solutions; secondly, monitoring the activities and outcomes that deliver impacts for biodiversity, climate resilience, climate regulation and societal goals of health and well-being, inclusion and green growth. We also outline the need for inclusion of sector-specific goals where relevant, such as for agriculture, hydropower and fisheries to ensure synergies are maximised and trade-offs are evaluated and not ignored. We will outline how this monitoring framework is being applied in 17 freshwater and wetland restoration case-studies across Europe in the MERLIN project, which aims to deliver biodiversity enhancement alongside the wider goals of the European Green Deal.

OR082

Seasonality enhances protist coexistence in planktonic oligotrophic communities

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Despite the oligotrophy, the number of protist individuals in planktonic communities is extremely high. There are about 10^3–10^4 protist cells mL^{-1}, which is more than a billion per cubic meter, and ~10^{16} in the photic zone of a lake. Consequently, observations consider only a tiny fraction of the whole community, whatever the technique. Given this large number of individuals, an alternative view to the seasonal replacement of species is the stable non-equilibrium coexistence of many species in a fluctuating environment (Chesson 2018). The necessary condition for stable coexistence is that all species should show positive long-term average growth rates. Inequalities related to relative fitness (i.e., competitive ability) are compensated by stabilizing niche differentiation. In the planktonic oligotrophic context, we may hypothesize that lower affinity for a limiting nutrient can be compensated by growth differentiation according to seasonal fluctuating non-limiting nutrients. In the Episodic Nutrient Enrichment Experiment (ENEX) performed in the epilimnion of the high-mountain lake Redon (Pyrenees) using 100-L columnar self-filling enclosures, we measured and compared the protist species growth response to gradients of P enrichment and N stoichiometric imbalance, with replicate treatments using ammonium or nitrate as the N source. Most protist species recorded in previous studies across seasons in this lake were recovered, including some rare species observed only in the slush layers of the ice cover. Autotrophic protists fulfilled several relationships predicted by the coexistence theory, and response similarities between them and heterotrophic organisms indicate a network of interactions that may reinforce coexistence.

OR076

Impacts of alien species on native freshwater megafauna

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Large freshwater animals (i.e., freshwater megafauna) are subject to multiple threats including overexploitation, dam construction, habitat degradation, pollution, and alien species. These threats have led to population declines and range contractions of freshwater megafauna globally. Compared to other major threats to freshwater megafauna, little attention has been paid to the impacts of alien species, which have caused considerable biodiversity loss in freshwater ecosystems. We reviewed reported evidence and conducted a comprehensive assessment to determine ecological impacts of alien species on native freshwater megafauna. Globally, negative impacts of 61 alien species on 44 freshwater megafauna species were identified. Among the 114 unique records with sufficient information, predation (44% of all records) was the most common impact mechanism, followed by competition (31%), hybridisation (6%), and poisoning/toxicity (5%). Alien species have led to population declines of 14 freshwater megafauna species and local extinction of one species. A clear variation in main impact mechanism was observed among different life-history stages (i.e., egg, juvenile, and adult) of freshwater megafauna. Alien species have posed negative impacts on native freshwater megafauna globally, leading to reduced performance of individuals, declined population, and even local extinction. The vulnerability of freshwater megafauna to different impact mechanisms changes when they proceed to the next life stage. In addition, the magnitude of impacts posed by alien species on native freshwater megafauna could have been underestimated due to a lack of long-term monitoring data, particularly in Africa, Asia, and South America.

OR086

Experimental analysis and numerical modelling for dissolved gases transfer through spillways

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Supersaturation and undersaturation of dissolved gases in water are abnormal states for natural water bodies. These two abnormal states usually bring a series of impacts on the aquatic ecosystem. The establishment of an accurate dissolved gas transfer model verified by experiments is necessary, which is helpful to the mitigation of the negative impact of abnormal dissolved gas states. This paper presents the degassing experiment of supersaturated dissolved gases on a physical model of a spillway. The experiment data, including velocity, water level, aeration concentration and dissolved gases saturation, were used to verify the established degassing model. The results show that the CFD model can be used to simulate the dissolved gas transfer through the physical model and the accuracy is acceptable. Finally, scenarios of dissolved gases transfer in the spillway on the physical model scale and the prototype scale were simulated and compared. The differences between the physical model and prototype are analyzed. The conclusion of this paper can provide a theoretical basis for the application of the CFD model of dissolved gases transfer in the prototype.

OR018

Assessing lake ecosystem recovery from acidification and responses to emerging environmental stressors: a paleolimnological perspective

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Mining and smelting activities have strongly influenced the Sudbury (Ontario, Canada) region since the 1880s, leading to acidification and metal contamination in many local ecosystems. Regulations on restricting acidic emissions were enacted in the 1970s, after which many paleolimnological studies were completed to assess the impacts of acidification and metal deposition on Sudbury lakes and their subsequent biological recovery. Twenty years after the last regional assessment, many lakes have undergone significant changes in limnological parameters (e.g., increases in pH and decreases in metal concentrations), while under the potential impacts of newly emerging environmental stressors (e.g., climate warming). Here, we revisited a suite of Sudbury lakes (n=80) by examining their current water chemistry and diatom assemblages preserved in surface sediments. Canonical correspondence analysis was used to assess the relationships between the diatom community and environmental variables. Although the pH gradient in our study lakes is much shorter than in earlier calibration studies conducted in this region, lakewater pH was still identified as the strongest environmental variable shaping diatom distributions, and so was used to construct a robust inference model (R^2_{boot}=0.73; RMSEP=0.32). By assessing ecological changes experienced by Sudbury lakes over the past few decades, we identified two major trends: an overall increase in diatom-inferred pH, and a rise in the relative abundance of planktonic taxa. Lastly, several down-core analyses were conducted to assess detailed ecological changes of these lakes over the past ~150 years: some lakes are tracking recovery in diatom assemblages, but others have less clear ecosystem trajectories.

ORAL RECORDED

OR062

Genotype specific and microbiome effects of hypoxia in the model organism *Daphnia magna.*

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The depletion of oxygen as a result of increased stratification and decreased oxygen solubility is one of the most significant chemical changes occurring in aquatic ecosystems as a result of global environmental changes. Hence, more aquatic organisms will be exposed to hypoxic conditions over time. Deciphering the effects of hypoxia on strong ecological interactors in this ecosystem's food web, such as *Daphnia*, is critical for predicting how aquatic communities can respond to such disturbance. Here, I investigated (i) the (sub-)lethal effects of hypoxia and whether these are genotype specific. As studies in *Daphnia*have already described the role of genotype x microbiome interactions in their response to toxic cyanobacterial stressors, I investigated (ii) the effect of hypoxia on the microbiome and (ii) whether the microbiome plays a role in hypoxia tolerance. For this, I performed two experiments: *Daphnia*were exposed for two weeks to either hypoxia or normoxia and (i) survival, growth and reproduction were monitored together with (ii) the microbial change after this period. Drivers of hypoxia tolerance were investigated (iii) in a transplant experiment where germ-free recipient *Daphnia*were inoculated with gut microbiota from*Daphnia* donors of their own genotype or from the other genotype, that had been either pre-exposed to normoxic or hypoxic conditions. After receiving the gut transplant, (sub-)lethal effects were evaluated for ten days in hypoxia. Gut samples were taken during the transplant experiment to determine shifts in the gut microbiome community composition between normoxic and hypoxic associations.

OR032

A multi-scale analysis and classification of the hydrogeomorphological characteristics of Irish headwater streams

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We present a spatially hierarchical, hydrogeomorphological stream classification, based on data collected in Ireland, and reflecting our hypothesis that local (site scale) stream physical habitat characteristics are related to the physical properties of the extended reach within which a site is located, and, in turn, to the physical character of the catchment. Using a top down approach, data on catchment, reach and site scale stream physical properties were collected for 42 Irish headwater streams. Summary catchment properties (rock type, topography, soil type, hydrology) were extracted from secondary sources. Reach scale physical controls on stream hydrogeomorphology (planform, gradient, degree of confinement, bed material) were assembled mainly from secondary sources. Site scale information on the stream physical habitat mosaic was collected by field survey. Data analysis identified six new 'River Types' for steep mountain streams that extend a pre-existing classification system developed for English streams and rivers. Five of the new types with sufficient replication were associated with 'indicator' habitats and characteristic habitat assemblages.The classification method is simple to apply and so is suitable for operational use. We believe that it is applicable beyond Ireland and England to other areas of northern and western Europe with similar climate-landscape conditions.

OR077

Effect of copper (Cu) and temperature on the feeding behavior of the invasive (*Mesocyclops pehpeiensis*) and native (*Mesocyclops longisetus and Microcyclops dubitabilis*) copepods (Crustacea: Copepoda)

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Deterioration of water quality due to metal contamination is increasing; copper (Cu), is one of the most important heavy metal pollutants in Mexico. While rotifers and cladocerans are frequently used in ecotoxicological bioassays, copepods are rarely used. Here we compared the effect of copper on the feeding behavior of the invasive copepod *Mesocyclops pehpeiensis*and the native species, *Mesocyclops longisetus*and *Microcyclops dubitabilis*. Weoffered 6 prey species (rotifers and cladocerans) at two copper concentrations and three different temperatures (18, 23 and 28°C). We observed significant differences in the prey preference and consumption by the three copepod species depending on the Cu concentration and temperature level. All test copepods showed a greater preference for the prey *Moina macrocopa* (Cladocera) and *Brachionus calyciflorus* (Rotifera). The copepods selected more prey types in the controls and at lower Cu concentrations. The results have been analyzed in relation to the effect of copper on prey selection by native and invasive copepod predators.

OR034

Connectivity across the European waterscape: relevance of source-sink dynamics across freshwater bioregions

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Freshwater ecosystems are one of the most impacted natural systems. Generally, their management has been focused at the local or country scale, which does not necessarily match natural freshwater bioregions and their projected climatic-driven changes. On the other hand, the quantification and mapping of broad-scale connectivity patterns has been strongly suggested as an adaptation strategy to climate change. This quantification constitutes an avenue to assess how dispersal allows species to track changing habitat conditions, enhancing populations persistence and community assembly. In this study, we propose to advance on the understanding of wide-scale connectivity patterns of freshwater ecosystems across Europe. Using satellite images, we quantified the areas of ephemeral, temporal and permanent freshwaters for 10x10Km cells. The landscape structure was represented as a graph with weighted links based on distance. Three centrality metrics were used to identify potential priority areas for connectivity. Out-degree centrality, which represents a community potential to operate as a source for their neighbours. In-degree centrality, which reflects the role as a sink. Betweenness centrality, which indicated community relevance in connecting their neighbours through the shortest paths. Notably, we identified areas with high potential for generating mass effects in the diversity for other communities or with an oversized role in connecting distant communities, providing a global connectivity map of European waterscape. Management of freshwater biodiversity may combine the approaches herein introduced with information about other determinants of biodiversity structure and stability in order to improve adaptation and resilience to future human-derived changes.

ORAL RECORDED

OR027

Smart sensors to predict entrainment of freshwater mussels: A new tool in freshwater habitat assessment

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The quantification and assessment of dynamic hydrogeomorphological processes is crucial in defining suitable habitat for aquatic benthic species. Yet a consistent approach to accurately record and monitor near-bed flow characteristics, remains largely undefined in freshwater ecology. The purpose of our work was to develop a direct, non-intrusive, low-cost and accessible tool to evaluate near-bed incipient flow conditions and predict when flow forcing results in the entrainment of individuals. Our study designed, for the first time, an instrumented freshwater mussel, encompassing inertial microelectromechanical sensors (MEMS), housed within *Margaritifera margaritifera*shells. Following initial calibration of the embedded sensors to ensure accurate detection of three-dimensional displacement, dedicated flume experiments were undertaken to assess instrumented shell movement metrics, for a range of flow conditions and shell orientations. Analysis found that data from the sensors' readings could successfully detect, and potentially predict, entrainment events through the examination of variability in recordings of total acceleration, with entrainment risk shown to vary across flowrate, shell orientation and size. Instrumented shells could provide a valuable tool for assisting conservation management of freshwater mussel species: aiding the identification and monitoring of suitable habitat in reintroduction and restoration schemes. Instrumented shells could also assist habitat suitability surveys for a range of freshwater species, intimately linked to the physical environment of freshwater ecosystems. Here, we provide an overview of this work and offer insights into the further development and utility of this technology towards the remote sensing of hydrodynamic habitat in aquatic systems.

OR015

Isotopic disentanglement of moisture sources: Insights into the precipitation histories of mountain river systems

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The application of stable isotopes in the fingerprinting of moisture sources has its perks and falls. While we can establish with some degree of accuracy the process and provenance of a moisture parcel, our assumptions largely rely on the Rayleigh distillation model and the isotopic end-member parametrization of different phases of water. To this end, the potential for discriminating water based on δ18O, δD and d-excess values become limited. The isotopic systematics involved in the water cycle i.e from ocean to atmosphere to land and back to the ocean is fairly simple if each stage of fractionation can be identified and characterized. The water cycle progresses in a binary fashion where local environmental variables determine the evolution of the daughter isotopes. We demonstrate a physics-based ML-powered architecture founded on satellite-derived and hydrological input parameters which mimic the water cycle at any spacetime coordinate to yield optimum isotopic signature of water from snow, rain, glacier melt, groundwater, and other sources. In addition, the architecture back propagates the isotopic composition of a parcel of water (e.g. in a river) to its corresponding sources (e.g. snowmelt + groundwater influx) and their relative contribution percentages, given the location and time of the sample. We derived this model for the Himalayan river basins, arguably one of the most complex climatological systems in the globe due to its intricate topography, multiple sources and types of precipitation, and anomalous cryospheric input.

OR045

Development of Phosphorous Removing Bioreactors with Woodchip and Eggshell Substrates for Agricultural Land

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Recent studies have shown loadings from non-point P sources have caused a resurgence in algal blooms. Furthermore, legacy P release may intensify due to climate change as a result of more frequent high precipitation events. The discreet nature of non-point and legacy P requires de-centralized, and mobile solutions with the potential for a circular economy. Our work suggests that modular bioreactor systems are an attractive option in this regard. The bioreactor systems we designed employ calcinated eggshell and woodchips as reactive substrates. These two substrates were chosen as the calcinated eggshells promote adsorption, by increasing surface area, and porosity through conversion of $CaCO_3$ to CaO. On the other hand, woodchips have been applied previously in bioreactors because of the ability of woodchips to stimulate denitrifying microbes. Additionally, CaO is highly reactive with phosphate, triggering the formation hydroxyapatite, a potential fertilizer supplement.
To determine the viability of the suggested substrates and implementation logistics, our studies focused on batch and adsorption experiments with calcined eggshells. Our results showed that up to 80% of dissolved P could be removed with as little as 2-3 total weight% calcined eggshells within a bioreactor. We developed a flow-through benchtop bioreactor to treat natural and synthetic P loaded waters. The experiments with the bioreactor confirmed results from batch studies. Full-scale pilot reactors were installed at key locations within a Canadian watershed and are currently being monitored.

OR022

Multiple stressors impact macroinvertebrate shredder communities. Insights from a microcosm experiment

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Benthic freshwater detritivores have a crucial role in the decomposition of vegetal detritus. Shredders discriminate among the variety of leaves usually found in the stream; this discrimination may be related to differences in leaf toughness, plant nutrient content of leaves and the presence of secondary compounds. The immediate consequence of invertebrate feeding on leaves is incorporating plant material into secondary production and the fragmentation of leaves. However, the effects of food quality change due to the invasion of plant species in the riparian area (e.g., *F. japonica*) acting simultaneously with the accumulation of fine sediment due to hydromorphological changes are poorly understood. We designed a full factorial microcosm experiment to disentangle the impact of the stressors above on benthic shredder communities and the decomposition process. The experiment lasted 10-12 days and simulated the sediment and food quality changes. Here we show that the native food (*A. glutinosa*) has a higher processing rate than the invasive one (*F. japonica*). The impact of stressors depends on the complexity and the composition of the invertebrate communities. We also show that some shredder species are more resilient to food quality changes than others. Our results may assist freshwater biodiversity managers in adapting and applying the best measures for conservation.

OR008

The enemy of my enemy - a new microsporidian symbiont and its context-dependent effects on *Daphnia*

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A microsporidian organism was found to infect the guts of multiple *Daphnia* species in lakes of midwestern USA. Field data indicate that this microsporidian can decrease reproduction of its host (parasitism) but infected *Daphnia* are less likely to become parasitised with deadly fungal pathogen *Metschnikowia bicuspidata* (mutualism). In this study, we sequenced five genes of this microsporidian (SSU rRNA, actin, β-tubulin, γ-tubulin and chitin synthase); we found it is very closely affiliated to *Ordospora*

pajunii and *Ordospora colligata* but most likely a different species. To estimate the effects of this new microsporidian on the life history traits of *Daphnia*, we exposed 7 genotypes of *Daphnia dentifera* to its spores. Our preliminary results show that only four *Daphnia* clones could become infected, which indicates genetic variation in susceptibility of the host. Infected *Daphnia* had their reproduction reduced in comparison to uninfected controls, but the severity of this reduction varied across genotypes. Additionally, we observed that *Daphnia* infected with this microsporidian often had their peritrophic membrane detached from the gut wall, resulting in a reduction in the effective gut lumen volume. This finding might be the key to explaining prior observations of lower susceptibility of *Daphnia* infected with the focal microsporidium to the virulent fungus *M. bicuspidata*, which infects via the gut. It also suggests that this microsporidian might have substantial impacts on host interactions with resources; given that the host is the dominant grazer in many lakes, epidemics of this symbiont have the potential to have ecosystem-level impacts.

OR071

Particulate organic matter properties shape the microbial metacommunity in river networks

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Understanding patterns of biodiversity in river networks is fundamental for maintaining fluvial ecosystem functions in a rapidly changing world. Heterotrophic microbes (i.e., fungi, bacteria and protists) play key roles in the decomposition of particulate organic material (POM), i.e., in organic carbon and nutrient cycling. Beside resource, nevertheless, POM particles are also “vectors” and thus essential for microbial dispersal and for structuring the fluvial microbial metacommunity. Here, we aim to better understand microbial community composition and diversity patterns in river networks and their linkage to POM properties, in particular size and composition. We analyzed bacterial and fungal DNA marker genes in three deposited POM size classes (50µm-1mm, 1-5mm, >5mm) along two river networks differing in topology and land cover (Kamp and Ybbs, Austria), to maximize potential differences in POM particle distribution patterns, both in terms of size (biomass of POM per size class) and composition (CNP ratios). We expect fungi and bacteria to dominate communities on larger and smaller particles, respectively. As particle size controls the probability of transport vs. retention in the river network, we expect implications for the structure of fungal vs. bacterial community assemblies. Smaller particles should efficiently integrate upstream species pools, while larger particles may more closely reflect local communities. This would have important implications for α- and β- diversity patterns of both bacterial and fungal communities along different river networks. We will present first results of this investigation linking microbial metacommunity structure with dynamics of POM properties in real river networks.

OR110

Decision support tools for river diagnostics and management

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Many streams and rivers in Europe are impacted by multiple anthropogenic stressors such as water pollution, hydrological alteration and land use. The assessment of riverine ecological conditions often aims at integrating the combined stressors' effects into a single status class. However, identifying appropriate management options based upon a single status class remains a challenge for many practitioners. The same applies to the evaluation of potential ecological implications of different management options. Decision support tools can help overcome these challenges. We present a series of tools that were developed i) to diagnose the causes of ecological deterioration of rivers and ii) to estimate the potential implications of river management options on riverine biology and ecosystem services. The tools build upon Bayesian Networks (BNs) and allow to model the probability of effects conditional on a set of causes. Domain experts helped structuring and validating the tools, while data analyses and literature surveys informed the parameterization of the BNs. Three different decision support tools will be presented. Two tools are diagnostic and aim at supporting decisions on appropriate management options to improve the ecological status of lowland and mountain streams. The diagnosis is primarily built upon benthic macroinvertebrate conditions. The remaining tool aims at estimating the probability of potential management effects on selected species, water uses and water quality conditions. The tools illustrate, how experts' knowledge, empirical data analyses and evidence from the literature can be synthesized, to support decisions in freshwater ecosystem management.

OR115

Combined effect of hydrogen peroxide, aeration, and zooplankton on *Microcystis* spp

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In tropical and subtropical regions, the search for and application of strategies for the reduction of cyanobacteria is poorly investigated. The use of integrated strategies could be an alternative to reduce the ecological impact on aquatic ecosystems. In this work, we evaluated the effect of hydrogen peroxide (H_2O_2), aeration, and zooplankton grazing as a strategy for the reduction of cyanobacteria, *Microcystis* spp. The cyanobacteria sample was obtained from a high-altitude reservoir, Valle de Bravo (Mexico). Two concentrations (2.5 and 5 mg L^{-1}) of H_2O_2 and aeration were applied to plankton samples containing *Microcystis*. Cyanobacteria present in 200 ml medium, exposed one day earlier (day 0) to one of the two concentrations of H_2O_2, were subjected to mild aeration for 24h (day 1). Subsequently, on the second day, the cladoceran *Daphnia pulex* was introduced into the test containers at a density of 0.2 ind ml^{-1}. Our results showed that H_2O_2 damaged *Microcystis* colonies and aeration further caused break-up of cyanobacterial colonies to <200 µm. A late regrouping of colonies was observed in the treatments with aeration. Grazing by *D. pulex*decreased the *Microcystis* levels by more than 30%. Application of these three methods appeared to be a good strategy for the reduction of *Microcystis*. However, the composition and density of the cyanobacterial bloom should be considered along with the frequency of use of chemical and physical methods. It is possible that the damaged colonies can still release toxins into the medium and their effects on zooplankton need to be evaluated.

OR016

Evaluation of Metal (loid) Accumulation in the Surficial Sediment of Mavi Lake, Ankara

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The presence of heavy metals in drinking water environments is one of the important issues that threaten public health. Within the scope of this study, answers were sought to the questions of revealing the current metal status of the Mavi Lake, which is one of the important drinking water sources for Ankara, the state of the accumulation relations between the individual elements, and whether the current elemental situation poses a risk for living organisms. In addition, the effect of the human role in the existing accumulation has been revealed. In the study, 18 surface sediment samplings were made from the lake for once. The amounts of 13 elements Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb and Zn were determined in the samples. The current elemental situation was compared with the sediment quality guidelines (SQGs) (Toxic unit (TU), Contamination factor (),, Enrichment factor (EF), Geoaccumulation index (Igeo)) limit values and investigated with different sediment assessment methods. In the study, multivariate statistical analysis was used to reveal the elemental profile, different elemental profiles were extracted with cluster analysis (CA). Among the studied elements, As and Ni are quite remarkable. It has the potential to show high toxic effects in both elements.

ORAL RECORDED

OR011

Primary production determined by ^{13}C-labelling is a viable alternative to the classic radiocarbon incubation

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Pelagic primary production is one of the most central processes in aquatic ecosystems. For more than six decades now, the standard method to monitor aquatic productivity has been paired dark and light bottle incubations with ^{14}C-labelled bicarbonate. However, with growing environmental awareness, progressively restrictive regulations, and associated rising costs, these monitoring programs have become increasingly challenging and, at times, prohibitively expensive. Here we take advantage of advances in stable-isotope technology to evaluate whether incubations with non-radioactive ^{13}C-HCO_3^- can replace the radiocarbon method without disrupting long-term time series and thus ensure the smooth transition of monitoring efforts. As the natural ^{14}C abundance is in the range of 1 part per trillion (ppt, 10^{-12}) and the natural ^{13}C abundance is approximately 1%, ^{13}C incubation concentrations must be considerably higher than with ^{14}C labels. Moreover, as ^{13}C of particular organic carbon (POC) is measured by mass spectrometry, the incubation of samples must be stopped and preserved without introducing additional carbon. A series of methodological experiments and comparisons with standard ^{14}C incubations over one year demonstrates that ^{13}C incubations may serve as an excellent alternative to measuring pelagic primary production in lakes. The approach is cost-efficient and environmentally friendly. Production rates determined along depth profiles over an entire annual cycle show that ^{13}C- and ^{14}C-methods are interchangeable and do not require empirical conversion factors.

OR085

Unexpected multi-year changes within biotic communities in warming alpine streams

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Global warming intensifies environmental change in high-altitude ecosystems worldwide, but while past and ongoing research focused on how retreating glaciers might affect the ecology of glacier-fed streams on the long-run using space-for-time substituted study designs, real-time observations of such habitats are scarce.
This study reports on water temperature (2011-2018) and invertebrate communities in 18 sites in 14 different alpine streams with distinct water sources (glacial and non-glacial) and found that warming rates are linked to stream size, with maximum rates in smaller rivers beyond +7°C decade^{-1}. Comparing benthic datasets from these streams over several years (2011, 2014, and 2015), this study demonstrates real-time shifting community metrics and group-specific changes. Further, we identified partial discrepancies between results derived from modelled space-for-time substitutions and real-time observations of the same communities. We revealed that cold-adapted species (i.e., Diamesinae) unexpectedly expand their dominance over the observed years, while other groups (e.g., Ephemeroptera, Plecoptera, Trichoptera) remained stable or increased only marginally – findings that remain hidden in space-for-time substituted study designs. Warming in general and milder conditions during summer thus alter benthic population densities, but group-specific adaptations lead to differently strong responses to such changes.
The observation of this coherent warming of all investigated streams makes clear that this is a general pattern with effects for lowland and high-order streams as atmospheric warming continues and accelerates. In particular, however, it is the aquatic communities in smaller rivers that will experience the greatest summer warming and consequential changes within the next years.

OR072

Different habitat requirements of *Ranunculus aquatilis* and *R. peltatus* in running waters

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The whole group of water crowfoots vegetation is a botanical determinant of habitat 3260 protected under the Habitats Directive and a valuable element of the river ecosystem. *Ranunculus aquatilis* and *R. peltatus* are morphologically similar species grouped in a section *Batrachium* (water crowfoots). Problems with their identification are a reason that their ecological characteristics and distribution are still unclear. To verify the distribution patterns of these two water crowfoots was the aim of the study. The environmental dataset (physical, chemical and hydromorphological parameters) was surveyed to describe the habitat conditions of river stretches with *Batrachium* vegetation. Due to the high plasticity of the whole group of *Batrachium* and the high similarity of species, molecular markers were used to identify the two analysed species.
Our study showed that the distribution of *R. peltatus* is much broader than *R. aquatilis*, which appeared to be relatively rare and their geographical distribution is limited to central Poland. The study revealed that *R. aquatilis* is growing only in small channels with low energy flow whereas *R. peltatus* was identified in the various kinds of rivers in terms of width, depth and flow type. DCA analyses detected different types of plant communities associated with these two *Ranunculus* species.

OR097

Assessment of physicochemical properties and capture fisheries/cage culture activities in Koga Reservoir, West Gojjam, Ethiopia

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Reservoirs are potential freshwater bodies that have a significant impact on the development of Ethiopia's fishing industry. This study aimed to assess the potential yield of fish and the current status of fishing activities in Koga Reservoir. Primary data was obtained through semi-structured questionnaires, group discussion, observation, and field and laboratory measurement of water quality. Fishermen's cooperative management team members were selected purposefully to assess the reservoir fisheries. Water samples were collected at four sampling sites in the reservoir (outlet, left side, right side, and pelagic part of the reservoir). In-situ measurements of dissolved oxygen, pH, temperature, conductivity, and total dissolved solids were performed on-site using a portable multi-meter. Reservoir fisheries potential was estimated using empirical models. The result indicated that the analysis of physicochemical and nutrients showed non-significant differences among sampling sites except for TDS ($P<0.005$). The mean fisheries potential of the reservoir was estimated at 104.85 tons/year while capture fisheries has been declining due to overexploitation and over abstraction of the reservoir water. According to the investor response, the productivity of cage culture was attractive in the reservoir, but it was not sustainable due to management and environmental limitations. This study indicated that the water quality of the reservoir was found within an acceptable range for fish and irrigation, however, depletion of dissolved oxygen and turbidity were critical problems in the reservoir cage culture farm. An urgent management action is needed to sustain the reservoir fisheries based on the capacity of the reservoirs' potential by restricting the number of fishermen and fishing effort and focusing on stock enhancement.
Key words: Cage culture, Fisheries, Koga Reservoir, Physicochemical conditions

ORAL RECORDED

OR120

Influence of irrigation infrastructures and water quality on fish assemblages in Lake Tana tributaries, north-west Ethiopia

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Lake Tana is one of East Africa's largest freshwater bodies, yet many of its fishes are migratory and utilize in-flowing tributaries as critical spawning habitat. However, factors such as expanding water resources developments and sand mining along these rivers and streams may disrupt this ecosystem function. We monitored juvenile and adult fish abundance and water quality across five lake tributaries from August 2014 to April 2015 to examine how irrigation schemes and water quality affect assemblage and population structure. Adult assemblages were dominated by Labeobarbus cyprinids and varied between tributaries, albeit without separation by irrigation development or sand mining. Overall, adult abundances of the dominant migratory Labeobarbus species were four-fold higher below the Shini River irrigation weir than upstream. Contrastingly, juvenile abundances were often significantly higher above these structures. Juvenile abundances decreased on average by 46% along the first 1000 m of two irrigation canals, suggesting poor habitat suitability or high mortalities from water withdrawals. Water quality varied more between rivers than sampling times, but without any separation of tributaries by irrigation or sand mining. Conductivity and turbidity related parameters had the highest correlation with adult assemblage structure and individual species abundances. These findings indicate that Lake Tana tributaries must be managed on a case by case basis, with more focus given to mechanisms allowing fish to bypass irrigation developments and the direct assessment of fish populations between sand mining and other sites. Keywords: Fish assemblage, Rivers, Weirs, Aquatic habitat management

OR123

Lake Sevan, Armenia: Assessment of current phytoplankton and ecological state

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Lake Sevan (Armenia), the largest freshwater body in the Caucasus, was subjected to tragic events in the past. The lake water level fell dramatically (from 1915.8 m.a.s.l. down to 1897.0 m.a.s.l.) due to the unspare use of water supplies from 1933 to 1993 which was combined with the eutrophication of lake. This led to changes in the biological communities in the ecosystem, including an increasing share of cyanobacteria in the lake's phytoplankton community. After undertaking restoration measures (since 2002), the lake began to return to a sustainable hydrological regime, which was paralleled by a shift in phytoplankton community composition back to diatoms and green algae. The aim of the present work was to assess and characterize the current ecological state of Lake Sevan. To achieve this goal, the lake phytoplankton and physicochemical properties were studied in 2018-2021. Although water managers expected further improvement of the ecological state of the lake in the current situation, however, the results of the investigation showed unfavorable changes in the phytoplankton composition. The lake shows signs of eutrophication which is strongly expressed by substantial changes in the phytoplankton community especially during warm periods. The lake phytoplankton occasionally showed cyanobacteria dominance but sharply changed in July 2018, when a massive bloom of cyanobacteria was registered in the lake and repeated in the warm periods of 2019 and 2020. Still ongoing nutrient pollution, relatively high phosphorus concentrations in the lake, and increasingly warmer summers probably supported the occurrence of cyanobacterial blooms in this large alpine lake.

OR075

Trichoptera species on the North-Atlantic islands with emphasis on Iceland

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Biological diversity of the Arctic has been shaped by the Pleistocene glacial periods. Species have diverged in allopatric areas during prolonged periods and expanded their distribution following the retreat of the glaciers.
Nine Icelandic Trichoptera species are of Palaearctic origin, but three species have a Holarctic distribution.
Origin of two species, the Palaearctic *Potamophylax cingulatus* and the Holarctic *Apatania zonella* and the variation of the COI gene of the mtDNA in Iceland and from their distribution ranges were studied. In *P. cingulatus*, no variation was detected in the Icelandic population. The genetic patterns of the Icelandic population of *A. zonella*, revealed two lineages, one Nearctic and other Palearctic which diverged during last Ice Age from the Bering Strait area.
The distribution of the Palaearctic species indicate they are from Scandinavia and Norther Europe, but the two other Holarctic species need further studies on their origin.

OR009

Single-cell population genomics of a bloom-forming microalga

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Microbial dispersal and expansion patterns are notoriously difficult to study when population numbers are low, the cell size is small, and cryptic diversity confounds the pattern. However, population genetic methods offer an approach to study these patterns. Here we investigated the population structure and genetic differentiation of *Gonyostomum semen*, a bloom-forming and potentially invasive protist. While the species appears to be expanding in distribution and bloom frequency in Europe, similar trends are not observed in the United States. Population genetics in protists, however, is severely hampered by the need to culture strains of clonal isolates to obtain sufficient amounts of DNA for generating genomic libraries.
We developed and implemented the analysis of single amplified genomes (SAGs) followed by restriction-site associated DNA (RAD) sequencing to bypass labor-intensive culturing and avoid culturing bias in population genomic studies of microeukaryotes. This novel approach (SAG-RAD) allowed us to sample cells from *G. semen* populations across Europe and the United States without subsequent culturing. Using SAG-RAD, we identified two distinct population clusters, with higher genetic similarity within than between the continents. Relatively low genetic diversity in European populations supports the hypothesized recent expansion of *G. semen* on this continent. Clear geographic population structure within each continent was associated with differences in environmental variables which potentially has led to local adaptation and ecological divergence of population clusters. Overall, our results show that SAG-RAD can be used to analyze microalgal population structure and genetic differentiation based on single-cell isolates from natural samples.

OR019

Flexible life history is essential for the mayfly, *Hexagenia limbata*, to survive in western Lake Erie

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The mass emergence of *Hexagenia* mayflies from Lake St. Clair during June & July of each year appears to be a regular event consistently produced by 2 coexisting cohorts that require 22 months to develop from egg to adult. In contrast, the same June & July mass emergence of *Hexagenia* mayflies from the western Lake Erie appears to occur only as a consequence of the great flexibility in their life history. Cohorts in western Lake Erie show dramatic declines in abundance over some winters. Eggs laid by those few adults that emerge from August through October (i.e. strays) or during periodic mass fall emergences (e.g. 2016)

produce individuals that likely supplement depleted cohorts. Furthermore, individual growth rates significantly increase when one of the cohorts is greatly reduced in abundance (possibly as a result of late summer hypoxic conditions); so much so that individuals are possible able to reach maturity within one year (hatch in August and emerge the following June). The contribution of "stray" adults, adults from fall emergences, and increased growth rates in response to reduced nymph abundance are essential to maintain an annual June-July emergence of *Hexagenia* in the stressful environment of western Lake Erie.

OR094

A novel high-resolution *in situ* tool for studying biogeochemical processes in aquatic systems: The Lake Aiguebelette case study

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Inland waters are a significant source of atmospheric methane (CH_4), a greenhouse gas (GHG) 34-85 times stronger than carbon dioxide (on 100 to 20-yr timescales) and responsible for ~23% of global radiative forcing. Of the GHGs produced by inland waters (i.e., carbon dioxide, CH_4 and nitrous oxide), CH_4 is responsible for ~75% of the climatic impact of aquatic GHG emissions with aquatic CH_4 emissions comparable to the largest global CH_4 emitters - wetlands and agriculture. Considering that aquatic systems contribute up to half of global CH_4 emissions, and the fact that CH_4 is predominantly formed in anoxic environments such as lake sediments, the source and quantification of ubiquitous surface CH_4 observed in most aquatic systems are a question of global importance.
In this work we present the first deployment of a novel membrane inlet laser spectrometer (MILS) instrument, composed by a mid-infrared spectrometer for simultaneous detection of CH_4, C_2H_6 and $d^{13}CH_4$ coupled with a fast response (t_{90} < 30sec) membrane extraction system. During a 1-day field campaign, we performed a 2D mapping of dissolved CH_4, C_2H_6 and $d^{13}CH_4$ of surface water of Lake Aiguebelette (France) highlighting the advantages of continuous high-resolution mapping of dissolved gases.
The results highlighted the presence of CH_4 sources less enriched in ^{13}C in the littoral zone (presumably the littoral anoxic sediments). The CH_4 pool became more enriched in ^{13}C with distance from shore, suggesting that oxidation processes were prevailing over epilimnetic CH_4 production. The data obtained were in line with recent multi-lakes studies.

OR074

Wetland detritus vs. stream detritus – Food quality determines fitness of juveniles of the highly endangered freshwater pearl mussel (*Margaritifera margaritifera*)

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Detritus is an important energy source of stream food webs. Being a mix of both external and internal sources, it is often unknown, which components of detritus contribute to the growth of stream organisms.This study focused on the comparison of two different detritus types (external wetland detritus and internal stream detritus) with respect to food quality and effects on growth as a central fitness parameter of juveniles of thehighly endangered freshwater pearl mussels (FPM).We performed feeding experiments with juvenile FPM under laboratory conditions using the two different detritus types from four different natural sources for each type. Food quality was determined by analysing the fatty acid composition.
Stream detritus resulted in significantly higher growth rates of juvenile FPM than wetland detritus indicating higher food quality. Significantly positive correlations were found between mussel growth and different groups of polyunsaturated fatty acids (PUFA) as well as the ratio of n3 to n6 PUFAs. This suggests that especially trace substances such as n3 PUFAs and a high ratio of n3 to n6 PUFAs determine the food quality of detritus for juvenile FPM. Especially long chained n3PUFAs are found in higher proportions in stream detritus, which supports high growth.
These results underline the importance ofinstream conditioning of detritusfor the food mix in headwater streams and provide novel information on feeding conditions relevant for the protection and breeding of FPM.

OR096

Production and oxidation of methane (CH_4) in sediments of tropical lakes, Chiapas, Mexico

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Lakes and wetlands are the most important natural source of $CH_4$to the atmosphere. It is estimated that aproximately 30 % of global methane emissions are emitted by lakes. Most of the $CH_4$is produced in the anaerobic lake sediments but a large fraction is often oxidized under anaerobic and aerobic conditions before it reaches the atmosphere. The present study assessed the potential production and oxidation of CH_4in sediments of tropical Mexican lakes (Lagunas de Montebello, Chiapas) along with eutrophication (from oligo to eutrophic). Sediment slurries were prepared using core sediments taken in each lake in 2019, which were incubated during 16 days under anaerobic and aerobic conditions after addition of CH_4. Changes in headspace $CH_4$and CO_2were analyzed by gas chromatography and sediment porewaters were processed to determine the main electron-accepting ions (SO_4^{2-}, NO_3^-, NO_2^-,Fe(III) and Mn(IV)).
Overall CH_4productions (FCH_4) were not significantly different between the lakes, while CO_2production (FCO_2) did (Kruskal Wallis, P=0.01). Under aerobic (FCO_2; -19.679µmol $CO_2L^{-1}g\ DW^{-1}d^{-1}$± 12.856, FCH_4; -46.949 µmol $CH_4L^{-1}g\ DW^{-1}d^{-1}$± 15.146) and anaerobic (FCO_2; -9.306 µmol$CO_2L^{-1}g\ DW^{-1}d^{-1}$± 6.870, FCH_4; -37.262 µmol $CH_4L^{-1}g\ DW^{-1}d^{-1}$± 16.586) conditions both GHG presented significant differences (P<0.001). A positive correlation between $FCO_2$and $FCH_4$was found,where CO_2increased possibly as a result of CH_4oxidation.
The highest fluxes were obtained to the eutrophic lake. The production and emission of GHGin sediments of tropical lakes could be highly related with the trophic status, and it could be a key factor in the GHG emissions control.

OR090

These ebullitions could be formed by deepening emissions and strategies for carbon reduction and electricity lowering

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Wastewater treatment plants (WWTPs) are important hubs connecting natural and human ecosystems, and their operation inevitably uses excessive electricity consumption and emits greenhouse gases (GHGs) . The nexus analysis of water-electricity-carbon emissions plays a huge role in the proposal of carbon reduction and electricity lowering strategies for WWTPs, but the current researches on this aspect are not very clear. This paper established and quantified the carbon balance relationship between water and carbon emissions under the conditions of different pollution loads, as well as correlated and analyzed water, electricity consumption, and carbon emissions (W-E-C). Using multiple linear regression, the carbon reduction and electricity lowering strategies for different pollution load periods were reasonably proposed. The results show that: (1) Under high-load operation conditions, power consumption and GHGs emissions increased significantly. (2) The carbon balance relationship was in an unbalanced state, which may be related to the metabolism of activated sludge. (3) Power consumption and GHGs emissions were mainly affected by the removal of COD, TOC, TN/TP, COD/TN, and TOC/TP in wastewater. (4) Based on just reaching the first-level A standard, CO_2_e, CH_4_e, N2O_e, Total_e (direct emissions and indirect emissions) and electricity consumption could be reduced by 14.29%-44.03%, 5.82%-6.23%, 7.99%-15.56%, 4.04%-6.02%, and 0.15%-4.27%. respectively.

ORAL RECORDED

OR114

Terrestrial DOC mobilization across the northern circumpolar permafrost region; a systematic review

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Rapidly increasing air temperatures in the northern circumpolar permafrost region are leading to widespread permafrost thaw. In this region, the lateral transport of soil organic carbon (C) as dissolved organic carbon (DOC) represents a significant source of organic C in aquatic ecosystems. As permafrost thaw increases, this C pool becomes vulnerable to enhanced lateral transport and microbial decomposition. Here, we present a systematic review of concentrations and mobilization of DOC in pristine and permafrost-thaw affected ecosystems in the northern circumpolar permafrost region published between 2000 – 2020. This dataset consists of 2,260 DOC concentrations from 96 studies, collected from the top 3 m in permafrost soils. The median DOC concentration was 30 mg L^{-1} across all studies and ecosystem type was the best predictor of these concentrations. DOC concentrations followed a latitudinal gradient. The highest concentrations were found in permafrost bogs (60 mg L^{-1}), with concentrations decreasing in upland tundra (24 mg L^{-1}), and Yedoma (28 mg L^{-1}) sites found further north. The lower concentrations in Yedoma and upland tundra sites were due to high rates of DOC degradation, high proportion of thaw affected sites, and decreases in DOC concentrations following thaw. This systematic review suggests that while the highest DOC concentrations are found nearer the southerly extent of the permafrost region, the highest effect of enhanced mobilization of DOC on its concentration is found further north.

OR101

Origin, fluxes, and reservoirs of *Escherichia coli* in aquatic ecosystems of a French floodplain

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The release and spread of opportunistic pathogens – some of which being resistant to antibiotics – in the environment is a major public health challenge worldwide. We have found evidence of the origin and characterized the dispersal, and survival of these microorganisms in floodplain ecosystems to understand their fate in the environment. Using a culture-based method, we determined the concentrations of total *Escherichia coli* and extended-spectrum b-lactamases (ESBL)-producing *E. coli*in three floodplains of Eastern France, and we then focused on one of these floodplains by applying a higher sampling pressure. Using quadruplex PCR, PCR-based replicon typing, and PCR and sequencing, we assessed the population structure of *E.coli*isolates, their plasmid replicon content, and the nature of their bla_{ESBL} genes, respectively. The main aquatic ecosystems of the floodplain – river, tributaries, riverine wetlands, and groundwater – were sampled monthly over a year cycle. We found that the majority of *E. coli*isolates retrieved in the studied floodplain may have a human origin. Moreover, we have demonstrated that the contamination of floodplain aquatic ecosystems by opportunistic pathogens mainly results from hydrological fluxes during high-flow periods, suggesting that dispersal and dilution predominated. During low-flow periods, *E. coli* could survive several months in isolated ecosystems where it may find favourable conditions to thrive. The most nutrient-rich and isolated wetlands are consequently potential reservoirs of pathogens. The production of ESBL did not disadvantage *E. coli* in low-anthropized floodplain ecosystems.

OR035

Effect of microplastics on the population growth of rotifers (Rotifera)

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Many epicontinental aquatic ecosystems are constantly exposed to polluted wastewaters or partially treated industrial and domestic effluents. Currently, microplastics have a great relevance to ecosystem health due to their minute size and high abundances, both of which allow them to be ingested by many filter-feeding aquatic animals at different trophic levels. Microplastics in different size ranges (100 nm to 5 mm) can affect the demography of herbivorous zooplankton species in different ways, such as clogging the filtering apparatus (mechanical interference) or reaching the gut through ingestion. In this work we evaluated the demographic responses of two herbivorous rotifers of different sizes *Plationus patulus* (160 µm) and *Brachionus havanaensis* (120 µm) that were exposed to one concentration (5 mg L^{-1}) of polystyrene microspheres 30 µm in diameter together with the green alga *Chlorella* as food. Compared to controls, algal food containing microplastics had significant effects on the selected demographic variables. Results were discussed in relation to the growing threat from microplastics to filter-feeders in freshwater ecosystems.

OR127

Comparison of utilization advantages of *Microcystis aeruginosa* and *Scenedesmus quadricaudatus* on different nitrogen and phosphorus forms

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The cyanobacterial blooms have been a challenge, total N and P are the most important reason for the occurrence of it. Our previous studies found the high total N and P don't lead to the rapid growth of *M. aeruginosa*, but *S. quadricauda* became the dominant species. We monitor chlorophyll fluorescence parameters and chlorophyll *a* of the two algae, aiming to clarify utilization advantages of the tow algae on different N and P speciation and competitive advantages in these nutrients. The results showed that *M. aeruginosa* had the utilization advantage ammonium chloride and phosphate (K_2HPO_4) and became the main dominant species in co-cultured experiment. *S. quadricauda* prefer to absorb alanine, nitrate nitrogen ($NaNO_3$) and organicphosphorus. The chlorophyll fluorescence parameter, such as the photochemical efficiency (Fv/Fm), the relative electron transfer rate of PSII (rETR) and the semi-saturated light intensity (Ik) can reflect the degree of stress in environment. These parameters of *M.aeruginosa* rose with the increase of NH_4Cl concentration. In the same P concentration, K_2HPO_4 make these parametersof*M. aeruginosa* higher than that of organic phosphorus. In the same N concentration, the average Fv/Fm of *S. quadricauda* in alanine water was higher than that in NH_4Cl water, indicating alanine promotes the growth of *S. quadricauda. M. aeruginosa* prefers to utilize ammonium, we should pay attention to the outbreak of cyanobacterial blooms through ammonization in lake. In organic P water, *S. quadricauda* has an inhibitory effect on *M. aeruginosa*, which can inhibit algal water bloom to some extent.

OR125

Record-setting algal bloom in polymictic Lake Balaton (Hungary): a synergistic impact of climate change and (mis) management

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After 25 years of apparently successful eutrophication management, a record-breaking mixed bloom of*Aphanizomenon flos-aquae*and*Ceratium furcoides*developed in 2019 in large, polymictic Lake Balaton. The peak chlorophyll concentration exceeded 300 mg m^{-3}, 1.5 times higher than the pre-management maxima. The external load was insufficient to provide the phosphorus (P) required to support this bloom, and its taxonomic composition was radically different from blooms in the 1980s. We hypothesized that (i) unusually long periods of intermittent stratification led to anoxic P release from the sediments, providing the required P and (ii) peculiar bloom composition indicated a regime shift. To test hypothesis (i), we analyzed high-frequency data by a one-dimensional dissolved oxygen (DO) model, based on the General Ocean Turbulence Model. DO depletion (< 1 g m^{-3}) preceded both a moderate*Anabaena*bloom in July, and the large bloom in late August. Hypothesis (ii) was examined by a sequential t-test analysis of multidecadal (1976-2020) data on phytoplankton biomass and composition, nutrient loads and summer mean air temperature. The synergistic impact of a climatic regime shift and multiple coincident management actions provoked a shift in phytoplankton composition in 2013 and forced the ecosystem into the state of internal eutrophication, in which similarly large

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blooms could develop in any summer. Within the present, warmer climate regime the effectiveness of external nutrient control may be limited due to changes in the thermal structure. Therefore, external nutrient control should be supplemented with internal nutrient control strategies, such as water level regulation, to manage eutrophication.

OR058

Aged riverine DOC export to the two contrasting estuary systems: Geum and Seomjin, South Korea

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We investigated the source, composition, and reactivity of dissolved organic carbon (DOC) in closed Geum (i.e. with an estuary dam at the river mouth) and open Seomjin estuary systems, South Korea. Surface water was collected from the brackish water zone, and concentration, stable and radiocarbon isotopes of DOC were analyzed. The average DOC concentration in Geum estuary (3.8±1.0 mgC L^{-1}) was higher than in Seomjin (1.8±0.6 mgC L^{-1}). The average $\delta^{13}C_{DOC}$ was similar with value of –25.5±2.2‰ and –25.5±2.6‰ in Geum and Seomjin, respectively, while the average $\Delta^{14}C_{DOC}$ in Geum estuary (–101.8±38.0‰) was higher than Seomjin estuary (–176.4±101.9‰). The $\Delta^{14}C_{DOC}$ in Seomjin estuary had a negative correlation with average monthly Q90/Q50 ratio which represent a relative contribution of groundwater flow to the river flow, and had a positive correlation with DOC to sum of major base cations (DOC:ΣB+). Contrastively, $\Delta^{14}C_{DOC}$ in Geum estuary did not show the correlation. This suggests that deeper groundwater flow passed through the deep soil column could bring older riverine DOC into the estuary. However, in closed Geum estuary system, the $\Delta^{14}C_{DOC}$ value is further increased due to the increase in primary production in the dam reservoir. As a result, our study suggested that aged DOC could influence the estuary system during the base flow season, while this signal would be possibly covered by the in situ produced modern DOC in the impound river system.

OR121

A Europe-wide overview of variation in river phytobenthos

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A large dataset with samples from across the EU was analysed in order to determine the major factors influencing the condition of phytobenthos assemblages in Europe's rivers.We used boosted regression trees (BRTs) and structured equation models (SEMs) to determine which factors were responsible for variation in status class assessments for the Water Framework Directive.BRTs explained about 70% of variance in diatom assemblages, with TP being the most important predictor (explaining ~57% variance), followed by nitrate-N and ammonium-N (~14% each). Longitude also explained about 10% of variance.Structural equation models confirmed these patterns, but emphasised the relative importance of ammonium-N over nitrate-N.Considerable uncertainty remains regardless of the modelling technique used, and there is evidence that the statistical power of many national monitoring programs is too low to allow stronger models to be developed.A further source of uncertainty is that current sampling techniques not being sufficiently sensitive to the fine-scale structure of riverine biofilms.This work emphasises the importance of reducing phosphorus concentrations in Europe's rivers if good ecological status is to be attained whilst also emphasising the need for decision-making to incorporate the inherent uncertainty associated with the link between stressors and ecological status.

OR089

ROS-driven methane formation across living organisms: new perspectives for understanding of methane formation in oxic aquatic environments

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Traditionally, biogenic methane has been regarded as the final product of the anoxic decomposition of organic matter by methanogenic *Archaea*. However, plants, cyanobacteria, algae, lichens and fungi have recently been shown to produce methane in the presence of oxygen. While methanogens produce methane enzymatically during anaerobic energy metabolism, the requirements and pathways for methane production by "non-methanogenic" cells are poorly understood. In this presentation, we describe a methane formation mechanism that most likely occurs in all living organisms. We present results from two bacterial species (*Escherichia coli* and *Bacillus subtilis*) demonstrating that methane formation is induced by free iron and reactive oxygen species (ROS), which are generated by metabolic activity and enhanced by oxidative stress. ROS-induced methyl radicals, derived from organic compounds such as methionine, dimethyl sulfoxide or trimethylamine containing sulfur- or nitrogen-bonded methyl groups, are intermediates that ultimately lead to methane. Furthermore, numerous experiments were made from many other model organisms from the three domains of life unambiguously showing that all of the selected species formed methane under sterile growth conditions. As the mechanism described for methane formation depends on several factors such as the availability of methylated precursor compounds, free iron, cellular stress factors and antioxidants, production rates can vary by several orders of magnitude. Thus, the established ROS-driven pathway might provide an explanation for the large variability of methane emission rates so far observed for organisms living in aquatic environments such as marine and freshwater algae and cyanobacteria.

OR050

Freshwater Ichnology: A New Way for Interpreting Organism Responses to Changing Environmental Conditions?

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Trace fossils are important paleoenvironmental indicators that record the interaction of organisms with the substrate. The study of trace fossils (ichnology) has been done extensively in the marine environment and are utilized to identify changing physico-chemical conditions (such as oxygen concentrations and sedimentation rates) that would otherwise be difficult to interpret from physical sedimentary structures. However, less study has been done in freshwater sediments.
Trace fossils in deltas are well characterized and can be used to identify the influence of freshwater and/or sediment input from rivers on benthic communities. Estuarine environments are also well studied, but to a lesser extent due to more diverse sub-environments that would affect animals in different ways.
On the other hand, ichnological studies are scarce for continental areas. This is understandable in fluvial environments as minute traces left by freshwater organisms will easily be destroyed by erosional processes of channel waters. However, despite being less erosive in nature, trace fossils in lacustrine settings are also understudied. One possible reason for this is because freshwater invertebrates are generally much smaller compared to their marine counterparts, making them much more difficult to study. Another possibility is that studies might be hampered due to varying environmental conditions experienced in different lakes.
Despite these limitations, ichnological studies of lake environments have a huge potential in tracking changes of sediment-organism interactions through geological histories and in refining interpretations of paleolake environments. They may also contribute to understanding how lake organisms respond to anthropogenic influences.

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OR061

The Aral Sea: mixing regime of its basins after desiccation and restoration measures

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The fact that anthropogenic alteration of the regional water budget may change completely the mixing regime of lakes is demonstrated by the notorious example of the Aral Sea. Formerly a brackish dimictic lake, the Aral Sea turned into a number of isolated water bodies with contrasting physical and biogeochemical characteristics, after losing about 80% of its water volume. Later mitigation measures, such as the construction of a man-made dam isolating the northern part of the Sea, increased the salinity divergence between different basins. The largest remaining basin, *Large Aral*, has lost completely the Amudarya inflow and became to a hypersaline lake. The second largest remaining basin, *Small Aral*, turned back to dimictic regime, while part of the freshwater from the Syrdayia River and isolated by a man-made dam from the rest of the former water area. As a result, a large heliothermal lake had formed in the central part of the Aral basin, accumulating solar energy within the strong chemocline. The lake reveals extreme thermal and chemical characteristics revealing extraordinary physical conditions with acute effects on biogeochemical processes, such as accelerated production and accumulation of methane in the monimolimnion and strong remineralization of the organic matter in the chemocline with potential backward effect on the density stratification. The newly formed large meromictic lakes had lost the ice season, potentially affecting the land-surface interaction in winter at regional scales. The example of the Aral Sea demonstrates the complexness of the arid lakes response to intense water use and climate change.

OR012

An extreme drought event homogenises the diatom composition of two shallow lakes in southwest China

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In the context of global warming, extreme drought events have occurred more frequently and this is projected to continue in the future in many parts of the world. However, their ecological consequences on shallow lakes are not well studied. Here we compare the succession of diatom assemblages of two medium-sized shallow lakes in southwest China during the past ~70 years, comprising an extreme drought event between ~2009 and ~2013. The diatom community of Lake Chahei showed a clear response to eutrophication from ~1980. The pioneer species Achnanthes minutissima increased strongly with elevated sedimentary total nitrogen content and at the expense of Epithemia sorex. In contrast, the diatom community of Lake Yuxian was stable and constantly dominated by the Fragilaria construens/pinnata complex. For both lakes, the most striking change occurred with the extreme drought event when environmental conditions and diatom compositions were homogenised. With strongly shrinking lake areas, peaks in the proportion of silt were observed in the sediments, suggesting increased particle burial rates and decreased light availability. These conditions selected for motile and presumably heterotrophic species mainly of the genera Navicula and Nitzschia which exhibited abrupt increases in their relative abundances at both lakes. Meanwhile, the degree of community homogeneity (inferred by Jaccard's similarity index) of the formerly distinct diatom assemblages increased strongly between both lakes. Hence, the extreme drought event has overridden and homogenised previous abiotic conditions and led to a decrease in beta diversity between the two study sites.

OR056

Reservoir eutrophication due to catchment deforestation emphasizes the indirect effects of global change

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Deforestation is a growing environmental concern with rapid climate change. It is challenging to quantify the impacts of deforestation on the dynamics of catchments and their downstream aquatic ecosystems such as reservoirs, and to disentangle the indirect, i.e. catchment-mediated effects from the direct climate change impacts on surface water quality. Here, we tackled this issue in the well-monitored Bode catchment in central Germany by investigating a unique catchment-reservoir system with two upstream reservoirs in distinct trophic states (meso- and eutrophic), both of which drain into the largest drinking water reservoir in Germany. Due to the prolonged droughts in 2015-2019, the catchment of the mesotrophic reservoir lost an unprecedented area of forest (exponential increase since 2015 and ca. 35% loss in 2020 alone). We coupled catchment nutrient exports (HYPE) and reservoir ecosystem dynamics (GOTM-WET) models using a process-based modelling approach. The coupled models were calibrated and validated against high-frequency measured datasets spanning periods of rapid deforestation, ensuring model robustness for simulating future projections. Results showed that increasing nutrient fluxes from the catchment due to vast deforestation (80% loss) can turn the mesotrophic reservoir into a eutrophic state within the next decades. Our results emphasize that deforestation had a more prominent impact on surface water quality than the direct effect of climate warming. This dominance of indirect over direct effects in the case of deforestation alerts management, which is in urgent need of new integrated projections that include climatic drivers as well as catchment and land-use changes.

OR001

Unusual abundance of bloom forming *Aulacoseira*spp. diatom populations in an anthropogenically impacted stretch of lower part of the River Ganga

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River Ganga is reeling from pressures of rapid urbanization and resulting anthropogenic forcings. In this study phytoplankton community assemblages were deduced from Dakshineswar site located in the lower stretch of River Ganga to understand the health of river. samples were collected from six stations of Dakshineswar spanning across monsoon and post- monsoon seasons of 2019 and 2020. Stations were categorized into point source and surface water based on proximity to municipal discharges. Measurement of *in situ*environmental parameters showed significant differences in dissolved oxygen, total dissolved solids, electrical conductivity and suspended particulate matter between the two seasons. In particular, concentrations of dissolved nitrate and silicate were found to be higher in point source stations, compared to surface water stations. Phytoplankton communities consisted of 23 diatom taxa and 14 green algal taxa and they showed distinct seasonal and spatial variations in study site. Phytoplankton communities were dominated by diatom taxa namely *Aulacoseira*, *Bacillaria, Coscinodiscus*, and green algal taxa such as *Ulothrix, Chlorella,*and *Scenedesmus*. There was a dramatic increase in cell abundance of *Aulacoseira*spp. in post-monsoon seasons indicating bloom-like scenario. Moreover, the rapid increase in cell abundance of *Aulacoseira*spp. also coincided with an increase in Chl-a and sharp fall in concentration of dissolved silicate. Some of encountered phytoplankton taxa such as *Tetraedron*, *Cosmarium, Nitzschia*and *Scenedesmus*showed strong co-occurrence patterns indicating possible association at ecological scales. Network analysis revealed for the first time in River Ganga evidences of co-occurrence patterns between a number of diatom and green algal taxa.

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OR031

Harmful algal blooms - Putting toxigenic genotypes and nontoxic mutants of microcystin-producing cyanobacteria on a map

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Economic losses because of harmful algal blooms formed by cyanobacteria occur due to impacts on recreation, such as fishing, swimming, and increased costs to manage and treat recreation and drinking water supplies. Perhaps the most dramatic health-related and economic impacts are due to mass accumulation of toxic harmful algae in drinking water reservoirs. Much of our molecular understanding of cyanobacteria toxin synthesis has been derived from isolated strains. While working with clonal strains is considered essential in order to understand metabolic pathways it is not quantitative and representative of evolutionary processes taking place in the environment. This study aims to resolve the quantitative occurrence of a variety of genotypes among the bloom-forming cyanobacteria Planktothrix spp. on a geographic scale among European waterbodies. Toxigenicity as indicated by PCR based methods has been combined with phylogeographic analysis to infer a hypothetical phylogenetic dependence. In particular the distribution of specific mutations of microcystin biosynthesis has been mapped to identify the geographic origin. Such surveys have indicated a geographical more local restriction of specific mutations, i.e. only within the Alps certain mutations resulting in the inactivation of microcystin synthesis have been found to occur regularly (by transposable elements or partial deletions). This geographic restriction of mutations might imply that such mutations are either evolutionary young or linked to phylogenetic fixation through ecological diversification.

OR047

Reducing internal phosphorus loading and preventing flooding in a popular Wisconsin, USA seepage lake using a siphon pipe system

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In 2002 a hypolimnetic withdrawal siphon pipe (1,676-m long, 51-cm OD) was installed in Devil's Lake (151 ha, ~14.3 m deep), Wisconsin, USA. For decades, the popular dimictic seepage lake had experienced reduced water clarity and cyanobacteria blooms fueled by internal phosphorus (P) loadings emanating from high sediment P concentrations – a legacy of external pollution no longer entering the lake. In addition, large growths of filamentous algae and periphyton occurred throughout the lake shallows. The periphyton in turn supported dense populations of snails linked to swimmer's itch. To decrease internal P loadings, water withdrawals were initially conducted mostly during September and early October when hypolimnetic P concentrations were highest. The withdrawals also helped lower lake levels that were troublesomely high. However, in 2008 following record winter snowfall and spring rains, lake levels became very high prior to an extreme June precipitation event that produced a catastrophic overtopping of the seepage lake. Because climate change projections are for increased precipitation and greater frequency of extreme events in the region, in fall 2009 the siphon pipe was modified for easier filling and degassing so that it could proactively prevent high lake levels throughout the year. Further pipe modifications in 2019 increased flow rates by adding epilimnetic water. During 2002-2021 (20 years), the withdrawals removed 5,075 kg P and water equaling 10.9 meters of lake level or 118% of the lake's volume. This presentation summarizes the siphon's operation and water and sediment chemistry responses in Devil's Lake.

OR051

Effects of different concentrations of Methylene Blue on the growth and reproduction of *Daphnia magna*

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Disinfectants are widely used to control aquatic pathogensin in tensive aquaculture systems. However, the excessive use and misuse of disinfectants will harm the ecosystem in the aquaculture ponds, especially the plankton community, the residual discharge to natural water bodies and produce toxic effects on ambient aquatic organisms. Methylene blue (MB) is frequently used in aquaculture as a disinfectant, which can prevent and cure saprolegniasis, branchiomycosis and ichthyophthiriasis since the prohibition of malachite green in China. However, the effects of MB on the zooplankton has not been studied. *Daphnia magna*has been widely used for toxic evaluation of chemical products, detection of water pollution and reference for setting safety concentrations standards. In this study, the acute toxicity and the chronic effects of MB on *D.magna*were investigated to observe the toxicological of different concentrations (0, 1.5, 2.7, 4.7, 8.4, 15, 26.7 $\mu g \cdot L^{-1}$). We used the SGompertz model to fit the trend of *D.magna* inhibition and mortality with concentration of MB, and obtained the nonlinear equations for the 24h half-lethal test is $y = 107.150 * e^{(-e(-0.047*(x-141.086)))}$ ($P<0.001$).The results showed that the 48h-EC_{50}, 24h-LC_{50}, 48h-LC_{50}were 63.18$\mu g \cdot L^{-1}$, 146.93$\mu g \cdot L^{-1}$,78.56$\mu g \cdot L^{-1}$,respectively. Long-term exposure had impact on the average heart rate, the beat frequency of thoracic limb, the body lengths, the number of molts, days to the first egg production, eggs amount, total egg production number, total number of broods, especially the high concentration. Accordingly the environmental risks of ME cannot be ignored.

OR091

The net GHG emissions of the Three Gorges Reservoir in China in full-scale synthesis

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Greenhouse gas (GHG) emissions are receiving worldwide attention and concern over the past decades. However, the net change of GHG emissions due to reservoir creation is not well reported. The objective of the study was to evaluate the net GHG emissions of the Three Gorges Reservoir (TGR), the largest reservoir in volume and installed capacity in China. Here, we provide the first full-scale synthesis of GHG emissions in the TGR. Data from two large sampling campaigns between 2010 and 2017 showed that the post-impoundment GHG emissions of the TGR were $1.36 \pm 0.16 \times 10^6$ $tCO_{2eq} \cdot yr^{-1}$. A majority of GHGs (30% ~ 70%) are emitted from air-water diffusive pathway in the main stem. Anthropogenic carbon and nutrients loads from the reservoir vicinity did not significantly contribute to the post-impoundment GHG emissions. Reservoir GHG emissions were mainly regulated by annual inflow. Subtracting pre-impoundment GHG emissions from post-impoundment emissions, the net GHG emissions of the TGR in our sampling campaigns were $10.41 \pm 1.28 \times 10^5$ $tCO_{2eq} \cdot yr^{-1}$. In terms of CO_2 equivalents per unit of hydropower production in the same years, they were 11.8 ± 1.8 $gCO_{2eq} \cdot kWh^{-1}$. Mass budget analysis showed that flooding and decomposition of organic matter in flooded land could only explain 19.9% of reservoir net GHG emissions. A large proportion of the net GHG emissions needs further study to be quantitatively identified. In addition, our study elaborated the current limitations and further research needs in evaluation of carbon footprints of reservoir creation.

OR014

Trace elements distribution of the sediment core in a high sedimentation reservoir

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Sediment cores have valuable information about past human activities, climatic, and tectonic. The Zipingpu reservoir is typical with a high sedimentation rate of about 74 cm/yr. This study retrieved 4 sediment cores of the Zipingpu reservoir to appraise contamination status. Each sediment core was cut into 10 cm, 90 sub-samples were obtained and measured using XRF to get trace elements (Ti, V, Cr, Mn, Ni, Cu, Zn, As, Sr, and Pb) concentrations. Contamination in sediment core and potential risks posed by trace elements accumulation were assessed by enrich factor, geo-accumulation index, and Hakanson's potential ecological risk index.
Results showed that the concentration of trace elements in the 4 sediment cores were as follows: Ti > Mn > Sr > Zn > V > Cr > Cu > Pb > Ni > As. Values of enrich factor and geo-accumulation index exhibited that Mn, Cu, Zn, and Sr contamination was moderately

in this area. A portion of Mn, Cu, Zn, and Sr may be delivered from non-crustal materials. Hakanson's potential ecological risk indexes ranged from 29.07 to 59.53, suggesting that the analyzed layers of sediment were in low-risk grade. This study revealed the current contamination status of the sediment core of a high sedimentary reservoir, which could be used to guide the inferences of sedimentary record and the confirming of dredging depth to a reservoir.

OR104

Spatial and temporal organic carbon dynamics in a non-perennial river basin

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Freshwater ecosystems play an active and significant role in the global carbon cycle. In non-perennial rivers and streams, flow intermittence can severely alter organic carbon dynamics through changes in the lateral and longitudinal hydrological connectivity. This alternation between dry and wet phases drives pulsed processing of organic matter in cycles of accumulation, transport, and decomposition. Consequently, the study of organic carbon in non-perennial systems has received increasing attention from the scientific community in recent years. Here, we aimed to analyze the spatial and temporal organic carbon patterns in the transport, processing, and storage of organic matter in a non-perennial river basin. We conducted a seasonal sampling in 16 sites scattered throughout the river basin. We collected samples of benthic organic matter (as storage), dissolved and particulate organic matter (as transport) and resazurin (as processing). Then, we combined the observed organic matter data with a hydrological model to properly represent the spatial and temporal dynamics. We found a consistent seasonal longitudinal pattern in the transport of organic carbon across the river network. Conversely, the storage showed a highly irregular longitudinal behaviour in the river basin over time, possibly due to local site characteristics. Regarding processing, we found a longitudinal and lateral seasonal pattern with lower activity during winter and higher organic matter processing in summer, especially in the wet section of the channel. A better understanding of the organic carbon dynamics in non-perennial systems will help quantify the role of hydrology in organic carbon variation and anticipate climate change effects.

OR052

A process-based microcosm model to disentangle the combined effects of multiple stressors in lentic and slow-flowing shallow aquatic ecosystems

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Multiple stressors, in particular, elevated water temperatures and increasing concentrations of fertilisers and pesticides due to enhanced agrochemical use, run-off and topsoil erosion in rural areas may compromise important functions of adjacent lentic and slow-flowing shallow freshwater ecosystems. The French-German project CLIMSHIFT (www.climshift.eu) aims to disentangle their combined effects. We developed a simple mechanistic model based on datasets from several microcosm experiments. The model includes a process-based representation of pelagic and benthic organisms: phytoplankton, periphytic and epiphytic microalgae, submerged macrophytes, first-order consumers and decomposers; as well as warming, nutrient dynamics and pesticide breakdown over time. Stressors may be applied in any fashion (e.g., gradual temperature increase or sudden heatwaves, nutrient and pesticide concentration pulses of varying periodicity, etc.). By conducting in-silico experiments, we gained insight into additive, synergistic and antagonistic effects of combined stressors under different scenarios of stressor application mode and degree of ecosystem complexity, community adaptation and organism acclimation. As an example, we present results from a microcosm experiment focusing on primary producers, where macrophytes were negatively affected by the toxicants while phytoplankton benefitted from the reduced competitive pressure, especially under warmer conditions. Simulation results highlighted the importance of considering community adaptation over time to more accurately experimental observations. Our model will aid in the design of future microcosm experiments and the interpretation of empirical results thereof.

OR003

Effect of crustacean (cladocerans and copepods) conditioned medium on the algal food intake and filtration rates of the rotifer *Brachionus havanaensis* (Rotifera)

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Competitive interactions of herbivorous crustaceans such as cladocerans and copepods with rotifers, indicate that the former group seems to have an advantage over the latter not only mechanically but also chemically by releasing compounds into the medium. By both, mechanical and chemical interference, crustaceans dominate in natural waterbodies. Infochemicals released by the crustaceans may interfere with other ecological and physiological processes of rotifers such as feeding and filtration rates, which in the short and long term influence the organisms' fitness. To test whether crustacean allelochemicals can affect short-term and long-term feeding process of rotifers, we measured the feeding and filtration rates of the rotifer *Brachionus havanaensis* using the conditioned medium obtained separately from the cladocerans *Ceriodaphnia dubia* and *Moina macrocopa*, and the copepod *Arctodiaptomus dorsalis* (females and males, separately). For feeding rotifers, we used the single-celled green alga *Chlorella vulgaris* at a concentration of $0.5x10^6$ cell/ml. The rotifers were pre-starved for 30 min, and then fed on alga for 1 h in the presence or absence of crustacean conditioned medium. The response of rotifer feeding and filtration rates differed significantly depending on the source (cladocerans or copepods) of the conditioned medium.

OR064

Microplastics occurrence in surface waters and sediments in lakes Edward and George in Uganda

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Background: In Uganda microplasticsare increasingly affecting the lakes.**L**akes and their related ecosystems are threatened by the catastrophic effects of the triple planetary crises – biodiversity breakdown, the climate emergency, and rampant pollution**.** This studyevaluated the abundance, distribution, and composition of microplastic pollution in Lakes Edward and George.
Methodology: Surface water and sediments samples were collected, then passed through a stack of sieves with sizes from 2.36mm at the top to 0.075mm at the bottom. These samples were digested to remove organic matter, and salt solutions were added to allow the microplastics to float. Extracted particles were examined under a stereo microscope, and quantified.
Results: Pollutionin the lakes, takes the form of waste, such as plastics**,**fishing gear, nutrients from agricultural run-offand degrading ecosystems services**.** About 1 in 5 of the fish in the lakes had ingested plastic and microplastics were observed in surface waters with concentrations varying from 1,580 to 57,665 particles/m3 (surface water) and 386 to 1,357 particles/kg (dry sediment). The microplastic concentrations were significantly correlated with urbanisation and population density, indicating that the microplastic concentrations in the lakes depend on human activities. There was a significant relationship between the numerical and mass concentrations and Biochemical Oxygen Demand (BOD), which is an environmental indicator of water pollution.
Conclusion: To address plastic pollution,people should reuse plastic items; properly dispose them of in garbage bins or recycle them; avoid pouring untreated chemicals, oil, toxic chemicals or harmful medicines into the lake.
Keywords: Microplastic, Pollution, Surface water, Lakes Edward and George.

ORAL RECORDED

OR081

Typification of oligotrophic lakes using the ciliate assemblage structure re-visited

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Extended data set on the ciliate assemblages covering low productive lakes was enriched. Ciliate were identified through Quantitative Protargol Stain while feeding patterns using fluorescence microscopy methods. The data set includes the whole ice-free-season studied lakes above the timberline (Øvre Neådalsvatn and Stavsvatn, Norway; Lochnagar, Scotland; Starolesnianské and Nižné Terianské pleso, Slovak Republic; ozero Chuna, Russia), mountain-forest acidified and recently recovered lakes (Černé, Čertovo and Prášilské jezero, Czech Republic), and short term-studied European lakes (a dystrophic Grosse Fuchskuhle and iron-buffered meromictic Waldsee, Germany, a meromictic karstic lake La Cruz, Spain, and point-studied 100 Finland lakes). The data were contrasted with the extensively studied high altitude monomictic soda lake Alchichica, Puebla/Veracruz, Mexico. We did not find any remarkable differences within the above timberline- and forest surrounded lakes. The pristine oligotrophic lakes were typified mainly through the taxon / feeding-behaviour groups of (i) oligotrichous mixotrophs and/or (ii) *Askenasia* spp. & *Mesodinium*spp., meanwhile (iii) minute prostomatids (particularly *Urotricha*spp.) numerically prevailed in acidified lakes. The significant contribution of (iv) picoplankton-feeders (including genera *Halteria*, *Rimostrombidium*; scuticociliates and peritrichs) in the water column was scarce but in the soda lake Alchichica. In the previous studies anaerobic species were discarded from the analysis due to their high individual biomass (e.g., *Spirostomum teres*, *Caenomorpha* sp., *Brachonella* sp.). However, now we characterised them as an integral part of the assemblages in various oligotrophic lakes. To complete the carbon & energy cycling budget we propose to incorporate the detailed sampling of hypolimnetic & anoxic layers to the lakes' analysis.

OR080

Mineral sedimentation in landslide fen deposits: temporary mountain lakes affected by extreme rainfalls - from present day records to the past; Polish Western Carpathians

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Landslide fens (formed within landslide depressions) represent a specific depositional environment, where biogenic accumulation is temporary replaced by lacustrine deposits. Downpours and/or long-lasting rains cause cyclic flooding of fens during phases of climate humidity growth and supply the mineral material to the sedimentary basins. In effect, the peat accumulation is temporary interrupted by mineral inserts (various thickness) within peat sequences. As a result of permanent interruption of peat accumulation, mineral covers have been formed on the peatlands. The change from biogenic accumulation to lacustrine sediments deposition in landslide fens reflects climate fluctuation (periodically climate humidity growth) which have occurred since the Late Glacial, along with mass movements intensification in the Polish Carpathians. Also today, within some landslide fen basins, lacustrine sedimentation occurs as a result of a single hydrometeorological events. Usually daily precipitation exceeding ca 50 mm (with sum of ca 100 mm during 3-4 days) causes flooding of fens and forming periodic lake. Then, thethickness of mineral deposit (clayey silt delivered to reservoir as suspension) doesn't exceed 0.1-1 mm. If the daily sum of rainfall exceeds 100 mm (with sum of 200-250 mm for 4-5 days), the thickness of the deposited mineral sediment (clayey silt or sandy clayey silt) may be even up to 20 mm. Grain size of contemporary deposited mineral material is similar the deposits forming mineral horizons in peat during the Late Glacial and Holocene. This study was supported with funds from the National Science Centre, Poland,grant No. 2017/25/B/ST10/02439 (2018–2022).

OR105

Saharan dust promotes acidic polysaccharides coagulation and carbon export in an eutrophic reservoir

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Inland waters can act as important carbon sinks, when emissions of CO_2 and CH_4 are lower than carbon export and sequestration in sediments. Acid polysaccharides can coagulate into particles and sink toward sediments when are ballasted. Saharan dust appears to ballast organic aggregates in marine systems, however this mechanism has not been studied in reservoirs. Mediterranean biome is submitted to intense and recurrent Saharan dust intrusions with unknow effects on particulate organic carbon sinking rates. In this study, we quantified sinking rates of particulate organic carbon and acid polysaccharides in a eutrophic Mediterranean reservoir and determine their main seasonal drivers. Finally, we assessed the role of Saharan dust depositions promoting carbon exports to sediment. We deployed eight sediment traps at two depths and samples were collected on a weekly basis during two years. Our results showed a clear seasonal pattern in the particulate organic carbon sinking fluxes associated with the concentration of chlorophyll-a. The acid polysaccharides fluxes were also related to divalent cations and particulate organic carbon concentration. Furthermore, we found notable increases in chlorophyll-a, dissolved organic carbon, divalent cations and the particulate organic carbon fluxes during or shortly after intense Saharan dust deposition intrusions. Our findings shed light on the importance of carbon exports to sediments in reservoirs and provide mechanistic knowledge on the processes behind the sinking of organic carbon, enhanced by Saharan dust depositions, in the water column.

OR099

The interplay of deterministic seasonal changes and stochastic events determine the structure and interactions of soda pan planktonic communities

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Soda pans are endorheic shallow saline aquatic habitats characterized by high pH. Due to their shallowness, water depth substantially fluctuates, which together with the importance of evaporation leads to strong temporal variation in environmental parameters. In this study we aimed to explore the impact of this temporal environmental fluctuation on the structure and interactions of the prokaryotic and eukaryotic planktonic communities. Therefore, biweekly samples were collected from five Hungarian soda pans throughout three seasons (spring, summer, autumn). Planktonic community composition was determined by sequencing 16S and 18S rDNA for prokaryotes and eukaryotes, respectively, while interactions were revealed by Local Similarity Analysis (LSA) networks and weighted topological importance of network nodes was used to identify the keystone species of the communities. The results indicated that the pans share a core microbial community and have similar temporal trends, although desiccation events and cyanobacteria blooms introduced drastic shifts in community composition and network structure. Both prokaryotic and eukaryotic communities differed throughout the seasons and the topologically organization of the LSA networks showed two distinct hubs corresponding to spring and summer. Furthermore, many keystone taxa were shared across the pans, such as acIII-A1, Burkholderiaceae, Nitriliruptoraceae for prokaryotes and *Choricystis*, *Nitzschia*, Chlorellales for eukaryotes. Our results demonstrated that the temporal variability of planktonic communities of soda pans is driven by deterministic seasonal changes that affect the structure of the entire planktonic trophic network, however local stochastic events such as drought or blooms introduce lead to substantial deviations from the common seasonal trends.

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OR059

Plant protectant agents and metabolites in freshwater systems – new insights into process understanding

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Plant protectant agents (PPA) and their metabolites are found frequently in different freshwater systems and by that potentially threaten their health and biodiversity. The complex interaction of PPAs' chemical characteristics with environmental conditions such as weather, soil/sediment, hydrological and morphological settings limit our understanding of their environmental behaviour and fate. Also, most investigations are limited to either spatial or temporal resolution of the occurrence of PPAs. By that many patterns of PPA detections and concentrations remain unexplained. The current study contributes to process understanding by presenting time series results from agricultural ponds and adjacent near-surface groundwater investigations of PPAs and their metabolites. The results reveal simultaneous dynamics between subsurface and surface water with respect to both, occurrence and concentrations of a number of substances. These dynamics are not restricted to individual locations but are found on a larger scale with a maximum distance of 12 km between the study sites. We suspect subsurface hydrology to be a driver of similar patterns in surface water and groundwater.

OR112

Limnological dynamics of methane and carbon dioxide emissions from a tropical hypertrophic reservoir

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Methane (CH_4) and carbon dioxide (CO_2) emissions from tropical freshwater ecosystems have been understudied, particularly in terms of their relation to their limnological dynamics, and also on the cycling dynamic and the mechanisms involved in the CH_4 emissions. To help reduce that knowledge gap, we addressed these processes in an important high altitude tropical (located at 19°N) hypertrophic reservoir, Valle de Bravo (VB), which provides water supply to the Mexico City Metropolitan Area**.** We measured both CH_4 and CO_2 concentrations, and CH_4 and CO_2 emissions in VB during four campaigns equally distributed along the annual limnological cycle of the reservoir. Dissolved CH_4 concentration varied over 4 orders of magnitude (0.015 µmol L^{-1} to 176.808 µmol L^{-1}), and dissolved CO_2 varied from below atmospheric saturation (15.062 µmol L^{-}) to over 10 times that concentration (219.505 µmol L^{-1}). CH_4 fluxes ranged from 23.25 to 1220.80 µmol m^{-2} d^{-1}, while CO_2 fluxes ranged from -60.11 to 254.99 mmol m^{-2} d^{-1}. Seasonal monitoring allowed the assessment of the total annual emissions as well as the greenhouse gas(GHG) storage during thermal stratification, which represent over >58% of the total GHG annual emissions from VB. Overall, the hypertrophic reservoir of VB is an important source of greenhouse gases, from which the main contribution is the CH_4 released during autumn overturn.

OR070

Evaluating the ecological status of large rivers in the context of the WFD: the new phytoplankton index for French large rivers

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Large rivers are streams at great risk of multiple contaminations due to their downstream location in the river continuum. The evaluation of their ecological status is therefore of utmost importance in order to ensure the conservation of aquatic biodiversity and preserve the water resource in the floodplain. In Europe, such an evaluation is based on the responses of biological compartments (fish, macroinvertebrates, diatoms, macrophytes and phytoplankton) to gradients of anthropogenic pressures. In this presentation, we will relate the development of a new multi-metric index based on the responses of the phytoplankton communities observed in French large rivers. We explored how multiple types of metrics, such as biomass-based indices, trophic indices and metrics based on the structure (composition, diversity and morpho-functional traits) of the phytoplankton communities, would correlate to trophic parameters (nitrogen and phosphorus forms). "Standard" metrics, routinely used at the European scale for bioassessment, such as (transformed) concentrations of chlorophyll-a and double-weighted trophic indices (cf. Zelinka & Marvan 1961) exhibited the best performance, among all studied metrics, to predict trophic pressure. Such a result highlights the global robustness of past indices and their related development approaches. Nevertheless, we also tried to further improve the bioassessment by selecting other metrics related to non-trophic anthropogenic pressures, such as toxic ones linked to pesticides. Development is not finalized, but preliminary investigations show that using metrics based on bioecological traits of phytoplankton taxa is a promising approach to indicate such non-trophic pressures.

OR007

Temporal monitoring of cyanotoxin dynamics in the Lalla Takerkoust dam and transfer to the surrounding farms

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The eutrophication of the Lalla Takerkoust dam in Morocco constitutes a severe health threat to the surrounding population. These freshwaters used for human consumption and crop irrigation of crops experience toxic blooms caused by Microcystis aeruginosa. This study aimed to temporally monitor the transfer of cyanotoxins from the dam to agricultural farms. Thus, water samples were collected during the bloom period between September 2019 and March 2020 and then between November 2020 and March 2021 at three locations: the dam at 20 cm deep, at the dam outlet, ca. 15 m deep, and 3 km away at an agricultural farm. Cyanotoxins were quantified by LC-ESI-MS using three Microcystin standards (MC-LR, MC-RR, MC-YR). Our results revealed two variants with highly significant variations in MC concentrations over time, namely MC-LR, MC-YR. While November in 2020 recorded the highest concentration ever of 159.67 ±1µg/L MC-LR, in November 2019 was 5.081±0.01 µg/L MCLR. Nevertheless, in all cases, from November to February, MC-LR concentration remained above the WHO guideline for drinking water of 1 µg/L. Furthermore, another disturbing fact was that the concentration of MCs varied significantly according to the vertical stratification of the dam. Although the MC-LR concentration in December 2020 at the dam outlet was 33.42 ±1.07 µg/L, this concentration was 116.108 ± 3.79µg/L MCYR. The MC concentration significantly decreased before reaching the farms, $r=0.969$; $p<0.001$ and $r=0.860$; $p<0.001$ for MC-LR and MC-YR, respectively. Our results indicate that using the Takerkoust dam water during the bloom period is dangerous and calls for decision-making.

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OR025

Bitter facts of India's largest inland saline wetland: 96 years of analysis

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Saline lakes occupy 44% of the volume of all lakes that are tending to suffer from extended dryness, reduced hydro period, or complete desiccation by 2025. The current study is conducted on Sambhar Salt Lake, the largest inland saline Ramsar, site of India, contributing to 9.86% of total salt production. Due to illegal salt pan encroachment, its losing salt worth 300 million USD. Geospatial modelling was conducted for 96 years (1963-2059), integrating ground data . Land Use Land Cover classification was conducted for 1972, 1981, 1992, 2009, and 2019, and future prediction for 2029, 2039, 2049, and 2059. Further, images were classified into 8 classes that include the Aravali hills, barren land, saline soil, salt crust, salt pans, wetland, settlement, and vegetation. Past trends show a reduction of wetland from 30.7 to 3.4% at a constant rate (4.23%) to saline soil, which subsequently seemed to increase by 9.3%, increasing thereby the barren land by 4.2%; salt pans by 6.6%, and settlement by 1.2% till 2019. Future predictions show loss of 40% wetland and 120% of saline soil and net increase in 30% vegetation, 40% settlement, 10% salt pan, 5% barren land, and a net loss of 20%, each by Aravali hills and salt crust. Additionally, the ground result shows its alteration and reduction of migratory birds from 3 million to 3000. In the light of UN Decade on Ecosystem Restoration (2021-2030), restoration strategies are suggested; if delayed, more restoration capital may be required than its revenue generation.

OR036

Safeguarding freshwater ecosystems and biodiversity in the African Great Lakes: evidence synthesis for researchers and decision-makers

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Globally, freshwater ecosystems and their biodiversity provide goods and services to billions of people. The African Great Lakes (AGL) basin spread across 11 countries is endowed with lakes, forests, wetlands and rivers with diverse ecosystems providing shelter to highly endemic biodiversity across a large range of groups of taxa. Harbouring 25% of the world's freshwater, these lakes provide essential services to over 62 million people. However, these vital ecosystems and their livelihood support systems are threatened by numerous anthropogenic stressors at local, regional, and global scales. There is an urgent need for rigorous evidence syntheses to provide a valuable resource to enable more evidence-based decisions and implementation of effective policy and practice that will not only halt declines in freshwater biodiversity but reverse the declining trend. In this study, we adopt a systematic review to gather evidence on freshwater ecosystems within the African Great Lakes region by focusing on persistent and emerging biodiversity threats and impacts; prioritising research activities, collaboration and networking opportunities; harmonized monitoring and data sharing efforts, ecosystem valuation services and nature-based solutions and education and training of next-generation scientists for sustainable management of these resources. Through comparative studies conducted in Canada, the review will generate summarized and scored evidence syntheses, alongside interactive appraisal tools, to serve as a model for engaging and empowering researchers, practitioners and policymakers in AGL. Finally, we outline the roles and responsibilities of actors involved with policy, research, professional bodies and societies, advocacy, industry, and practitioners.

OR006

Rapid evolution of morphological defences in *Daphnia galeata*

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Revival of dormant organisms from resting stages of known age ("resurrection ecology") allows quantification of phenotypes and evolutionary change. Here we use resting eggs of *Daphnia galeata* deposited in sediment layers of known age of Lake Constance to study rapid evolution of *Daphnia* anti-predator traits and their induction, evolution of plasticity, by two invertebrate predators, *Leptodora kindtii* and *Bythotrephes longimanus*.We successfully hatched *Daphnia galeata* clones from eggs produced since the 1970s, thus spanning 5 decades of environmental change, especially oligotrophication, in Lake Constance. Using 38 resurrected clones we observed clonal variability and evolution of larger spines in the absence as well as in the presence of predator kairomones. Hence, for spina size the evolutionary change in the mean trait was larger than the evolution of phenotypic plasticity. Our results suggests that with reduced food availability due to oligotrophication, there is selection for greater investment into anti-predator defences in *Daphnia*.

OR116

New methodologies for living zooplankton separation and their applications in large-scale experiments

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Zooplankton can suppress phytoplankton biomass. However, which zooplankton species, groups or species combinations cause phytoplankton changes in the natural environment is still understudied. This very basic cornerstone of limnology was traditionally investigated either in a small laboratory environment or by obtaining field data. In the first case, experiments were done in controlled conditions, looking for feeding rate and selectivity, but could not apply for seasonal changes, population dynamics and species interactions that occur in nature. In the second case, all these parameters were included, but without control, therefore, it was difficult to disentangle the role of individual zooplankton species in continuously changing and complex lake ecosystems. Mesocosm experiments offer a solution for the weaknesses of both approaches since they provide controlled replicates and semi-natural environments. The main difficulty is to provide high numbers of single zooplankton species to inoculate large mesocosms in sufficient densities. In our study, we tried to improve methodologies for the separation of living zooplankton, obtained in large quantities from net towing in a lake. Combining sieving, bubbling, CO2 applications and other techniques, we obtained around 500.000 cladocerans with 99% purity, above one million calanoid copepods with 98% purity and almost two million cyclopoid copepods with 88% purity. Those taxa were inoculated in mesocosms to disentangle their top-down effects on phytoplankton. The results of this experiment as well as the benefits and limitations of separation techniques for the future in large-scale zooplankton studies are discussed.

OR128

Constraining effect of moving river bedforms on sediment microbial community is not influenced by variability in ripple migration velocity

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Climate change associated hydrological extremes cause increased sand load to rivers and will expand the naturally occurring phenomenon of migrating bedforms (sand ripples). As ripples move downstream, single sediment grains follow a moving-resting cycle: They are frequently exposed to light during the moving phase, while dark conditions prevail when they are buried under following sediment grains during the resting phase. The frequency and length of time period at which sediment grains are transported and exposed to light are dictated by ripple dimension and migration velocity. Previous studies showed the constraining effect of sediment migration on microbial phototrophic and heterotrophic activity. In a microcosm experiment, we aimed to clarify how different shifting frequencies of moving-resting in combination with light-dark cycles affect the microbial activity and structural assembly (photoautotrophs and heterotrophs). We exposed sediments from a lowland river (Spree, North-

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Eastern Germany) sampled in July 2021 to three treatments: (i) low shifting frequency (moving every 92 min during 19.3 min of light), (ii) medium shifting frequency (moving every 13 min during 3.8 min of light), and (iii) high shifting frequency (moving every 5 min during 1.8 min of light). Our results revealed that phototropic and heterotrophic microbial activity and abundance are largely unaffected by changing frequencies of moving-resting and light-dark cycles. Heterotrophic community structure but not phototrophic community structure was affected by treatment during the 8-day experiment. Our results imply that variability in migration velocity and light oscillation frequency added further constraints for the sediment-associated heterotrophs, but not for phototrophs.

OR013

Mitigating cyanobacterial harmful algal blooms (CyanoHABs) in a world facing increasing human and climatic perturbations

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Cyanobacterial harmful algal blooms (CyanoHABs) are a major threat to environmental and human health along the freshwater to marine continuum. As global proliferation of CyanoHABs continues to increase in prevalence, intensity, and toxicity, it is important to identify and integrate the underlying causes and controls of blooms in order to develop effective, long-term mitigation strategies. Nutrient input reductions should receive high priority. However, climate changes are driving CyanoHAB proliferation through increasing global temperatures and altered precipitation patterns, including more extreme rainfall events and protracted droughts. Resultant hydrologic extremes have led to the “perfect storm scenario;” due to increases in pulsed nutrient loading events, followed by persistent low-flow, lengthened water residence times, favoring blooms. To meet the CyanoHAB mitigation challenge, watershed and airshed N and P input reductions must be formulated under extreme hydrologic conditions in order to maintain CyanoHABs below bloom thresholds. Specifically, long-term CyanoHAB management strategies must incorporate anticipated climatic changes and extremes, and nutrient management strategies should be compatible with other physical-chemical-biological mitigation approaches, such as altering freshwater flow and flushing, artificial mixing, dredging, chemical applications, and top-down biological controls. Lastly, based on evolving knowledge of environmental controls on cyanotoxin production, these management strategies should find ways to reduce CyanoHAB toxin production, to minimize adverse ecosystem and human health impacts.

OR098

Physiological conservation of anuran: Application of combined veterinary clinical examinations to diagnose the health condition in frogs

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The physiological response can be analyzed for understanding of ability to adapt the environmental change of organism. This is one of key purpose in conservation physiology for establishing a successful conservation strategy and management. Veterinary clinical examinations can be used to accurately and safely diagnosis the physiological condition of animals. Especially, these examinations are synergistic when combined. We attempted to apply a veterinary clinical examination to amphibians with high species diversity and which are experiencing a serious endangered event in vertebrate groups. The radiographic technique was used to determine the nutritional and food-intake status of frogs, and to identify phylogenetic and environmental effect in body composition and bone mineral density. Additionally, reference intervals of parameters in body composition, bone mineral density, innate immunity, and serum chemistry analysis were established to use veterinary clinical examination for individual diagnosis. Finally, we suggest the results that studied the physiological response by salinity changes through histological analysis and serum chemistry of frogs, compared the physiological difference in captive and wild environment through serum chemistry and radiographic techniques, and identified the connections of behavioral and physiological response by wind turbine noise through hormonal assay and innate immunity test. These combined veterinary clinical examinations can be used to understand the physiological conditions of an individual according to biotic and abiotic factors on a complex spatiotemporal scale in an ecosystem. Consequently, these combined examinations can be adopted as an auxiliary tool for systematic management and conservation of the species and ecosystem.

OR068

Trophic plasticity of a widespread top predator across a land use and stream productivity gradient

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Terrestrial prey form an essential resource for many taxa at the top of freshwater food webs, such as salmonids. Yet how the reliance on these energetic subsidies varies along a gradient of resource availability and interspecific competition remains largely unknown. Here we analysed the stable isotope composition of a widespread top predator brown trout (*Salmo trutta*) and its resources across temperate (UK) streams differing in land use and ecosystem productivity. In low productivity forested streams, where other fish species were absent, trout exhibited a large reliance on terrestrial prey with a narrow isotopic dietary niche signifying a highly selective diet. But the dietary niche of trout became broader with increasing stream productivity (and number of fish competitors), with a greater reliance on aquatic invertebrate and fish prey. Such trophic plasticity has implications for species interactions and energy flow in fresh waters and might help explain the widespread distribution of this species.

OR079

What do we know about variation of the crayfish plague pathogen? Overview from both invaded and native ranges

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The crayfish plague pathogen *Aphanomyces astaci* (Oomycetes) has been, due to its devastating impact on populations of native European crayfish, included in the list of the 100 world's worst alien species. Crayfish plague outbreaks have been occurring in Europe since the 19th century but still continue to endanger local crayfish. At present, this pathogen is primarily dispersed by a few widespread invasive crayfish of North American origin. They are the original hosts and asymptomatic carriers of *A. astaci*, usually tolerant to infection due to long-term coevolution with the pathogen. With their introduction to other parts of the world for aquaculture purposes, *A.astaci* threatens endemic crayfish in the wild and aquaculture facilities of susceptible species also elsewhere. The so far studied crayfish mortalities across Europe were all caused by only a few *A.astaci* genotypes, which can be mostly linked to their original crayfish vectors, a feature useful for tracking the sources of infection in mass mortalities. Despite still-frequent crayfish plague outbreaks, we are observing emergence of resistance in some presumably susceptible host populations in Europe. However, the new data on diversity of *A. astaci* from its North American homeland indicate that it is much higher than observed in the invaded range. With introduction and expansion of new crayfish invaders, and increasing contact of various potential hosts of this pathogen, opportunities for horizontal transmission of *A. astaci* strains emerge both between novel carriers and to new susceptible host populations. Results of these novel host-pathogen interactions are yet to be investigated.

ORAL RECORDED

OR065

Insights on sediment management for macroinvertebrate forage resources in Northern Great Plains lakes

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Variable hydrological conditions in Western Canada's lakes have necessitated engineered water management, raising concerns for aquatic habitat in these ecosystems. These lakes have moderate salinity and less diverse communities than fresher waterbodies—confounding existing expectations of ecosystem response to perturbation. One hypothesized stressor, fine-sediment deposition, is expected to alter benthic habitat and the forage resources available for fisheries.I present the results of an experimental sediment deposition experiment on the benthic community and relate these characteristics to observed benthic communities existing in areas affected by sediment deposition throughout Northern Great Plains waterbodies. Although community composition of benthic macroinvertebrates is significantly changed with increases in sediment deposition, total density was unaffected, overall diversity was increased, and ecosystem function moves from filter feeding to collector gathering and shredding. Further, observed community change may affect diet preference by specific game fish. Ultimately, this work provides evidence that the communities in saline waterbodies characteristic of the Northern Great Plains are resilient to deposited sediment and maintain high potential forage resource for the fishery.

OR084

From a lake to a fen – a detailed record of the Late Glacial short-term climatic oscillations from the Klaklowo fen deposits (the Western Carpathians, Poland)

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In times of a strong anthropogenic impact on freshwater ecosystems still little is known how small mountain lakes and wetlands may respond to the global short-scale climatic oscillations. To address this knowledge gap and contribute to a long-term conservation and monitoring a traditional paleolimnological study of the Late Glacial sedimentary records, characterising some of the present-day landslide fens, may come in handy. Previous research conducted in the Western Carpathians has proven that Late Glacial deposits of the landslide fens (small mires developed within landslide depressions) occurring in this region are sensitive indicators of paleoenvironmental and paleoclimatic changes. Herein, we present multiproxy analyses (lithological, macrofossil, palynological) of sediment cores collected from the Klaklowo landslide fen (Beskid Makowski Mts., part of the Western Carpathians), which we applied to track past vegetation and hydrological changes related to the Late Glacial climatic oscillations. Results show that Klaklowo fen used to be a periodically wet depression surrounded by steppe-tundra vegetation in Bølling Interstadial, a limnic water body with rich macrophyte associations in Older Dryas Stadial and ultimately, under boreal forest conditions of Allerød Interstadial, it reached a fen moss stage. This detailed palaeoecological documentation reveals also that climate cooling triggered an intense material delivery to the lake, which was filled with 0,5 m of mineral deposits only within 190 years (Older Dryas) and it was gradually overgrown by peat-forming vegetation during the subsequent climate warming (Allerød).
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OR055

Neonicotinoid Occurrence in Environmental Waters of Indramayu Regency, Indonesia

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Indonesia as the 3rd largest rice producer in the world utilizes neonicotinoids, a group of systemic insecticides reported to have polluted environmental waters and reduced the abundance of aquatic invertebrates mostly in sub-tropical and temperate countries. To date, no study and regulation on neonicotinoid pollution have been established in Indonesian environmental waters which situates in tropical zone. This research was conducted to analyze neonicotinoid residues in seven types of environmental waters of Indramayu Regency (one of the largest rice producing areas in Indonesia), and to analyze the toxicity level of detected neonicotinoid residues to the tropical aquatic environment. Data collections included interviews with government officials, and water sampling and analysis using LC/MS/MS. The results showed that the detection frequency of neonicotinoid residues was 62.5% (in 25 out of 40 samples), with imidacloprid and thiamethoxam being the most common types found. The highest total concentration was 141.83 ng/L, contained by a sample collected in August 2021 from an estuary in Patrol sub-district. Nine samples contained imidacloprid residues exceeding the chronic benchmarks regulated by The Netherlands, so did two samples which were above The United States' regulation. No sample was found to have neonicotinoid concentration above the acute and chronic toxicities of several tropical aquatic organisms assessed. This study delivered the first report of seven neonicotinoid contamination in Indonesian environmental waters.

OR041

Reconstruction of the regional environment and biogeochemical evolution of high altitude relict Himalayan Lake using stable isotopes

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A paleoenvironmental study was performed in the western Himalayan region by extracting sediment samples from a ~ 4-meter-long paleolake trench/sequence from the Kashmir Valley, India. Using the radiocarbon dating method, the chronology of the sequence was established, which covered the last 33 ka of the Quaternary period. For long-term information about the environment and biogeochemistry of the lake, carbon and nitrogen stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) in lake sediments were analysed. The stable isotopic records from the paleolake sequence indicated an increase in lake productivity from the late (28–24 ka) to early (24–19 ka) Last Glacial Maxima, which was due to the weakening of the westerlies. The weakening of the westerlies has been reported due to an increase in the obliquity of the Earth, which decreased the strength of the meridional insolation gradient between northern mid and high latitudes. Additionally, evidence for two colder/drier events was noticed at 29 and 11 ka from this sequence that coincided with the Heinrich (H3) and Younger Dryas events, respectively. During the cold periods, the surface of this high altitude lake was partially covered with ice, resulting in a limited exchange of atmosphere-water CO_2 and nutrient supply, as documented by higher $\delta^{13}C$ and $\delta^{15}N$. During the weakening of the westerlies, the temperature of the region increased, melting the ice cover, which resulted in the resumption of atmosphere-water CO_2exchangeand nutrient input to the lake surface from the catchment and the hypolimnion.

OR106

Altered plant detritus processing in streams affected by multiple stressors in the Argeş River basin, Romania

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Multiple stressors of anthropogenic origin introduced simultaneously by hydromorphological and land-use changes impacted ecosystems worldwide. *Fallopia japonica* (Japanese knotweed) is an exotic plant species rapidly spreading into riparian areas

across Europe, including Romania. Stands of this invading species have low species diversity but high aboveground production and can drastically alter both riparian and aquatic habitats. The effects of such changes on stream ecosystems are not well known. Less is even known about the changes in the aquatic community structure and processes when other stressors (e.g., increased temperature and nutrient content) co-occur. To assess the impact of this aggressive invader on leaf litter processing, we conducted a field experiment across 30 sites in the Argeş river basin, Romania. We focused on low order streams along a gradient of land-use changes and impoundments of lateral connectivity. Leaf litter bags of native alder (*Alnus glutinosa*) and *F. japonica* were incubated in streams from late October to December 2017. Our results suggest that macroinvertebrate consumers use knotweed leaf litter in streams where the species is not yet present or has extremely low densities. However, the processing rates of *F. japonica* are significantly lower compared to those of native alder leaves. The patterns of nutrient mineralization and the relative contribution of macroinvertebrates and microorganisms to the decomposition of the two types of litter are discussed. We concluded that alteration of stream-riparian systems by the spread of *F. japonica* could impact biodiversity, ecological processes, and ecosystem services these widespread systems provide.

OR083

Diatoms as indicators of habitat and chemical characteristics of páramo lakes in Colombia

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The páramo lakes (tropical Andes) have been poorly studied and there are few tools that can be used to understand the impacts of the global change. The objective of this work was to evaluate the ecological relationships between species and functional groups of diatoms and the physical, chemical and habitat characteristics in páramo lakes of the Eastern Cordillera of Colombia. 60 lakes were sampled during the drought period of 2017. A characterization of the environment was carried out. Diatoms were collected from the superficial bottom sediment at the deepest part of the lake. The lakes sampled presented a wide range of environmental conditions, with differences in the degree of anthropic influence and in the types of cover. Using multivariate analysis and regression models, it was evaluated which environmental variables explain the species composition and the different functional groups. The main factor explaining the chemical variation of the lakes is the pH-Alkalinity gradient. A second axis of variation is related to nutrients. A total of 339 diatom taxa were identified belonging mainly to the genera Eunotia and Pinnularia. The diatoms showed a high variety of functional groups. Variables related to pH-alkalinity gradient, trophic condition, and physical factors had a significant effect on diatom composition. The different functional groups showed a significant relationship with pH, the ratio of euphotic zone: maximum depth, and phosphorus. These results show that both the species composition and functional groups of diatoms could be used to reconstruct the impact of global change on páramo lakes.

OR118

The effect of iron coagulant on submerged vegetation in conditions of increased temperature – laboratory experiment

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Nowadays, restoration treatments seem to be the only way to improve water quality in lakes. One of the most common methods is phosphorus inactivation, by adding iron or aluminium coagulants to the waterbodies. These compounds are considered safe for the environment, however, there is still a lack of data on the influence of such substances on organisms inhabiting the lakes, particularly macrophytes. To contribute to filling this gap, we conducted a short-term laboratory experiment of factorial design, with an iron coagulant ($Fe_2(SO_4)_3$) on two macrophyte species –*Ceratophyllum demersum* L. and *Myriophyllum spicatum* L. (which occur in high trophy) which were also subjected to two water temperatures. Both species were initially acclimatised in the medium with high nutrient concentrations (0.2mg P L^{-1}, 5.0mg N L^{-1}), reflecting the high trophy of lakes undergoing restoration. Twenty-four specimens of each species were divided into two groups to be grown at 20°C and 26°C. Three iron coagulant treatments were tested (Low: 0.2 mg Fe L^{-1}, Medium: 4.3 mg Fe L^{-1}, High: 10.7 mg Fe L^{-1}; Control: no Fe addition; 3 replicates each (n_{total}=48)). The considered variables were: plant biomass, total length, number of lateral branches, relative growth rate, plant chlorophylls (a, b) and carotenoid content. Preliminary results indicate that *C. demersum* coped better with the prevailing conditions (high nutrient concentration, coagulant presence) than *M. spicatum*. The research was supported by the scholarship of the Director of the Polish National Agency for Academic Exchange – the Bekker NAWA Programme, no BPN/BEK/2021/1/00079/DEC/1 obtained by Joanna Rosińska.

OR030

Coupling conductivity and stable water isotopes to infer chloride transport and flow paths in an urban stream

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The climate of Southern Ontario, Canada is strongly influenced by the Great Lakes and has cool winters with regular freeze-thaw cycles. Over the winter, rock salt rich in chloride is applied to roads, sidewalks, and parking lots to mitigate hazards. As a result, heavily salted areas have in-stream chloride concentrations that regularly exceed Canadian water-quality standards. These conditions are consequential to aquatic organisms and are a stressor on degraded river water-quality. These impacts are particularly evident in urbanized areas, like the Black Creek Watershed in Toronto. With a combination of natural rivers, engineered channels, and other infrastructure for water transmission, there are ambiguities regarding flowpaths of water and chloride transfers within the watershed. These knowledge gaps complicate our understanding of pollution and inhibit chloride mass balances and the quantification of legacy chloride that is retained over time. One step towards better understanding chloride transport is to link patterns in concentration-discharge relationships with water source dynamics quantified using stable water isotopes for individual runoff events and during warmer weather while salt application is suspended, and residual chloride may flush from soils. The goal of this work was to use water chemistry data (conductivity, chloride, and stable water isotopes) from the Black Creek to quantify chloride transport under different hydrometeorological and seasonal conditions and along different flowpaths. In addition to the delivery of chloride via overland pathways, preliminary results show temporally variable chloride releases from soils that are difficult to predict and are strongly influenced by the spatial distribution of salt applications.

OR023

The Resulting Threats of Pollutants in the Solomon's Pools (Borak Suleiman), Bethlehem Governorate, Palestine (Occupied), Added to the Already Existing Threats

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The Solomon's Pools (*Borak Suleiman*, in Arabic), located about 15 minutes from the Church of Nativity in Bethlehem and less than 25 minutes from Jerusalem in the Occupied Palestinian Territories, are very attractive historical and natural sites. Their pleasant stillness is nestled between two historical villages: *Alkhader* which houses the "Greek Monastery of St. George", and*Artas* with its beautiful Catholic Monastery, known as the "Daughters of St. Mary of Hortus Conclusus". The Solomon's Pools are three large pools with a total capacity of 450,000–500,000 cubic meters of water. They are constructed in steps, each 6 meters above the next to enable the water to be carried as far as the Old City of Jerusalem by sheer force of gravity. The three pools, cut in limestone rock, were built, some 2,000 years ago, during the reign of King Herod in the times of the Romans. The three pools are currently facing considerable problems, politically, ecologically, environmentally, and anthropogenic, which represent real threats to the pools. This paper sheds light on the history, archeology, and nature of the Solomon's Pools, as well as their importance, in terms of the environment, biodiversity, pollution, politics, renovation, businesses, and socioeconomic impacts. Unfortunately, the pools are highly polluted, resulting from several kinds of pollutants. For the purpose of this study, review and analysis of the available literature have been made, field reconnaissance trips to the pools' sites were undertaken, and some important recommendations are reached and presented in this paper.

ORAL RECORDED

OR117

Fish removal at high external loading: it costs and it pays

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We review experience of a long-term management of Lake Tuusulanjärvi (592 ha) by fish removal after the diversion of sewage loading but during a heavy non-point loading from agriculture and internal loading partially mitigated by aeration. The catch of management fishing in 1997-2021 was 1052 t / 1777 kg/ha / 71 kg/ha/a. The main method was pelagic seining in autumn which is cost effective due to the shoaling of juvenile cyprinids. The amount of phosphorus removed in fish biomass was c. 7300 kg. Significant sustaining changes were observed in water quality. Compared with a 11 year period before biomanipulation, the summer mean concentration of total phosphorus in 1998-2021 declined by > 20 %, the concentration of chlorophyll-a by > 40 % and the persistent blooms of cyanobacteria were drastically reduced. Due to the high productivity of the lake fishing had to be continuous to maintain the situation. The mean annual catch was c. 8 % of external loading, but we found it more important that it was c. 34 % of the phosphorus retained in the lake. The annual cost of the fish removal is c. 35000 €. It is considered a reasonable cost by the environmental authorities since reduction of HABs has improved the recreational value of the lake. The most important challenge for Lake Tuusulanjärvi is to reduce the external nutrient loading by 50 %. Fish removal is mainly an additional but relevant remedy and one tool to remove phosphorus from the lake.

OR037

Zooplankton indicators of Water quality in three reservoirs in the State of Mexico

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The Cutzamala system supplies water to millions of people in Mexico City. Among the important sources of water for this hydropower system are the two reservoirs, Valle de Bravo and Villa Victoria, both in the State of Mexico. The Madín reservoir, also in the State of Mexico, provides drinking water to several thousands of residents in northern suburbs of Mexico City. In this study we analyzed the water quality based on zooplankton density and diversity from six sites of Valle de Bravo, Villa Victoria and Madín. Eighty litres of water were filtered at each site using a 50µm mesh and preserved on the spot using formalin at 4%. Standard physical and chemical variables of the reservoirs water were also estimated. Samples will continue to be collected during September 2022 to August 2023. Our analysis indicated that the Villa Victoria reservoir had the highest density of zooplankton. The dominant rotifers were included various species of *Trichocerca*, *Polyarthra vulgaris*, *Kellicottia bostoniensis*and *Pomholyx sulcata*and the cladocerans *Daphnia laevis* and *Bosmina longirostris*. In the Valle de Bravo reservoir we observed dense blooms of cyanobacteria, especially *Microcystis, Oscillatoria*and*Dolichospermum;*the rotifers *Polyarthra vulgaris* and the cladoceran*Chydorus* sp. were dominant. In the influent and effluent of the water treatment plant of Madín reservoir we observed low densities of cyclopoid and calanoid copepods and few species of rotifers, mostly brachionids. The zooplankton analyses showed that the water in the treatment plants of Villa Victoria and Madín reservoirs are mesotrophic with low saprobic indices.

OR028

Techniques and applications for Cyanobacteria and Phytoplankton monitoring at high spatio-temporal resolution using multiple satellite sensors

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How can we quantify the impact of increasing water temperatures and changing environmental conditions for Cyanobacteria and phytoplankton in lakes at a larger scale? In-situ sampling techniques provide a limited information on the naturally extreme high spatio-temporal dynamics in lakes, for a very limited number of lakes. Cyanobacteria measurements from space at high spatio-temporal resolution have been introduced in 2016 at the SIL and have been applied globally in 2018 for UNESCO or in UNEP world water quality assessment use-cases. Today, this space-based approach has evolved as continuous monitoring instrument for state agencies and reservoir operators. Various sensors such as Sentinel-2 and -3, Landsat 5-9 and SuperDove satellites together provide space-based data at an yearly increasing temporal and spatial resolution.
We will present current data processing techniques and validity ranges for Cyanobacteria and Chlorophyll measurements at high spatio-temporal resolution, using multiple satellite sensors in different freshwater systems. The development of blooms, its spatio-temporal dynamics, the interaction between phytoplankton and cyanobacteria shall be discussed based on actual monitoring applications - in single lakes and at large-scale cross-national reaction during the heatwave 2018. We will discuss approaches to align in-situ and satellite-based measurements for an improved monitoring concept as part of the regulatory European Bathing Water Regulation.

OR024

Environmental stress increases the effects of pesticides

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Pesticide effects may occur at very low concentrations, below those considered safe by the governmental risk assessment. Mechanisms potentially responsible for this unexpected sensitivity include environmental stress-factors such as food deficiency. Here, we used*Daphnia magna* as a test organism and investigated how food limitation affects the mixture toxicity of a pyrethroid insecticide and an azole fungicide. Further, we investigated how food stress interacts with insecticide-induced biochemical fingerprints. We revealed that under low food conditions, the strength of synergism between esfenvalerate and prochloraz increased with an increasing concentration of prochloraz. Under high food conditions, we observed a marginal synergistic effect with an MDR = 2.1 at 32 µg/L prochloraz and 2.2 at 100 µg/L prochloraz. In contrast, the combination of both pesticides and food stress caused synergistic effects shown by an MDR=10.9 even at 1 µg/L of prochloraz which is frequently detected in the environment.
To investigate the sub-organismic response, we measured metabolomic perturbations in *Daphnia magna* following a 24h exposure to esfenvalerate under high and low food conditions. At 0.001µg/L esfenvalerate – a factor of >200 below the acute median lethal concentration (LC_{50})– the endogenous metabolome was significantly affected. Further, the effect under low food conditions was considerably stronger compared to high food conditions. Individual metabolites showed up to 7-fold stronger effects under low food conditions. We conclude that common environmental stressors can strongly increase the synergistic effects of toxicants. Further, the metabolomic changes might be a possible key to explaining population-level changes at ultra-low pesticide concentrations in the field.

ORAL RECORDED

OR042

Phosphorus diagenesis linked to methane and iron in lake sediments of a coastal embayment of eastern Georgian Bay, Lake Huron

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Georgian Bay in Lake Huron is the largest bay of the Laurentian Great Lakes, characterized by diverse coastal embayments with predominantly oligotrophic waterbodies. However, water-quality impairment problems have been reported in some wind-protected coastal embayments of the eastern shore area. One concern is the release of legacy phosphorus (P) from sediments to the overlying water column, leading to elevated nutrient levels. In this study, we focus on the impact of methane (CH4) and iron (Fe) transformations on P cycling in the sediments.
We collected six to seven sediment cores in the North Bay of Honey Harbour using a gravity corer in July and September 2021. Depth profiles of P and Fe binding forms, corresponding metal contents, CH4, carbon dioxide (CO2) and its isotopic composition, and porewater chemical and physical parameters, were analyzed. We observed that the CH4 concentration increased with the sediment depth and reached the maximum concentration of 770 ppm in the deepest layers. The ratio of Fe2+ to total Fe in the reducible Fe oxides fraction increases with the depth. The depth profiles of sediment and porewater geochemical parameters let us assume that Fe2+ results from iron oxides reduction coupled with AOM. Total P content reached the maximum of 2.5 mg P/g d.w. in the surface sediments. The redox-sensitive bound P fraction, called BD-P, is the dominant fraction of total P, with up to 55% contribution to the total P. The low BD-Fe to BD-P ratio suggests that the Fe-hydroxides have a limited spare capacity to bind P.

OR026

Simulation of flow pattern in ice-covered lakes using a 3d circulation model

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This study presents preliminary results on the simulation of three-dimensional flow in ice-covered lakes with the Regional Ocean Modeling System (ROMS). The effect of lateral boundaries on circulation in ice-covered lakes was compared using idealized conical and cylindrical bathymetries. The surface temperature was set to 0°C to imitate ice-covered circumstances, with an initial linear stratification within the water column to 4°C at the bottom. The water salinity was set to zero. Two major scenarios were investigated: (i) flow caused by molecular viscosity at sloping boundaries in a stratified fluid, which generates macroscopic up-slope current, and (ii) gravity currents along the bottom slope caused by lateral edge heating. The representativeness of a hydrostatic Boussinesq model for weakly energetic flows dominated by viscous forces and rotation in enclosed ice-covered domains is discussed, as well as the role of model spatial resolution and boundary conditions in successfully simulating such flows.

OR002

Zooplankton abundance and biomass in shallow eutrophic Yeniçağa Lake (Bolu, Turkey)

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The dry weight biomass and seasonal changes of zooplankton were determined in hypereutrophic Yenicaga Lake in Northwestern Turkey. Samples were collected in monthly intervals from May 2017 to April 2018. A total of 17 taxa have been identified as 9 taxa belong to Rotifera, 4 taxa to Copepoda and 4 taxa to Cladocera. The lowest species richness was recorded in November, while the highest was recorded in July and August. The dominant zooplankton group in terms of abundance and biomass was determined as Copepoda; they comprised 52% of zooplankton abundance and, 70% of zooplankton biomass. The zooplankton species that are dominant in terms of biomass changed throughout the year: cyclopoid copepod *Cyclops strenuus* was dominant in winter, followed by cladoceran *Daphnia pulex* in March. Nauplii was dominant in April and replaced by calanoid copepod *Acanthodiaptomus denticornis* in summer. With the exception of *Daphnia pulex* dominant September, autumn was dominated by copepod species. The average total zooplankton abundance and zooplankton biomass during the investigation ranged between 773 to 38804 ind./m^3 and between 166 to 99256 µg/m^3. This study was also compared with previous studies containing zooplankton data between 1997-1999 and a decrease is observed in terms of species diversity in all zooplankton, especially in the Rotifera group. ACKNOWLEDGEMENT: We would like to express our appreciation to the Hacettepe University Scientific Research Project Commission, which supported this study (Project no: FHD-2021-19615)

OR017

Impacts on ancient lakes: Loss of level in Prespa Lakes (North Macedonia) as a case of study

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The Ohrid and Prespa Lake complex is one of the oldest and most diverse lakes in Europe dating back to the Pliocene, with more than 3 myr old of existence. Lake Macro Prespa (hereafter called Prespa), located on the border of North Macedonia, Albania and Greece (40º46'-41º00'N, 20º54'-21º07'E), is a tectonic lake situated at 849 m a.s.l. whose exact age is still uncertain, although it has been suggested that the endemic fauna species inhabiting it, despite being less numerous, are older than those of Lake Ohrid. Lake Prespa is a shallow lake, the average depth of which was 14 m and the maximum 48 m until the last century. A drop in the lake level of almost 10 m has been documented between 1950 and 2020. The rate of decline has become more pronounced in the last decade and currently the water level is the lowest it has been in the last 100 years. Remote sensing methodology is a useful means of studying recent changes in the Prespa Lake watershed in terms of lake size and changes in vegetation in the surrounding area. The increase in vegetation may be related to increased irrigation in Pelagonija County for agricultural use, a factor that may influence the loss of water from the lake. The survival of the lake requires environmental protection measures and increased cooperation between the three countries involved in the management of the lake.

OR073

Overview of coastal lagoons in mediterranean Basin by remote sensing

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Coastal lagoons are declared a priority habitat in the European environment because of the biological communities that inhabit them. Their origin is related to sedimentary material from a nearby river or the movement of beach sands by marine currents that gradually produce the closure of a gulf. They are recent geological formations, which also disappear rapidly when environmental conditions change. Coastal lagoons with a surface area of more than 5 km2 located in the Mediterranean Sea basin have been studied. The traditional use of these lagoons has been as a port for navigation when they are open to the sea, as well as for fishing. The cultural values of these lagoons are also important and should be preserved. Sentinel-2 images taken in the summer of 2020 were used to study water transparency, suspended matter and chlorophyll a concentration. The result was that only 15% of them

are in good ecological condition. Most of them are eutrophic due to the pressures in their environment and the inflow of poor quality water. The literature also cites the problems of sediment accumulation and the presence of toxic substances. Communication with the sea is one of the factors affecting quality, because a high exchange makes them similar to the Mediterranean, but also favors maritime transit and problems derived from anthropic impact.

OR057

Spatiotemporal analysis of water quality using multivariate statistical techniques for the Usumacinta River, southeast Mexico

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Understanding the spatiotemporal patterns of water quality is crucial because it provides essential information for water pollution control. This study aims to assess the spatial and temporal water quality variation in the Usumacinta River, the largest river in Mesoamerica. The water quality data were collected in two contrasted hydrological seasons: the rainy season (RS-October 2017) and dry season (DS-April 2018) from eighteen sampling stations distributed along the mainstem and principal tributaries. Multivariate statistical techniques are applied primarily to determine proxy variables and establish relevant model coefficients. The water quality and trophic state classification were performed by adapting and calculating the Water Quality Index (WQI min) and Trophic State Index (TSI). The results reflect the typical seasonality of the region. Temperature, dissolved oxygen, pH, electrical conductivity, nitrites, major ions (Ca^{+2}, Mg^{+2}, Cl^{-1}, and SO_4^{+2}), and chlorophyll-a concentration were higher in the DS. Meanwhile, total suspended solids, total nitrogen, total phosphorus, and soluble reactive phosphorus were significantly higher in the RS. Ammonium and nitrates showed minimum differences between seasons. Overall, the WQImin and TSI indices revealed medium to excellent water quality and oligotrophic to eutrophic status with significant differences between seasons (better quality in the DS) and between sites (higher productivity in the lower basin). WQImin and TSI indices identified the lower Grijalva River as the most degraded site and the Tzendales River as the most preserved site of the Usumacinta basin. Our results show that WQImin and multivariate statistical techniques are helpful tools to evaluate the aquatic environment's water quality.

OR124

Developing and Testing Diatom Indicators of Ecological Change for Wetlands in Big Cypress Nature Preserve

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The United States National Park Service has been developing and applying a wetland assessment program using periphyton diatoms for the Big Cypress Nature Preserve (BCNP) since 2008. The goal of the program is to assess human disturbance in BCNP wetlands and monitor changes in conditions over time. The dominant threat to this area is human disturbance near the northwest corner of the region. The first years of program development involved finding changes in species composition along a gradient of human disturbance. Those changes in species composition were related to literature references for species environmental preferences and were found to show a shift from oligotrophic to eutrophic taxa along the south-to-north human disturbance gradient. Sampling in subsequent years found little interannual variability in spatial pattern of diatom taxa in BCNP and that two sampling methods used in two regional programs gave similar results. From 2013-2020, four sampling campaigns assayed periphyton phosphorus concentrations as well as species composition with results showing clear increases in species diversity as human disturbance increased, periphyton P increased, and periphyton species membership was not constrained by low P availability. Many more diatom species were classified as eutrophic than oligotrophic taxa. Some changes from literature-based trophic classifications were found. The refined metrics for oligotrophic and eutrophic taxa based on new place-based data show stronger relationships to periphyton P than literature-based metrics and thresholds in responses that could be used as management targets to protect sensitive oligotrophic taxa and prevent invasion and dominance by eutrophic taxa.

OR088

Damming river shapes distinct patterns and processes of planktonic bacterial and microeukaryotic communities

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Planktonic bacterial and microeukaryotic communities play important roles in biogeochemical cycles, but their biogeographic patterns and community assembly processes in large damming rivers still remain unclear. In this study, 16S rRNA and 18S rRNA coding genes were used for sample sequencing analysis of planktonic bacterial and microeukaryotic communities in the upper Yangtze River. The upper Yangtze River was divided into dam-affected zones and river zones based on the influence of dams. The results showed that there were significant differences in the bacterial and microeukaryotic communities between the two zones and that dams significantly reduced the α-diversity of the bacterial communities. Co-occurrence network analysis indicated that networks in the river zone were denser than those in the dam-affected zone. The relationships among species in bacterial networks were more complex than those in microeukaryotic networks. Dispersal limitation and ecological drift were the main processes influencing planktonic bacterial and microeukaryotic communities in the dam-affected
zone respectively, whereas the role of deterministic processes increased in the river zone. Anthropogenic activities and hydraulic conditions affected suspended sediment and controlled microbial diversity in the river zone. These results suggest that dams impact planktonic bacteria more strongly than planktonic microeukaryotes, indicating that the distribution patterns and processes of the bacterial and microeukaryotic communities in large rivers are significantly different.

OR087

Eutrophication impacts on methane emission from temperate mediterranean lakes: a case study

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Inland waters are important sources of natural CH_4, but the impact of cultural eutrophication on anthropogenic CH_4 emissions is usually unaccounted for. The present study evaluated the CH_4 emissions in three karstic Mediterranean lakes (Lagunas de Ruidera, Spain) with different trophic status to assess the role of cultural eutrophication play on the CH_4 emissions. Vertical profiles of temperature, dissolved oxygen, electrical conductivity, and pH were measured along with dissolved nutrients and CH_4 as well CH_4 flux during early morning, noon, and evening in each lake during summer 2021. CH_4 flux was measured using open floating chambers and the diffusive CH_4 flux was computed through changes in CH_4 concentration in the water profile. Gas extraction was carried out following the headspace technique, and the gas concentration was analyzed by gas chromatography. CH_4emissions increased at midday in all lakes, independently of eutrophication (49.6±51.6 $mgCH_4m^{-2}$ d^{-1}at morning, 163.80 ±186.03.6 $mgCH_4m^{-2}$ d^{-1}at midday and 105.9±124.1 $mgCH_4m^{-2}$ d^{-1}at night; two-way ANOVA$p < 0.05$). However, the eutrophic lake exhibits the highest CH_4 fluxes and dissolved CH_4 concentration in the water column (222.8±177.6 $mgCH_4$ $m^{-2}d^{-1}$, compared with the oligotrophic and the ultra-oligotrophic lakes: 83.6±35.8 $mgCH_4m^2$ d^{-1} and 12.9±15.8 $mgCH_4m^2$ d^{-1}, respectively).
Our results indicate that temperate karstic lakes are important sources of CH_4driving climate change, particularly due to their correlation with lakes' trophic status and their high global warming potential.

ORAL RECORDED

OR053

Pharmaceutical disruption: Effect of psychoactive pharmaceuticals on behavior of freshwater snail, *Lymnaea stagnalis*and their role in disrupting anti-predator response to kairomone from Common carp, *Cyprinus carpio*

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Aquatic ecosystems are a chemical cocktail comprising of both natural and synthetic chemicals. Natural chemicals such as kairomones play a crucial role in chemical communication which can be disrupted in presence of synthetic chemicals such as pharmaceuticals. In this study, we tested the effect of two psychoactive pharmaceuticals, fluoxetine and venlafaxine on behavior of freshwater snail, *Lymnaea stagnalis*. The potential of both compounds to disrupt innate anti-predator response, such as crawl-out response of juvenile *L. stagnalis*to 5α -cyprinol sulfate (5α-CPS), a characterized kairomone from bile of common carp (*Cyprinus carpio*), was also tested. We exposed acclimatized naive*L. stagnalis*to a concentration gradient ranging between 0.01 to 50 µg/L of both compounds individually in presence and absence of the kairomone, 5α-CPS. Behavior of the individuals were tracked for 60 minutes with DanioVision tracking system where the video was recorded using Basler GeniCam (Basler acA1300-60) with a framerate of 60 frames per second(fps) and resolution of 1280 X 1024. The recorded videos were analysed using Ethovision XT16 for the distance moved(mm), velocity(mm/s), and crawl-out time(minutes). Overall, total distance covered by *L. stagnalis*in presence of fluoxetine was lower than distance covered in presence of venlafaxine. Our results suggest that both fluoxetine and venlafaxine have no significant effect on the distance covered by *L. stagnalis*.In addition, the presence of kairomone, 5α-CPS does not alter this response. Based on preliminary results, that antidepressants such as fluoxetine and venlafaxine does not negatively affect the behavior of *L. stagnalis*over acute exposure.

OR093

Experimental Study on Adsorption Effect of Porous Media on Supersaturated Total Dissolved Gas

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A large amount of air is sucked into the depth of stilling basin and dissolved in the water under high pressure when dam discharging, resulting in supersaturation of total dissolved gas (TDG), which is threatening to fish survival. Supersaturated TDG is difficult to release in a short time, so it is necessary to explore methods to accelerate the release of TDG. Considering the adsorption effect of porous media, experiments were carried out to explore the promotion effect of different porous media types, properties, and mass density on the release of supersaturated TDG. The experimental results show that the presence of porous media in water accelerated the release of supersaturated TDG. The larger the porosity and the more of the added porous media, the stronger the promoting effect was. An expression of mass adsorption coefficient was established to characterize the adsorption effect of porous media on supersaturated TDG. It was found that the mass adsorption coefficient of porous media for supersaturated TDG changed with media materials, and had nothing to do with mass density. The relationship between the mass adsorption coefficient of activated carbon and biological filter media, specific surface area and total pore volume was analyzed, and the relationship between the mass adsorption coefficient of activated carbon, specific surface area and total pore volume was finally obtained by fitting. The results of this paper can provide an important theoretical basis and technical support for the research on the mitigation of TDG supersaturation caused by dam discharge.

OR078

The role of intra-specific diversity on microbial invasions in lakes

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Biological invasions are a major threat to freshwater ecosystems. Among microbial invasions, the invasive cyanobacterium *Rhaphidiopsis raciborskii* (former: *Cylindrosperopsis raciborskii*) is one of the most prominent microbe having globally invaded many freshwaters. According to general theory, a high genetic diversity on the invader side increases the potential invasion success, whereas a high genetic diversity of the resident competitor side has the potential to counteract invasions. In the present study the role of genetic diversity on the invasion success of *R. raciborskii* was investigated in a series of invader addition experiments: 1) the effect of genetic identity and genetic diversity of the invader was tested by adding different strains of *R. raciborskii* as single strains or in combination of three, six and ten strains to a resident community. We found a strong effect of the genetic identity and only a weak effect of genetic diversity on the invasibility of *R. raciborskii*. 2) To test for the effect of genetic diversity of the competitor side, we manipulated, within a phytoplankton community, the genetic diversity of the competing *Aphanizomenon gracile*. As for 1), the genetic identity of the competing resident had a stronger effect on the invasion success than the genetic diversity. 3) in an experiment testing for the effect of varying vs stable temperatures on the invasion, we found both, a temperature treatment and a strain effect. These results point to a strong strain-specific role in biological invasions and diversity acts mainly through increasing the chance of finding a competitively strong strain.

OR102

Non-detrimental viral infections in cultured algae

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The common way in which algal virus-host systems are discovered is when an algal culture collapses due to the virus-induced lysis. Therefore, the presence of a viral infection in a seemingly healthy culture of *Chlamydomonas sp.* is an oddity. This study describes such an infection in an algal sample from Örsjön, a lake in southern Sweden, sustained in culture for over six years with no observed adverse effects on the host culture. Sequencing of the viral major capsid protein (*mcp*) gene confirmed this virus was previously undiscovered, grouping in the Phycodnaviridae family, though not in any known clade. The infection was verified and quantified by TEM over four time points of the growth curve, and observations show virus factories consistent with lytic viruses despite the absence of culture collapse. All attempts at inducing culture collapse through the re-isolation of monoalgal cultures from the infected culture failed. This, and results of PCR screenings indicated the presence of tolerant and resistant mutants, but not sensitive ones. A method was developed to screen algal cultures for viral infections despite the absence of culture collapse, and infections were implicated in 65% of screened cultures from Örsjön, as well as 60% of cultures from Krageholmssjön, also a lake in southern Sweden. One sample from Krageholmssjön provided a second, previously unknown *mcp* sequence, indicating that non-detrimental virus infections are more common than would be expected, and may open a new field of study within the rapidly growing aquatic virology.

OR111

Towards critical white ice conditions in lakes under global warming

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Many studies report on a shrinking cryosphere with a rapid lake ice cover loss in a warmer world, but very little information is available on ice quality changes. Here we show for the first time spatial and seasonal variation in the thickness and proportion of white ice on lakes across the Northern Hemisphere during one of the warmest winters since 1880. Based on 167 field observations during 2020/2021, we found white ice conditions in 77 % of the sampling occasions with a white ice layer varying between 0 and 44 cm, contributing between 0 and 100 % to the total ice thickness. We noted that white ice built up over the winter season, being thickest and taking up the largest proportion towards the end of the ice cover season when fatal winter drownings occur most often and light limits the growth and reproduction of primary producers. We attribute the dominance of white ice before ice-off to air temperatures varying around the freezing point, causing the upper ice layer and snow on ice to melt and refreeze to a white ice layer. During warmer winters, the seasonal cycle of freezing air temperatures flattens, resulting in an increased number of days when air temperatures vary around the freezing point. Thus, under continued global warming, the prevalence of white ice is likely to increase during the critical period before ice-off, for which we adjusted commonly used equations for ice safety and light transmittance through ice.

OR044

Links between cellular phosphorus storage and P uptake strategies of freshwater cyanobacteria populations

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Cyanobacteria form harmful blooms even when dissolved inorganic phosphorus (Pi) concentrations are below most analytical detection limits. One of the most widespread toxic cyanobacteria species,*Raphidiopsis raciborskii,*switches from passive to active uptake at a Pi concentration threshold of ~5 µg L^{-1}. However, relationships of Pi uptake, internal P storage, and uptake of dissolved organic P are poorly understood, particularly at strain level. We grew six*R. raciborskii*strains under three conditions: replete nitrogen (N) + Pi (+N+Pi), Pi free but replete N (+N-Pi), and N + Pi free (-N-Pi). Alkaline phosphatase activity and Pi uptake rates were also measured. The maximum Pi uptake rate (Vmax) differed 3-fold among the six strains in the +N-Pi treatment, was significantly higher for each strain in the +N+Pi treatment; and was generally lower for the-N-Pi treatment. Across all strains, average Pi uptake affinity (Vmax/Ku, where Ku is the half-saturation constant) and alkaline phosphatase activity (APA) decreased with increasing cell P quota. Active Pi uptake and APA occurred at a threshold level of ~0.01 µg P (µg C)$^{-1}$. Our results imply that internal P drives Pi uptake and DOP utilization. Strain-based assessments and internal P storage should be included in process-based models of*R. raciborskii*blooms and other cyanobacteria to improve predictions of blooms in low-P environments.

ORAL RECORDED

OR029

Ecological drivers of ghg emissions in the Central Anatolian saline lakes based on a field study and mesocosm experiments

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In order to assess the impact of salinization and other ecological drivers on the GHG dynamics, we conducted a snapshot survey in 15 central Anatolian shallow lakes with a salinity range of 0.4 to >70 ppt in July 2021. In addition, we addressed the effect of salinity on GHG emissions in mesocosm experiments started in Fall, 2021 with 16 salinities (0-50 ppt) in two different climate zones (cold-arid and arid Mediterranean) in Ankara and Mersin, Turkey, respectively. The average diffusive CH_4, CO_2 and N_2O fluxes in lakes and warmer Mersin mesocosms were in the range of 0.02-1.6, 0.2-10.4 and 0.2-6.7 mmol $m^{-2}d^{-1}$, respectively, with higher emissions in shallower water bodies. Furthermore, negative emissions were recorded in the colder Ankara mesocosms. Although the diffusive fluxes generally corroborate with the previously reported estimations for saline lakes, high ebullitive fluxes in the high salinity treatments of the warmer (Mersin) mesocosm experiment exceeded the emissions expected for corresponding salinities. Overall, GHG efflux were strongly determined by the combination of depth, habitats (littoral or pelagic), nutrient concentrations and salinity. Contrasting emissions of CH_4 and N_2O observed in lakes with apparently similar conditions (spatial proximity, nutrient concentration, salinity, depth) suggest that different factors are at play in their sedimentary production. With the selected space-for-time and mesocosms-based approaches, the estimated fluxes provide an insight to the future alterations to the GHG status of saline lakes in the context of climate change.

OR122

eDNA metabarcoding revealed phytoplankton diversity and community structure in Dianchi Lake and the three inflowing rivers

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Phytoplankton diversity is closely related to water ecological environment and has been widely used to assess aquatic ecosystem health. Combining advantages of DNA-based identification and high-throughput sequencing technology, eDNA metabarcoding permits a new measurement for biodiversity monitoring in aquatic ecosystems. However, it is largely unexplored to apply the eDNA approach to analyze phytoplankton community responses to environmental factors in urban lakes and rivers. Via eDNA metabarcoding, this study investigate the spatial distribution of phytoplankton and the environment stressors of Dianchi Lake (one of the most polluted urban lakes in China) and its main inflowing rivers (Panlong River, Baoxiang River and Chai River). 243 distinct phytoplankton taxa were detected, covering 9 phyla, 30 classes, 84 order and 132 families. Distinct biodiversity patterns (e.g., community structure, dominant taxa, taxa diversity) were observed among the sampled habitats of Dianchi Lake and the three inflowing rivers. The taxa diversity of rivers was significantly richer than that of Dianchi Lake. Little differences were demonstrated in phytoplankton structure and abundance among different sites in Dianchi Lake, though phytoplankton structure was correlated with environmental factors. Phytoplankton community structure and diversity index varied greatly at river sampling sites. The diversity of Baoxiang and Chai River showed reduced diversity upstream to downstream, and were positively correlated with TN, C and NH_4^+. The diversity of Panlong River fluctuated greatly, with DO the most important factor affecting phytoplankton community in the upper and middle reaches. Overall, this study provides sights on phytoplankton diversity monitoring and environmental response mechanisms of phytoplankton community.

ORAL RECORDED

OR010

Nutrient export from agricultural catchments to eutrophic lakes in New Zealand: insight from isotopes to inform catchment management

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Determining the sources of excessive nutrients inputs from the agricultural systems is a priority action to inform freshwater management. This study focused on further understanding different sources and estimating their relative contribution to nutrient export. The study was carried out in 2020 within two agricultural catchments with different percentages of pastoral catchment land area on the central plateau of New Zealand's North Island. We performed comprehensive stable isotope measurements (using $\delta^{15}N$ and $\delta^{18}O$) and a Bayesian isotope mixing model (Simmr) to investigate the significant potential sources of nitrate in New Zealand soil, which are soil N (SN), nitrogen fertilizer (NF) and manure-sewage (MNS). The dual isotopic composition of nitrate suggested that the variability in contributions of nitrate sources is influenced by mixing and transformation through soil organic nitrification and depends on hydrological conditions. Simmr model outputs revealed a similar pattern for both agricultural catchments during a high-flow season, with the percentage of nitrate contribution were in order SN > NF > MNS (~50%, ~30%, and ~20%, respectively). During a low flow season, the contribution of MNS was also prominent, especially at the catchment with a more intensive pasture area. Stable isotopes show potential for identifying dominant nitrate sources and how they are reprocessed, stored then transported from land to receiving water. The application of isotopic tools in the freshwater system provides an insight into identifying management opportunities to control excessive nutrient loads, which can be easily integrated into monitoring programs by catchment management authorities.

OR021

Unique ecological characteristics of pristine bog lakes in Latvia

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Bog lakes are threatened by human activities including eutrophication and climate change which may lead to loss of a unique freshwater biome and the biota associated with it. The Teici Nature Reserve in Latvia comprises 198 km^2 of raised bog habitat and includes 18 lakes that are assumed to be in a pristine state as it is off limits to human visitation. The lakes were studied back in the 1990-ties as part of a general lake survey. We hypothesized that due to their remoteness the lakes have kept their unique status as pristine ecosystems.
Seven lakes were chosen as study sites. They varied in size from 0.11 – 0.74 km^2 and average depth from 0.8 – 5.2 m. Data on nutrient concentrations; phytoplankton and macrophyte abundance, diversity and biomass; zooplankton and zoobenthos abundance, diversity and biomass; fish abundance, diversity and biomass and fish diet and growth were collected on a monthly (nutrient data) and seasonal (faunal and floral communities) basis starting May 2021.
Phytoplankton and zooplankton communities were dominated by a few abundant species. Zoobenthos communities were comprised of insect larvae. Four of the lakes were found to have single species (*Perca fluviatilis*) fish communities; 4 species of fish were found in one lake.
The preliminary analysis indicates that the lakes exhibited high variability in ecological characteristics and despite some temporal changes are still in a pristine state both structurally and functionally. Our next goal is to identify measurable parameters that allow us to quantify the unique functional features of undisturbed ecosystems.

OR004

Impact of cyanobacteria on the physiological performance of *Daphnia magna*

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In eutrophic lakes, the contribution of cyanobacteria to the phytoplankton community can increase particularly during the warm summer month. Toxic metabolites including inhibitors of proteolytic enzymes impair their digestion by zooplankton organisms. The physiological consequences may be specifically severe at elevated temperatures with enhanced metabolic rate and consequently high demand for food. In the presented study, *Daphnia magna* were challenged by exposure to *Microcystis aeruginosa*. Their physiological performance, indicated by growth and reproduction, was impeded in comparison to controls fed with green algae (*Desmodesmus subspicatus*). Additionally, energy stores were diminished as a function of temperature and food conditions. Proteomic analyses revealed differential gene expression of metabolic enzymes. The animals' main proteolytic enzymes were studied in detail, revealing compensation effects in response to the presence of inhibitors. Moreover, their susceptibility was modified by temperature. The results allow to estimate the physiological consequences of increasing cyanobacteria biomass in lakes for their consumers, integrating from the lab to the field and from molecules to populations.

OR043

Relationship between cyanobacteria and phosphorus during 24 solar terms in Lake Taihu, China

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Lake Taihu, the third largest freshwater lake of China, is suffered from Microcystis bloom more than 40 years. Being its shallow and large size characteristics, internal phosphorus release is strongly buffered the bloom control process. Based on the weekly monitor of phytoplankton community structure and daily observotory of meteorological condition, as well as weekly nutrient monitoring, the relatively high frequent cyanobacteria-phosphorus was built in Lake Taihu. Water temperature significantly influence the cyaonbacteria biomass:phosphorus ratio. While the increase of water tempurature also stimulate the dissolved phosphorus release, then change the biomass:phosphorus ratio in the lake. Seasonal warming also significantly strongthen the summer bloom in Lake Taihu. A significant winter warming event causing a very stong summer bloom in 2017 in Lake Taihu. In this talk, based on the 24 solar term interval, the cyanobacteria phosphorus relationship will be discussed.

OR119

Response of thermal stratification to sediment in subtropical reservoirs

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Sediment will have a series of effects on the reservoir, and the thermodynamic characteristics of the water temperature stratification in the reservoir will inevitably be affected by the sand-laden water. In order to study the effect of sediment on thermal stratification of reservoirs, we took Zipingpu, a subtropical reservoir as an example, based on the sediment-water temperature model constructed by CE-QUAL-W2 to study the effect of different concentrations of sediment-laden water inflow on thermal stratification. The water temperature distribution of the model is verified by the measured data collected in 2015-2016. The results show that with the increase of the inflow sediment content, the water temperature stratification of the reservoir will weaken, and the temperature difference between the surface and bottom will weaken, and the decline range is 4.03-7.38°C; the stratification stability index (*SI*) decline range is 17.81-102.86kg/m2. The inflow of sandy water weakens the stratification of the reservoir and promotes the vertical mixing of the water body; however, the inflow of sandy water not only replenishes the dissolved oxygen at

the bottom of the reservoir, but also brings nutrients into the middle and lower layers of the reservoir, increasing risk of biological outbreaks such as algae. Therefore, the change of sediment on the thermal structure of the reservoir will have a series of effects on the water quality,and these processes should be paid more attention to in future research, which is helpful for predicting water quality problems in reservoirs and making plans for water quality management.

OR107

Seasonal compensation-flow changes from reservoirs modify leaf litter decomposition and biofilm accrual in UK upland rivers

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Damming of rivers is a major threat to riverine ecosystems worldwide, driving changes in ecosystem structure and processes in downstream sites. However, there is still a paucity of knowledge on functional responses to flow change, especially where environmental flows have been implemented in attempts to mitigate regulation effects. Here we report the results of a Before-After-Control-Impact (BACI) study to test the hypothesis that implementation of seasonal compensation outflows to rivers from reservoirs (1 decrease and 3 increases) would lead to changes in three ecosystem functional measures (1. alder litter decomposition [microbial driven – fine mesh; 2. total microbial + invertebrate consumption of alder litter – coarse mesh]; 3. biofilm accrual). The three measures were responsive to seasonal compensation flow releases but showed no consistent changes. Flow decreases reduced microbial decomposition in impacted sites. Increased compensation flows led to elevated decomposition for both microbial and total decomposition.However, decomposition rates for both coarse and fine mesh remained higher in unregulated sites. Biofilm accrual slowed during seasonal compensation flow increases but increased with flow decrease. The temperature sensitivity of leaf litter decomposition for both mesh sizes was similar to metabolic theory predictions, suggesting that this water quality parameter acted as a strong control in addition to flow. Our findings suggests that seasonal compensation flow changes could be utilized to modify river ecosystem functioning, although further research is needed to generate flow-functional process relationships for different regulated river systems.

ePOSTER

EP160

Effect of dredging on the phytobenthos composition, structure and ecological status (based on phytobenthos) of hilly streams

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In spring and autumn 2021, we investigated the effects of dredging on small Hungarian rivers dredged 1, 2 and 3 years ago. We selected 9 hilly streams, 3 of which had been dredged for 1 year, 3 for 2 years and 3 for 3 years. At each time and from each sampling site, one control and one dredged area closest to it were sampled. The main objective of the work was to investigate how dredging causes changes in phytobenthos community structure and the value of the diatom indices. The determinism of diatom community structure is mainly related to water chemistry, being less sensitive to physical changes in aquatic ecosystems (channelisation, bed perturbations, etc.). Nevertheless, a detectable correlation was found between dredging and changes in phytobenthos community structure and composition, which was particularly pronounced in newly dredged areas. The linear discriminant analysis supported that community structures have changed in dredged river sections. The impact of dredging disrupted the community structure, with significant changes in species abundance and diversity (not only is there a species emigration immediately after dredging, but also an increase in the dominance of species that have tolerated more extreme conditions), and by year 2, their values had more or less returned to their pre-dredging state. As dredging triggers stochastic processes at the level of community organisation, phytobenthos in newly dredged areas becomes unsuitable for ecological status assessment. However, our results showed that in the 2nd year after dredging, phytobenthos is again well suited to assess ecological status.

EP135

The relationship between the number of native fishes and the number of alien fishes in Lake Biwa

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In Lake Biwa, it is thought that the native fishes are decreasing due to environmental changes or by predations by invasive fishes. To prove this hypothesis, I studied the relationship between the number of native fishes, the number of invasive fishes, and environmental changes, using open sources. As a result, I reached a surprising result that there is not so much relationship between the number of native fishes and the number of invasive fishes. Using this result, I discuss of a new way to protect the native fish.

EP136

Lower the water temperature of Lake Biwa by using the treated water of the sewage treatment plant that flows into Lake Biwa

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I thought about cooling the water in Lake Biwa using the chlorine mixing pond, which is the final treatment stage of the sewage treatment plant. To test this, I have constructed three experiments. First, the effect of ambient conditions was tested using the water tank as a chlorine mixing pond. Three types of water tanks--one covered with blinds, one covered with black cloth, and one control group--wereexamined for their temperature differences. The temperature change was small, probably because of the low outside temperature, but the water tank with black cloth showed a lower temperature. Next, we investigated temperature changes, assuming the treated water was drained into the river. Water tank was used to simulate river water, and was mixed with treated water, cooled to 2 °C. When the river water temperature was high, the temperature change was large, and conversely, when the

river water temperature was low, the temperature change was small. Finally, the water tank was used to simulate Lake Biwa with a water temperature of 10 °C, and the temperature change was investigated by mixing river water at 4 °C. As a result of this, the water temperature in the tank dropped from 10 °C to 9.1 °C. The amount of treated water and the amount of inflow into the river in the experiment simulated the amount of water for a year, and I found that the water temperature of Lake Biwa changes by lowering the temperature of the treatedwater.

EP039

Unravelling the drivers of nitrous oxide emissions from streams (DrivNOS)

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The project DrivNOS aims to understand how nitrous oxide (N_2O) emissions from streams, and the underlying processes driving them, are altered by nitrogen (N) pollution and soil properties, particularly iron content and pH. Streams have been highlighted as significant but poorly constrained sources of N_2O, a greenhouse gas ~300 times more potent than carbon dioxide. A large share of stream N_2O emissions arises from the use of N fertilizers by agriculture and therefore most of the research on N_2O emissions from streams has focused on agricultural areas, especially on fertile calcareous soils having near-neutral pH. However, recent research demonstrated that streams in forested areas, without agriculture, can also be a substantial source of N_2O, with emission levels comparable to those of agricultural streams, despite the fact that forest streams had lower N concentration. This unexpected result was ascribed to the possible effect of low pH (<5.5) and high iron content on N_2O production processes in the soils of the forested catchments. The validity of this hypothesis will be tested by investigating the drivers of N_2O emissions in streams and drainage systems located in western Denmark where soils with low pH and high iron contents are prevalent. These soil properties may promote disproportionally high N_2O emissions from the streams of this region. we will identify potential N_2O emission hotspots in natural and agricultural streams, characterise production pathways emissions and determine how N pollution interacts with iron content and pH to alter the emission of N_2O from streams.

EP095

The reaction of bottom sediments of shallow, restored lake (Mielenko Lake, Poland) to the prolonged circulation due to lack of ice-cover during winter season

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Anthropopressure on water ecosystems is constantly growing due to expansion of human population. The water quality deterioration due to pollution emissions to water bodies is one of its aspects. The Holocene-like conditions are also evolving, because of global climate changes. On the Northern hemisphere the increasing in average air temperatures is observed, which implies the occurrence of shorter period of snow and ice covers during winter season. The winter 2019/2020 was unusual, because that was the first time in the record, that a complete lack of ice cover was observed on numerous lakes in Poland. Such unusual conditions could have influence on lakes functioning. Hence we analyzed the chemistry of water-sediment interface (near-bottom and interstitial water and sediment) in the shallow, eutrophic Mielenko Lake (area 7.9 ha, max depth 1.9 m) in 2013, 2019, 2020 and 2021 in order to assess the influence of prolonged water circulation on the bottom zone. Mielenko Lake was subjected phosphorus inactivation procedure using Al and Fe salts (PAX 18, PIX 111) in 2020 and 2021. Our research revealed, that unusual prolonged winter circulation caused the decrease in organic matter content in bottom sediment in 2020, as well as the decrease in NaOH - nrP fraction and TP amounts. That effect was short-term and it did not significantly influence on the NaOH-rP fraction amounts. The released P was built in biomass during vegetation season, and coagulants adding was able to direct that pool of organic matter towards the sediment effectively.

EP162

Avian diversity in Nyangezi wetlands: the case of Nyamubanda Swamp in Territory of Walungu, Sud-Kivu, Democratic Republic of Congo

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This work consisted in assessing the diversity of bird species in the Nyamubanda Swamp in Nyangezi, Walungu Territory, Sud-Kivu Province in the Democratic Republic of Congo. Field observations with binoculars optical magnification 10 x 42.6 and capture with mist-nets allowed us to explore 4 types of plants habitat: Papyrus, Sorghum, woody and Rice. A total of 203 individuals belonging to 27 species and regrouped in 19 families and 8 orders were found. The distribution of abundance of birds in the 4 habitats was statistically equal ($\chi^2 = 0.884$; df = 3; p-value = 0.829). Correspondence Factor Analysis (CFA) with 80.2 % for the two first axes showed that the rice and papyrus habitats are close and abundant in terms of the number of bird species. As a result of a rapprochement between these two habitats causing species frequent in the rice to rest in the Papyrus. This demonstrates that cereal cultivation in Nyamubanda swamp has an impact on bird diversity in Nyangezi swamp. Future work should focus on the seasonality and diet of the birds with ecological approaches as well as crops cultivation stages to deepen the understanding of the wetland bird diversity in the Nyangezi swamps.

EP055

Methane production in the oxic water column of shallow lakes from the Pampean Plain with different alternative regimes (Buenos Aires, Argentina)

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The traditional paradigm about methanogenesis in freshwater systems is that methane (CH_4) is produced in the sediments under anoxic conditions, but a substantial CH_4 production in the oxic water column of lakes has been reported in the last decade. This pelagic methanogenesis appears to be closely linked to algal dynamics, probably because they offer micro-anoxic habitats where methanogenic bacteria can survive, and also because microalgae themselves may be capable of producing CH_4. In this study we explored pelagic CH_4 production in shallow lakes from the Pampean Plain (Argentina) under different regimes: clear-vegetated and phytoplankton-turbid. We performed field experiments in two turbid and one clear lake, were we allocated 4 enclosures per lake - closed in the bottom to avoid sediment methanogenesis and opened in the surface to allow exchange with the atmosphere and sampling. We measured CH_4 concentrations in each enclosure at least twice a day for four days. We also measured CH_4 evasion rates using floating chambers, estimated CH_4 oxidation rates through incubations and determined phytoplankton structure. Preliminary results indicate pelagic methanogenesis in all three lakes, although its contribution seems to be higher in the turbid lakes. The clear lake had a less abundant but more diverse phytoplanktonic community, including Cryptophyta, Chlorophyta and Cyanobacteria, whereas the turbid lakes presented a much abundant but less diverse phytoplankton community, with one lake dominated by Chlorophyta and the other one by Cyanobacteria. We conclude that CH_4 pelagic production is contributing to the total CH_4 emissions in shallow lakes of the Pampean Plain.

EP171

Synergistic effects of crowding and food shortage on growth, reproduction, and longevity in *Daphnia magna*

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Growth, reproduction and longevity in a clone of *Daphnia magna* were determined under food satiated (HF, 1.0 x 10^5cells/ml of *Chlamydomonas reinhardtii*) and food limited conditions (LF, 2.5 x 10^3cells/ml) at single (1 ind./50-ml) and crowded treatment (10 ind./50-ml) using a flow-through system (70-80 ml/h) to clarify synergistic effects of these two environmental stresses on zooplankton life history traits. Body length, number of neonates released, neonate size were measured daily until all experimental animals died. Body length in all 4 treatments was ca. 0.8 mm just after released (day 0) and almost the same during juvenile stages until day 6-7. After the maturation, the growth was depressed in crowding at HF (HF_{10}), following in non-crowding and crowding at LF ($LF_1$and LF_{10}, respectively). Reproduction was also depressed in HF_{10}, and more in $LF_1$and LF_{10}. Cumulative number of neonates released in life time was highest, 425 ind./female, in HF_1, but decreased to 309 ind./female in HF_{10}. It was greatly depressed to < 40 ind./female in both $LF_1$and LF_{10}. Whereas neonate sizes, depending on size of the mothers, were highest in LF_{10}, following those in LF_1, $HF_{10}$and HF_1. Longevity as days when half of the initial number of the animals died was shortest in HF_{10}, following that in HF_1, $LF_{10}$and LF_1. This suggests that *D. magna* invests more energy to reproduction and produces larger offspring under crowding situation even in the food limited condition, and that longevity may be related to reproductive investment.

EP109

Attempts to develop a non-invasive method of phosphorus removal from eutrophic lakes

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We tested performance of a novel method for orthophosphate (OP) removal from eutrophic lakes. Principle of the method is the use of an OP binding agent fixed onto a carrier. In this form, the agent can be placed in the water column to allow for OP sorption, and then removed, to harvest both, the agent and OP, from the lake. Thus, the OP binding agent is not deposited in the environment. According to this approach we developed and tested two solutions for application of a natural OP binding agent – calcite (CaCO3, Cc): laminates – sheets made of a backing material coated with Cc, and modules – plates with merged Cc, covered with a nonwoven, preventing Cc loss. Laminates and modules (0,15 and 0,07 m2, with 3 and 300 g Cc, respectively) were tested in a long-term laboratory experiment (59 days) in simulated hypolimnion (8°C in darkness) in tanks filled with 180L lake water. Initially, both treatments showed similar OP elimination by 20 and 18%, respectively. However, laminates actually stopped removing OP after 7 days, whereas modules continuously eliminated OP achieving 50% lower level compared to control after 59 days. This was due to much higher Cc mass possible to be applied per unit surface area in modules. Only slight changes, compared to control, were observed with regard to pH, alkalinity and conductivity. Although field validations are needed, we propose modules as a non-invasive method for OP inactivation and sustainable OP removal, to avoid accumulation of OP binding agent in the ecosystem.

EP033

Compiling and harmonizing thermal tolerance data to assess variability within species and across organism groups, size, and phylogeny

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In the context of global climate change, thermal tolerance has received considerable attention in ecological research. The variation of upper physiological thermal tolerances within and between species and phylogenetic groups informs potential responses to increased temperature. Intraspecific variation in upper thermal tolerance limits can provide a basis for adaptation to increasing temperatures and extreme heat events, while variation in tolerances between organism groups can result in changes in community structure as a habitat heats up or after a major heat event. Several studies have found a link between smaller body size and higher upper thermal tolerance, however the relationship between body size and tolerance variability is unclear. Many studies have evaluated trends in thermal tolerance in the last decades and efforts to gather and synthesize the multitude of available thermal tolerance data have intensified recently, yet existing collections have mainly been conducted independently and often do not include the same data. To obtain large sample sizes and assess the variability within species and across organism groups, as well as the relationship between tolerance and body size, thermal tolerance data from multiple sources have been combined, harmonized, and evaluated across phylogenetic groups with a focus on freshwater taxa.

EP165

Effects of climate change and grazing on assembly processes and ecosystem functioning in bacterioplankton communities

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Stochastic community assembly processes can influence the beta-diversity of microbial communities. This includes ecological drift, which describes the random occurrence of birth and death of species in a community and therefore their probability to go extinct before reproducing. Climate change increases the frequency and magnitude of extreme weather events such as heat waves and heavy precipitation, which can cause sudden warming of lake water and highly nutrient concentrated runoff into aquatic systems. Moreover, predation is an important factor of community assembly and is only rarely considered in studies on microbial community assembly. We therefore still lack information about how different community assembly processes are affected by interactive changes in biotic and abiotic factors and how they influence the functioning of bacterial communities. Here we hypothesize that enhanced nutrient concentrations and increased temperature resulting from extreme events in aquatic systems can increase drift as well as functioning in microbial communities. Moreover, selective grazing is hypothesized to promote drift, but to decrease functioning of bacterial communities. To test these hypotheses, we currently conduct a three-factorial semi-continuous microcosm experiment over a 21-day period with grazing and nutrient and temperature pulses with six replicates per treatment. To measure functioning of bacterial communities, samples for bacterial cell abundance, extracellular enzyme activities and bacterial carbon production are regularly measured throughout the experiment. Drift will be determined as the dispersion in beta-diversity among the six replicates of each treatment using bacterial community composition data based on Illumina sequencing data.

EP184

Dam removal and the fate of sediment: can macrophytes minimize sediment leakage of greenhouse gases, nutrients and heavy metals?

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River damming is an increasing practice worldwide due to the escalating demand for energy. However, dams hinder the natural fluxes of sediment, nutrients, organic matter, and migratory species, leading to decreased river functioning and biodiversity loss. Therefore, dam removals have become more common as dams reach the end of their lifespan, but the fate of the sediments that have accumulated in the reservoir is not well understood. This is relevant as sediments can release greenhouse gases, nutrients, as well as contaminants, particularly when they are mobilized and exposed to oxygen.

Here we investigate the leakage of environmentally harmful substances, i.e. greenhouse gases, nutrients and heavy metals, from the sediment of a reservoir in a river in southern Sweden. Prior to the dam removal, planned in 2023, we perform experiments on the effect of changes in environmental conditions on the leakage of nutrients, heavy metals and greenhouse gases from the sediment. Sediment mesocosms are divided into four treatments: water-logged sediment (simulating reservoir conditions), air-exposed bare sediment, and air-exposed sediment vegetated with two different macrophyte species. We hypothesize that the presence of macrophytes increases the degradation of sediment organic carbon to carbon dioxide, while the water-logged sediment is a strong methane source. We further hypothesise that macrophytes take up nutrients and heavy metals from the sediment, and thus reduce the leakage of these substances to the water. Results from this experiment are expected to inform strategies for minimizing environmental impacts from sediments at dam removal.

EP149

Biological invasion success of *Pontogammarus robustoides* G. O. Sars, 1894 in the Daugava River (Latvia)

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The Ponto-Caspian amphipods, including *Pontogammarus robustoides,* are one of the most successful invaders in the Central European rivers. *Pontogammarusrobustoides* is the dominant alien gammarid in the lower reaches and mouths of rivers emptying into the Baltic Sea and mostly occurs in the Lower Daugava River, mainly in the Daugava River reservoirs. Such occurrence is related to species expansion in the Baltic Sea basin after deliberate introduction into the Kaunas Reservoir located on the Nemunas River and into Latvian waters, the nearest to Riga - the Lake Lielais Baltezers and the Lower Daugava River (the Ķegums Reservoir) in the 1960s as valuable fish food. Genetic variability determines alien species capacity to adapt to new or changing environmental conditions. The genetic variability of*Pontogammarus robustoides* population of the Latvian reservoirs was analyzed using iPBS markers. The results show that the populations have settled in the waters of the Daugava River, are genetically stable, able to adapt to changing environmental conditions. The genetic structure of the population shows a high polymorphism at the genome level (from 65% in Riga to 82% in Pļaviņas population). The presence of unique gene alleles in the Pļaviņas population indicates a greater genetic difference. Populations are genetically related (genetic distance is from 0.04 to 0.11), but they form different groups that could be explained by the secondary distribution of the species in time and space after introduction.
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EP048

Dammed Fish - Impact of structural and functional river network connectivity losses on fish biodiversity – Optimizing management solutions

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Dammed Fish is a research project that aims to evaluate and propose solutions and tools to inform river network connectivity management to improve fish biodiversity and to enhance biotic quality of European rivers. For this purpose, river network connectivity management needs guidance to choose the best available solutions within a frame of ongoing human activities. Dammed Fish approaches connectivity management at a European-wide basin scale, and for three different time periods – past, present and future. The project is structured in 5 interconnected tasks: 1) Setting the scene: River network data management and tools; 2) Quantifying river network (dis)connectivity; 3) Dam impacts on freshwater fish distribution and biotic quality; 4) RivOpt barrier connectivity enhancement management tool and; 5) Outreach and scientific literacy. These tasks aim at the evaluation on how dams, by themselves and combined with other pressures, affect river network connectivity, biodiversity loss, species range contraction and species turnover in (riverine) fish. We then assess the degree to which connectivity impairment due to barriers can interfere in environmental practices to achieve goals set forth in policies such as WFD. Results will contribute to further research and improved management of river network connectivity by developing three free tools: RivFish – to link fish data and river networks; RivConnect – to calculate basin-wide network connectivity; and RivOpt – to optimize basin-wide connectivity management solutions considering conflicting management goals.

EP156

Diatom Community Dynamics in Recovering Agricultural Stream in Milledgeville, Georgia, USA

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Streams are monitored to establish numeric targets for nutrients that ensure protection of ecosystem services. Reference stream criteria for EPA ecoregion IV are set at 0.037 mg/L total phosphorus (TP) and 0.69 mg/L total nitrogen (TN). Tobler Creek is a recovering agricultural stream on the site of Andalusia Farms in Milledgeville, Georgia. Andalusia Farm was listed on the National Register of Historic Places in 1980 and was designated as a National Historic Landmark by the National Park Service in 2022. Previous research in 2011 documented TP of 0.69 mg/L and nitrate nitrogen was 0.58 ± 0.3 mg/L. With TP exceeding criteria set for reference streams with a 31-year recovery after agricultural use, diatom community was dominated by *Gomphonema parvulum* (Kützing) Kützing. The goals of this research were to (1) assess nutrient levels in Tobler Creek seasonally in 2022 and (2) to compare diatom community structure and composition with the finest taxonomic identification. In winter 2022, nitrate nitrogen was < 0.064 mg/L and TP was <0.01 mg/L in the environment. Tobler Creek is meeting reference stream criteria with an additional 11-year recovery period. Diatom communities show high community diversity driven by higher evenness. Species optima and tolerances are recalculated and compared with reported values in the literature. Diatom communities in sites recovered from agricultural activities show that recovery is a long and complex process. This research provides a useful model for the Southeastern United States when considering compliance with criteria mandated by the Clean Water Act of the United States.

EP176

Influence of temperature and nitrogen on the growth of *Raphidiopsis raciborskii*strains originating from different climate zones

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Raphidiopsis raciborskii is a potentially toxic cyanobacterium that has successfully expanded its geographical range from tropical to temperate zone. It can form blooms at temperatures higher than 25°C, however its occurrence has been documented at the much lower temperature of 10°C. The successful expansion and growth under a wide range of temperature and nutrient concentration seems to be related to the occurrence of different ecotypes of *R. raciborskii*. Therefore, the aim of the study was to determine the influence of the temperature and dissolved nitrogen concentration on the growth of two*R. raciborskii* strains isolated from Poland and Australia representing an invasive and a native strain, respectively.
The strains were incubated using different combinations of temperature (10, 22 and 31°C) and nitrogen concentration (28.1, 14.0, 7.0 mg L^{-1}).
The results demonstrated a different response of the two *R. raciborskii* strains to temperature and nitrogen concentrations. The growth rate of the Australian strain CS-506 was highest at 31°C and 28.1 mg L^{-1} of nitrogen, while the highest growth rate of

the Polish strain from Biskupińskie lake (BiRr) was observed at 22°C and 14 mgL^{-1} of nitrogen. Moreover, the productivity of the BiRr strain was higher than CS-506 under all nitrogen concentrations (in the nitrogen availability experiments). Additionally, the highest growth rate reported for CS-506 strain in the highest nitrogen concentration.

EP153

Digital microscopy improves diatom research

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Identifying and counting diatom cells under the light microscope is a key element of diatom research as well as ecological and water quality investigations. In an effort to advance this kind of work into the digital age, in this study we present a new variant based on the manual analysis of digital virtual slides, and compare it to the traditional non-digitized light microscopy workflow. We compared three replicates of six diatom samples a) preparing digital virtual slides by high resolution slide scanning and subsequently identifying and counting individual valves or frustules using a web browser-based image annotation platform, or b) working the traditional way directly on the light microscope. Both methods led to comparable results in diatom community structure, species richness and diatom indices. The slight increase in expenditure of time in the digital method can be weighed against higher taxonomic resolution due to easier and hence more frequent use of morphometry. Furthermore, improved reproducibility and quality assessment in the digital approach can increase transparency and taxonomic precision. This digital workflow can also be applied for inter-calibration of individual experts through the web, and for producing training image sets for deep- learning-based diatom identification, making it a promising and versatile alternative or extension to traditional light microscopic diatom analyses in the future.

EP098

Influence of the addition of calcium nitrate and oxygen-enriched water (Schäfersee-Verfahren®) on the hypolimnion of a contaminated urban lake

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Lake Schäfersee, located in the urban space of Berlin Reinickendorf, has been exposed to the discharge of untreated rain (waste) water for several decades. This led to increasing eutrophication and pollution, regular fish die-off, and the development of H_2S. To alleviate the lake, sediments of the fringe zone were removed in 2014 and a lake remediation company installed a system to add $Ca(NO_3)_2$ and O_2-enriched water to the hypolimnion (Schäfersee- Verfahren®). Previous studies showed that the addition of Ca(NO3)2 can reduce PO_4 loading as well as H_2S and methylmercury production in eutrified lakes. However, concerns remained regarding the potential mobilization of other metals by the addition of $Ca(NO_3)_2$ or a mixture of $Ca(NO_3)_2$ and O_2 in lakes with diverse contaminations. In this study, different organic and inorganic parameters, including the concentration of several metals were analyzed in the sediment and in the bottom water of lake Schäfersee during the treatment with $Ca(NO_3)_2$ and O_2-enriched water. Preliminary data show no substantial increase in arsenic, boron, cadmium, chromium, copper, iron, nickel, or lead concentrations in the bottom water over five months after the addition of $Ca(NO_3)_2$ and O_2-enriched water. However, zinc for instance showed an increased concentration in the bottom water concomitant with the treatment. Five months after the start of the treatment, zinc concentrations reached again levels comparable to the initial concentration. This shows the importance of further research on how $Ca(NO_3)_2$ and O_2-enriched water influences contaminated lake systems with different contamination profiles.

EP053

Impact of bioturbators on methane emission across the sediment-water interface from a model perspective

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Due to anthropogenic disturbances, along with climate change effects, shallow lakes often have high availability of degradable organic matter in their sediments which results in anoxic conditions below the upper millimeters of the sediment. These anoxic conditions are favorable for sediment methane (CH4) production, which can be emitted to the overlying water through diffusion or ebullition (i.e. bubbles formation). The reworking and mixing of the sediment and porewater by bioturbators can alter the sediment CH4 production, oxidation, and transportation. In my Ph.D. I will develop a process-oriented reaction-transport model to study the impact of selected key aquatic bioturbators on the biogeochemistry and physical changes of shallow waters sediments and the formation of gas bubbles. So far, quantitative knowledge on the impact of bioturbation on CH4 emissions is limited, as well as the application of mathematical models evaluating or predicting their effects. To validate and parameterize the model I will use a state-of-the-art mesocosm set-up with below-sediment scanners that allow to visually monitor gas bubble distribution in the sediment. I will use different types and densities of bioturbators, temperatures, and sediments. With the presentation of my Ph.D. plans in this poster, I'm looking forward to receiving the reader's feedback and comments.

EP002

Combining modelling and automated monitoring at the hydroelectric reservoir of Eguzon to predict the evolution of water quality and algae blooms

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Eutrophication, anoxia and algae blooms determine, to a large extend, the water quality issues in reservoirs. In recent years, a strong effort has been deployed around the world to preserve and manage freshwater resources. Water quality monitoring and assessment plans are used to characterize water quality, identify trends over time, reveal emerging problems, and assess effectiveness of water management programs. Complemented by remote sensing, in-situ data from automated buoys represent an important dataset to model the ecosystem of reservoirs, and subsequently predict the evolution of water quality. In order to enhance our comprehension of reservoir's ecological dynamic and water quality issues, the hydroelectric reservoir of Eguzon (France) is monitored by an on-going survey to track the water quality (including anoxia and algae blooms), predict its evolution at short term and under climate change. An automated buoy measuring meteorological, hydro-physical and biogeochemical parameters (temperature, conductivity, turbidity, oxygen, chlorophyll a, phycocyanin) has been deployed and complemented with bi-weekly in-situ measurements in the reservoir, upstream and downstream. In addition, the coupled hydrodynamic-biogeochemical model GLM-AED2 is being implemented for the reservoir of Eguzon. The on-going collaborative research on the study site of Eguzon will bring together researchers and stakeholders to progress on the metrology, the modelling and the global knowledge of water quality of reservoirs.

EP085

Toxicity of profenofos to early life stage of whitegoby (*Glossogobius giuris*Hamilton)

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To determine the effects of one of the widely used organophosphate insecticide on Philippine native freshwater fish, sub-acute exposure of young juvenile*Glossogobius giuris*to 0.252µg/L profenofos was performed in the laboratory for 28 days under a semi-static renewal system. Ten randomly selected individuals per replicate were exposed to the concentration for 7, 14, 21, and 28 days. The acetylcholinesterase (AChE) activity in the brain was significantly reduced during the 7 days and 21 days exposure while the enzyme activity in the muscle exhibited significantly lower values in all exposure periods. The rate of inhibition in the brain AChE activity was significantly higher after 7 days and 28 days exposure. Further verification of the ecotoxicological findings was done through histopathology of gill and muscle tissues. The gill and muscle tissues of control fish appeared to be normal while treated group exhibited certain degenerative changes such as unattached, blunt, short, highly folded, and unbranched gill filaments. The chloride and pilaster cells were hyperplastic and hypertrophic. Muscle fibers were degenerating and gangrenous and slightly disarranged. Based from the findings, it can be concluded that profenofos negatively affects both enzymatic activities, gill and muscle tissue morphology of*G.giuris*. Therefore, all possible measures should be taken to regulate or prevent the occurrence of profenofos in the aquatic environment to avoid poor water quality and reduction in lake biodiversity.

EP178

Zooplankton Communities as Bioindicators of Water Quality in Lake Palacpaquen and Lake Pandin, San Pablo City, Philippines

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The study identified the zooplankton communities present in Lake Palacpaquen and Lake Pandin in San Pablo City, Philippines as bioindicators of water quality. The study employed methods including water sampling, zooplankton identification, and statistical analyses.The physico-chemical parameters determined were Secchi disc transparency (SDT), temperature, dissolved oxygen (DO), conductivity, pH, nitrates and total phosphorus (TP). All the water quality parameters in Lake Palacpaquen were within the values set for Class C water except for total phosphorus which exceeded the allowed limit. Based on the presence of*Brachionus*and*Keratella*species, high densities of rotifers, and zooplankton ratios, the lake was determined to be mesotrophic to eutrophic. In Lake Pandin, all parameters were within the range of values for Class C criterion. High densities of calanoids suggests that the lake is oligotrophic. Results of CCA showed the wide range of tolerance of rotifers to physico-chemical parameters while calanoids showed positive correlation with SDT and conductivity. GLMM results determined that nitrate and total phosphorus concentrations were the most important predictor of the species richness of rotifers and calanoids, respectively. Moreover, the most important variable determining the density of rotifers is dissolved oxygen, while for calanoids, the most important predictor is water transparency.

EP009

Irrigation dams alter biogeochemicals cycling in intermittent streams of Appenines

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Dammed streams have a central role to ensure irrigation and drinking water in catchments characterized by summer water scarcity. However, while dams allow water availability during the dry season, they also cause stream discontinuity, modify transport of essentials nutrients and alter magnitude and stoichiometry of nutrient loads. The net effect can depend on season and dam management, which is also a function of catchment hydrology, precipitation patterns and water residence time. This study aims to examine the coupling of Si, N, and P cycling, together with their stoichiometry in two dammed streams located in the Mediterranean area (Apennine side of the Po river watershed, Northern Italy) during a particularly dry year. Water samplings were conducted in each stream at the beginning and at the end of three reaches: two free flowing reaches located upstream and downstream the artificial lake and the third containing the dam. Changes in dissolved and particulate concentrations of Si, N, and P and their mass budgets were calculated by quantifying loads in each of the reaches over a period of 12 months during both base flow and high flow events. The two artificial lakes, managed as irrigation reservoirs, alter river flow along with nutrients loads and stoichiometry. Filling and draining of lakes determine an anti-seasonal flow rate, with a higher flow in summer to supply irrigation demand and lower flow in winter to storage, and alternatively change dam behaviour as trap or source of nutrients.

EP064

A deep dive into methylparaben: Investigating its natural presence in freshwater biota

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The widespread use of parabens has caused increased exposure to natural aquatic systems in recent decades. Methylparaben (MePB), one of the most commonly used preservatives in skincare products and food items, is considered to be highly accumulative and toxic for aquatic organisms. Recent studies have also suggested that exposure to MePB can result in endocrine-disrupting effects, raising much concern regarding its environmental impact. On the other hand, however, MePB has been found to be part of the metabolome of some organisms. The objective of this study was to therefore assess the natural presence of MePB in holometabolous Trichoptera collected *in situ*, and to examine the movement of MePB across different life stages (larvae, prepupae, pupae, adults). We collected Trichoptera from both contaminated and pristine freshwaters to measure levels of MePB present in their tissues. In addition, the impact of complete metamorphosis on the transfer of MePB was investigated by monitoring various life stages of holometabolous Trichoptera collected from a pristine river in a 54-day mesocosm experiment. MePB was detected in all biota collected *in situ*from our sampling locations. In our mesocosm experiment, Trichoptera measured increasing concentrations of MePB across all life stages, from larvae to adults, suggesting the natural presence of MePB in Trichoptera. Our mesocosm results indicate that MePB may not be an emerging contaminant, and we therefore cannot be certain to which extent MePB detected within the tissues of Trichoptera is the result of contamination, and which amount is naturally present within these aquatic invertebrates.

EP067

Environmental Flow Requirements of Estuaries: Providing resilience to current and future climate and direct anthropogenic changes

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Freshwater flow regimes are critical to the ecological functioning of inland waters, including estuaries, by mediating key ecosystem processes: hydrodynamics, salinity regulation,
sediment dynamics, nutrient cycling and trophic transfer, and connectivity. These processes interact over a variety of spatial and temporal scales, driven by variations in freshwater flow, to modify the physical, chemical and biological characteristics of estuaries and generate a wide range of ecological niches. This supports rich biodiversity, as many organisms have evolved life-history traits tuned to the wide variations in physicochemical conditions. However, the quality, quantity and timing of freshwater flow is being modified by climate change and direct anthropogenic stressors, resulting in the degradation of estuarine ecosystem health. To build resilience to this degradation, the re-establishment of the natural characteristics of freshwater flow regimes must be fulfilled.

EP097

Mass balance and critical load of phosphorus in the Lago del Fuerte reservoir (Tandil, Argentina)

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The knowledge about the nutrients inputs and outputs in surface water bodies is one of the key points to determine management strategies around the problem of eutrophication due to changes in land use. The aim of this work was to quantify the loads of total phosphorus (TP) that enter and leave in the Lago del Fuerte reservoir, and estimate its critical load, in order to generate information for future management actions. The reservoir is a shallow artificial body of 19 hectares that has recently presented eutrophication problems. It is located in the periurban area of a hilly watershed in the city of Tandil, Argentina, which has experienced changes in land use with a growth in residential use. TP measurements were carried out in water at 2 tributary streams, the reservoir and the dam outlet, with a seasonal frequency during a year. An annual mass balance was carried out, using mean concentrations of TP and Vollenweider's eutrophication and critical load model was applied. PT input (180 kg/year) exceed the output (106 kg/year) causing a retention of 41%. An internal loss of 92 kg was also obtained, which indicates the sedimentation of phosphorus that could become an internal load under certain conditions. According to the model, the reservoir received a phosphorus load between 4 to 7 times higher than the permissible one, which shows its eutrophic state and the need for management measures aimed at reducing the external load.

EP151

Application of benthic diatom community developed on brick artificial substrate in ecological status assessment of soda ponds

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Inland salt waters of the Carpathian Basin are unique habitats that are protected as "Pannonic salt steppes and salt marshes" according to the EU Habitats Directive (92/43/EC). Despite that, disturbances of their natural hydrological regime along with climate change make them one of the world's most threatened ecosystems. Diatoms, a widely used bioindicators, play an important role in the conservation of alkaline soda ponds. However, the use of substrates such as mud and submerged plants for intra- and interannual comparison of astatic water bodies have some disadvantages. We conducted a one-month study in three soda ponds in early spring 2021. Brick artificial substrates (BAS) were placed in replicates in each pond, and diatoms from mud, reed and BAS were sampled after two and four weeks. Our first aim was to investigate diatom community succession in natural and degraded ponds. Secondly, we wanted to test the applicability of two diatom indices used for the ecological status assessment. Diversity and changes in diatom communities on different substrates were analyzed. Diatom Index for Soda Pans (DISP) and Trait-Based Index (TBI) based on BAS diatom communities were calculated. Regardless of the length of time that bricks remained submerged, no statistically significant differences between means of DISP index in three ponds were observed. On the other hand, the TBI index clearly separated natural from modified ponds. In conclusion, the application of BAS with a more robust index based on ecological traits can be a promising tool for the ecological status assessment of soda ponds.

EP180

Using UV-fluorescence fingerprints to assess lake browning effects

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During the summer of 2021, a browning experiment was conducted at the LakeLab mesocosm facility at Lake Stechlin, Germany, as part of the AQUACOSM Transnational Access program. From mid-July to mid-August, a total of 10 sampling campaigns in 16 enclosures was run to assess the effects of artificial browning (HuminFeed® addition) on water clarity and light penetration in the epilimnion. Four different treatments: control (CC), +nutrients (CN), control +browning (BC) and +nutrients +browning (BN) were applied to a subset of 4 enclosures; additional control measurements were taken at different locations in Lake Stechlin. Each sample aliquot was analyzed with a fluorescence spectrophotometer (Hitachi F-7000) to obtain its spectral fingerprint. Common fluorescence peaks were measured and their respective behaviors analyzed throughout the study period. The results indicate that all fluorescence peaks and fluorescence-based indicators were attenuated and remained low after addition of artificial humic substances. Only peak C fluorescence, reflecting humic-like compounds in water, increased in enclosures BC and BN that received the browning treatment; thus highlighting the specific HuminFeed® signature. Interestingly, after a 2-week lag phase, fluorescence of peaks B and T (tyrosine- and tryptophan-like compounds) and BIX, the Biological Index characterizing the biological production of DOM, increased significantly in enclosures CN and BC. These observations may be linked to phytoplankton growth which did not occur in photic zones of BN enclosures. Spectral signatures of CC enclosures mimicked those from lake controls and none demonstrated significant fluorescence variations.

EP089

What are the current sources of nutrient pollution and effects on lake stability for the Rappbode Reservoir System, in Germany?

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Major sources of nutrients in freshwater ecosystems are caused by intensive agricultural practices. Non-point sources of nutrient pollution are one of the main pressures on European aquatic ecosystems, affecting 38% of European water bodies, resulting in water eutrophication. This deteriorates the condition and the functions of lakes and reservoirs impacting their ecosystem services. In addition, climate change is affecting aquatic ecosystems through higher temperatures and altered surface water hydrology due to changes in precipitation patterns. Previous research demonstrated that climate change interacts in synergy with eutrophication increasing its effects and vice-versa. Hence, complex ecological models need to be applied and further developed to forecast the consequences of future climate change and nutrient loading in lake/reservoir ecosystems to propose adaptation measures.
This project aims to quantify the different sources and effects of nutrient inputs from lands into a typical European reservoir, in the context of climate change. Integration of a nutrient loads model (MARINA_GLOBAL) and a lake model (PCLake) will be used

for this study. This integration was used successfully in studies to assess lakes' water quality in China but rarely applied in Europe. The integrated approach will help to better understand the effect of nutrients on freshwater ecosystems and to propose effective measures to mitigate the effects of global change (eutrophication and climate change). This project will use the Rappbode Reservoir (Germany) as a case study. Previous studies on this reservoir generated long-term data sets at the temporal resolutions which will be used for the modeling.

EP175

G x G interactions between algal and zooplankton clones isolated during the spring season

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According to the Plankton Ecology Group (PEG) model, seasonal phyto- and zooplankton dynamics in lakes are explained by a change in phytoplankton community composition determined by abiotic and biotic factors. Consumer-resources interactions are central to this model as zooplankton dynamics depend on the quality and quantity of food while also influencing algal succession. Phyto- and zooplankton dynamics have been analysed mainly at an interseasonal and interspecific scale and we are lacking information on the potential key role played by intraseasonal and intraspecific variations in phytoplankton and their consumers. To test for this variation, we isolated clones of the diatom *Asterionella formosa*and clones of the major consumer *Daphnia longispina* from Lake Constance. We checked for differences in interaction strength by conducting time-shift experiments where we combined clonal populations of the algal and *Daphnia* isolates from the beginning (March) and end of the spring season (June) and measured ingestion rates of *D. longispina*. With this experiment we tested the prediction that *Daphnia* clones isolated in March and June differ in their filtration rates, as they experienced different food quality and quantity. Specifically, *Daphnia*clones from March are predicted to have high filtration rates as they are adapted to low algal densities of mainly undefended preys (according to the PEG model). Isolates from June are predicted to have low filtration rates as they are adapted to high algal quantities of mostly defended prey. The results of our experiment suggest that intraspecific variation occurs during the seasonal dynamics of consumers and their resources.

EP034

Temporal dynamics of freshwater fish assemblages - a systematic review

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The temporal dynamics of biotic communities have been widely examined by ecologists. However, systematic reviews on how habitat features, sampling and data evaluation influence temporal patterns are rather sporadic. Here, we reviewed 307 peer reviewed scientific articles to characterize the methods and the approaches, as well as to identify the knowledge gaps in the assessment of the temporal dynamics of freshwater fish assemblages with special regard to their stability patterns. The number of publications increased exponentially through decades. We revealed a highly uneven distribution of the studies among continents and ecosystems with a dominant number of papers derived from North America and Europe, and from lotic systems, especially. We also found large variability among studies even within similar habitat types in the examined spatial and temporal scales, sampling methods used, examined assemblage attributes, potential stressors, and data analyses. Several knowledge gaps, such as the limited number of large-scale studies, the insufficient knowledge on the long-term dynamics of early life history stages and on trait-based assemblage organization were highlighted. For enabling meaningful comparisons of fish assemblage dynamics in space and time, further developments in standardization procedures are needed across sampling and data evaluation possibilities. Publicly accessible long-term datasets with more details on sampling and environmental parameters would also be critically important to determine the effect of a variety of factors on the stability vs. variability of fish assemblages.

EP183

Combatting eutrophication and recycling of nutrients: can fishpond sediments be used for crop cultivation?

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Aquaculture ponds are commonly nutrient-rich due to the high input of nutrients from feed and/or fertilizers. Generally, only 10 to 25% of the added nutrients are incorporated in harvested fish. Most nutrients end up in the sediment (60-70%). The nutrient deposition on the sediment leads to organic matter (OM) accumulation, and oxygen depletion by microbial activity, which decreases water quality, hindering fish growth. Removing the sediment from the ponds and using it as a fertilizer may not only improve water quality in the fishpond but also contribute to the optimization of nutrient-use. My poster will show the results of our on-going experiment aiming to evaluate the potential use of fishpond sediment (FPS) as fertilizer in the cultivation of arugula (*Eruca vesicaria*). We collected sediment from two fishponds. In experimental units of 1L, we compared the application of the two FPSs in different amounts with a treatment with commonly used fertilizer (ammonium sulfate). Small arugula plants were planted at densities used by horticulturist and will be grown until they reach harvest-size. Our objective is two-fold to (i) quantify the sediment nutrient recovery by arugula, (ii) quantify the organic matter decrease during the cultivation period, and (iii) measure plant biomass and growth rate in the different fertilizer concentrations.

EP052

Lake Yambo as a model crater lake to better understand methane dynamics in tropical East Asia

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Freshwater systems are primary natural sources of atmospheric methane. Global estimates have reported up to 30% of the methane emitted to the atmosphere, which are mainly from boreal and temperate regions. Tropical East Asian lakes, which are exposed to higher temperatures which in turn affects the rate of methanogenesis, remain underrepresented. From 2016 to 2019 and again from 2021 onwards, we monitored the methane concentration of Lake Yambo (Philippines), by collecting monthly water samples from varying depths and conducting gas chromatography analysis. We also looked at factors which may affect methane production and emission through the quantification of methane-oxidizing bacteria (MOB) and classifying the lake's mixing regime. Monthly vertical profiles of temperature showed that Lake Yambo undergoes complete mixing during the northeast monsoon (monomictic). Interestingly, produced and stored methane in the profundal zone (35m) was not observed to be significantly disturbed during the lake's mixing period, and methane concentration reached zero at the 20–30m depth. MOB presence was also shown to be highly concentrated at the metalimnion (25m) and profundal zones, which may explain the depletion of methane concentrations towards the epilimnion. Since 2021, intensive monitoring of Lake Yambo's limno-physical characteristics using a fixed monitoring station was started to further elucidate the interconnections of the processes occurring in the lake. Using these data, we propose that Lake Yambo be used as a model Philippine crater lake for studies on methane dynamics, addressing the underrepresentation of tropical crater lakes in global estimates of lake methane dynamics.

EP170

Effectiveness of stable isotope analysis in understanding the nutrient reliance of ectoparasites in freshwater ecosystem to their respective hosts

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The contribution of parasitism in food web structures remains unclear despite the significance of parasites in understanding the feeding dynamics and energy transfer within ecological communities. Various techniques, such as stable isotope analysis (SIA), are now being utilized to determine host-specificity, nutrient reliance, and trophic position of parasites in a food web.A collection of peer-reviewed journals from 2010 to 2022 – containing the keywords: SIA, freshwater food web, and host-parasite relationship, were sifted and reviewed to assess the advantages of SIA in showing the nutrient reliance of parasites to their respective hosts, particularly of freshwater ectoparasite-host trophic linkages. Based on literature survey, stable isotope values revealed that $\delta^{13}C$ signature of the parasites is almost similar to their respective hosts, while its $\delta^{15}N$ signature differs relative to host blood, muscle, and eye due to trophic fractionation. Similar observations were made through a preliminary SIA data of the food web of Lake Taal, which included a known ectoparasite (*Corallana grandiventra*) that has been previously reported to cause massive fish kills.This demonstrates the effectiveness of SIA in providing nuanced understanding on the nutrient reliance in parasite-host relationships and overall food web structures in freshwater ecosystems. Furthermore, this shows the great importance of including greater diversity of parasites, both ecto- and endoparasites, in constructing food webs, to provide greater resolution of the nutrient and energy transfer in complex food webs, and how these species affect the overall trophic interactions of their hosts organisms.

EP140

A collapse of a European temporary protected wetland: the plankton dynamics leading to an ecological disaster

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Plankton dynamics and environmental factors have a pivotal role in the services and functioning of aquatic ecosystems. Knowledge of these processes underlying an ecological disaster is a major scientific challenge for effective conservation and restoration initiatives. The aim of the present study was to investigate the biotic (phytoplankton and zooplankton) and abiotic interactions before and during a fauna mass kill in a European protected wetland (Natura 2000 network and RAMSAR Convention) facing extended drying periods. Before the mass fauna kill, mixed blooms of known harmful cyanobacteria and the killer alga *Prymnesium parvum* occurred. High nutrient concentrations and inhibitory ammonia levels (0.6 mg N L^{-1}) led to the blooms' collapse, and the low phytoplankton numbers resulted in a dramatic drop in photosynthetic oxygenation. At the same time extremely high densities of red *Daphnia magna* individuals occurred, visible through satellites, indicating low oxygen conditions as well as a decrease or lack of fish predation pressure. This was confirmed when through the gradual decline of water level the mass episode of fish and birds kill was revealed, providing clear evidence that this ecological disaster did not take place in a short period, but it was the result of severe changes in plankton dynamics, and alternation on key abiotic parameters. Our study underlines the importance of plankton related ecosystem functions with structural properties for better understanding the accumulated heavy anthropogenic impact on ecosystem life and service provisioning, as well as the reasons for restoration measures failure.

EP005

Modelling the effect of variability of inflow nutrient concentrations on lake nutrient retention

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The input of nutrients into lakes or reservoirs varies seasonally and also by discharge (Q) depending on the type of solute (C, e.g. Nitrogen or Phosphorus). Change may subject lakes to changed variability of either inflow rates or loads or both. However, the impact of changes on lake nutrient conversion mechanisms, for instance due to changes in climate or hydrology, is only partly understood.
Here I seek to determine how outflow solute concentration varies in relation to inflow concentration. I want to gain insight into the impact of changed variability of nitrogen and phosphorus concentrations.
For this study a 1-d lake model (Gotm-Fabm-Wet) was set up for a reservoir in the Harz mountains (Central Germany), where 5-years of observation data was available to validate model performance. The model was used to investigate scenarios of altered variance of nutrient inflow concentration, created using artificial time series for inflowing solute concentration of P and N, while keeping the annual nutrient load and discharge constant.
Observed dynamics of temperature, oxygen and chlorophyll were simulated well by the model with generally decent model efficiency. The lake model was used to simulate nutrient transformations and to examine retention and export ratios of N and P and the ability of the reservoir to buffer or transmit solute patterns.
The preliminary modeling results invite to conduct a deeper analysis of variability in seasonal timing and magnitude of lake input. Understanding the ability of lakes and reservoirs in dealing with changed input will help to maintain water security.

EP035

On-site ultra-rapid environmental DNA detection for freshwater fish

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Environmental DNA (eDNA) methods for species detection provide essential information for the management and conservation of freshwater species and communities in various ecosystems.eDNA measurements have been mainly performed by quantitative real-time PCR. However, it is limited to laboratory analysis, and laboratory processing can take many hours. These time delays often limit the range of uses for on-site eDNA detection. Field-portable DNA extraction and PCR platforms offer the potential to change species detection by eDNA on site. However, these approaches still take a similar time to laboratory measurements.
Here, we developed an innovative novel method for on-site eDNA measurements using an ultra-rapid mobile PCR platform. In lakes and rivers, we tested the ability of our method to detect the distribution of silver carp, Hypophthalmichthys molitrix, an invasive fish in Japan. Our method reduced the measurement time to 30 min and provided high detectability of aquatic organisms compared to the national observation surveys using multiple fishing nets and laboratory extraction/detection using a benchtop qPCR platform. We also show the mobile PCR system can quantify the fish eDNA concentration using the external standard curve.Our developed on-site rapid detection methods for eDNA can provide data for on-site decisions regarding the next sampling locations and the possibility of DNA-tracking in the field for understanding behavior and habitat use in a short (hours) time.

EP112

Nitrate treatment as a tool for lake restoration in agricultural watersheds

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Lakes situated in agricultural watersheds suffers from cyanobacterial blooms due to extensive external loading. Nitrate-rich waters supply freshwater ecosystems, stimulating phytoplankton proliferation. At the same time, bottom sediments feeds water column with phosphates, especially in eutrophic lakes with anaerobic hypolimnion in summer. The utilization of nitrates by redirecting the water of the tributaries to deep lake water layer serves as a tool for lake restoration by: (1) an increase of the redox potential in the sediment-water interface to limit the internal phosphorus (P) loading, and (2) reduction of nitrogen concentrations due to the denitrification. This approach has been firstly applied in hypertrophic Lake Uzarzewskie (10.6 ha, max depth 7.3 m) in Western Poland since 2008, after partially successful P inactivation with iron sulphate in 2006-2007. Water analyses were conducted in 2005-2021, with special attention to nutrients and chlorophyll-a concentrations, to assess the effectiveness of restoration. *Ex situ* experiments on undisturbed sediment cores were conducted to determine the direction and intensity of P exchange in water-sediment interphase. The obtained results proved the efficiency of lake restoration by means of nutrient content reduction as well as chlorophyll-a till 2018. Internal phosphorus loading was gradually reduced and P binding in sediments was observed in 2016 and 2017. A deterioration of water quality in the peak of summer in 2019-2021 was noted, manifested by higher content of chlorophyll-a and nutrients, as well as by reduction in water transparency. It was related to changes in weather conditions and periodical malfunction of pipes delivering nitrate-rich waters.

EP006

Modelling a deep oligomictic lake: the relevance of the quality of input data

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In the last decades, deep lakes have been strongly affected by climate change, which has impacted on mixing and stratification dynamics and consequently on nutrient and dissolved oxygen concentrations in the deep waters. In this framework, being able to model lake processes is critical to understand the ensuing lake evolution. The reliability of the models depends on several factors, among which the quality of input data is of primary importance. In this research, we calibrated and validated the 1D coupled hydrodynamic-ecological General Lake Model/Aquatic Ecodynamics (GLM/AED2) for the deep oligomictic Lake Como, Northern Italy. The lake belongs to the district of the Deep Subalpine Lakes (DSL) and is divided into three basins, being Y-shaped. Since 2020, the lake has been studied with high-frequency monitoring (HFM) stations under the cross-border cooperation project SIMILE (Integrated monitoring system for knowledge, protection and valorisation of the subalpine lakes and their ecosystems). The first results of the modelling activity will be presented with peculiar attention to the preparation of input data and to the potentialities of HFM to calibrate and validate lake models.

EP111

The Future of the River Network Toolkit (RivTool)

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Environmental, ecosystem functioning and human activities must be considered at multiple river scales for an effective research, conservation and management of freshwater ecosystems. The ability to integrate, at multiple scales, an ever-growing plethora of information of this nature into a hierarchical dendritic and directional network, such as river networks, is a challenging task. The river Network toolkit (RivTool) is a freely available, user-friendly and table-driven software of universal applicability that enables the integration of these inputs for large scale river network analysis. Downloaded in nearly 70 countries across all continents, this software is a platform with high potential for future scientific and management approaches with the flexibility to accommodate new features. Supported by the project Dammed Fish, three new add-ons are being conceptualized and developed to expand the ability of this software to contribute to the freshwater community: 1) RivFish, an add-on to integrate the rGBIF package resources with the framework of RivTool; 2) RivConnect, a plugin to enable the calculation of fragmentation metrics and river connectivity indexes using graph-theory, i.e., to perform quantitative network connectivity analysis; 3) RivOpt, an optimization tool to support decision making for barrier connectivity enhancement, accounting for conflicting ecological and socioeconomic goals. This set of new features increases the overall utility of RivTool, widening its potential scope of action for the freshwater science and management community. Thus, soon, RivTool will contribute towards enhancing the ability to interpret and manage river ecosystems, i.e., towards attaining European biodiversity goals.

EP161

Diverse diatom communities of an oxbow lake of the River Tisza with the description a new *Mayamaea* species

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Diatoms frequently constitute a dominant group in benthic aquatic habitats. These algae have significant role not only as primer producers but also as bioindicators in ecological status assessment. Traditional identification of species is morphology-based, besides, DNA-based method (metabarcoding) has been proposed recently.
Within the framework of a national scale project associated with the EU Water Framework Directive 92 Hungarian standing waters were studied aiming to assess their ecological status based on phytobenthos. In this project, spring and autumn epiphytic diatom assemblages from Körtvélyesi-Holt-Tisza, a hypertrophic oxbow lake of the River Tisza were investigated using light and scanning electron microscopy supplemented with metabarcoding. High diversity of species was revealed including several small-celled „naviculoid" diatoms. In the spring sample a *Mayamaea* species was dominant that separated from other species of the genus based on both morphology and DNA sequence. It is going to be described as a new species. In addition, light and electron microscopy and metabarcoding was used for the identification of other small „naviculoid" diatoms (e.g. *Brevilinea kevei*, *Navicula microrhombus*, etc.) from the sample. Due to global warming, oxbows are becoming increasingly vulnerable habitats due to the prolonged loss of lateral connectivity, although they play an important role in maintaining biodiversity.

EP032

Does solar activity affect the dynamics of cyanobacteria community worldwide and how?

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The sun has critical influences on our planet; it drives weather, ocean currents, seasons, and climate. The sun also affects the activity of aquatic organisms. Cyanobacteria are a crucial aquatic organism from an ecological, economic, and evolutionary point of view. These photosynthetic prokaryotes made life on earth possible, as the source of our oxygenated atmosphere and ozone shield. Conversely, in high numbers, cyanobacteria may produce toxins that pose a human health risk. Sporadic reports from different parts of the world mention a relationship between the activity of the sun and cyanobacteria blooms. Additionally, cyanobacterial growth and bloom potential in fresh water are affected by the climate. This suggests that there may be a downscaling process from the sun‘s activity to the occurrence of cyanobacterial blooms. To test this hypothesis, we used a recently compiled global data set of more than 15 lakes and investigated the potential effects of solar activity and weather variability on cyanobacteria biomass. We used wavelet analysis on long-term times series to evaluate the relationships among cyanobacteria dynamics, the cycle of the sun‘s activity, and large-scale atmospheric pressure systems. We then tested the causality between solar activity and the cyanobacterial biomass using shorter time series datasets. We applied regression tree (CART) models and explored whether a common threshold of weather variables (i.e. irradiance, humidity, wind speed, rain) and sunspot number exists for cyanobacteria growth. Our work provides a global perspective on the role of weather variability and solar activity on the occurrence of cyanobacteria blooms.

EP132

My Research in Lake Biwa Part 1

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This autumn, I had fun observing a lot of plankton using a microscope on the research vessel, HAKKEN of Lake Biwa Trust. I am interested in why water quality and odor deteriorates in summer, and went around Lake Biwa to find the characteristics of the waters at the beaches of Lake Biwa. I was able to feel the size of Lake Biwa and the conditions were different depending on the location. I was able to see the differences between water quality in beach areas but unfortunately, I was unable to find much zooplankton on the surface of Lake Biwa. I couldn't find any of my favorite daphnia. The cause could be that the water temperature was too low. Because it was so cold that there was news that full-thickness circulation was confirmed a few days after the water was collected.

EP060

Evolution of surface temperatures in Austrian alpine lakes under climate change

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Lake Surface Temperature (LST) is a key characteristic that reflects meteorological and climatological influences on lakes. In general, LST data from high-altitude lakes are scarce as these areas are remote and not part of regular monitoring programs. Nonetheless, in order to develop effective management strategies for high-altitude lakes, it is important to understand their response to climate warming. This study aims on both the reconstruction of LST and the projection of LSTs for 21 alpine lakes (1500-2300 m a.s.l.) in the Niedere Tauern region in Austria until the year 2100. For the determination of the relationship between atmospheric variables (temperature and precipitation), near-lake snow depth and observed LST, general additive models were trained with a daily temporal resolution for the years 1998-2003, and 2019-2020. We subsequently employed the model with the highest fit to reconstruct LSTs for the whole period 1998 to 2003. Furthermore, we estimate LST until 2100 using an ensemble of regional climate projections for the RCP2.6 (in-line with the COP 21 Paris Agreement) and RCP8.5 ("worst-case") scenario. Under the RCP8.5 scenario, the average rise for August temperatures in the distant future (2071-2100) is predicted to increase by 2.3°C compared to temperatures in the near future (2020-2049). Consequently, the ice-free period is expected to rise on average 1-1.2—fold in the near future (2031-2060) and 1-1.5-fold in the distant future. These alterations in the lakes' temperature regime probably affect multiple limnological parameters related to ecological quality such as primary productivity and trophic state.

EP100

Pathways of nutrient pollution in the Volga Reservoirs

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The reservoirs of the Middle and Lower Volga are affected by cultural eutrophication due to extremely high anthropogenic impact from agricultural, industrial and urbanised areas. It is necessary to have accurate data on the nutrient load of reservoirs, which comes mainly as river inflows, to better understand the exact factors determining this process, but information on the structure of the nutrient budget of the rivers in Russia is extremely scarce. Our summer field studies of the Gorky, Cheboksary and Kuibyshev reservoirs in 2017-2021 provided a detailed picture of the dynamics of suspended and dissolved nitrogen and phosphorus as the Volga experiences significant hydrological and biogeochemical changes. It is demonstrated that the Oka River is the main source of nutrients in the Cheboksary Reservoir, which creates some distinctive features of the nutrient regime of more than 100-km long part of the Volga cascade and contributes to a considerable increase in the nutrient load on the main river.

EP070

Past, present and future anthropogenic stressors in a large Swedish lake

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Lake Vättern is the second largest lake in Sweden (and sixth largest in Europe) and home to a unique ecosystem due to its large size and cold, ultra-oligotrophic water. In the past century, sewage emissions, industrial pollution and agriculture led to eutrophication as well as pollution with both persistent organic pollutants and metals, thereby affecting nutrient concentrations, water clarity, species distribution and resource usage. Due to the implementation of countermeasures in cooperation around the lake, Lake Vättern recovered. Today, many of the problems of the mid-20th century are solved and the lake is, again, an (ultra-)oligotrophic lake with clear water and rich biodiversity. Management and monitoring of Lake Vättern has been conducted intensively since the 1960s, coordinated by the Lake Vättern Society for Water Conservation. New challenges are on the horizon. To measure the prevalence and effect of new anthropogenic stressors, a number of studies have been conducted in cooperation with Swedish universities – from microplastic pollution in the water column and sediment to organic micropollutants and PFAS. A changing climate already now significantly affects water temperature, ice coverage and water levels. New alien species are likely to enter the lake. These 21st century pressures will affect the lake ecosystem, management and resource usage moving forward.

EP083

Transcriptome response of *Gasterosteus aculeatus* in natural habitats affected by multiple anthropogenic stressors

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European running waters are heavily affected by human activity which can have detrimental effects on the fish fauna. Some species, however, seem to be able to cope well with anthropogenic changes e.g. increased salinity and temperature. The mechanisms and underlying pathways of this adaptation in natural conditions, however, remain poorly understood. Here we present evidence of differential gene expressions in *Gasterosteus aculeatus* that correlate with different levels of anthropogenic stressor conditions

in the river Boye (Germany). We chose one river transect with natural cover and mainly agricultural influx and two field sites in an urban and industrial landscape that showed higher nutrient and salinity concentrations. For each site, we did Illumina high throughput mRNA sequencing of three specimens and performed a differential gene expression analysis. We found a set of significantly differentially expressed genes between the fishes of the different transects. A gene ontology analysis showed an enrichment of gene expression in the pathways related to the activation of immune response and response to osmotic change. Osmoregulation and immune response pathways were upregulated in both transects with higher urban and industrial land cover and higher concentrations of chloride and total nitrogen. Candidate genes for general stressor and local adaptation are currently being identified and will be confirmed using qPCR. Our transcriptome results are a promising first step into understanding fish adaptation to stressful environments in natural habitats.

EP119

Pioneer temporary moraine ponds: a specific freshwater habitat in Maritime Antarctica

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Currently, Antarctica is experiencing some of the most rapid climate changes on Earth with frequency and duration of summer warming events likely to double or triple. Extended snow-free periods and permafrost thawing have been registered on Livingston Island, Maritime Antarctica. Thermokarst describes landscapes and processes associated with collapsed terrains triggered by permafrost thawing. Thermokarst is typical of the Arctic, while very few studies discuss such processes in Antarctica. Since 2016-2017, thermokarst features have been developing above the Bulgarian Antarctic Base following periods of active melting of ice and snow cover. As a result, negative forms filled up with water, forming pioneer ponds. The aquitard layer of these ponds is permafrost, similar to Arctic thermokarst ponds. In January – February 2022 we studied morphological and water characteristics of 13 temporary ponds east-southeast of the Espagnol and Rudozem Hills. What is specific of the studied Antarctic ponds is that they are situated on the elevated part of the side glacier moraine and their formation is not directly associated with the adjacent glacier. Their maximal depth varied between 7 and 45 cm, water was alkaline and oxygen-rich. Some of these ponds enhance expansion of specific aquatic biota (i.e. algae, invertebrates) and are life-rich as compared to the adjacent bigger glacial lake. This is likely due to more favourable conditions and resource availability. Classification of inland Antarctic freshwater habitats is needed to better explore their role as indicator ecosystems for monitoring trends of global changes in Antarctica and to enable their protection.

EP172

Winter diatom ecology in a eutrophying lake and effects on summer biogeochemistry

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Winter has been understudied in temperate lakes due to its traditional consideration as a biologically dormant season. Nevertheless, several lakes support phytoplankton blooms, often constituted to a large extent by large-celled diatoms, which can even attain the annual maximum phytoplankton biomass in late-winter before stable stratification. These blooms can strongly influence nutrient cycling and the phytoplankton community in subsequent seasons. Therefore, understanding the dynamics of these blooms is key to predict phytoplankton succession patterns particularly with respect to climate change, which is heavily affecting winter conditions and lake thermal dynamics. Here we aim to identify the mechanisms leading to late-winter diatom blooms, and relate the late-winter biomass to physical and biogeochemical characteristics through an analysis of a long-term dataset from Lake Stechlin (1994-2020): a deep, dimictic, clear-water lake in Northeastern Germany. Results revealed alternating shifts between cyanobacteria-dominated and diatom-dominated phytoplankton communities in summer and winter seasons, and an important influence of winter-blooming diatoms on phosphorus cycling. In years with winter diatom blooms, there were positive correlations when comparing the annual maximum diatom biomass, and its biomass peak, with the concentration of dissolved phosphorus and whole-lake total phosphorus in deep water at the following stratification period. The analysis of this 26-years record provides insightful information about the dynamics of phytoplankton communities during winter in a lake that appears to respond sensitively to pressures of global environmental change including nutrient enrichment and changes in stratification patterns.

EP113

Historical changes of the dissolved silicate supply and its effects on benthic animals in a tidal flat ecosystem

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Dissolved silicate (DSi) is essential nutrient for the growth of diatom, which is important basal dietary sources in coastal food webs. DSi in the coastal areas is derived from the inland. However, DSi supply to coastal area is reduced by reservoirs located its upstream through DSi uptake and sedimentation by diatom in the reservoirs, in turn, the structure of the coastal benthic communities may be affected. Here, we evaluated the effect of a reservoir on DSi dynamics and benthic animal communities at a tidal flat ecosystem. Monthly water sampling was conducted at inflow and outflow of the Zuibaiji reservoir in Fukuoka, Japan from June 2021 to March 2022. Sixty-cm sediment core sample was collected at the Imazu tidal flat where is located at the downstream of the Zuibaiji reservoir, and analyzed biogenic silicate to estimate the historical DSi supply. Temporal distribution of diatom in Zuibaiji reservoir and benthic animals in the Imazu tidal flat was investigated in literatures. We found that about 10 ton month^{-1}of DSi was removed by the Zuibaiji reservoir. The distribution of biogenic silicate in the sediment core sample indicates that supply of DSi have been reduced since around 1980's when the Zuibaiji reservoir started its operation. Furthermore, the negative relationship was found between the amount of diatom in the Zuibaiji reservoir and the amount of benthic animals in the Imazu tidal flat. Our findings indicate reservoirs can affects the benthic communities in coastal area through reducing the supply of DSi.

EP049

The effects of road crossings on stream macroinvertebrate diversity

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Linear infrastructure such as roads, railway lines, canals and pipelines are among the most widespread manifestations of human activity. Despite the fact that roads can promote diversified societal and economic benefits, they can also generate high environmental costs. Although it is well known that roads and associated crossings of roads and streams (bridges and culverts) can modify and degrade the natural flow and biodiversity of streams, the subject of whether or how the intersection of roads and streams influence the diversity of stream macroinvertebrates is under-researched. To fill this gap in our knowledge, we collected stream macroinvertebrates from road crossings (bridges and culverts) and compared their diversity with upstream and downstream sections. Stream sections were characterized by nine visually estimated environmental variables considering water depth, current velocity and substrate composition. Water chemistry parameters were also measured. We found that road crossings had negative effects on the richness and abundance of native macroinvertebrates, as well as on the number of protected taxa. Our results showed also that alien individuals were more abundant at road crossings.These findings support the assumption that road crossings contribute to the spread of alien species. The assessment of environmental variables indicated that road crossings caused habitat modifications, and based on these it can be assumed that habitat modifications and associated phenomena (e.g. pollutants and storm events) were the major drivers of the observed patterns in biodiversity. Our results fill a knowledge gap and contribute to the deeper understanding of the effect of road crossings on freshwater biodiversity.

EP167

Morphometric variations of rotifers in a high altitude reservoir in Central Mexico

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Studies on rotifers from Mexico have mainly focused on species richness and abundance. Biotic factors such as predation and abiotic factors such as temperature and pH cause morphometric variability of rotifers. There are only a few studies that mention the morphometry of rotifers mainly based on laboratory experiments between predator and prey interactions. In this study, geometric morphometry was employed to characterize and quantify the lorica variations in the selected rotifer species of the genera *Trichotria, Testudinella, Trichocerca, Mytilina*, *Lecane* and *Keratella*. Rotifers used to estimate the geometric morphology came from the high altitude (2850 m.a.s.l.) Llano reservoir, located in central Mexico. Both *Mytilina ventralis* (180-260 µm) and *Trichotria pocillum* (190-265 µm) showed marked variations in the lorica lengths. Morphometric variations of chosen rotifer species were interpreted in relation to temperature, pH, dissolved oxygen, conductivity, chlorophyll a, and nutrient levels.

Keywords: *Lecane closterocerca*, *Mytilina ventralis, Testudinella patina, Trichocerca elongata, Trichotria pocillum, Keratella cochlearis,*geometric morphometrics, Llano reservoir.

*Presenting author, Poster presentation

EP169

Zooplankton networks conditioned by winter warming in small anthropogenic reservoirs

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Water temperature significantly influence interspecific interactions in aquatic ecosystems. We tested the hypothesis that the thermal gradient significantly differentiates the dynamics, significance and type of relationships in the structure of zooplankton communities colonizing mine pit reservoirs. Zooplankton were sampled monthly in years 2014-2016, from three reservoirs of the drainage system in Poland's biggest brown coal stripe mine. The reservoirs are fed with water coming from different depths, of different temperature, including geothermal properties. As a result, the reservoirs differed significantly of thermal conditions, especially in the winter. The interactions between zooplankton species were evaluated by network graph analysis for three water thermal classes: low (LT), moderate (MT) and high temperature (HT). The LT network was most cohesive expressed by clustering and centrality metrics, and the shortest of communication paths and the highest average number of neighbors per species, i.e. the number of interspecific interactions. The MT network was characterized by the highest density and heterogeneity, which proves its greatest diversity. The HT network was the most fragmented, with the weakest interspecies relationships and less importance of antagonistic interactions (predation and competition). Our studies of the impact of „warm winters" and „flattening" of the annual water temperature amplitude on the shape and functioning of the zooplankton network in the year-round cycle may be a projection of changes due global warming. This is particularly important in the case of reservoirs subject to continuous anthropogenic impact, where the effect of a changing thermal regime may determine the ecosystem services.

EP088

Lake Długie in Olsztyn (Olsztyn Lakeland) as an example of good practice in lakes restoration

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Excessive human pressure on the environment has led to degradation of many lakes. The most visible effects of lake water pollution were blooms of phytoplankton, cyanobacteria, deoxidation of bottom water and the initiation of the internal loading of P and N from bottom sediment. As a result, the economic and natural functions performed by the lakes so far were limited. It was necessary to develop protective and restoration solutions. Achieving positive effects of restoration is possible only in the case of optimal selection of methods for the unique conditions of the lake. The sequencing of used treatments is also very important. Lake Długie for 20 years was acted as wastewater receiver (400 m^3/d), which has led to its complete degradation. After cutting off the inflow of pollutants, an artificial aeration, P inactivation method and biomanipulation were used for restoration.
Before the restoration content of total nitrogen was ±22.89 $mg \cdot L^{-1}$ and total phosphorus ±3.50 $mg \cdot L^{-1}$ in the lake water. An average concentration of chlorophyll a was ±200 $\mu g \cdot L^{-1}$ and SD did not exceed 1 m. In 2020 (seventeen years after the end of restoration treatments) total phosphorus concentrations did not exceed 0.340 $mg \cdot L^{-1}$ and total nitrogen 3.0 $mg \cdot L^{-1}$. Chlorophyll a contents oscillated in the range of 1.5 to 28.3 $\mu g \cdot L^{-1}$ and SD was more than 7 m.
Results obtained that the comprehensive restoration methods and applied in right order on one object can be good practice, and their effects are durable in long term.

EP127

***Planktothrix agardii* Bloom in Yahuarcocha lake - Ecuador**

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Yahuarcocha is a shallow tropical lake, of volcanic origin, located in the province of Imbabura, at 0°23'N, 78°05'E; 5 kilometers northeast of the city of Ibarra, at an altitude of 2201 meters above sea level, it has an area of 257 ha and a current maximum depth of 7 m. The lake's watershed has long been populated, but human impact has recently worsened. In studies carried out for 40 years, the phytoplanktonic community consisted mainly of chlorophyceas and diatoms and to a lesser extent by cyanobacteria. Fish kills in 2003, raised alarms about changes in the lake, a process of eutrophication was evidenced. Work carried out in 2014 showed blooms of cyanobacteria of the genus *Raphidiopsis*. Taxonomic analysis of samples obtained in the dry and rainy season, between 2020-2021, show a current bloom consisting mainly of *Planktothrix agardhii*, followed by *Raphidiopsis raciborskii*. Metagenomic analyses corroborated the result, that the dominant canobacterium in Yahuarcocha, is *Planktothrix agardhii*. We also detected in our samples Anabaenopeptins B, A, E / F, toxins produced mainly by *Planktothrix*.

EP047

Effects of a tributary inflow and sediment replenishment on riverbed environments and benthic macroinvertebrates communities downstream of a dam

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The supply of sediment was dramatically decreased in the downstream area of a dam and caused the coarse riverbed issue. The coarse riverbed habitats significantly modify benthic-macroinvertebrate communities' structures. Recently, to eliminate coarse riverbeds, artificial sediment replenishment below dams and utilizing tributary inflow are considered environmental mitigation. These mitigations have been shown to re-supply fine sediment, e.g., sand and gravel downstream of the dam, consequently, restoring both riverbed environments and benthic macroinvertebrate communities. The sediment replenishment only re-supplies fine sediments once and tributary inflow also supplies those continuously. Therefore, we hypothesized the different effects on benthic macroinvertebrate communities by tributary inflow and by sediment replenishment, but there are very few studies comparing the effects of both mitigations. In this study, we compared the effects of tributary inflow and sediment replenishment on the riverbed environments and benthic macroinvertebrates communities in 12 dammed rivers in Japan. From the results, downstream of the tributary inflow mitigated the dam effects on both the riverbed environments and benthic communities. Whereas sediment replenishment mitigated the riverbed environment, while limitedly mitigated the benthic communities.

EP056

Hydrology drives GHG dynamics in a boreal headwater stream affected by clear-cutting

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Forestry plays an important role as a climate change mitigation tool and is the dominant land-use in Sweden. While terrestrial processes like nutrient leaching are well described, we lack insight into how clear-cutting affects greenhouse gas (GHG) emissions from streams, and how these responses are influenced by climate and hydrology. Here we ask how clear-cutting affects GHG emissions from a boreal headwater stream and how this is influenced by the size of riparian forest buffers as well as by hydrologic variability. To answer these, we measured discharge, dissolved inorganic carbon (DIC, predominately as CO_2 due to low pH), methane (CH_4), and dissolved oxygen (DO) at four sampling stations along a 400 m stream reach. After one year of sampling, the catchment was clear-cut, such that each station had either a thin or wide buffer zone remaining (5 or 15m). Preliminary results suggest minor differences in gas concentrations between segments with thin versus wide buffers. Instead, the clearest differences were observed between years, and reflected major shifts in climate and hydrology. Specifically, low levels of precipitation in 2020 led to drought conditions, which culminated in a series of disconnected pools characterized by low DO concentrations (2.12-6.41 mg/L) and relatively high concentrations of CH_4(14.23-126.22 µg/L). By comparison, greater precipitation in 2021 versus 2020 resulted in generally higher base-flow conditions, and higher DIC concentrations (1.63 vs. 2.02 mg/L). Overall, our results highlight that hydrology was the dominant driver of stream gas dynamics during those two years.

EP121

S-Oases: An open-source database on the environmental and cultural state and future development of oases globally

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Drylands cover 41.3% of the global land surface, containing at least 30% of the world's cultivated plants and livestock and being considered a significant genetic reservoir. Surface water in drylands is scarce and, when available, usually proceeds from old groundwater deposits. Water availability is a precondition for the presence of oases. Oases *s.str.* are "intrazonal vegetation islands surrounded by drylands (AI<0.02), either natural or human-made, characterised by a persistent water supply, which make them a fertile area". Oases *per se* provoque microclimates that allow their own maintenance. Water evaporation captures energy reducing temperature which produces a ring breeze circulation with the hot air from desert acting as a vertical wall avoiding moisture exchange. Oases are ecosystems of pivotal biological, ecological and cultural importance. They may serve either as climatic refugia or stepping stones, and have given shelter to civilizations since ancient times. At the same time, oases are highly threatened by human population growth, disrupting the hydrological and thermal balance. Therefore, major attention in conservation and management planning is needed. We are creating an open-source database (S-Oases: Senckenberg Oases Database), with extensive bibliographical research. The goal is to delineate oases, to assess their environmental and cultural state, and encourage oasis research and management globally. Data will be made available in an open-source database meeting the FAIR principles. We present the first map of oases in Africa and the Middle East, as well as the outcome of extensive bibliometric and data analyses.

EP025

Changes in catchment modifies alpine lakes heat budget

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Mountain lakes are often described as sentinels for climate change as they react rapidly to the global and local climate. Due to their small size, small catchment areas, and steep surrounding slopes, mountain lakes also respond rapidly to changes in their catchment. Traditional one-dimensional models based solely on meteorologic conditions fail to represent their temperature cycles. In contrast to low altitude lakes, energy balances in mountain lakes are highly impacted by catchment properties such as snow cover and inflow rather than direct fluxes with the atmosphere. An additional practical challenge comes from the lack of accessibility and harsh field conditions of these lakes. The evolution of mountain lakes in a changing climate is thus still unknown. This study quantifies the role of throughflow in the heat budget in various Alpine lakes in the French alps spanning from 2000 m to 3000 m a.s.l, in glacial and non-glacial watersheds using meteorological and water temperature data collected in the "Réseaux Sentinelle" Lakes in France. Our results highlight these changes in the watershed have to be included in the classical one-dimensional vertical description of the heat exchanges based on meteorological conditions to characterize the evolution of mountain lakes under climate changes.

EP016

Dissolved organic matter quality variations as function of time and space in two drinking water reservoirs in Germany

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Dissolved organic matter (DOM) is ubiquitous in aquatic systems. Discharge of DOM to reservoirs via shallow ground and surface waters from the catchment poses major problems for drinking water production. For drinking water treatment, efficient removal of humic substances by coagulation / flocculation and limiting the formation of disinfection byproducts are the most pressing challenges. DOM consists of thousands or even millions of different molecules. The identification of the isomeric structure of each molecule is still far from any instrumental analytical realization. From the analytical point of view the highest molecular resolution of DOM can be achieved by Fourier-transform ion cyclotron resonance mass spectroscopy (FTICR-MS).
As a first result of FTICR-MS measurements we observed that few components (molecular formulas) showed high abundance differences as function of depth during reservoir stratification. Some polyphenol-like components (relevant for flocculation) declined in the epilimnion of both investigated drinking water reservoirs potentially due to photo degradation. Some of the (more aliphatic) photo products, which were enriched in both epilimnetic water bodies, are suspected to be disinfection byproduct precursors. This knowledge can be used to investigate the adaptation of the raw water subtraction depth in the reservoir.
As future application, such important elemental formula components, whose biogeochemical reactivity was identified, might be used for lake modelling using their percentage (relative) mass peak intensities.

EP078

Linking forest to fish: the story of coastal darkening

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Changes in land use, reduced acidification and climate are causing increased terrestrial vegetation density in the boreal zone. This greening on land leads to increased exports of natural organic matter that have made inland waters become browner. The resulting darkening of inland waters and rivers cause decreased underwater light availability for visual predators and primary producers and promote GHG emission. The darkening of inland waters also propagates into the coastal zone when brown-colored freshwater mixes with clear oceanic seawater. There is rising evidence that this documented centennial trend in coastal water darkening has consequences throughout the coastal food web. We here present this story of coupled ecosystem responses based on long time series of afforestation, increased coastal darkening that is manifest by reduced secchi depth. This affect both blooming depth and blooming period along the Norwegian coats, and seem to be the likely driver of major changes in spawning phenology of cod populations.

EP099

Spatial and temporal pattern of phosphorus release from sediments of a eutrophying clear-water lake

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Nutrient enrichment leading to lake eutrophication has been a dominant theme in limnology for more than a century. As a result, the extent and underlying mechanisms are generally well known. Interest in the causes and consequences of eutrophication still continues, however, in part because eutrophication symptoms are increasingly observed in nutrient-poor lakes even in remote areas where external nutrient supplies are small. This suggests a key role for internal loading. Here we report on spatial and temporal patterns of phosphorus contents in sediments of Lake Stechlin, a deep endorheic clear-water lake located in a small forested catchment of north-eastern Germany. Long-term monitoring data show a dramatic increase in the average P concentration in the water column of the lake since 2010, accompanied by elevated oxygen consumption rates in the hypolimnion, which have gradually increased the area of lake sediment exposed to anoxic conditions during summer stratification. Sediment cores were taken at 59 sampling points in June and October 2021 and analysed for P in the sediment, pore water and the overlying bottom water. Calculated SRP diffusion rates from sediments at different water depths were compared with P accumulation rates in the water column. Results provide only weak evidence in support of the hypothesis that P release is highly redox-dependent, possibly because a fraction of the mobile P has already been released. These data improve the current evidence base to develop potential restoration strategies for clear-water lakes experiencing unexpected internal P loading.

EP037

Response in the fish assemblage due to temporal opening test of the Nakdong estuarine barrage

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Renaturalization of rivers have recently been emphasized to achieve a naturality and high biodiversity. In this study, we conducted a field study on fish assemblage during the temporal opening test of the Nakdong estuarine barrage, which has been progressed 7 times to judge rehabilitation from 2017 to 2021. Fish monitoring were conducted monthly (n=45), then we analyzed fish assemblages by combining 5 years data into eight periods, in which the periods are in between temporal opening test of the Nakdong estuarine barrage. The sampled fishes then classified into three categories; Freshwater, Anadromous and Catadromous. As a result, total 12 families, 27 species and 12,337 individuals were collected. The dominant species was *Erythroculter erythropterus*(R.A: 86%),followed by *Lepomis macrochirus*(R.A: 5.1%),which were introduced and exotic species respectively. The'*b*'value in length-weight relationships of freshwater fishes showed decreasing patterns after the temporal opening test, while anadromous and catadromous fishes showed increased patterns. Diversity indices, on the other hand, showed rather fluctuating patterns while the Nakdong estuarine barrage remained open. Conclusively, we found opening test could affect on the well-beingness of fishes. Also, further researches on interaction between fish assemblage and physical parameters should be required.

EP173

Roles of the host phylogeny on the formation of host-associated microbiota in *Daphnia pulex*

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The host-associated microbiotas in animals are known to contribute to the host's fitness. Studies showed that these host-associated microbiotas are genetically influenced by their hosts. However, it is not well understood whether the host-associated microbiota is restricted depending on the host phylogeny. Individuals of *Daphnia*cf.*pulex*sensu Herbert in Japan are obligate parthenogenetic and divided into four genetically distinct lineages (JPN1–4). Two of these lineages (JPN1 and JPN2) have multiple genotypes that are thought to have differentiated in Japan after the invasion. Thus,they are ideal organisms to examine if and how their host-associated microbiotas are genetically and phylogenetically regulated. Therefore, in this study, we experimentally investigated the variations of host-associated microbiotas in vital, starved and dead individuals of several genotypes in the JPN1 and JPN2 lineages. The experiment showed that the host-associated microbiota differed significantly not only among the host genotypes but also among the lineages when they lived, although it became similar among these individuals when they starved and dead. These results indicate that a part of the vital host-associated microbiota is phylogenetically maintained among different lineages of *Daphnia*species.

EP058

Nutrients and microorganism assemblages in snowpacks in North-Patagonian Andes Mountain

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Snowfields cover temporarily up to 32% of Earth´s surface. Their microbial community is being studied with interest because of its particular sensibility to climate change, their effect on biogeochemical cycles and on downstream aquatic communities. We studied the microbial community and elemental relationships of temporal snowpacks of North-Patagonian Andes around 41 °S. We sampled different snowpacks in two different mountains (Cerro Catedral and Cordón de los Inocentes) of two different colors (white and pink) that would affect headwaters. We measured chlorophyll *a* (Chl*a*), dissolved nutrients (Dissolved organic carbon, DOC, total dissolved nitrogen, TDN, and Total dissolved phosphorus TDP) and particulate Carbon, Phosphorus, and Nitrogen concentrations. We analyzed bacterial and eukaryotic composition by sequencing 16S and 18S DNA fragments. DOC and TDN concentrations were higher in pink snow, while phosphorous concentrations did not vary among snow colors and sites. While pink snow showed the highest algal abundance, the highest bacterial-abundance was found in Cordón de los Inocentes white snow, followed by Catedral pink snow. We recorded 266 bacterial and 1371 eukaryotic ASVs. Eukaryotic community was different in all the sampling sites and snow-colors, dominated by green algae (Chlorophyta), followed by Ascomycota, Basidiomycota and Chytridiomycota, varying the species composition and abundance among snow color and sampling sites. On the contrary, bacterial community was similar in all sites, and was dominated by Bacteroidota, Proteobacteria and Actinobacteria. Our results suggest that, when melting, the different snowpacks will affect the downstream communities by releasing nutrients differentially and as a source of diverse microorganisms.

EP137

Decadal ecological recovery associated with removing overgrown macrophytes

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Excessive aquatic plant populations often become a problem in shallow, eutrophic lakes. Artificial control is necessary when they interfere with societal uses of lakes and/or declining biodiversity. Submerged macrophytes in the South Basin of Lake Biwa, Japan, have been increasing since 1994. They covered the bottom of the entire basin in 2009. The submerged macrophytic biomass was estimated to be 9,000 to 12,000 dry-tonnes in 2007-2011. Overgrowing macrophytes caused ecological problems, such as water stagnation due to the density of the macrophytes, and induced cyanobacterial blooms, oxygen deficiency at the bottom concurrent with biodiversity loss and increased alien fish shelter. The local government has removed macrophytes at a rate of 300-450 dry-tonnes per year since 2011. Thereafter, annual fluctuations of macrophytic biomass were large, oxygen deficient areas became smaller, the number of native fish species increased, and the density of benthic worms changed according to the amount of macrophytes. Bivalves showed little change. Our field observations indicated that biodiversity loss recovery would take a long time and may be particularly difficult for organisms without means of movement to increase their biomass.

EP007

The precipitation retention time in Lake Biwa and its catchment area using the response function

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Various delay times ($0 < \tau < 45$ days) were identified to be associated with precipitation retention time in Lake Biwa and its catchment area using the response function. These were then separated by spectrum analysis for water level changes, especially inherent oscillation and the process of water flow into Lake Biwa. The direct response on the lake with $\tau < 45$ days was the strongest one observed, followed by small river inflows of < 2 km (2–3 h). Of the several small rivers or streams, a stronger response was observed in the northern river inflow (6–8 h) with a similar catchment scale. A first mode seiche exists between these rivers due to river inflow response (4 h). Interflow (quick return flow and slow return flow) was identified as the delay time of return flow on a scale of 0–45 days. The last delay times (Average $\tau \approx 45$ d) identified were as follows: average subsurface flow (classified as response lags corresponding to the hydrological concentration due to relatively slow subsurface flows), delays due to melting of snow reserves, and delays caused by agricultural water reserves. This response was approximately 45 d, and the water temperature and dissolved oxygen observed data in Lake Biwa were discussed for the validation of this estimation. Moreover, shallow groundwater, changes in seasonal scales, geographic time scales, and those due to climate change should also be discussed on a longer timescale.

EP148

Invasive alien species in freshwater systems of Georgia

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The Caucasus is a hotspot of biological diversity and is distinguished by the relic / endemic and vulnerable species and habitat diversity as well. Within the36 „hot spots“, as being the richest and at the same time most threatened reservoirs of plant and animal life on Earth, defined by the Conservation International, territory of Georgiaincluded in two - The Caucasus and Iran-Anatolian hotspots. Invasive species have a special risk in such regions, as they can have a large-scale negative impact on local biodiversity.
There are many invasive species in Georgia. In some cases, alien species have had a negative impact on local species and played an important role in habitat modification. For example, based on conducted studies on the lakes of Javakheti region, it was revealed,that main reason for reducing fish is invasive Prussian carp (*Cassius gibelio*). In general, Prussian carp is a major threat to the local species, since it easily occupies a dominant position in the new water ecosystem and can modify the nutrient cycle. Prussian carp is a strong competitor for food resources and spawning areas. In addition,*Carassius gibelio* actively utilizes males of other species of Cyrpinidfamily for reproduction, which in a result reduces reproduction success of other species. Thus the appearance of the Prussian carp in the water reservoir is one of the main reason for the reduction of local population of fish. In addition, gibel carp promotes the growth of water turbulence, which is an important prerequisite for lake eutrophication.

EP079

Seasonal variation in transport of bioavailable organic carbon

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The transport of terrestrial carbon through riverine systems to lakes and coastal water have a negative impact on the oxygen concentration. However, information on seasonal variation and the impact of catchment composition on the bioavailability of carbon is lacking.In this project we address this knowledge gap by investigating the reactivity of DOC in nine river mouths with different catchment areas during a yearlong study. Using a high-capacity oxygen sensing system to measure respiration we were able to achieve a spatial and temporal resolution necessary to understand how multiple factors such as DOC quantity, quality and environmental variables interact and control bioavailability. We found that DOC bioavailability was explained by concentration of nitrogen, phosphorus, TOC, and the composition of carbon and that the significant contributing factors changed over the year. Oxygen consumption was highest during April and June for most of the rivers but varied considerably during October. Overall, there was not a significant difference between oxygen consumption rates between rivers with forest or agricultural dominated catchment areas. This might be explained by rivers with catchment area dominated by forest having higher DOC concentrations and more refractory pools of carbon, while rivers with catchment area dominated by agricultural land have a greater percentage of bioavailable carbon. It is therefore important to focus management efforts on rivers from both environments and especially in the late spring and early summer months.

EP020

Disentangling the relative importance of water quality and spatial factors on aquatic fungal assemblages across 50 reservoirs

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Aquatic fungi play an important role in the material cycling through parasitizing phytoplankton and decomposing organic matter. It is still not clear how aquatic fungal communities are structured. Together with the environmental factors (e.g., water quality, phytoplankton composition), spatial processes related to fungal dispersal, such as the distance between lakes, are expected to affect the fungal community. To clarify the relative importance of spatial and environmental factors, we investigated the fungal community composition across 50 reservoirs in Japan with DNA metabarcoding. In addition, we identified the parasitic fungi, mainly chytrids, infecting phytoplankton by microscopic observations and single-spore-based DNA barcoding. Metabarcoding revealed that chytrids were the most dominant group among fungi. By combining microscopic observation and DNA metabarcoding, we confirmed that the parasitic chytrids infecting diatoms were present in almost all reservoirs. Dikarya were also abundant in certain reservoirs, some of which were closely related to the endophytes of terrestrial plants. Variation partitioning indicated that the community composition of overall fungi, including presumed terrestrial groups, was jointly affected by spatial and environmental factors, but the percentages explained were low (both 1 %). Whereas community composition of parasitic chytrids was mainly

explained by environmental factors (6 %), especially host phytoplankton composition (3 %). Our results suggest that while both spatial and environmental factors can be important in determining aquatic fungal community composition, assembly rules for fungal community may become clearer when we focused on purely aquatic group, i.e., parasitic chytrids infecting phytoplankton.

EP087

Organic carbon transfer across the river-sea interfaces in three estuary systems in South Korea

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As a pathway of terrigenous carbon to the adjacent seas, the river-sea interface is a key place for better understanding regional and global carbon cycles. Dam constructions in the estuary exert strong impacts on riverine carbon transfer and its characteristics. In this study, we collected surface water samples across the river-sea interfaces along a salinity gradient in order to investigate spatiotemporal variations in particulate organic carbon (POC) content and isotope in three Korean river systems (Han, Nakdong and Yeongsan). The Han River which has an underwater weir at the river mouth flowing across the mega city while the Nakdong and Yeongsan River have an estuary dam. The POC concentration increased in the Han River Estuary while decreased in the Nakdong and Yeongsan estuaries. Interestingly, C/N ratio showed different trend in three estuary systems while $\delta^{13}C_{POC}$ values increased to the sea in all of the estuaries. This suggests that river in-situ derived POC dominated in upper estuary in the Han and Nakdong Rivers while terrestrial plant derived POC was mainly contribute to total POC pool in the Yeongsan River. In lower estuary site, marine in-situ derived POC was major source of the Nakdng and Yeongsan river estuaries, but terrestrial-derived POC was mainly contribute to the total POC pool in Han River due to the high resuspension. In summary, our results show that the three estuary systems are differently functioning due to surrounding land use and hydrological characteristics, influencing OC concentrations and characteristics transferred from land to sea.

EP104

Evolutionary Adaptation of Arctic Daphnia to Environmental Change

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Temperature rise, a key process of climate change, can pose a major challenge for organisms and their ecosystems. Whether species can adapt fast to higher temperatures is an important question for their survival. In the Arctic, temperature has been rising at one of the highest rates globally. Remote lakes in such ecosystems can serve as model systems for possible adaptations to higher temperatures and to the additional effects this process might cause. This doctoral research plans to use *Daphnia pulex* dormant eggs collected from lake sediment in Kangerlussuaq, Southwest Greenland. Applying resurrection ecology, we will revive clones that represent a single population throughout the past 100 - 200 years, spanning a period prior to the onset of anthropogenic climate change until today. The resurrected clones will be used in experimental assays to study their physiology and gene expression patterns under different temperature and dissolved oxygen scenarios. Physiological and transcriptomic data will be compared across clones from different time periods. A final synthesis of both data sets will shed light on possible evolutionary adaptations across two centuries.

EP157

The diversity of microsporidian parasites infecting divergent coexisting lineages of the *Gammarus fossarum* species complex in the Western Carpathians

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An important parasite group frequently detected in freshwater amphipods, an ecologically important group of macrozoobenthos, are microsporidians – unicellular endoparasites with different transmission strategies and diverse effects on host ecology and evolution. Several microsporidian taxa are known to affect mortality, changes in reproduction, behaviour, and sex ratio in many gammarid species, including the *Gammarus fossarum* species complex. Detailed analyses of *G. fossarum* populations across its European range revealed a high diversity of divergent lineages that apparently represent distinct biological species. The coexistence of such lineages seems common in at least some regions. However, little is known about their ecological differences and interactions. Our study investigates microsporidian lineage diversity and infection patterns with respect to host lineage identity within the *G. fossarum* complex in the Western Carpathians. We screened over 1000 individuals of genetically characterized gammarid individuals for infection by PCR using microsporidian-specific primers targeting the small subunit rRNA. We documented not only the widespread presence of common microsporidian taxa known to infect *Gammarus* (genera *Nosema*, *Cucumispora* and *Dictyocoela*) but also several rare unidentified lineages, some of which were never previously characterized molecularly. Common clades do not appear to be selective for particular host lineages but more detailed data from syntopic sites are needed to test for potential differences in their prevalence between distinct hosts. Our results increase knowledge about microsporidian diversity, infection patterns, and their potential role in ecological interactions and coexistence of amphipod hosts.

EP045

Sediment replenishment mitigates riverbed environments and benthic macroinvertebrates communities downstream of a dam

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Riverbeds downstream of dams are starved of sediment, impacting habitat structure and ecological function. Despite the implementation of sediment management techniques, there has been no evaluation of their conservational effectiveness; the impacts on high trophic level organisms remain unknown. This study examined the effects of sediment replenishment on riverbeds and macroinvertebrates in a dammed river before and after sediment replenishment. We evaluated the particle sizes of replenished sediments and the case material of a case-bearing caddisfly. We observed significant changes in macroinvertebrate assemblages before and after sediment replenishment, and between the upstream and tributary references and downstream of the dam.
The percentages of Ephemeroptera, Plecoptera, and Trichoptera, and the number of inorganic case- bearing caddisflies downstream of the dam following sediment replenishment, were significantly higher than the upstream and tributary reference sites. The particle size of case materials used by case-bearing caddisfly corresponded to the size of the replenished sediment. Dissimilarity results after replenishment showed that assemblages downstream of the dam differed from upstream sites, although they were similar to the tributary sites. The dissimilarity between the tributary and downstream of the dam was the same as that between the upstream and tributary. Sediment replenishment was observed to reduce the harmful effects of the dam, and partly restore benefits such as increasing species diversity and altering community assemblages, similar to the effects of tributary inflows.

EP057

Sediment microbial ecology and methane dynamics during resuspension events in a hypersaline coastal lagoon

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Wetlands play a dual role in the global greenhouse gas (GHG) cycle, acting as important carbon sinks, while also influencing GHG production, particularly methane (CH_4). Methanogenesis is not typically associated with hypersaline wetlands due to competition from sulfate-reducing microbes, capable of more energy efficient metabolism while competing for similar substrates within the same niche. However, salinity stress adaptations employed by resident methanogenic Archaea may introduce an interesting evolutionary edge in this cycle. Methane production may be further enhanced by wind-induced sediment resuspension. In anoxic sediment, CH_4 production is typically controlled by methanotrophy in the oxic water column. However, sediment resuspension may create anoxic micro-niches near the water-atmosphere interface, potentially enhancing atmospheric CH_4 flux. Our study site, The Coorong, is a shallow coastal lagoon in south-eastern Australia, which experiences a warm-temperate to arid climate. It functions as a reverse estuary and is subject to hypersalinity, particularly during drought conditions, reaching up to 5 times marine salinity. Resuspension events are a regular feature of the system, driven by high wind energy. A 4-7-fold increase in CH_4 concentration was recently measured during a 2021 resuspension event, which may represent a novel pathway of CH_4release to the atmosphere, bypassing coupled methanotrophy in the oxic water column. The dynamics between GHG emissions and microbial regulation persists as a knowledge gap in global climate modelling. To address this, we take a multi-disciplinary approach, integrating microbial ecology, biogeochemistry and hydrodynamic modelling to elucidate methane flux pathways in hypersaline environments, improving robustness of global GHG budgets.

EP008

Go with the flow – impact of connectivity on nutrient regimes and phytoplankton dynamics in river-connected lakes

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The increasing frequency and extent of extreme weather events challenge freshwater ecosystems. Especially, in river-connected lakes such events can impact not only the directly affected lake, but also lakes downstream. Studying these impacts in dynamic and complex freshwater systems is challenging due to the multitude of factors influencing lake response related to characteristics such as morphometry, catchment, trophic state and connectivity. Furthermore, the currently available knowledge is limited by spatial and temporal resolution of the data. In this study, we aimed at analyzing at high spatial and temporal resolution how nutrient regimes and phytoplankton development propagate through a river-connected lake system. Over two consecutive years, we performed monthly field campaigns in 19 lakes with different trophic state, mixing regime and degree of connectivity; contrasting strongly connected lakes along the Upper Havel-river system with weakly and dis-connected lakes in NE Germany. Physical, chemical and biological parameters were measured by *in-situ* probes, while nutrient and phytoplankton pigment concentrations were measured in the lab. Self-organizing maps revealed a high similarity between directly connected lakes and showed seasonal as well as trophic gradients in the connected lake-river system. Each individual parameter was analyzed by empirical orthogonal functions showing a clear signal propagation of Chlorophyll-a along the river-connected lake chains. Our results highlight the role of connectivity for nutrient and phytoplankton dynamics in river-connected lakes. Especially in monitoring and evaluating the ecological consequences of extreme weather events such as floods and droughts, this is crucial for future projections and sustainable water management.

EP086

Environmental fate and trophic transfer of synthetic musk compounds and siloxanes in Geum River, Korea: Compound-specific nitrogen isotope analysis of amino acids

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Despite the extensive usage of synthetic musk compounds (SMCs) and siloxanes in various personal care products (PCPs), trophic magnification of such chemicals in aquatic environments remains unexplored. In June and September 2020, eleven SMCs and nineteen siloxanes were measured in water, sediments, and biota. High concentrations of SMCs and siloxanes entered through WWTP were measured in water, sediment, and biota at the both sites and both seasons. The $\delta^{15}N$ of amino acids provided a high-resolution food web and accurate trophic position (TP), which is an important factor for determining the trophic magnification factor (TMF). In particular, the $\delta^{15}N$ of amino acids was useful tool than $\delta^{15}N$ of bulk tissue for TP calculation in river ecosystem. The TMFs of PCPs closed to 1 or slightly higher (TMF range: 1.0–2.3) indicating no or a little trophic magnification, and were constant across sites and seasons. Because the TMFs seem to have little relationship with log K_{ow} of PCPs, the TMFs might be affected by species specificity and food web structure rather than by chemical properties, which describes a wide range of TMF values in various environments. This study presents valuable implications for assessing risk and managing environmental fate and trophic transfer of SMCs and siloxanes in freshwater environments.

EP126

Transcriptomic responses of the blooming cyanobacteria *Microcystis aeruginosa* against PAC: Implications for ecological adaptation

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Cyanobacteria can grow rapidly and densely in aquatic environments during the summer, which reduces the utilization of water resources in lakes and reservoirs. To control cyanobacterial organic matter, polyaluminum chloride (PAC) is widely used for aggregating algal cells. Despite the increased research of cyanobacterial blooms, little is known about gene expression changes in response to the PAC treatment at the molecular level. In this study, we surveyed transcriptional changes of cyanobacteria *Microcystis aeruginosa* against the PAC treatment. To investigate the intracellular response to the PAC, transcriptome analysis was conducted for 3h, 6h, and 24h at 40 ppm, and for 3h at 400 ppm. Differentially expressed genes based on the p-value of less than 0.05 were 173, 137, 209, and 302, respectively. The PAC treatment affected algal growth, resulting in cell numbers by half compared to the control at 23 days. This study may provide new insights into the ecological adaptation against chemical stimuli and improve the fundamental knowledge of intracellular responses for understanding defense mechanisms.

EP142

Cyanobacterial dominance in the regulated Moselle River in 2017-2020 correlates with low flow conditions and high temperatures

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In late summer of the years 2017-2020, long stretches (>250 km) of the Moselle River in Western Europe were covered with a cyanobacteria bloom. To understand the causes and consequences of these blooms, we measured cyanotoxins and compared physico-chemical and biological variables of the cyanobacteria-period 2017-2020 with the previous 20 years.
Long-term data showed a reduction of nitrogen (N) and phosphorus (P) since 1997, albeit nutrient concentrations remained high

(TN 3.3, TP 0.15 mg/L in 2020). Average discharge in the Moselle was reduced to 52-70%, while water temperature increased by 0.6-1.9 °C during the summers of 2017-2020 compared to the reference period. Water clarity and solar radiation were higher especially in July. The phytoplankton community shifted from a diatom-dominated community with high biomasses in spring in the reference period to a cyanobacteria (*Microcystis*)-dominated community in the late summers of 2017-2020. Dissolved nutrients were reduced by the cyanobacteria blooms to comparatively low levels. Cyanobacteria-dominated community composition in the summers of 2017-2020 correlated best with high water temperature and conductivity as well as with low discharge, silica and nitrate. Toxin analysis (LC-MS/MS) revealed low concentrations (max. 3 µg/L) of microcystin (MC) variants MC-RR, MC-YR, MC-LW and MC-LR with MC-RR showing the highest concentrations.
We conclude that the recent blooms of cyanobacteria have not been caused by increased nutrient concentrations but by dry and warm weather resulting in low flow conditions in the regulated Moselle. With current climate predictions, the Moselle may serve as a model for the future of regulated temperate rivers.

EP021

The prevalence of chytrid fungus infection of glacier algae on a glacier in Alaska

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The melting rate of glaciers has increased recently due to darkening of the ice surface as well as climate warming. One of the reasons for the ice darkening is blooming of glacier algae, which have dark-colored pigments in their cells. The blooming of glacier algae is likely controlled by environmental conditions of the glacier surface, but also by chytrid fungus infections. Parasitic chytrids are known to have a great impact on ecosystems, causing extinction and/or population dynamics of host species. Thus, it is important for assessment of ecosystems and melting process of glaciers to understand ecology of chytrids parasitizing glacier algae. The purpose of this study is to describe morphology, distribution of chytrids, and the prevalence of chytrid infection of algal cells using snow and ice samples collected on Gulkana Glacier in Alaska. There were mainly five morphological types of chytrids infecting the algal cells of *Ancylonema nordensholdii*, *Ancylonema alaskana, Chloromonas* sp., and *Sanguina* sp. on this glacier. The type of chytrids infecting each alga was distinctive among the algal species, indicating that each chytrid can infect specific algal species. The prevalence of infection also varied among the different types of habitats on the glacier. It was significantly higher in cryoconite holes than on the ice surface. This is probably due to static environment of melt water in cryoconite holes, which allow the chytrid zoospores actively moving and finding the host in the water.

EP024

The effect of drought on bottom fauna succession in streams in primeval forest, North Eastern Poland

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Drought is important natural disturbances in small stream ecosystems, that determine their dynamics and succession patterns. During last years periods of complete or partial drying of streambeds have been recorded in almost all Central European countries. Drought will increase its severity and frequency as a consequence of climate change. Benthic macroinvertebrate assemblages were studied in four streams inflowing Łękuk Wielki lake and from the outflow of this lake (NE Poland) during unusually dry year and year of normal rainfall. Differences between perennial and intermittent years were detected using Bray-Curtis dissimilarity measure. The results ranged between 39 and 70%. Regarding species abundance, overall, no marked differences were found between years at eight of ten studied sections of streams ($p<0,05$). The average abundances of macroinvertebrates of all studied streams were equal in both compared seasons. This suggested that there were no significant changes in the structure of the macroinvertebrate fauna after dry summer phase. Biological diversity indices (Shannon (H'), evenness (J')) were calculated to evaluate rate of observed changes. Three categories of species were identified: 1) high densities in post-drought year and significant lower densities in perennial streams, 2) equal abundances in both years, 3) absent or scarce in intermittent season and high abundance in perennial streams.

EP108

Degradation of charophytes in a mesotrophic lake and attribution to herbicide application in sub-catchments

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In the extremely wet summer 2017 submerged macrophytes (SUM) disappeared in the Northeast of the lake Suhrer along agricultural sub-catchments, and in 2020 in a Northern bay too, after a nearby fallow was recultivated. Thus, agriculture made the difference. With secchi depth > 3m and total Phosphorus < 25 µg/l throughout the years, non-point source pollution by nutrients could be excluded as cause. According to basic knowledge and catchment evaluation it could instead plausibly be assumed that high subsurface hydrological transport of applied herbicides might have caused the drastic losses of SUM in the given situations. Since the special protection goal of lake Suhrer, being a natural reserve with charophytes and other endangered species, was at stake, the challenge was i) to assess the ecotoxicological risk of longterm losses of SUM and ii) to substantiate the assumed causal chain between herbicide application and losses. For i) local responses of SUM could be ranked: The worst case was a permanent loss of all SUM, next came the complete replacement of charophytes by angiosperms, then a development of charophyte meadows in summer only and at best perennial meadows. This ranking reflects a classical response pattern to grades of ecological stress and corresponding concurrent influences could be attributed to local differences. To complete the causal chain, herbicide concentrations at the sediment surface were measured in a pilot study using passive samplers.

EP117

Preliminary study on isotopic niches of freshwater planktonic crustaceans in three lakes functioning under different thermal regimes

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Planktonic crustaceans are a widespread group of organisms, often responsible for conducting important ecosystem processes, such as carbon cycling. Various functional traits of planktonic crustaceans and their ability to adapt to changing environmental circumstances allow them to dwell diverse habitats including freshwater ecosystems. Freshwaters are particularly vulnerable to environmental changes, such as climatic changes. Under projected climate change scenarios, thermal regimes and functioning of freshwater ecosystems will be extensively modified. The present study aimed to determine isotopic niches of planktonic crustaceans from lakes functioning under different thermal regimes. The study was conducted in three shallow, eutrophic waterbodies: Lake Sakadaš (Croatia, Southern Europe), Tyniec 2 oxbow lake (Poland, Central Europe) and Lake Gineitiškės (Lithuania, Northern Europe). Stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) and C:N content ratio were analyzed in samples of four groups of planktonic crustaceans: Calanoid copepods, Cyclopoid copepods, *Daphnia* spp., *Diaphanosoma* spp. We found that the highest trophic position was occupied by Calanoid copepods, and the lowest by *Daphnia* spp. and *Diaphanosoma* spp. Cyclopoid copepods established a transitional trophic level. The results showed that isotopic niches of studied groups of crustaceans were segregated between studied lakes and partially overlapped within each lake. We also found that C:N content ratio (which is a proxy for fatty acids and lipids content) was negatively correlated with $\delta^{15}N$ in each lake. Our results shed light on the complex problem of trophic position of crustacean zooplankton and its role in freshwater ecosystems in different latitudes.

EP105

Potential of waterbird environmental DNA to investigate ecosystem changes in Lake Constance and surroundings

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Because birds play an important role in ecosystem maintenance and are an early indicator of changing ecosystems, they have long been a popular field of research. With aquatic ecosystems currently under severe anthropogenic stress and rapidly changing, new methodological approaches are called for. By investigating the waterbird distribution in and around Lake Constance using aquatic and sedimentary environmental DNA we aim to evaluate a new approach in a well-studied system and extend monitoring time series. Lake Constance is a well-known and well monitored wintering area for many water birds: on average from 2005-2014 43 % of the waterbirds of the northern alpine edge gather at Lake Constance in January (Werner et al., 2018). Simultaneous analysis of waterbirds and other groups, such as neozoa or pathogens, could shed light on the role of birds as vectors in the network of lakes and freshwaters. Currently, we are completing an investigation of aquatic eDNA of waterbirds spanning 12 months. Together with sedimentary eDNA of waterbirds and neozoa from sediment cores from Lake Constance, we plan to link their distribution and elucidate whether birds play a role as potential vectors. With a combination of species-specific and metabarcoding approaches, we aim to obtain high taxonomic resolution and the possibility for quantification. This approach could become especially important in regions, where no bird monitoring is performed or possible.

EP130

What is happening in the world's third ancient lake „Lake Biwa"

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In Lake Biwa, the population of endemic and native species have decreased sharply due to environmental changes caused by riverbank construction and invasive species. In addition, global warming makes it difficult for total water circulation driven by the influx of thawed water to occur, and rare creatures on the bottom of the lake are in danger of extinction. Microplastic problems and poor garbage controls are also a serious issue at Lake Biwa. In addition, the culture of eating fish from Lake Biwa is dissipating, and the fishing industry is also at stake. Being familiar and experiencing nature at Lake Biwa as a child may lead to sustainable environmental protection and development.

EP143

Key environmental factors controlling primary production of phytoplankton in Yeongju Dam, Korea

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The Nakdong River, important as a water resource in Korea, is suffering from cyanobacterial harmful algae blooms (cHABs) every summer. In order to understand the main reasons, we investigated the spatio-temporal variation of primary production (PP) and major environmental factors affecting PP in the Yeongju Dam located upstream of the Nakdong River. Sampling was carried out total 10 times from June to October 2021 twice a month at three stations. PP was measured through an in-situ incubation experiment using a ^{13}C tracer. The PP was the highest in summer and the lowest in October (291 ~ 17,162 mgC m^{-2} d^{-1}), which was about 4-fold high PP than those of Nakdong River estuary (543 ~ 4112 mgC m^{-2} d^{-1}) determined by Lee et al.(1994) before constructing a dam. In most of the sampling period, cyanobacteria accounted for more than 90% of the total phytoplankton community. The principal component analysis (PCA) was performed to examine the correlation between PP and various environmental factors. As a result, water temperature and light intensity were a significant correlation ($p < 0.01$) with PP, suggesting that these two factors should influence cHABs. It is thought that the cell number of cyanobacteria increased as the water temperature and light intensity increased, showing the highest PP in summer. This study provides valuable information for water quality management related to cHABs.

EP158

Evaluating the utility of citizen science in bird monitoring

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Citizen science requires data from the public and has educational value in itself, but sporadically collected data needs to be evaluated for its utility before it has scientific meaning. This study aims to evaluate the utility of citizen science through a comparison analysis with national monitoring in South Korea. Monitoring using citizen science was conducted three times in February, June 2021 and February 2022, and was surveyed at 51, 38 and 60 sites respectively. We used the Winter Waterbird Census performed at 111 branches in February 2021 and 112 branches in February 2022 for national monitoring data. In the case of citizen monitoring, not only bird communities but also river was investigated. As a result of comparing 31 sites that both national monitoring and citizen science were conducted, citizen science recorded more species and populations at 8 points, including Jungnang-cheon, but national monitoring recorded more bird communities at the remaining sites. There were more National monitoring survey sites than citizen science, so there seems to be a difference in the bird communities between both monitoring sets. This study demonstrated that citizen science can be a means of identifying bird communities in conjunction with national monitoring. Citizen science needs to continuous monitoring by expanding sites in the future.

EP082

Effect of Land Use on Stream Water Quality and Biological Conditions in Multi-scale Watersheds

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Understanding the relationship between watershed land use and stream conditions is of critical importance for watershed planning and management. This study aimed to identify the effects of land use on stream water quality and biological conditions at the sub-watershed and micro-watersheds across the Han River watershed in South Korea. We developed random forest models for each water quality and biological indicator using proportions of urban, agricultural, and forest. Our results indicated that water quality and biological indicators were significantly affected by forested areas at both watersheds. The results also indicated that models at the sub-watersheds performed better than those at the micro-watersheds. Accumulated local effects were used for interpreting the effect of each explanatory variable on the response variable, and the plots for water quality and biological indicators with proportions of watershed land use demonstrated similar patterns at both scales, although the relationship between land use and stream conditions were slightly more sensitive in the micro-watersheds than in the sub-watersheds. Urban and agricultural areas showed variability in water quality and biological conditions at a lower rate at the micro-watersheds than on the sub-watersheds, and the opposite result was shown in the forest. The findings of this study suggest that different spatial scales should be considered to develop effective watershed management strategies for maintaining stream ecosystems.

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EP012

Natural Vs. Artificial River Network Fragmentation in Europe

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Longitudinal connectivity of freshwater systems can be disrupted by natural or artificial barriers. In addition to limiting fish migration, barriers can also affect habitat quality by creating changes in flow regime, sediment and nutrient transport, and water temperature. Most of the research on river network fragmentation lacks the distinction between the independent effects of natural pre-existing barriers, such as waterfalls, and the constructed artificial ones, such as dams. Additionally, studies on the impacts of dams have considered the dam as the principal or only barrier impairing longitudinal fish movements. But the upstream water reservoir itself represents a strong ecological barrier because it creates completely different hydrological and limnological conditions. Consequently, besides the limitations imposed by the dam, these impoundments represent a behavioural obstacle to migration of fish. To understand the impacts of riverine longitudinal connectivity loss, regarding potamodromous and diadromous fish species across Europe, the work aims at solving a one question – Are we under or overestimating the effects of artificial river barriers on fish species? For this we compare the effects of natural and artificial barriers, including the reservoir as an ecological barrier, on river network connectivity. Natural fragmentation has to be considered in river network connectivity studies, not to overestimate the impact of barriers; and, the integration of the reservoirs as ecological barriers, demonstrates how we may have underestimated the impact of barriers by considering that these structures only affect the river segments where they are implanted.

EP120

Remote Quantification of the Turbidity of Chinese Lakes (>1 km²)

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Lake turbidity, seen as the 'cloudiness', is affected by strong absorption and backscattering of optically active water constituents contributing reflectance signals jointly modulating by the geomorphologic and hydrological processes. In this study, we provided a methodological framework to quantify the lake turbidity by clustering the reflectance spectra, building turbidity models, and mapping turbidity using the Sentinel Multispectral Imager (MSI) sensor and *in situ* measured turbidity over lakes across China. Then, we developed a back propagation neural network with band combinations responding to the turbidity models considering different clusters, with satisfactory performance as Cluster-1 dataset (N=115, R^2 = 0.83, RMSE= 4.42 NTU),]Cluster-2 dataset (N =245, R^2 = 0.82, RMSE= 3.67 NTU) and Cluster-3 dataset (N =195, R^2 = 0.89, RMSE= 17.54 NTU). Further, the BP-TURB models exhibited stable performance demonstrating good spatiotemporal transferability, and have potential to map turbidity in typical lakes. We also mapped the turbidity dynamics of typical lakes in spring (March to May), summer (June to August) and autumn (September to November) 2020, i.e., Chagan Lake, Hulun Lake, Taihu Lake, Qinghai Lake and Dianchi Lake, with our BP-TURB models. The results showed that the distributions of lake turbidity in five lake zones have remarkable spatial variations, with lakes in the plateau regions generally exhibiting lower turbidity than those situated in the plain regions. Our framework and BP-TURB models used bands available on MSI sensors to develop a novel approach for generating historical turbidity data for large-scale evaluation of aquatic environmental changes.

EP096

An innovative method of lakes restoration - selective water flow control

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The research work concerns the development of an original concept and implementation of an innovative method of lakes restoration consisting in the selective control of water flow. The traditional method of removing the hypolimnion water (the Olszewski's method, implemented on Lake Kortowskie in Poland since 1956) is based on withdrawal the bottom water through a pipeline outside the lake ecosystem in order to deplete it in nutrients. The method presented in this paper is based on the simultaneous operation of two independent pipelines: one for withdrawal a fragment of the hypolimnion in accordance with Olszewski's assumptions, and the other for redirecting the stream supplying the lake to the bottom of another part of the lake to oxygenate the near-bottom waters. Between the lake basins affected by the operation of these pipelines, an underwater curtain has been designed to isolate both hypolimnions. The developed concept was implemented on the eutrophic Lake Święte in Obra, Poland (area 23.3 ha, maximum depth 15.3 m) meeting the criteria for the applicability of this method: flow-through hydrological type, stratified and with morphometry enabling the separation of two fragments from the hypolimnion. In the first year of monitoring the effectiveness of restoration (2021), on the basis of year-round limnology studies, a significant improvement was found in the environmental conditions in the bottom waters of both experimental sub-basins of the lake, including shortening the period of anaerobic conditions and about a 4-fold reduction in hydrogen sulfide concentrations.

EP138

Assessment of cladocerans recolonization from the egg bank in a neotropical temporary pond

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Wind dispersal and recruitment from the sediment egg bank are the key processes to colonization by zooplankton in temporary ponds. Through in situ hatching experiments, we studied the recolonization of cladocerans from the egg bank during the drying phase (DR), and the dry phase (DY) in a temporary pond in Ecuador. In addition, cladocerans assemblages in the water were weekly sampled during the DR phase. Over both phases, each experiment consisted of eight 10L-plastic microcosms placed on the shore of the pond and filled with commercial mineral water. Four microcosms contained sediment layer placed at the bottom and the other four remained without sediments to assess the arrival of cladocerans via dispersal. Experimental treatments were sampled each week for 6 weeks. The richness of cladocerans assemblage reached four species in the water column and the total density was higher before total desiccation of the pond. *Diaphanosoma spinulosum* was the most frequent taxa while *Ceriodaphnia cornuta* was the dominant in terms of abundance. I*lyocryptus*sp. and *Moinodaphnia macleayi* had the lowest abundance of this assemblage. In the DR experiment, only two taxa hatched (*Moina micrura* and *D. spinulosum*) while during the DY season, a third taxon also hatched in microcosms (*Ilyocryptus* sp.). For each taxon, the hatching timing and the reached abundances in the microcosms differed among them and between experiments. Recruitment from the sediments became more important than wind dispersal in the recolonization of this pond and this process was different between the two environmentally contrasting phases.

EP101

An empirical assessment of the threat of suspended microplastics to aquatic food webs in a neotropical freshwater wetland

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La Segua is an important freshwater wetland in Ecuador, highly threatened by human pressures and unsustainable landscape uses. This study is the first report on the suspended microplastic/zooplankton ratio in Ecuador freshwaters and estimated empirically and simply the potential threat of suspended microplastics on the filters and suspension feeders in aquatic food webs. Aiming to analyze the occurrence, concentration, and horizontal distribution of microplastics and zooplankton, water samples were simultaneously collected at the surface in 16 sampling points in the wetland. Ratio suspended microplastics/microplastics were calculated. Microplastics were found in all sampling sites and concentrations were between 313 and 490 particles/liter. Fragments were the most abundant category followed by fibers, films, and later pellets. The highest concentration of microplastics was found in sampled sites on the east coast and in the middle of the wetland. The frequency and concentration of categories of microplastics categories found on the water surface largely reflect the reality of local human activity (aquaculture and artisanal fisheries) around La Segua wetland and add the absence of solid waste management as another local stressor. Only rotifers and copepod nauplii were found in zooplankton. The suspended microplastics/zooplankton ratio indicates that fish and other filter and suspended feeders of aquatic food webs could be more likely to feed on suspended microplastics than natural item foods around the whole wetland. Suspended microplastics represent an evident threat to the stability and efficiency of the food webs in this wetland and may negatively affect fisheries and aquaculture activities and other ecosystem services.

EP102

Holocene ecosystem development as recorded from benthic cladocerans in Laguna de Río Seco (Sierra Nevada, S Spain)

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Sierra Nevada is one of the most important mountain ranges in southwestern Europe and a region of extraordinary sensitivity to climate change. Here, we analysed cladoceran sub-fossils from the alpine lake Laguna de Río Seco (LdRS) to investigate the biological response to environmental variables and to infer the role of natural variability on species composition. Benthic cladocerans exhibit a habitat and resource response during the Holocene, which is coupled with different stages in ecosystem development. From ca. 10500 to 5500 cal yr BP, when a pristine lake with abundant vegetation existed, pioneer cladocerans such as *C. sphaericus* dominate the assemblages. High abundances of *Alona rustica* and the appearance of the tuberculate forms of *Coronatella elegans* might be an ecological adaptation to the substrate (minerogenic/organic). From ca. 5500 cal yr BP a decrease in lake levels and lower development of aquatic vegetation might benefit *Coronatella elegans,*which uses more detritus than periphyton as a food resource. Although the species composition did not show a direct response to the changes in temperature documented in this region, the body size of *Chydorus* might be related to climate. Further investigations on cladocerans in other ecosystems of Sierra Nevada are needed to discriminate local vs. regional controls on this benthic fauna.

EP103

The challenge of finding a metabarcoding region for cladocerans in sedimentary DNA

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Cladocerans are the only zooplankton group that is most readily preserved and identified in sedimentary records. This fact has allowed the reconstruction of past environmental conditions (e.g. temperature, trophic state, species introduction) using changes in species composition.However, the information provided by morphological remains sometimes is biased by the relatively low preservation of some planktonic species and by the impossibility of truly differentiating similar and close taxa (e.g. carapace of *Alona*-group). In this context, recent advances in DNA metabarcoding and high throughput sequencing (HTS) have facilitated the efficient use of environmental DNA (eDNA) and sedimentary ancient DNA (sedaDNA) to detect hidden taxa in classical morphological analysis. However, there is a lack of standard methodological approaches for using total DNA extracted directly from sediments in cladocerans and for paired comparison of morphological and genetic results. Here, we present the steps that we are following to obtain methodological advances in this field: 1) Building a reference collection of DNA sequences, which includes sampling, specimen identification, DNA isolation, amplification and sequencing of local and/or species not present in the public genetic database; 2) Bioinformatic analysis and primer design, using these sequences together with ones available in public reference databases, to specifically retrieve and identify cladocerans in sedimentary DNA; 3) Primer testing in silico and in vitro; 4) Paired- comparison with morphological results. This emerging analysis would be an invaluable recorder of past and present aquatic biodiversity.

EP050

The former lakes of Valley of Mexico, a retrospective study from Alexander von Humboldt to the present

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The endorheic basin of the Valley of Mexico was formed by five large lakes: Texcoco, Xochimilco, Chalco, Zumpango, and Xaltocan. The inhabitants of Mexico-Tenochtitlan built artificial islands (Chinampas) to gain land for agriculture or to build settlements (Tenochtitlan). Thus, the drying up of the lake system began in pre-Hispanic times. In the 17th century, the so-called New Spain was subject to countless floods. Drainage was built to transfer water out of the basin, leading to the almost total disappearance of the five lakes. A unique feature of this lake system was the different character of its waters previous to current impacts. Xochimilco and Chalco had freshwater, while the other lakes were brackish. In 1803 Alexander von Humboldt studied the water of the five lakes using simple analytical methods. Nowadays, only four lakes remain (urban wetlands); some receive treated wastewater facing algae blooms. Despite Xochimilco (a world heritage site from UNESCO) and Texcoco lakes (Protected Area) being under protection, the lakes have undergone urbanization impacts causing different chemical and biological conditions, mainly salinity changes. However, these lakes are habitats for resident and migratory waterfowl species and endemic aquatic species. This presentation aims to show a comparative vision between the analytical methods used by von Humboldt and how these can be evaluated using modern chemical-analytical methods. Our results include the current water quality compared with the historical results. Also, current water samples were examined with Humboldt's procedures at that time. It is necessary to include more sustainable programs to preserve these lakes.

EP124

An integrated monitoring and modelling system for the shallow subtropical Ypacaraí Lake (Paraguay)

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Ypacaraí Lake is the most renowned lake in landlocked Paraguay and a major source of drinking and irrigation water for neighbouring towns. Over the last few decades, the rapid growth of human presence and activities within its basin has led to its environmental degradation. Eutrophication, in particular, has resulted in severe cyanobacterial blooms that compromise the ecosystem‘s health and the services it provides. Because of its socio-economic and cultural significance, its ecological state is a heartfelt matter for Paraguayans. Consequently, it receives great attention from national media, compelling authorities to take action through the funding of research and development projects. Here, we present the interdisciplinary project MOLYP, which is part of a collaborative research line established by the University of Trento (UniTrento, Italy) and the “Nuestra Señora de la Asunción” Catholic University (UCNSA, Paraguay). Co-funded by the National Council of Science and Technology of Paraguay (CONACYT) and the UCNSA, the project aims to develop an integrated monitoring and modelling system for this subtropical lake. The MOLYP system includes continuous measurements (automatic weather station and water quality sensors mounted on a buoy); systematic use of satellite imagery; citizen reports submitted via a freely available mobile app; local knowledge collected through interviews with locals (e.g., fishermen, people who practice aquatic sports in the lake, inhabitants of surrounding towns, etc.); numerical weather prediction; hydro-thermodynamic and ecological modelling. The system will aid future studies through the integration of several information sources that help understand and simulate the physical and ecological dynamics within the lake.

EP062

Macroinvertebrate community at a restored river site shows resistance to increased salinity

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Degraded stream ecosystems generally harbor biological communities which are resistant to anthropogenic stressors. Ecological restoration releases the stressors and aims to facilitate reassembly of natural communities and reestablishment of respective ecosystem functions. However, species recruitment during early stages of recovery is biased towards regional species pools which often have been exposed themselves to stressors and thus may show local adaptations. Scientific evidence of stressor legacy on community reassembly is sparse. Therefore, we used ExStream, a stream mesocosm experiment, to study individual and combined effects of two common anthropogenic stressors, reduced flow velocity (10 cm/s vs. 20 cm/s) and increased salinity (8 levels, up to 700 mg/l added chloride), on a recovering stream macroinvertebrate community and leaf litter decomposition by shredding taxa. The study was performed at a recently restored site of the Boye within the Emscher catchment (North-Rhine Westphalia, Germany). All macroinvertebrates were collected after two weeks of stressor exposure and analyzed using DNA metabarcoding, and standardized leaf litter bags were weighed to analyze decomposition. Whereas reduced flow velocities negatively affected species richness of pollution-sensitive taxa (Ephemeroptera, Plecoptera, Trichoptera) and leaf litter decomposition, even high levels of salinity had a surprisingly weak influence on community composition. This unexpectedly high resistance to salinity is likely a legacy effect of the intense anthropogenic disturbance in the past. Thus, our data support that the trajectory a community takes and the resulting endpoint of community composition are not only affected by present stressors, but strongly depend on eco-evolutionary adaptations resulting from previous stressor exposures.

EP071

A new process-based model for regional-scale assessment of lake CH_4 emissions: resolving the spatio-temporal variability in diffusive and ebullitive fluxes from European lakes

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Natural emissions of CH_4 from lakes are poorly constrained as shown in the last budget by the GCP (Saunois et al., 2020). This results from our limited ability to resolve the complex interplay of the many processes and drivers controlling CH_4 cycling in lakes and their spatio-temporal variability. A major challenge is to find the optimal model complexity that allows to extend our limited knowledge of lake CH_4 emissions obtained from punctual and local measurements to regional scales and through time. Here, we present an approach that relies on lake physics model and a biogeochemical process-based module of the coupled autochthonous C-O_2-CH_4 dynamics driven by atmospheric forcings and nutrient loads. The temporal dynamics in the autochthonous C cycle, O_2 profiles and diffusive/ebullitive CH_4 fluxes, from sediments into the water column and from the water column into the atmosphere, are generally well captured for lakes of distinct trophic status and is scaled-up regionally using a lake clustering approach according to the lake area. Overall, we find that our model estimates match well the late-summer observations in boreal and central European lakes (Rinta et al., 2017), and can be used to resolve the strong seasonal variability in CH_4 fluxes.

EP133

New initiative in Shiga prefecture

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There is a lake called “Lake Biwa” in Shiga prefecture which is the biggest lake in Japan. The Shiga prefectural government has started a new initiative from 2021, called the Mother Lake Goals (MLGs). The MLGs is based on the Sustainable Development Goals (SDGs) , which means the MLGs is the Shiga-version of the SDGs. The MLGs sets thirteen goals for establishing sustainable society by 2030.For example, goal one aims to “purify the waters”, and events are being heldto protect rivers. Anyone, regardless of their age can join this event, which also relates to Goalthirteen, "cooperate with each other to achieve goals". It is very important to set clear goals to solve environmental problems including water issues. We also need to spread this concept, not only to researchers and experts, but also to the locals to gain their interested in various environmental problems. I would like to share this idea with the world.

EP054

Bioturbation effects on sediment CO_2 and CH_4 emissions from inland waters

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Activities performed by bioturbating organisms strongly impact sediments from inland waters, thereby influencing the production and emission of methane (CH_4) and carbon dioxide (CO_2). When the CH_4 concentration in the sediment porewater exceeds the solubility concentration, bubbles are formed that can rise to the atmosphere (ebullition). Those rising CH_4 bubbles most likely will escape microbial CH_4 oxidation, therefore becoming the main emission pathway. Since bioturbators in these ecosystems are under climatic and anthropogenic stress leading to shifts in the benthic community, it is highly important to unravel how they control CO_2 emission and CH_4 ebullition through biological and physical. Therefore, I aim to assess the effect of key bioturbator species, with varying bioturbation traits, on CO_2 and CH_4 emission pathways and microbial processes rates. To this end, I will use a state-of-the-art mesocosm set-up and microbial incubation techniques. In addition, I will assess possible relations between

bioturbator communities and greenhouse gas emissions in the field. The novelty in this approach includes the use of a scanner that allows to visually monitor gas bubbles in situ which will link bioturbator trait-mediated biological and physical changes in the sediment for the first time. Moreover, I will use different types of sediments to obtain insights on bioturbator trait effects on CH_4 and CO_2 process rates under different physico-chemical properties and under ambient and warmed conditions. In my poster presentation I will present my PhD-plans and I hope to receive your feedback.

EP023

Impact of a widely used herbicide on the chytrid infection of toxigenic cyanobacteria

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Chytrids are zoosporic fungi ubiquitous in aquatic environments, including freshwater bodies, that are lethal parasites of phytoplankton, such as toxigenic cyanobacteria. Chytrids influence host abundances and thus delay or suppress cyanobacterial bloom formation, promote genetic diversity in their host populations, and establish alternative trophic pathways between primary producers and consumers. Yet, little is known about the impact of anthropogenic pollutants on chytrid infection and their ecological consequences. Herbicides are used in agriculture worldwide and can reach water systems by runoff from agricultural fields. We tested the effect of environmental concentrations of metolachlor (MET), a widely used herbicide, on the interaction between the toxigenic cyanobacterium *Planktothrix agardhii* and its chytrid parasite *Rhizophydium megarrhizum*. Parasite performance and cyanobacteria fitness were addressed to disentangle the effects of MET on the host and parasite. Our results will shed how widely present anthropogenic pollutants could promote or inhibit natural infection processes and thus modulate the ecological consequences associated with disease processes in aquatic ecosystems.

EP152

Responses of microphytobenthic communities to multiple stressors increase and release in a large-scale ExStream mesocosm experimental setting

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The impending climate change alongside chemical pollution and physical habitat disturbances is affecting inland rivers through a combination of multiple stressors. Since natural rivers are not available for full-scale experimental trials, the use of mesocosms can be seen as a previous step to understanding how such stressors (e.g. flow velocity, salinity, ...) affect stream ecosystems. It also makes it possible to investigate as yet understudied organism groups, such as the microphytobenthic communities, and their physiological and compositional responses. To do this, 128- channel flow mesocosm experiments with different salinity, flow velocity, and temperature treatments were set up in the Boye catchment, an urban river with anthropogenic influence located in the densely populated Ruhr area. We studied the diatom benthic communities of these mesocosm channels for their structure using digital microscopy and DNA metabarcoding, alongside photosynthesis-related traits. In the first experiment, no significant effects of either salinity or flow velocity treatments ($p > 0.05$) were observed upon total microphytobenthos chlorophyll biomass or upon community composition (as determined by amplicon sequencing analysis). Analyses of the second experiment, as well as diatom examination on virtual slides (digital microscopy) from both, is still underway. The results so far confirm the fact that microphytobenthic communities from the Boye are highly tolerant to changes in environmental conditions, in particular large salinity fluctuations.

EP044

Decomposing distributions into life stage-specific modules in freshwater Species Distribution Models

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The predictive performance of species distribution models (SDMs) can be enhanced by efficiently selecting the algorithms, variables and number of records to fit the models. Within this process, the specific life history and eco-physiological requirements of the modelled species are of high importance, strongly determining the ecological niche they occupy. For species with a complex life cycle, including, for example, various aquatic and terrestrial habitats, the realized niche in which the species thrive might change among developmental stages. Hence, the distribution of freshwater species with complex life cycles is rather dynamic and single life-stages depend on each other. This applies to both hololimnic (fully aquatic life cycle) and merolimnic species (with both aquatic and terrestrial stages). We explored the dependency of the distribution of single life stages of stream macroinvertebrates (hololimnic and merolimnic) to variables that are considered important during complementary stages of the species' life cycle. First, we constructed SDMs without considering the variable niche occupation of the species, then we compared their predictive performance to SDMs that were tailored considering the species' life cycle. Our results highlight that the distribution of species with variable niche occupation might be affected by individual variables that could seem "unrelated" to other life stages. This consideration becomes especially relevant for projecting the occurrence of species under stressor scenarios, where impacts could be over or underestimated when taking into account the complete life history of a species.

EP163

Plankton diversity in tropical-highland wetlands under different hydrological influences (Lake Tana, Ethiopia)

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The present study investigates patterns of local and regional plankton richness and taxonomic and functional community composition in wetlands under different hydrological conditions (riverine papyrus swamps, river mouth wetlands, and lacustrine wetlands) located in the Lake Tana sub-basin, Ethiopia. Data on phytoplankton, zooplankton and environmental variables were collected from 72 sampling plots during the dry and wet seasons of 2018. Multiple regression models, generalized linear model, and redundancy analysis were used to identify the main drivers of variation in plankton local taxon richness and community composition in these wetlands. The contribution of single-wetland (LCBD: comparative indicators of the ecological uniqueness of the wetland) and single taxon (SCBD) to overall plankton community composition variation (BD_{Total}) was calculated. A total of 85 phytoplankton taxa, distributed among 18 Reynolds functional groups and 57 zooplankton taxa, were identified as a regional taxa richness. River mouth wetlands were highly turbid, with a low local plankton richness, and phytoplankton functional groups typical of turbid environments compared to riverine papyrus swamps and lacustrine wetlands. Plankton community composition differed significantly between the three wetland types. Turbidity and total phosphorus were associated with phytoplankton local taxa richness and community composition, whereas specific conductance, water temperature, turbidity, and total phosphorus were associated with zooplankton local taxa richness and community composition. We recommend protecting the wetlands with high LCBD values and consider various wetland types for preserving the diverse plankton communities of Lake Tana wetlands.

EP179

Next-generation sequencing for studying spatio-temporal composition of phytoplankton communities in thermally stratified mesocosms

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Increasing evidence reports adverse effects of climate change on freshwater ecosystems and harmful algal blooms in particular, but response mechanisms of such heterogeneous communities are poorly understood. Environmental DNA (eDNA) analysis is a suitable and efficient tool for resolving biodiversity within complex ecosystems. Specifically, full-length 16S rRNA next-generation nanopore sequencing, combined with barcoding, was implemented in this work in parallel with FlowCAM-based imaging flow cytometry to resolve structure of phytoplankton communities in LMWE mesocosm experiment. Portable nanopore sequencing technology provides time-efficient, cost-effective, and reproducible analysis of environmental data, with taxonomic analysis up to genera. Since laboratory cultures have limitations in reflecting complex phytoplankton community interactions, mesocosm facilities were used as experimental setups for studying variability of these communities. Microbial composition dynamics were assessed for eight weeks using 12 outdoor mesocosm tanks, with three temperature regimes, varying nutrient levels, and two sampling depths. In total, 192 water samples were collected, followed by eDNA extraction, amplification, and sequencing. Obtained results revealed successful classification (up to 99.93%) of over 1200 genera in each mesocosm tank. Classified taxa of picoplankton included low-abundance (<0.01%) genera. Temporal analysis of obtained data revealed changes in microbial dominance throughout the *Microcystis* sp. bloom development. Correlation analysis coupled with the PERMANOVA test revealed significant correlation between temperature, pH, oxygen levels and picoplankton community composition. Obtained results provide insights into the effect of stratification on microbial community composition.

EP166

Biodiversity-ecosystem function relationships under resource-replete conditions - an experimental approach

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There is growing interest in using polycultures of microalgae as a source of industrial raw materials, and in combining the biomass production process with the capture of pollutants from flue gases and wastewater. While such enriched sources of nutrients and CO_2 could sustain high rates of primary production, they also create a challenging environment with the possibility of light limitation and acidification. The search for stable production systems, therefore, requires a fundamental understanding of algal trait complementarity with respect to spectral niche partitioning and inorganic carbon uptake under nutrient- and CO_2-replete conditions. To explore this experimentally, we developed a laboratory culture system where the supply of atmospheric CO_2 can be controlled on a finely tunable scale from ambient to highly enriched, as found in flue gases. The experimental set-up includes a continuously adjustable light source of sun-like PAR and provides an equal distribution of CO_2 to 60 culture bottles in which algae are gently suspended, minimizing sedimentation and wall growth. The system is well suited for the experimental study of the interplay between plankton biodiversity and various ecosystem functions. We present the culture system and show preliminary results on the performance of 8 microalgal species in mono- and polyculture in a high CO_2 regime.

EP040

Title: Radiocarbon Stocktaking of Swiss Lakes: Relevance to Carbon Budgets and Dynamics

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Inland waters play a crucial role in the global carbon cycle, with organic carbon (OC) burial in lake sediments constituting a removal of carbon from rapidly cycling Earth surface pools. However, the nature of sequestered OC has different climatic implications. The burial of recently synthesized terrestrial and aquatic biospheric OC represents a drawdown of atmospheric carbon. In contrast, the reburial of petrogenic OC exerts no net effect on atmospheric CO_2 levels, while oxidation of petrogenic carbon releases CO_2. Therefore, it is crucial to distinguish the origin of OC when quantifying lake sediment carbon budgets.

Radiocarbon (^{14}C) is a powerful tool to distinguish between recent, pre-aged, and fossil carbon sources. Moreover, the 20th-Century radiocarbon "bomb spike" offers the possibility of constraining carbon dynamics and deconvolute inputs on decadal time scales through down-core investigation of lacustrine records including quantitatively disentangling different sources of OC, which exhibit contrasting susceptibilities to remineralization.

Switzerland hosts various lake catchments within different biogeographical ecoregions, experiencing contrasting degrees of climate change. We use these natural gradients to assess controls on the abundance, sources, and dynamics of OC accumulating within Swiss lake sediments over the last century. We combine ^{14}C and stable $\delta^{13}C$ isotope signatures of bulk OC from sediment cores from a range of lake systems to constrain the nature and dynamics of OC accumulation. These data form the foundation for more in-depth investigations using ^{14}C measurements on source-specific biomarkers to constrain the temporal dynamics and transport pathways of biospheric carbon and to refine carbon stocktaking assessments.

EP063

Intensive human land-uses impairs ecosystem functioning through reducing taxonomic and functional diversities

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Human land-use is rapidly transforming Earth's surfaces, causing worldwide declines in biodiversity and ecosystem functioning. Although natural systems are rapidly losing biodiversity due to human pressures, we know little about how multiple land-use types jointly affect multifaceted animal and plant diversity. Also, the ecological pathways through which human land-uses affect the biodiversity-ecosystem functioning relationships (BEF) are largely unexplored. We compiled a dataset from 61 streams spanning two Neotropical biomes (rainforest and grasslands) to analyze (i) how multiple land-use types affect taxonomic richness, functional diversity, and diversity of trait categories (recruitment and life-history, resource and habitat-use, and body size) of animal (fish and arthropod) and plant (macrophytes) assemblages; (ii) how human land-use affect the relationship of taxonomic and functional diversities with ecosystem functioning (standing biomass). The effects of human land-use on taxonomic and functional diversities were as strong as other drivers known to impact biodiversity, e.g., natural environmental and climatic factors. There were strong negative associations of intensive agriculture, pasture and urbanization with taxonomic richness, functional diversity, diversity of recruitment and life-history, resource and habitat-use, and body size of both animal and plant assemblages. Human land-use

weakened the association of taxonomic and functional diversity with standing biomass. Human land-use also negatively affected standing biomass through a set of direct and indirect pathways mediated by declines in taxonomic and functional diversities. These results demonstrate that conversion of natural ecosystems to supply human demand results in species loss and traits homogenization across many biotic assemblages, which impair ecosystem functions in hyperdiverse biomes.

EP174

How does environmental temperature impact the ability of *Daphnia* to resist a novel fungal parasite?

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Increasing lake temperatures, associated with global warming, are fundamentally changing the structure of aquatic communities and these factors may increase the susceptibility of *Daphnia* species to certain parasites. We aimed to test how the ability of *Daphnia* to resist a fungal parasite *(Metschnikowia bicuspidata)* had changed in response to 60 years of artificial heating of natural lakes, by dumping a hot water from a nearby power plant (the average water temperature difference between heated lakes and nearby control lakes corresponds to ca. 4 °C). The increased physiological demands of living in a warmer climate may necessitate more resource investment into temperature tolerance and less into immunity. We hypothesised that *Daphnia* isolated from artificially heated lakes would be more susceptible to parasitic infections. Twelve *Daphnia* clonal lineages (isolated from two heated and two control lakes) were exposed to *Metschnikowia* spores or to placebo solution, and exposures took place under 18 °C (control) or 22 °C (elevated) temperatures. By keeping *Daphnia* from heated and control lakes at two different lab temperatures we aimed to test whether observed differences in resistance are due to evolution caused by long-term exposure to elevated temperature or short-term phenotypic plasticity to lab thermal environment. By comparing the intensity of infection in host *Daphnia* from different temperature environments we hope to determine to what extent temperature affects the ability of *Daphnia* to resist parasitism.

EP093

The effects of climate warming on the periphyton community in the River Thames (Oxford, England)

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Periphyton often dominate the primary productivity and microbial life in lotic ecosystems, yet its response to climate warming is poorly understood. Here, we investigate how warming and seasonality affect the establishment of a new periphyton community on the shoreline of the River Thames, Oxford, England. In the summer and fall of 2021, periphyton was allowed to colonize 12 *in-situ* heating settlement panels set at +2˚C, +1˚C or 0˚C(control) above ambient, placed at 10 cm below surface water level on a uniformly shaded ledge. On days 3,6,12 and 24 after settlement, periphyton accrual was analysed with an *in-situ* handheld spectrofluorometer (BenthoTorch, bbe-moldaenke®)and samples were collected for high-throughput microscopy and sequencing analysis. Here we present preliminary results based on the periphyton biomass accrual curves measured with the spectrofluorometer, which measures the fluorescence of the algal pigments of Cyanobacteria, Bacillariophyta, Chlorophyta, and the total algal biomass. We found that total algal biomass was significantly higher in summer, and that Bacillariophyta was the dominant group followed by Cyanophyta in both seasons. This suggests that seasonality is not affecting broad patterns of dominance, but slowing the rate of colonization of all groups. In summer, our warming treatment caused higher biomass of Cyanobacteria by day 24, indicating that periphyton community composition may change in a warmer world. We expect to gain more resolution and confirm our observations after processing the periphyton accrual with high-throughput microscopy and sequencing to determine if current*in-situ* methods are appropriate to replace more benchwork extensive methodologies.

EP066

Altered streams significantly contribute to the regional diversity of aquatic invertebrates in the Atlantic Forest

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Changes in the structural complexity of streams normally have negative effects on invertebrate diversity. Herein, we studied aquatic invertebrate assemblages in streams of the Atlantic Forest (SE Brazil) with and without changes in the riparian vegetation. Over two years, we sampled leaf patches found in riffle and pool reaches (habitats) of 5 preserved and 5 altered streams on four occasions. Our objective was (i) to assess how invertebrate abundance and taxonomic richness differ among habitats and streams, and (ii) to quantify the contribution of altered streams to the regional diversity of aquatic invertebrates. We hypothesized that even limiting the colonization of some taxa, the altered streams have ecological uniqueness in the composition of invertebrate assemblages. In total, we found 9214 individuals, belonging to 165 taxa. Values of abundance did not differ among habitats or streams; however, values of taxonomic richness were higher in the pools of preserved streams. Two altered streams had the greatest ecological singularities in the composition of the assemblages. Diversity partitioning analysis showed that altered streams contributed 15.38% to gamma diversity, while pools in altered streams contributed 16.45% to regional diversity. These results suggest that, in spite of the loss of their structural complexity, altered streams had a unique taxonomic composition, contributing significantly to the diversity of aquatic invertebrates in the studied region. The understanding of diversity patterns can be an important tool for the restoration of altered forest streams.

EP074

Concentration-Discharge Relationships to Identify Catchment Controls on Carbon and Nutrient Exports from a Boreal Landscape

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Phosphorus (P), nitrogen (N) and carbon (C) exports from catchments reflect the interplay of hydrological flowpaths, arrangement of soil storage pools, and biological demand in terrestrial ecosystems. We used concentration-discharge (c-Q) relationships for P, N and C to assess this influence over resource supply in nested boreal streams and assessed how these are affected during different time scales. We analyzed annual and seasonal c-Q relationships over a 12-year period (2008-2012) for 12 streams in the Krycklan Catchment of northern Sweden. At interannual time scales, we observed exports regimes for dissolved organic C (DOC), organic N (DON) and nitrate (NO_3) that ranged from chemostatic to transport limited among sites. By contrast, annual exports of inorganic P and ammonium (NH_4) were mostly supply limited, and this dilution has increased over time. We observed a broader set of responses within seasons, including shifts from supply limited to chemostatic behavior for PO_4 during autumn and winter, for NH_4 during spring and autumn, and for DON in spring. Finally, the magnitude of supply or transport limitation for different solutes was strongly correlated with catchment characteristics. Specifically, for DON and DOC, catchments with less mire coverage and large areas tend to be more supply limited, while for PO_4 and NH_4, these catchments tend to be more transport limited. Collectively, our results highlight distinct landscape and hydrological controls over export of P, N and C as well as seasonal changes that suggests that exports can become uncoupled from catchment processes and thus unresponsive to changes in hydrology.

EP022

Phylogeny and biogeography of the novel parasitic chytrids infecting snow algae in alpine ecosystems

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Chytrids are prominent parasites of phytoplankton in lakes. They also infect algae growing on glaciers and snowpacks in polar and mountain regions, reported from Alaska in 1942 by microscopic observations. Yet, their phylogenetic position has not been identified due to the difficulties of culturing and subsequent DNA sequencing. Recent metabarcoding analyses revealed the unexpected diversity of chytrids in mountain regions, some of which formed novel phylogenetic groups, so-called Snow Clade. However, their ecology and morphology are still unknown. In this study, we conducted single-spore-based DNA barcoding during snow algal blooms in Mt. Gassan of Japan to clarify the phylogenetic position of parasitic chytrids infecting snow algae, *Chloromonas* spp. By linking microscopically picked fungal spore on snow algae to subsequent sequencing, we identified three novel distinct lineages, all of which belonged to the Snow Clade 1, composed of only environmental DNA sequences detected mainly from mountain regions around the world. Furthermore, by comparing the obtained sequences of parasitic chytrids with the metabarcoding analyses of snow/glacier samples from various alpine regions in the world, we found the unique chytrid ASVs detected only from Mt. Gassan, indicating the local endemism of parasitic chytrids. These results suggest the hidden diversity of parasitic chytrids infecting snow algae and their local adaptations to their respective environments and hosts.

EP168

Spread of invasive and alien cyanobacterial species: phenomena of blooms, non-blooms, and biodiversity loss

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The harmful cyanobacterial blooms. i.e. 'cyanoHABs' are increasing worldwide due to especially nutrient enrichment, hydrological alteration, and climate changes. In the temperate zone, the cyanobacteria species are of special concern because of their invasiveness and harmfulness. Some cyanobacteria are well known worldwide as invasive, toxin-producing and bloom-forming, or even 'alien' species, including *Sphaerospermopsis aphanizomenoides*, *Raphidiopsis raciborskii*, and *Cuspidothrix issatschenkoi*. Therefore, a total of 100 Polish freshwater lakes were examined during the summer period to check the phytoplankton biomass intensity with possible bloom events, biodiversity, and cyanobacterial species of special concern. The total phytoplankton biomass ranged from 0.60 to 262.44 mg L^{-1}, while cyanobacteria formed biomass of 0.04-258.35 mg L^{-1}. Among these lakes studied, *C. issatschenkoi* with biomass up to 3.58 mg L^{-1} occurred the most frequently (i.e. in about half of studied lakes) in phytoplankton especially together with *Aphanizomenon gracile*. The presence of *S. aphanizomenoides* was recorded in twenty nine lakes. Its biomass ranged from 0.0004 to 3.13 mg L^{-1}. *R. raciborskii*with biomass of 0.003-5.50 mg $L^{-1}$was found in twenty lakes. The species grew in good to poor light conditions, and low to high phytoplankton biomass. The co-occurrence of two species of special concern was recorded less frequently, whereas all three species co-existed only in six lakes with generally higher total biomass and lower biodiversity. Summarizing, all three species were not recorded as the main but only as accompanying bloom-forming species. However, they are predicted to become the main nuisance species of the future.

EP147

Distribution trends of invasive Asian carps (*Hypophthalmichthys molitrix* and *Aristichthys nobilis*) in Europe in the context of climate change

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The influence of Asian fish species on the natural ecosystems of Europe is poorly understood. The popularity of these species in pond aquaculture contributes to their European-wide invasion. There are conflicting opinions on how Asian carps may affect natural ecosystems, either positively by control of „water bloom" as fish food, or negatively by reducing the pond vegetation, making them less suitable for aquatic herpetofauna, as e.g. the European pond turtle *Emys orbicularis*. To manage the impact of these thermophilic fish, it is important to evaluate the potential for the spread of these species, with regard to triggers and thresholds of climate change. As a result of GIS modelling (Maxent, selected 17 of 35 variables CliMond, 2000 and 2050), we found that the distribution of these species primarily depends on the bio1.Annual mean temperature - 22-24% contribution. *Hypophthalmichthysmolitrix* is more temperature tolerant and therefore currently more widely distributed up to 53-55°N. By 2050, there is a predicted shift in the range to the North of Europe up to 58-62°N, where suitable habitat will increase by factor 1.7. The more thermophilic fish *Aristichthysnobilis* is currently distributed up to 48-51°N. Potentially by 2050, this species may potentially move northward to 52-58°N around the Baltic Sea, where suitable habitat is predicted to increase by factor 1.3. Thus, active pan-European management plans need to be developed to control future expansion of these species in Europe. This study
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EP141

Using heat-adapted microalgae to prevent cyanobacterial blooms

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Global warming is one of the main threats biodiversity is facing, being one of the main triggers of cyanobacterial harmful algal blooms (CyanoHABs) in freshwater ecosystems. CyanoHABs are currently becoming more frequent, thus posing a threat to aquatic ecosystems. It is, therefore, important to understand how warming might affect, in the long term, the dynamics of different groups of phytoplankton, in an attempt to find nature-based solutions to the CyanoHABs problem. In this study, three groups of microalgae (a chlorophyte - *Desmodesmus armatus*, a diatom - *Navicula atomus* and a cyanobacterium -*Microcystis aeruginosa*) have been adapted for over a year to the predicted warmer conditions for the end of the century in order to test their competitive abilities under these scenarios. The competition between the three species was first tested in mixed cultures*in vitro*, followed by experiments in natural phytoplankton communities, using mesocosms. The aim of the study was to determine the competitive abilities of different groups of phytoplankton after a long-term adaptation to future warming conditions. Our hypothesis is that the heat-adapted diatoms and chlorophytes might be able to combat cyanobacterial dominance in eutrophic lakes, thus providing a nature-based solution in an effort to suppress CyanoHABs.

EP001

A web-platform to ease access and overview of collected real-time buoy data

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Seeded by Innovation Fund Denmark, the ASAP platform was developed to unlock operational forecasting for lakes, reservoirs and watersheds anywhere in the world via the GOTM-WET and SWAT+ model. The platform is now expanded to allow integration of buoy-based sensor data. The visualization and interaction with sensor data is tailored with the limnologist in mind and gives an overview of the real-time lake or reservoir state. This can be used to better understand mechanisms operating at high-frequency, but also for planning field trips around key events in the system being monitored. The platform can visualize existing buoy monitoring systems as it supports 3. party data integration or new systems in pipeline. While sensor data gives real-time insight and is valuable *per se*, it may also be assimilated into the modelling of the platform and facilitate improved forecast performance for the coming 10 days.
Collection of high frequent sensor-based data brings incredible possibilities for gaining a deeper understanding of lakes and reservoirs, but our experiences are that researchers often spend significant resources on technical aspects of data-handling. With the ASAP platform, we hope to enable researchers and others easy access to buoy data without tedious configuration. This will enable researchers to spend more energy and focus on scientific discoveries, rather than technical difficulties, and at the same stimulate interdisciplinarity by giving researches from different disciplines joint access to incoming data. The platform has already been utilized in several research projects and this e-poster demonstrates key features and examples of its application.
Conflict of Interest: Yes
If you have a conflict, please specify: Disclaimer: The authors of this abstract own, operate and maintain the ASAP platform.

EP075

Nitrogen and phosphorus transport throughout Mediterranean watersheds in response to land-use changes and hydrology

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Anthropic activities have altered the transfer of limiting nutrients to surface waters where changes in the absolute amount of nitrogen and phosphorus and their ratios, threaten water quality. Modification in crop typologies, increase in fertilizers use, simplification of the landscape and urban development are the main factors increasing nutrient loads. In addition, loads are subjected to a strong temporal and spatial variability, which does not depend exclusively on the direct effect of anthropic activity but is also influenced by catchment hydrology and precipitation patterns. In this context, understanding to what extent hydrological variability along with land use changes influence nitrogen and phosphorus availability in watersheds and their capacity to process, transform and retain the loadings along the aquatic continuum is essential to effectively tackle eutrophication at multiple spatial and temporal scales. This contribution aims at presenting the results of a study investigating net annual anthropogenic nitrogen and phosphorus inputs to and exports from heavily exploited Mediterranean watersheds in the Po River basin (Northern Italy) characterized by different hydrology and human pressures. Eight rivers were selected: four drain the Apennine side of the watershed and are characterized by an intermittent flow regime, with summer low to absent flow and autumn flash floods, the remaining four rivers, with the flow regulated by the presence of the large and deep lakes, drain the Alpine side. The results will be discussed to analyze the relationship between nitrogen and phosphorus loadings exported from the watersheds and their stoichiometry in relation to anthropogenic inputs and hydrology.

EP092

Experimental studies on the succession of phytobenthos with the simulation of different climate change scenarios

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The primary goal of our study was to examine the effects of global warming on the structure and composition of freshwater phytobenthos communities. For this aim, an outdoor mesocosm experiment was carried out between July–September 2021, where in two separate treatments water temperatures were elevated by +3 °C and +5 °C, relative to the reference (ambient temperature) treatment. Qualitative and quantitative analysis of the phytobenthos communities was carried out by using light microscopy, accompanied by laser scanning confocal microscopy in order to follow up the forming of algae on solid substrates. The relevant abiotic (water temperature, pH, conductivity, dissolved oxygen, light irradiation, nutrients in the water column) and biotic (phyto- and zooplankton abundance) background variables were also recorded in the tanks during the course of experiment. The results show that nutrient levels changed along the same trends in all treatments; concentration of different nitrogen forms in the water column slightly decreased during the first half of the experiment and then typically increased, while phosphorus levels showed a constant decline after the first week of the experiment. Chlorophyll-a levels in the water column also decreased gradually, along with an apparent increase in the biomass of benthic algae (expressed as chlorophyll-a levels and layer thicknesses). Zooplankton was more abundant and diverse in the control (unheated) treatment compared to the two heated treatments, while less important differences occurred between the latter two treatments in this respect.

EP134

Water issues and school lunches

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Recently, various problems related to the water environment have become more serious. In order to deal with these issues, I felt it is important to solve the garbage problem. Garbage is disposed of in a variety of ways. Two of them are natural dumping and incineration. Naturally dumped garbage can cause ocean pollution, while incinerated garbage can lead to water shortages and droughts due to global warming caused by carbon dioxide emissions. In order to minimize these problems, I think reducing the amount of garbage is important too. There are many ways to do this, but the one I'm especially interested in relates to trash from school lunches. The first is the individual packaging of bread, beans, etc. If you package them individually, that will generate a lot of waste. Instead of individual wrapping, we can put the food in large containers for each class, and the students can place the food directly from the containers onto their plates. By doing this, we can reduce the amount of packaging waste. The second is about disposable spoons for dessert. If we use disposable spoons every time, a large number of spoons will be thrown away. Therefore, I believe that if we use spoons that can be washed and used repeatedly, we can reduce the number of spoons thrown away. I also think that by taking this kind of initiative at school, we will be able to feel more familiar with the issues of water and garbage.

EP017

Alteration of dissolved organic matter from particulate organic matter in the riverine environment by *Ephemera* mayflies

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Dissolved Organic Matter (DOM), one of main components of carbon cycle consists of variety of organic substances, plays important roles in the biogeochemical functions of ecosystems, such as regulating solar light penetration, mineral and pollutant transportation. However, little is known about the factor that changes in dissolved organic matter concentration and chemical characteristics in river ecosystems. The *Ephemera* mayflies, one of main species of aquatic insects in the Japanese rivers, are classified as a filter feeder and also inhabiting the Asahi-gawa River System having niche differentiation patterns (Okamoto and Tojo, 2021, Okamoto et al., 2022). The *Ephemera* mayflies take in Fine Particulate Organic Matter (FPOM) but few studies have been conducted about their role in carbon cycle in the riverine environment. In this study, we aimed to elucidate the alteration process of POM to DOM in Asahi-gawa River water, Japan. We conducted feeding experiments of unfiltered river water including POM to the *Ephemera* mayflies (*E.japonica*,*E.strigata*,*E.orientalis*) in dark condition at 10°C. The river water samples were taken daily and subjected to three-dimensional excitation emission matrix spectroscopy (EEM) and dissolved organic carbon (DOC) measurements. In the control sample, without *Ephemera* mayflies, EEM spectrum did not change much during 14 days. In the feeding sample, protein-like fluorescence peak (Ex/Em=270/342 nm) intensities first changed, and then humic-like fluorescence peak (Ex/Em=340/413 nm) intensities changed drastically. These changes occurred repeatedly during the experimental period. We seemed that the *Ephemera* mayflies altered POM into DOM.

EP019

Salt pulsed effects on leaf litter decomposition extend beyond contamination cessation and depends on leaf colonization status

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Stream salinization is a recognized, although understudied, global threat to freshwater ecosystems biodiversity, functions (e.g. leaf decomposition) and services that they provide. Anthropogenic activity may define not only the salt concentration and ionic composition of the water, but the stream disturbance patterns in space and time. We assessed the importance of the conditioning status (i.e. unconditioned vs. 3-weeks conditioned) of chestnut leaf litter on microbial-mediated litter decomposition in a stream reach during daily salt-pulsed contamination (salinization period; 7 days) and after cessation of salt additions (recovery period; 4 days). Leaves were incubated in a mountain stream longitudinally divided over 22 m. Half of the stream (salinized half) was subjected to daily short-term sharp salinity increases (up to ~48 mS/cm) while the other half (control half) was used as control. Mass loss, microbial respiration and fungal biomass, in both stream sides was consistently lower in non- colonized leaves. During the salinization period, the mass loss of both leaf types was not affected by salinization. After the recovery period, the conditioned leaves, previously maintained in the salinized half, decomposed less, showed lower respiration rates and fungal biomass than the conditioned ones previously maintained in the control half. A parallel effect was observed in non-conditioned leaves. During the salinization period, intervals between salt pulses seem have permitted a partial recovery of microbial functions in colonized leaves favoring the development of more tolerant (eventually poorer) fungal communities while stream flow seem provided a continuous conidial imprint from upstream and colonization progression in preconditioned leaves.

EP018

Estimating inputs of aquaculture-derived nutrients to streams using dissolved organic matter fluorescence and in situ sensors detections

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Salmon aquaculture is an important economic activity globally and particularly in southern Chile where pristine lakes and rivers supply freshwater for land-based salmon aquaculture facilities to cultivate early life stage salmon. However, intensive fish farming in land based aquaculture system provides a number of potential effects over the environment that sustains it, due to that the Chilean legislation about liquid industrial wastes allow high N and P loads which contributes directly and indirectly to the trophic state of the aquatic ecosystems. On the other hand, these types of industries are not required to report particulate or dissolved organic matter (DOM), so the quantity and fate of aquaculture nutrient loads are poorly known. This study aimed to quantify the enrichment of nutrients in land-based salmon aquaculture facility effluents compared to receiving waters. We measured nutrient concentrations as well as DOM quantity and quality via fluorescence spectroscopy between natural waters and contaminated waters associated to 27 facilities throughout southern Chile. DOM in stream water was characterized by humic-like fluorescence, while aquaculture effluents were enriched in protein-like DOM fluorophores. Principal component and correlation analysis revealed that protein-like fluorescence was a good predictor of N and P in effluents, but these correlations varied depending on the facilities, especially for detecting pulses. Agreement between laboratory fluorescence and a portable fluorometer indicates the utility of in-situ sensors for monitoring of both protein-like fluorescence and covarying nutrients in effluents. Thus, continuous in-situ sensors are likely allowing more robust estimates of aquaculture-derived nutrients delivered to receiving waters.

EP146

Assessment of public awareness in freshwater alien species and anura by digital data analysis

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We attempted to understand for conservation and management of species. Public awareness and interest for species often provides an opportunity to conserve and manage the species. Recently, two techniques spotlighted to understand public awareness and interest. First, conservation culturomics is a technique for conserving species based on digital text. Second, iecology studies ecosystems using digital data. Therefore, we progressed to two experiments. One confirmed to public awareness and interest in species through digital text data, the other confirmed to public interest and preference in species by digital data. We analyzed digital text about freshwater alien species and analyzed public sentiment through sentiment analysis based on text mining techniques. We also analyzed YouTube data in anuran group and confirmed to public interest and preference. Public sentiment for freshwater alien species almost negative however, Spreading information without scientific basis or increasing aversion can limit of managing species. People had large interest for Invasive frogs relatively however, Endangered species had fewer interest. Consequentially, a management plan should be established by scientifically understanding the public awareness of alien species or endangered species. Additionally, in order to manage and conserve invasive or endangered species, it is necessary to increase the ecological understanding.

EP181

Phytoplankton dynamics shaping the efficiency of phosphorus accumulation by periphyton in the eutrophic reservoir

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Significant demographic and industrial expansion led to the increasing demand for the continuous supply of safe and high-quality water. Much effort is put to resist the effects of extensive eutrophication in reservoirs caused by excessive phosphorus enrichment responsible for cyanobacterial blooms associated with ecosystem degradation and adverse health effects. The potential of an environmental-friendly biological method for phosphorus removal by periphyton developed on the transparent polyacrylic substrates was estimated in eutrophic reservoir for water supply. Weekly, monthly, and continuously (two-, three- and four-month) grown periphyton was sampled from June to October. Qualitative and quantitative analyses of phytoplankton sampled at the same time as periphyton were done. Orthophosphate and total phosphorus concentrations were measured in the water column during the experimental time. Total phosphorus (TP) content in periphyton was estimated spectrophotometrically by the stannous chloride method. It was found that three maximal phosphorus assimilations of 1695, 2897, and 6058 mg TP/m^2

were achieved in one-, two-, and four-month grown periphyton, respectively, each harvested in October. The results of the study indicate that the competition between phytoplankton and periphyton communities was a key factor affecting the periphyton efficiency in phosphorus accumulation. Phytoplankton occurred to be competitively dominant over periphyton in phosphorus assimilation from the water column allowing periphyton to increase phosphorus accumulation only during the periods of very low phytoplankton abundance. If this method is potentially large-scale employed during the remediation process, the harvesting of substrates exposed during scarce phytoplankton biomass would be most effective.

EP182

Methane Emissions due to Reservoir Flushing: An Overlooked High-impact Pathway?

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Reservoirs are a significant source for the greenhouse gases methane (CH_4). In some reservoirs, sediment management strategies include reservoir flushing to counteract growing sediment deposits that pose a challenge to reservoir efficiency. During sediment flushing the sediment is mobilized and transported together with the water through a dam outlet into the downstream river. Consequently, the CH_4 stored in the sediment pore water is released and can eventually degas to the atmosphere. Therefore, reservoir flushing represents a CH_4 emission pathway that may contribute substantially to overall methane release from reservoirs. Here we assess the relative importance of this emission pathway. We measured the seasonal change of CH_4 concentrations in the sediments of Schwarzenbach reservoir and estimated the potential CH_4 emissions due to reservoir flushing. These potential emissions due to flushing are compared to CH_4 emissions by other pathways. Our data show that CH_4 concentrations can differ considerably in the upper sediment layers and increase throughout the season from spring to summer. Hence, the timing of reservoir flushing substantially affects the amount of CH_4 potentially released during this process. While flushing of Schwarzenbach reservoir can cause CH_4 emissions that contribute a considerable fraction of the overall annual CH_4 emissions, flushing induced CH4 emissions from Schwarzenbach reservoir are small because the flushing frequency is very low. However, in other reservoirs that are flushed more frequently CH_4 emissions due to reservoir flushing might be substantial.

EP123

Ecological status of Tunisia's coastal lagoons using remote sensing

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Coastal lagoons are highly fluctuating ecosystems, based on water exchange between the lagoon, which usually comes from rivers, and the sea. In this case, the aim is to study the ecological status by remote sensing of five lagoon on the Tunisian coast: Bizerte (128.82 km2), Ghar el Mehl (36.39 km2), Tunis-Avicena (68.54 km2), Boughrara (536.13 km2) and Il Bibane (232.97 km2). The maximum depth of all of them has been established from nautical maps and the ecological status parameters are analysed using Sentinel 2 satellite, which has optimised and validated three automatic products such as chlorophyll a (chl a), total suspended solids (tsm) and the maximum transparency at which 90 % of light reaches (kd_z90max). Maximum chl a value is 27.33 mg/m3 in Tunis Avicena and minimum value is 3.37 g/m3 in Boughrara. For tsm, the maximum value is 15.61 g/m3 and the minimum is 2.28 g/m3 at Tunis-Avicena and Il Bibane respectively. Finally, transparency (kd_z90max) which is closely linked to the two previous parameters, has a maximum of 4.48 m at Il Bibane and a minimum of 0.74 m at Tunis-Avicena. The smallest lagoons are the most problematic in terms of their ecological status, as they are the ones with the highest concentrations of chl a and tsm, and the lowest transparency. This fact, together with these areas are in constant progress and evolution in terms of maritime ports, deteriorate the ecological conditions of the area, leading to a great ecological and economic losses.

EP072

Three-dimensional hydrodynamic-biogeochemical modelling of a small urban lake

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The ecological state of lake ecosystems worldwide has deteriorated over the past decades. Eutrophication and climate change contribute to the increase of algal blooms, in particular of toxic cyanobacteria blooms, which currently constitute a main concern in the management of water resources. Modelling tools are of central importance to better understand the impact of climate change on the thermal regime of small and shallow lakes and its relation to phytoplankton growth. The recognized three-dimensional hydrodynamic model TELEMAC3D was recently coupled with the biogeochemical library Aquatic EcoDynamics (AED). Here, the coupled model is applied on Lake Champs-sur-Marne, a small and shallow lake (Great Paris), which suffers from recurrent cyanobacterial blooms.The available data set includes high-frequency data. Water temperature, oxygen, nitrate, chlorophyll and phycocyanin are measured at a 10mn time step. The results of a simulation run from February to November 2019 are presented. The model performance is assessed thoroughly against multiple variables and at different time scales. Regarding the thermal regime of this polymictic lake, the simulated water temperature is in very good agreement with observations. Moreover, the alternation of mixing and stratification is well captured by the model. The seasonal evolution of the phytoplankton biomass is correctly reproduced as well as its distribution between the main phytoplankton groups. Furthermore, the dynamics of dissolved oxygen and nitrate is well captured. This fully coupled 3D hydrodynamic-biogeochemical model provides a new robust tool for modelling the interplay between hydrodynamics and biogeochemistry in small polymictic lakes which represent the majority of global lakes.

EP107

Water quality evaluation and environmental awareness: a case study of European and Brazilian rivers

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Water quality evaluation and monitoring are critical for the regulation and monitoring of water resource management initiatives. To assess the water's quality is necessary to have analysis of the nutrients enrichment in the water bodies (based on category, type and geographical location), considering the influence of confounding factors on the nutrient-biology interaction. In this study the main objective was to compare the existing boundaries of the European Union member's states, which derives from the EQR (Ecological Quality Ratio) values obtained in broad rivers types with limit values of nutrients stipulated by the Water Framework Directive (WFD) and the boundaries values of the nutrients in Brazilian's Water Quality Index (IQA). The principal objective of the WFD is that all water bodies reach "good ecological and chemical status", regarding Brazil, the IQA was created to assess the water quality for human use. The selected nutrient measures that approached the limitation range for similar river typologies were BOD, Total-P and Conductivity. In Brazil, according to the National Water and Basic Sanitation Agency (ANA) conjuncture report (2021) in the year 2017 the water quality indices of more than 70% of the monitoring points are in good quality. A study conducted by the SOS Mata Atlântica Foundation examined 184 rivers and found that 70% of the sites are in regular conditions, 27.5% have Bad or very Bad quality, and just 2.5% have good quality. Some efforts must be made to improve the environmental awareness in Brazil which would necessitate an integrated solution.

EP042

Bottom-up vs top-down observations highlight potential overestimation of methane sediment fluxes in freshwaters with high sulphate concentrations

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Lakes are natural emitters of methane (CH_4), a potent atmospheric greenhouse gas. Emissions are the net result of production and oxidation. The first is a mainly sediment-based process, the latter mostly occurs at the oxic-anoxic interfaces. Methane fluxes across the sediment-water interface (SWI) are usually calculated as the concentration gradient between the upper sediments and the water column (Fick's 1stLaw). However, this approach potentially overlooks flux-influencing processes at the SWI due the coarse (usually 1 cm) resolution of porewater measurement techniques. Using both bottom-up (porewater gradient) and top-down approaches (flux chambers), we measured CH_4 fluxes on sediment cores (9) and incubations (9) from the small eutrophic Lake Soppen (Switzerland). Bottom-up flux estimates differed notably from top-down estimates in the sediment incubations, where the concentration of sulphate (SO_4^{2-}) in the water was higher (44.5mg/L) than in sediment cores (6.5 mg/L). These results suggest anaerobic oxidation of methane (AOM) may have occurred below the SWI in a layer too thin to be detectable with standard porewater techniques. The presence of sulphate may thus result in overestimates of littoral/benthic methane fluxes when relying solely on the porewater gradient method. Our results suggest that flux chambers may therefore be a more appropriate method for resolving these fluxes.

EP084

Exposure pathways of agricultural run-off matter for regime shifts in phototrophic communities

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Shallow lakes and ponds suffer from various stressors like high nutrient loads and pesticides from agriculture and are strongly affected by increasing temperature due to climate change. They are complex ecosystems with a high abundance of macrophytes, phytoplankton and periphyton who compete for nutrients and light. Exposure to these stressors can result in regime shifts from a macrophyte- to a phytoplankton dominated state. We investigate the combined effects of agricultural run-off (ARO) and elevated temperatures on regime shifts and whether the ARO effects differ depending on the exposure pathway (sediment versus water phase). Using microcosms with photoautotrophic communities, we tested these two exposure pathways for an artificial ARO mixture consisting of nutrients and pesticides. Both pathways were tested at two different temperatures (22°C & 26°C). While exposure via the sediment had little effect on macrophyte growth, exposure via the water phase inhibited growth. In contrast, phytoplankton grew strongest when the ARO was exposed via the water phase. We conclude that impacts on the macrophytes rather derive from indirect effects by shading from phytoplankton in water exposed microcosms than from direct effects from the ARO. We show that the ARO exposure pathway matters shape the effects on the whole ecosystems and must be taken in consideration for extrapolation of microcosm studies to in situ scenarios.

EP013

Effectiveness monitoring of 5 fish ladders in Catalonia, NE of the Iberian Peninsula

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In recent years, a remarkable effort has been made to recover the connectivity for fish in the rivers of Catalonia, mainly through the construction of new fish ladders. However, evaluating the effectiveness of new fish ladders is not yet a common practice. Catalan Water Agency has launched a study to monitor the effectiveness of several fish ladders recently built. A total of 5 ladders were selected in rivers with similar hydrology (average river discharge inferior to 1 m3/s), and similar potential fish assemblage (*Barbus haasi* or *B. meridionalis*, *Squalius laietanus*, *Anguilla anguilla*, and in some cases *Salaria fluviatilis*). Several exotic species are also present: *Gambusia holbrooki*, *Lepomis gibbosus*, *Phoxinus* sp., *Barbatula* sp.
During 2021, between two and three monitoring campaigns (spring, summer, fall) have been carried o ut. The methodology used has consisted first in the installation of permanent traps at the top of ladders to obtain estimates of pass rates, and on comparative fish samplings on each side of barriers. Additionally, regular monitoring of several hydraulic variables was performed on internal points on each ladder. Finally, the expected mobility per species was also estimated using the package Fishmove (Radinger, 2013). The evaluated ladders are effective for a part of the species present. Between native species, barbels (*B. haasi* and *B. meridionalis*) have showed the highest pass rates. Some exotic species have also been able to take profit of ladders. The efficiency of the ladders is mostly high but decreases when there are internal points with excessive velocity.

EP036

First results of great cormorant GPS tracking at a large Central European lake

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Conflict between cormorants and fisheries represents the challenges of sustainable natural resource management in the light of biodiversity conservation. The last few decade's considerable population increase along with climate change's impact on migration patterns of inland populations of European great cormorants (*Phalacrocorax carbo*) emphasizes the need for detailed movement data for the species. In order to assess habitat use, in this study we tagged 10 great cormorants (1 adult and 9 juveniles) with GPS-GSM transmitters in a moderately declining inland breeding population at Lake Balaton, Hungary. So far, the transmitters provided some 170.000 geographic positions. The single adult bird remained in its breeding area, a semi-natural shallow lake in a protected wetland. Six juveniles showed moderate to large distance post-fledging movements towards South-Southwest in the direction of Croatia, Slovenia, Bosnia and Herzegovina, and Italy. Juveniles left their fledging area within two months. Nine transmitters ceased to deliver movement data within a year, in most cases death of the birds could be assumed as reason, and in five cases shooting was the suspected cause of death. At least four juveniles foraged on fishponds extensively; however, considerable use of natural and semi-natural habitats should raise awareness of implementing best practice management principles.

EP031

Cyanobacterial blooms like it hot – or not

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The ruling paradigm 'blooms like it hot' poses that extreme weather events will result in wider spread and more prolific cyanobacterial blooms due in part to higher water temperatures and altered nutrient regimes. During an extreme hot and dry summer in southern Sweden in 2018, inconsistencies were however observed with this prediction. In a drinking water supply, Lake Vomb, which often experiences cyanobacterial blooms, there was instead a bloom of a potentially toxic dinoflagellate. Following this observation, Lake Vomb was sampled from May to October in 2019 and 2020 to compliment data already collected in 2018. The aim was to follow the phytoplankton community over multiple years and understand the driving factors behind the shift from cyanobacteria to dinoflagellates in 2018. In addition to the phytoplankton community, data was collected regarding zooplankton, nutrients, light, temperature, dissolved oxygen and microcystins, and combined with climate data from the catchment. Preliminary results from 2018-2020 show no correlation between cyanobacteria biomass and temperature. In terms of nutrients, cyanobacteria biomass was negatively correlated with nitrogen and positively correlated with phosphorus whereas dinoflagellates did not correlate with any of the measured nutrients. Additionally, in parts of the lake, stratification was significantly higher and dissolved oxygen significantly lower in June and July of 2018 compared with 2019 and 2020. We hypothesised that this may have provided a unique recruitment environment in 2018 that benefited dinoflagellates compared with other years.

EP030

Temperature-mediated diet preference in the invasive crustacean *Limnomysis benedeni*

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The unprecedented increase in mean global temperature has a huge effect on the physiology of organisms, especially in ectotherms. Recent studies showed that omnivorous ectotherms increase their uptake of plant-based carbohydrate-rich diet to accommodate their shifting metabolic demands. This comes with a shift in diet preference from more carnivorous to more herbivorous diet. *Limnomysis benedeni* is an omnivorous invasive aquatic predator that has successfully spread into the main river systems and adjacent lakes in Europe from its Ponto-Caspian native range. Its high population growth rates and diet largely based on pelagic resources suggests potentially high impacts on plankton community composition and functioning. The current study aimed to test the change in diet preference of *L. benedeni* using the alga *Cryptomonas* as autotrophic and the rotifer *Brachionus calyciflorus* as heterotrophic prey. Twenty-four-hour grazing experiments across six temperature ranges (15–27°C) were conducted with adult mysids. The results show significantly higher consumption of autotrophic food than heterotrophic with increasing temperature thereby supporting that *L. benedeni* has a temperature-dependent diet preference. This has important implications for the structure and functioning of communities and ecosystems, serving as a basis for future studies with more natural settings.

EP073

Biogeochemical heterogeneity at the stream-riparian interface of boreal headwaters

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In boreal forests, organic-rich riparian soils interact with dynamic groundwater flow to regulate stream biogeochemistry and water quality. Yet, variability in hydrological pathways, determined by small-scale topographical differences may cause large spatial heterogeneity in the connections between riparian zones and streams and in the biogeochemical characteristics of these interfaces. We explored this variability along a 1.5 km boreal stream by measuring soil solution and groundwater dissolved organic carbon (DOC) concentration, DOC character through mass spectrometry and resazurin bioassays, and organic and inorganic nitrogen (N) content. We observed high variability in soil solution chemistry with depth and between riparian sites with different levels of interaction with the fluctuating water table. Riparian surface soils (< 20 cm below soil surface) showed wider variation in DOC concentration, C:N ratios, and organic matter characteristics among sites, but this variability decreased with depth. Soils that were persistently below the water table throughout the summer and autumn had lower C:N ratios and lower mass to charge ratios of the soil organic matter, regardless of depth. Intriguingly, soil solution chemistry did not share the same biogeochemical signatures as the groundwater, suggesting that highly localized processes can modify the transfer of resources from soils to streams. This study brings us closer to reconciling the different riparian models currently used to understand boreal stream ecosystems, which we can use to predict how boreal riparian zones influence water quality.

EP128

Transfer of microcystins in the food chain - a case study in Lake Mindelsee, Germany

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Blooms of the red, filamentous cyanobacterium *Planktothrix rubescens* occur frequently in pre-alpine lakes in Europe, often with concomitant toxic microcystin (MC) production. Trophic transfer and bioaccumulation of MCs have been observed in bivalves, fish and zooplankton species. Uptake of MCs into *Diptera* species could facilitate distribution of MCs into terrestrial habitats and the food web. In this study, we used 16S-rDNA gene fragment sequencing to characterize a *Planktothrix* bloom in summer 2019 in Lake Mindelsee, a medium-sized, oligotrophic lake in southern Germany. We tracked possible trophic transfer and/or bioaccumulation of MCs via analysis of phytoplankton, zooplankton (daphnids) and aquatic insect species (*Chaoborus*, Chironomidae and Trichoptera) and analyzed co-occurring cyanobacterial secondary metabolites. Untargeted LC-HRMS/MS analysis of lake water showed co-occurrence of the *Planktothrix*-specific cyanobacterial secondary metabolites Oscillamide Y and Planktocyclin with the red phytoplankton, thus confirming a *Planktothrix* spp. bloom. Targeted LC-MS/MS identified two MC-congeners, MC-LR and [Asp3]MC-RR with peak concentrations of 45 ng [Asp3]MC-RR/L lake water in September. Both MC congeners displayed different predominance patterns, suggesting that two different MC-producing species occurred in a time-displaced manner, whereby [Asp3]MC-RR was clearly associated with the *Planktothrix* spp. bloom.The MC-LR producer was not reliably identified, albeit ongoing NGS analysis should provide more insight. Neither MC-LR and [Asp3]MC-RR nor their conjugates were detected in *Chaoborus*, Chironomidae and Trichoptera analysed. However, we demonstrate exclusive presence of MC-LR in zooplankton species, suggesting the presence of a coccal MC-LR producer, that is ingested more efficiently by daphnid species than filamentous *Planktothrix rubescens*.

EP015

Metabarcoding reveals effects of anti-mosquito agent on non-target chironomid communities

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Emergent aquatic insects serve as an important subsidy for adjacent riparian ecosystems. Thus, anthropogenic stressors in aquatic environments might have a substantial impact on terrestrial systems. So far, studies have focused on stressor-induced changes in the total number or mass of emergent insects. However, investigating changes in the community composition of emergent insects is equally important, as terrestrial predators might be adapted to prey-specific traits (e.g., body shape, emergence pattern). Therefore, we used DNA metabarcoding to reveal effects of the mosquito control agent *Bacillus thuringiensis israelensis* (Bti) on the highly diverse and abundant non-target dipteran family Chironomidae in a replicated but natural pond system. Aquatic insects were sampled once or twice a week over a period of sixteen weeks. We used floating emergence traps in twelve ponds, with six of them being treated three times with Bti at realistic field rates used in mosquito control. State-of-the-art DNA metabarcoding was conducted to characterise the chironomid community composition per pond for each sampling date. First results showed that chironomid diversity was marginally higher in the first third and considerably lower in the last half of the study period in Bti-treated ponds as compared to the control. We found a moderate but significant effect of the treatment on chironomid taxa occurrence (multivariate GLM, $p = 0.001$); around 20% of taxa were observed to be significantly affected by Bti. An in-depth analysis on the relevance of chironomid traits in this context is in progress, allowing us to estimate consequences for terrestrial predators.

EP068

Climate as the main driver of nutrients and phytoplankton dynamics in a deep oligomictic lakes South of the Alps

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Lake Maggiore is a deep oligomictic lake belonging to the "Southern Alpine Lake" LTER site. The lake has been studied for physical, chemical and biological aspects since the 1980s. It recovered from eutrophication thanks to the reduction of catchment loads and reached a stable oligotrophic status by the end of the 1990s. In the recent period, dissolved oxygen and nutrient dynamics were mainly driven by in-lake processes, in particular stratification and mixing regime, in turn affected by climate change. Water temperature increased, at different rates according to depth and season, causing an increasing stability of the water column and a decreasing frequency of deep mixing event, the last full turnover having occurred in 2006. As an effect, oxygen is steadily decreasing and phosphorus, nitrate and silica are accumulating in the deep layers, with limited replenishment of the trophogenic layers. These changes are affecting phytoplankton composition and seasonal succession and will become prominent in the future in shaping the lake ecosystem functioning as a whole. To collect further information on short-term lake dynamics, a program for high frequency monitoring (HFM) was started in 2020 within the cross-border cooperation project SIMILE (Integrated monitoring system for knowledge, protection and valorisation of the subalpine lakes and their ecosystems). First results revealed that HFM, used in conjunction with discrete chemical and biological monitoring, represent a useful tool to detect ecological changes, also in relation to climate divers. However, regular check and validation of the sensor readings through laboratory analyses are important to get reliable data.

EP076

Analysis of dissolved organic carbon effects on the mobilization of metals in a historic mine drainage

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Historic mining sites can be long-running and an intensive source of trace metals. Numerous historic mining sites in the Ore Mountains situated in Central Europe drain to the waterways of a now densely populated land- and limnoscape. Underground mine drainage constitutes former ground- and surface waters, both of which retain dissolved organic carbon (DOC), which interacts with trace metals on various biogeochemical pathways, including as a complexing agent and possible tracer of subsurface metal-mobilizing microbial communities.
In a multi-disciplinary project we therefore explore the co-occurrence patterns of organic and inorganic chemical constituents in drainage waters during the passage of a complex mine system. We place our research in the Reiche Zeche, a former lead-zinc-silver mine later converted to serving as a teaching and research facility. We use in situ sensors and autosamplers for hydrological and biogeochemical monitoring across multiple extraction horizons. Our preliminary results show dynamics in DOC quantity and quality concurrent with metal mobilization during the surface-to-adit passage of water through the mine network. The initial data provides us with a unique and promising framework to study the role of DOM in creating and/or indicating hot spots of trace metal mobilization. These findings may help laying the framework for novel management and maintenance practices in mining landscapes and the anthropogenically altered critical zone.

EP145

Effects of cyanotoxins on the demography of successive generations of the rotifer *Brachionus calyciflorus*.

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Rise in aquatic pollution due to an increase in anthropogenic activities has led to eutrophication, and proliferation of cyanobacteria. These cyanobacteria have several adverse effects on zooplankton, often due to the production of toxic secondary metabolites such as cyanotoxins. Many zooplankton species have developed physiological and behavioural strategies that allow them to coexist with cyanobacteria. We evaluated the acute and chronic effects of different concentrations of the cyanobacterial crude extract from the Valle de Bravo Reservoir on the rotifer *Brachionus calyciflorus* isolated from a local water body. We filtered 100 l of the reservoir water and estimated the diversity and density of cyanobacteria. The crude extract, after five cycles of freezing, thawing and sonication at 14 MHz, was filtered and the microcystin concentration quantified based on ELISA. Acute toxicity tests were conducted based on 24h mortality. Chronic toxicity tests (life table experiments) of *B. calyciflorus* were conducted for two consecutive generations (F_0 and F_1) at three sublethal concentrations (0.238, 0.476 and 0.952 µg/L) based on LC50 data (2.56 µg/L). The field sample was dominated by *Woronichinia naegeliana*. Population growth rates of the $F_{0B.\ calyciflorus}$ exposed to sublethal concentrations of the cyanotoxins ranged from 0.15 to 0.24 and for the $F_1$from 0.16 to 0.42. Our results further showed that the second generation exposed to cyanotoxins had a better fitness than the F_0.

EP114

Chemical precipitation of phosphorus with polyaluminium chloride: water quality development five and twenty years after treatment in two eutrophicated lakes

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To improve water quality in two badly eutrophicated shallow Finnish lakes, Kirkkojärvi and Littoistenjärvi, phosphorus in water and surface sediment was precipitated with polyaluminium chloride, in Kirkkojärvi in May 2002, in Littoistenjärvi in May 2017. Water became clear in hours. All plankton disappeared, but phytoplankton recovered in four weeks and crustacean zooplankton in two

months. In Kirkkojärvi the treatment killed all fish. In Littoistenjärvi, pH was tuned so that most fish survived. In Kirkkojärvi, the average summer phosphorus (TP) and chlorophyll (Chl) levels dropped from >400 and >350 µg l^{-1} in 2000-2001 to 60 and 40 µg l^{-1} in 2003-2005. Despite occasional cyanobacterial blooms in two years, the average TP and Chl of 89 and 55 µg l^{-1} in 2006-2020 indicated substantial improvement in the ecological state of Kirkkojärvi to "satisfactory" instead of earlier "bad" rating. In Littoistenjärvi, TP and Chl decreased from 76-106 and 26-86 µg l^{-1} in 2011-2016 to 22-38 and 4-15 µg l^{-1} in 2018-2020, respectively. Most importantly, July-August biomass of cyanobacteria declined from 11-24 to 0.01-1.5 mg l^{-1}. In spite of clear water, mass occurrences of submerged macrophytes did not appear. In 2019 and 2020 hot weather spells in June-July induced short-term increases of TP and Chl, and in the particularly hot summer 2021 high levels prevailed until September. From 2011-2016 to 2017-2020 the internal loading of phosphorus declined from 131 to 12 mg m^{-2} a^{-1} but increased to 99 mg m^{-2} a^{-1} in 2021. Warming climate seems to reduce the longevity of chemical treatment.

EP129

The disappearance of *Bdellocephala annandalei* in conjunction with environmental changes in Lake Biwa — Latest results of lake bottom monitoring

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The population of *Bdellocephala annandalei*, an endemic species of Lake Biwa that lives on the lake bottom, is decreasing dramatically. The cause may be the change in the lake bottom environment due to the total circulation suspension of Lake Biwa from 2019 to 2020. In 2021, the entire circulation of Lake Biwa was confirmed. After that, for five days from July 23 to February 7, we conducted a bottom exploration of Bdellocephala vulgaris with three AUVs (autonomous underwater robots) at Lake Biwa North Lake. As a result of the survey, the survival of several*B. annandalei* was confirmed. We obtained a lot of valuable data such as the size, number of individuals, and their habitats, etc. Compared to the July 2012 survey, the turbidity of the bottom of Lake Biwa was significantly worse, and the water temperature had risen by more than 1°C in 10 years. Particular attention should be paid to these two points.
The relationship between the survival of *B. annandalei* and the rise in water temperature in Lake Biwa is not obvious at this point. However, since *B. annandalei*originated from planarians of northern lineage that lives in an environment with a water temperature of 6°C to 8°C, it can be assumed that a sudden rise in water temperature will affect its survivability . Data obtained from lake bottom monitoring will continue to be important as an indicator of the global environment.

EP080

Metal pollution assessment in the region of the former Texcoco Lake (Basin of Méxio), a multivariate approach

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The basin of the Valley of Mexico includes the region of Lake Texcoco, which was the largest water body of the former five lakes of the basin in pre-Hispanic times. Since Colonial times, Lake Texcoco has undergone a reduction in size, urban encroachment pressures, and short-term desiccation. The ancient lake's bed currently has saline soils that increase water salinity, conductivity, hardness, and alkalinity. Nowadays, this region includes isolated wetlands and small artificial lakes, which can be interconnected during the rainy season, and some of them receive treated wastewater. In this sense, water and sediments contain metals that affect water quality, endangering aquatic biota. Twelve metals (As, Ba, Cd, Cu, Cr, Fe, Mg, Mn, Hg, Ni, Pb, and Zn) were assessed in eight water bodies, which were monitored bi-monthly from June 2015 to March 2018. Contamination index (Cd), Metal Pollution Index (MPI), Partition Coefficient (Kd), and Mean Distribution Coefficient (MDC) were computed. Fe was the most abundant metal, which is associated with the earth's crust composition, followed by Mn and Mg. Cd and Hg have the lowest average concentration in the water bodies. It was possible to observe those metals that exceed the threshold criteria through the Cd index. MPI indicates that sediments have a higher concentration of metals than water; furthermore, values of Kd and MDC suggest that metals are transferring from sediments to the liquid phase in all lakes studied and those arriving via sewage leachate and runoff.

EP010

Prioritizing pond restoration to recover the habitat connectivity of a pond-dwelling turtle

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Temporary ponds (TPs) are water bodies under 10 hectares distributed across southern Europe as an ephemeral habitat for many organisms adapted to their unstable annual water regime. In the southwestern coastal plateau of Portugal, these habitats are critical for a variety of freshwater organisms that use them to feed and reproduce. However, due to local agriculture intensification since the 1990s, 56% of these ponds have been destroyed or converted to artificial reservoirs. Furthermore, legislation was passed in 2019 affecting the Irrigation Perimeter of the Mira River located within a Natural Park, allowing for an increase in irrigation systems and greenhouse development. This adds ecological pressure to species such as the European pond turtle, *Emys orbicularis*, which shows a marked preference for TP networks. This study, covering 291 km^2, focuses on a large-scale measurement of intra-annual connectivity change for TP networks within of the Natural Park of Sudoeste Alentejano and Costa Vicentina. From the 293 ponds surveyed in January 2020, the probability of movement was analysed over two least-cost path scenarios representing dry and wet conditions. Two resistance rasters were created by combining land-use land-cover data with water availability conditions measured using the Multispectral Water Index derived from Sentinel-2 imagery. Ponds were ranked in terms of connectivity using the Probability of Connectivity and Betweenness Centrality Index. From this, the ponds were prioritized for restoration and a cost-benefit analysis was undertaken. The results of this study are critical to increase the efficiency of habitat restoration efforts.

EP043

Divergent litter traits of riparian plant species in humid and drier biomes within the tropics

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Plants in the riparian forest provide abundant plant litter – mostly in the form of dead leaves (hereafter litter) – for both forest soils and adjacent stream ecosystems, which support terrestrial and aquatic detritus-based food webs. Although the fate of litter is predominantly dependent on its chemical and physical traits, there is limited availability of data on those traits over large spatial scales or empirical comparisons of traits among tropical biomes. We filled this gap by exploring the differences and similarities of nine litter traits of 68 plant species from riparian forests across three, continental-scale, South American biomes Amazon Forest, Atlantic Forest and Cerrado (Neotropical savanna) and their dependence of phylogeny. All three biomes produced litter with similar %C, %P, C:P mass ratio, SLA and toughness.However, litter from Cerrado was better chemical defended (higher phenols content), had lower nutritional quality (higher C:N mass ratio) but showed lower nutritional limitation (lower N:P mass ratio)

than litter from the other two biomes. We found no phylogenetic signal for studied traits using a phylogenetic tree for all biomes, suggesting that trait differences among biomes were environmentally determined. However, a strong phylogenetic signal was observed for P in the Atlantic Forest, which indicates close-related species have similar %P. Our findings suggest that litter from more humid biomes are richer in nitrogen, although more phosphorus limited, than in drier climate of Cerrado savanna biome.

EP144

Cyanobacterial blooms in remote Minnesota lakes prompt exploration of atmospheric nutrient deposition and carbon dioxide as controls on algal community dynamics

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Despite billions of dollars directed towards combatting harmful algal blooms (HABs) worldwide, the frequency, intensity, and ubiquity of these blooms in freshwaters are increasing. Historically, HAB management has relied heavily on nutrient reduction strategies, specifically reducing inputs of nitrogen and phosphorus from agriculture and point sources. Recently, HABs have been documented in remote lakes in the relatively pristine waters of northern Minnesota, whose catchments are not disturbed by human landscape modifications. This has prompted a paradigm shift in our understanding of the drivers of HABs and a need to study environmental factors beyond watershed nutrient inputs that contribute to HAB formation. In this study, we will examine eight lakes representing a gradient of depth and watershed size within wilderness areas of northern Minnesota. We will monitor nutrients and phytoplankton in each lake monthly for two years to assess the relationship between nutrient concentrations and phytoplankton community composition in conjunction with high-frequency buoys to resolve temperature-dissolved oxygen patterns associated with stratification and ice cover. We will establish a dustfall network to monitor atmospheric dry deposition as a potential source of nutrients to these remote lakes. Finally, we will collect lake sediment cores to characterize historic changes in lake ecology, including phytoplankton diversity and abundance as well as nutrient inputs, which will help identify environmental variables affecting current and future water quality. These data will inform a predictive model that can better focus management efforts to protect the remote lakes most at risk for HAB formation and other water quality impairments.

EP038

Towards an Ecosystem-based management (EBM) in Sweden's second largest lake

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Lake Vättern is unique in several ways. A unique environment and ecosystem due to its large size and cold, oligotrophic water and long retention time (60 years). It is also a unique example of Ecosystem-based fisheries management (EBFM) that seeks to manage fish resources in lake ecosystems in a holistic way.
Since its foundation in 1957, the Lake Vättern Society of Water Conservation has been a local actor aiming to manage a broad range of environmental issues concerning the water quality of the lake. In 2005 a fisheries co-management group was established, mainly dealing with fisheries issues, and work along and towards the EBFM principles in a locally adapted way. Resulting in a stakeholder-influenced management with a more open and transparent policy system, often referred to as important for implementing EBFM. By adding a fisheries co-management group to the Lake Vättern Society of Water Conservation, a step towards an Ecosystem-based management (EBM) is taken. Thus, linking water- and fisheries related issues more closely together. The approach in Lake Vättern is referred to as a good example and practice (both nationally and internationally) and is about to be adopted in three additional Swedish large lakes.

EP077

Carbon bioavailability and oxygen consumption in a future scenario – A case study in Lake Bolmen

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Climate change is expected to result in an increased transport of terrestrial dissolved organic matter (DOM) to aquatic environments. The primary component of organic matter is carbon and utilization of the bioavailable fraction by bacteria cause consumption of oxygen. Increased concentration of DOM might therefore be a contributing factor to hypoxia. In a mesocosm experiment performed in Lake Bolmen we investigated the effect of increasing concentrations of terrestrial DOM and different N:P ratios on carbon utilization. We measured bacterial carbon production and respiration and studied the transformation of DOM by measuring changes in dissolved organic carbon (DOC) concentrations, absorbance and fluorescence. Respiration based on oxygen consumption increased in the treatments with addition of terrestrial DOM. However, there was no significant effect of nutrient addition either in treatments with or without terrestrial DOM. For bacterial production both DOM and nutrient additions had a positive effect. The stimulation was however short, and after five days there was only a significant effect in the treatment with DOM and high N:P ratio. Over time DOC concentration decreased in the treatments with added terrestrial DOM whereas it increased in the treatments without. This might indicate that addition of DOM caused a shift from an autotrophic to a heterotrophic dominated food web. In summary, our results show that increased transport of terrestrial DOM affects both respiration and bacterial production and can in the future significantly influence the oxygen concentrations in aquatic environments as well as the release of CO_2.

EP154

National scale patterns of diatom-environment relationships in rivers and streams of the United States based on DNA metabarcoding

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Diatoms have a long history of being used to characterize changes in environmental conditions and to identify effects of pollution in freshwater ecosystems. Recent advancements in DNA techniques and bioinformatics could help expand their use in monitoring and assessment programs by providing increasingly effective ways to quantify diatom diversity in environmental samples. Here, we present nationwide DNA metabarcoding (rbcL) results for diatoms collected from 1859 streams and rivers during the summers of 2018 and 2019. This survey was conducted for the United States Environmental Protection Agency's National Rivers and Streams Assessment. Based on nonmetric multidimensional scaling (NMDS) results, changes in diatom assemblage structure were associated with two predominant environmental gradients. The first, representing the greatest change in assemblages, was associated with factors often affected by human activities, such as increased phosphorus and nitrogen concentrations, conductivity, turbidity, and benthic chlorophyll *a*. The second gradient was correlated with pH. Relative abundances of gene sequence reads for acidophilic taxa increased as pH decreased. Ecoregional patterns in the NMDS indicated that diatom assemblages in Western Mountain and Northern Appalachian streams were associated with lower nutrient concentrations and conductivity, whereas those in Temperate Plain, Northern Plain, Southern Plain, and Coastal Plain streams were associated with higher nutrient concentrations and conductivity. Diatom assemblages in Coastal Plain, Northern Appalachian, and Southern Appalachian streams were associated with lower pH. Ongoing work is focused on further examining regional differences and how these results could inform indicator development and applications of molecular tools to help manage environmental problems.

EP046

Trophic status of the filter-feeder larvae and quantity and quality of drifted fine particle materials in a dam river

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Filter feeders downstream of dams utilize nutrient-rich phyto- and zoo-plankton from reservoirs. The high density of filter feeders would have a positive effect on high nutrient resources. However, the trophic states (e.g., lipid contents) of the individuals have not been focused. In this study, we conducted continuous monthly field surveys in the downstream area of the Amagase dam and a nearby tributary as a reference site. We measured the lipid content of individual larvae of the filter feeder (mainly, Hydropsychedae) and the quantity and quality of food resources, drifted fine organic materials (DFPOM) in the river water. We compared them between the downstream area of the dam and the tributary. Throughout the survey date, the amount of DFPOM was continuously higher in the downstream than in the tributary, but there were periods when both amounts were not different. The lipid ratio of Hydropsyche individuals was significantly lower in the downstream than in the tributary. The periods when the lipid ratio of individuals in the downstream was significantly lower than that of the reference individuals coincided well with the periods when the quantity and quality of drifted materials downstream of the dam differed significantly from these of the tributary.

EP091

The making of a river: Microbial dispersal and resource transport in a lab meta-ecosystem

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River networks can be understood as meta-ecosystems because their hierarchical dendritic structure and downstream flow impose constraints on the dispersal of organisms and the movement of resources. It remains unclear how resulting spatial patterns of microbial diversity and quality of resources interact and drive ecosystem functioning, e.g. microbial respiration. Moreover, natural connectivity patterns of rivers may be affected by fragmentation (i.e., altered flow regimes or damming), but the implications for meta-ecosystem functioning are mechanistically poorly understood. In this study, we assessed how microbial dispersal mechanisms influence local and regional patterns of microbial functional diversity and ecosystem respiration. The experimental setup mimics key features of river networks, namely, unidirectional resource transport with flowing water and multi-directional microbial dispersal at various intensities. Connected chemostats created the dendritic structure of a 3rd order river network, with continuous flow of a controlled mixture of carbon sources, and functionally diverse microbial communities coming from several headwater streams. Dispersal mechanisms were defined as only downstream and bidirectional imposing low, intermediate and high dispersal limitation. We expect that at an intermediate rate, microbial communities find their best match between environmental conditions and functional traits, leading to diverse communities with higher ecosystem respiration. Our results would allow us to have a better mechanistic understanding of the interactions between microbial and resource diversity, and their combined influence on ecosystem respiration at the local and regional scales of a river network.

EP061

Fish as sentinels of hydromorphological impact

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Fish communities are subject to multiple anthropogenic pressures such as habitat loss, deterioration in water quality or non-native species. Mountain and hilly rivers are also under hydromorphological pressures that deteriorate their longitudinal and lateral connectivity and cause land-use changes. We used the Multiple Correspondence Analysis of variables associated with the natural (altitude, slope and stream order) and anthropic altered (land use naturalness in the watershed, the presence and density of hydromorphological alterations) morphology to reveal a gradient of impact over 130 rivers and 240 sampling stations in the Romanian Carpathians. We analyzed changes in diversity, abundance, relevant traits and age structure of communities of near-natural and altered rivers. The main results show that most of the rivers in the region are impacted to some extent by human activity. Both natural and anthropic variables shape the structure and composition and fish communities. However, our research revealed some fish community indicators sensitive to the gradient of the anthropic morphological impact.

EP014

Trophic transfer of marker and essential fatty acids from chironomids emerged from saline siberian lakes to riparian orb-weaving spiders

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We conducted the study of trophic relations between amphibiotic insects, chironomids, that emerged from three saline lakes of steppe South Siberia, and terrestrial consumers, orb-weaver spiders, that obtained due to the emergence omega-3 polyunsaturated fatty acids (PUFA). Fatty acid composition and stable isotopes in bodies of the consumers from a riparian zone and an arid steppe zone were compared. Number of orb-weaver spiders in a riparian zone near all three lakes was in several times higher than that in steppe. Fatty acid markers specific for chironomids of each studied lake were found. Chironomids from one of the lakes brought to the spiders high amounts of short-chain fatty acids and heavy nitrogen signatures that were not previously observed in similar trophic transfer. The fatty acid and isotopic markers were accumulated in bodies of orb-weaver spiders of the riparian zone during emergence, thereby traced trophic link between aquatic and terrestrial biota. Chironomids from three lakes differed in content of omega-3 PUFA, whereas the spiders from the corresponding riparian biotopes did not. Average data for several seasons showed that steppe spiders had lower content of eicosapentaenoic acid per biomass unit, while riparian spiders had increased values of this essential compound both at early and late summer when the emergence finished. Thus, evidence was got that some terrestrial consumers are able to regulate content of omega-3 PUFA supplying during a relatively short period of insect emergence, and retain this compound in their tissues for some period.

EP026

Do chrysophyte cysts reflect the changes in meteorological conditions? A case study from northeastern Poland

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Chrysophyte cysts are considered as sensitive indicators of water environment conditions. In our study we hypothesized that seasonal variability of meteorological parameters, and the resulting changes in limnological conditions, were affecting chrysophyte cyst communities in two Polish lakes: Łazduny and Rzęśniki. High resolution monitoring of chrysophyte cysts deposition in sediment traps combined with on-site monitoring of limnological and hydrochemical variables indicate that dynamics of total fluxes of chrysophyte cysts are indirectly influenced by changes in meteorological conditions. Climate-related factors induce changes in water column mixing intensity that in turn control nutrient and light availability, and determine the seasonal pattern of chrysophyte cyst deposition. This is supported by statistical analysis (RDA) showing that taxonomic structure of chrysophyte cysts is directly influenced by air temperature. Multi-level pattern analysis pointed to specific cyst types as indicative of different periods of lake physical structure, hence suggesting the potential of chrysophyte cysts in paleoclimatic studies.

EP027

Effects of changes in meteorological/environmental conditions on diatom deposition and taxonomic structure in lakes Łazduny and Rzęśniki, northeast Poland

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Diatoms are among the most important components of limnological and paleolimnological assessments because of their ability to respond rapidly to changes in the environment, distribution among diverse array of water quality gradients, and good preservation of their siliceous frustules in sediments. The main goal of our study was to find and explain relationships between changes in meteorological conditions and diatom deposition in two lakes, Łazduny and Rzęśniki, located in northeastern Poland. Using sediment traps we conducted high-resolution monitoring of modern sedimentation accompanied by systematic measurements of limnological and hydrochemical variables as well as analysis of meteorological data from the nearest meteorological station. The results show that meteorological conditions indirectly influence seasonality of diatom assemblages, through changes in the mixing regimes that determine nutrient and light availability in lakes. Statistical analyses revealed that taxonomic structure and interannual variability of diatoms are influenced by multiple variables. Nevertheless, changes in air temperature and wind speed proved to be significant factors for diatom assemblages. Despite many similarities between investigated lakes, we noted differences in both seasonal succession of specific diatom taxa and the peaks of total fluxes. We believe that dissimilarities are connected to different hydrological type of the lakes and their location in the catchment.

EP139

Environmental filtering and limiting similarity as driving forces of macroinvertebrate community structure in drought effected lowland streams

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Climatic extreme events such as droughts and dry periods threaten freshwater ecosystems worldwide. The filtering mechanisms of these events and their strength on communities, however, can be different among regions. While time-for-adaptation theory defines whether water scarcity can be considered as disturbance, the stress-dominance theory predicts an increase in importance of environmental filtering and a decrease in influence of biotic interactions on communities with increasing environmental stress. Therefore we tested whether environmental filtering (leading to trait convergence) or limiting similarity (leading to trait divergence) is the main assembly rules shaping the structure and trait composition of benthic macroinvertebrate assemblages of a continental (Hungarian) temporary and perennial lowland streams. We assumed that the trait composition of macroinvertebrate assemblages in the two stream types would be different and this difference can be highlighted by mostly through dispersal functional traits. In this study, the waterbodies had been monitored monthly, from March to December in 2020. The annual appearance of macroscopic invertebrates is also affected by the quality of the waterbodies. In bad quality waterbodies the species composition was invariable and does not react to changes in the water regime. In contrast in the watercourses with better ecological status these communities performed significantly change by time-for-adaptation response within a year, which reflects in changes in alpha and beta and functional diversity measures.

EP131

Global Warming and its Impact on Lake Biwa Ecosystems - Changes in water temperature and decrease of endemic Biwa-salmon in Lake Biwa

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Lake Biwa, with 4,000,000 years history, is one of the famous ancient lakes in the world. There are about 1,700 species, and nearly 60 species are endemic. Biwa-salmon, an endemic species of Lake Biwa, has been decreasing since the 1960s. The purpose of this study is to clarify the factors of decreasing Biwa-salmon population and to prevent further loss. In Lake Biwa, Biwa-salmon live in relatively deep waters (15 to 20 meters) with water temperatures of about 15°C, and is known to prey on shrimps (*Jesogammarus annandalei*) living at the bottom of the lake. In this study, we focus on the rise of water temperature in Lake Biwa due to global warming, which is one of the causes for the decrease of Biwa-Salmon and shrimps. We examined the relationship between the catch of Biwa-salmon, and water temperature and dissolved oxygen in their habitats at the lake bottom.

EP003

A model coupling dispersal and resource fluxes in fluvial meta-ecosystems

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It is well-established, both theoretically and empirically, that biodiversity is an important driver of ecosystem functioning. Although many studies of biodiversity-ecosystem functioning relationships focus on local-ecosystem scales, many ecosystems are embedded in meta-ecosystems, i.e., in a continuum of local systems connected by dispersal and resource fluxes. Thus, many controls of the spatial distribution of resources and consumers unfold at larger-than-local spatial scales. This is especially apparent in fluvial systems, where the downstream flow of water provides an obvious mechanism connecting local ecosystems. In such systems, the degree of connection between local ecosystems will be a strong control on dispersal and resource fluxes, which will in turn strongly influence both the ability of organisms to process resources, and the shape of biodiversity-functioning relationships. Here we present a semi-mechanistic model that describes these fluxes in space and time. The movement of organisms and resources are explicitly coupled in the model via equations describing the rate of consumption of resources by organisms and the effect of resources on the dispersal, establishment, and persistence of organisms in local communities. We present worked examples using both simulated and field data that demonstrate model predictions in the context of ecological theory. We also present a pre-release version of an R-package, „flume," that implements the model.

EP094

Long-term observations of the progressive urbanization to the trophic state of an urban meromicticlake

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The research covered an urban lake, which in the initial period of research (1950s and 1960s) was located on the outskirts of the city and it was surrounded by an agricultural catchment. It was loaded by the sewage from a pig farm. As a result of urbanization, the direct catchment was diminished (from 55 to 14.3 ha) and transformed. This resulted a long-term tendency in a reduction in nutrients and organic matter loading from thissource.Theoretically the phosphorus supply decreased 3.5 times, but the load, according to the Vollenveider criteria, still exceeded the permissible value. The nitrogen supply was reduced by 5 times. The limitation of water dynamics and transition of the lake to the meromixis state were observed In the early 2000s.
The lake's trophy was characterized by TSI. From 1952, thevisibility of the Secchi disc was measured, the concentration of other parameters on the basis of which the partial TSI was calculated were measured respectively: TN from 1963, TP from 1970,

chlorophyll a from 1978. Based on real data, a highly significant statistical relationship between TSI (SD) and TSI (Chl a) (r = 0.669) was found. On this basis Chl a = -8.7812 SD + 29.245 the missing mean summer chlorophyll concentrations were adjusted. It was shown that in the initial period TSI (SD) <TSI (Chla), which means the dominance of trichomal and cenobial cyanobacteria. At the end of the research period (2021) , small algae limiting visibility were dominant. TN/TP ratio indicated the periodical presence of cyanobacteria.

EP041

Does burial of organic carbon reduce recent atmospheric CO2 concentrations: a case study at a German reservoir

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Reservoirs are a globally relevant source of greenhouse gases (GHG). The emitted GHGs impair the ecological balance of the reservoirs. This can be compensated by high burial rates of organic carbon (OC) in reservoir sediments, which may partially or fully offset the emissions. However, we argue that only the burial of carbon fixed after reservoir construction affects the GHG balance. Here, we took sediment cores from a small reservoir in Germany and determined the radiocarbon age of the bulk OC and in four fractions of the OC after sequential chemical extraction. The bulk OC contained modern carbon fixed after 1950. The OC in the fractions was of different ages. The NaOH-extractable OC (humic acids) was also modern, while the dithionite-extractable OC (bound to reactive Fe) and the OC in the extraction-resistant residual fraction exhibited radiocarbon ages of 240 and of 1000 years B.P., respectively. The combined contribution of the two fractions with aged OC to the total sediment OC was 80%. Likely, these fractions also represent the long-term stable OC. We conclude that only one fifth of the buried carbon in our reservoir originates from the recent atmosphere and can be offset against GHG emissions.

EP004

Analysis of the influence of different meteorological factors on lake surface water temperature across different climates

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Water temperature in lakes depends on many factors influencing the heat exchange between the water body and the surrounding environment. Among the different terms of the heat balance, the net exchange with the atmosphere heavily affects the response of lake surface water temperature (LSWT). Many studies have already assessed the primary role of air temperature (AT). However, how the other meteorological variables contribute to the LSWT response and if the relative importance of these variables depends on the lakes' climatic and morphometric characteristics still require deeper exploration. In order to address these aspects, we exploited the flexibility of artificial neural networks (ANN) in handling the model's inputs and the availability of global datasets for both remotely sensed LSWT and meteorological variables. In our model, we tested the influence of different atmospheric variables from ERA5 re-analysis (from ECMWF www.ecmwf.int), over almost one thousand lakes included in the GloboLakes LSWT dataset (www.globolakes.stir.ac.uk). The analysis was conducted by considering the individual variables and some of their combinations. The preliminary results suggest that the simple model based on day of the year (DOY) and AT already provides satisfactory results. The inclusion of additional meteorological variables (wind speed, shortwave and longwave radiation, specific humidity, atmospheric pressure) and the AT from previous days improves the model performance to a minor degree, with only a reduced variability across the different climate zones.

EP081

Fish scale stable isotopes as potential indicators of nutrient pollution

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Useful bioindicators should provide important clues about the quality of the environment. Here, we evaluated the potential of fish scales as indicators of nutrient pollution. We measured nitrogen and carbon stable isotopes ($\delta^{15}N$ and $\delta^{13}C$) in scales of a generalist fish species, roach *Rutilus rutilus*, taken from a set of 22 Czech reservoirs covering a wide gradient of catchment land use and water quality. We then examined the relationships between roach scale $\delta^{15}N$ and $\delta^{13}C$ and percentage of land in agriculture, human population density, and in-reservoir concentrations of nutrients and chlorophyll-*a*. Roach scale $\delta^{15}N$ values varied by 15‰ among the reservoirs and were strongly, positively associated with the percentage of agricultural land in the reservoir catchment, pointing to agriculture as the dominant source of nitrogen pollution and the key driver of roach $\delta^{15}N$ values. In contrast to $\delta^{15}N$, roach scale $\delta^{13}C$ values were not explained by either catchment characteristics or in-reservoir water quality variables. This suggests that fish scale $\delta^{13}C$ values may not be a suitable indicator of among-system differences in catchment land use and nutrient enrichment. In summary, our findings show that $\delta^{15}N$ values in fish scales are sensitive bioindicators of catchment-derived anthropogenic nitrogen inputs to freshwater ecosystems. We support the $\delta^{15}N$ analysis of fish scales as a promising method for monitoring nutrient pollution in the aquatic environment. The method is fast, relatively inexpensive and non-destructive because scales can be sampled non-lethally.

EP051

Assessing the controls on respiratory quotient across the land to sea continuum

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The respiratory quotient (RQ) is defined as the molar ratio of produced CO_2 and consumed O_2 during the microbial mineralization of organic matter. The resulting RQ value of microbial metabolism is dependant upon the composition of the organic matter and properties of the microbial community. Several studies have examined the controlling factors and the magnitude of RQ, in either terrestrial or in aquatic ecosystems. However broader cross-ecosystem comparisons are lacking, and universal insights into the extrinsic (environmental) and intrinsic (organic matter composition) controls on RQ are missing. To fill this gap, we calculated the RQ by measuring CO_2 production and O_2 consumption across a broad range of environmental samples, including soils, aquatic sediments, peat, lake and marine water, using membrane inlet mass spectrometry (MIMS). Partnered with the CO_2 and O_2 gas measurements, we assessed microbial community-level metabolic profiles using BIOLOG Ecoplates. We also used bomb calorimetry to determine the energy content of organic matter. Preliminary findings indicate that RQ differs among ecosystem types, consistently with the different metabolic fingerprintsof degrader communities. Moreover, the extent of microbial respiration across the different studied ecosystems was correlated with the bulk energy content of the organic matter (MJ per kg organic carbon). We argue that fundamental progress in our understanding of the persistence and decay of organic matter can be gained from cross-system comparison of multiple ecosystems.

EP090

Structure of microbial communities in benthic biofilms of glacier-fed streams from Patagonia, Argentina

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Glacier-fed streams are highly dynamic environments that constitute an important ecological component of the glacial ecosystem. The glacier retreat produces physicochemical and hydrological changes that affect the microbial communities in downstream

habitats. Here, we studied the biofilm community structure in three rivers that drain glacial waters (Tronador Mountain, Patagonia, Argentina). We analyzed environmental variables through the glaciality index, the bacterial community composition by 16S ribosomal sequencing (Next Generation Sequencing), and the presence/absence of functional genes of N cycle in biofilms of the different streams in two sampling occasions (summer and autumn). Ordination analysis (PCA) showed clear segregation of the streams where the glaciality index resulted in the most important variable. The dominant phyla recorded were Proteobacteria, Cyanobacteria, Bacteroidetes and Actinobacteria, however, differences were observed according to the glacial influence. While Cyanobacteria were dominant in the streams with high glacial influence (higher total suspended solids and conductivity), the other stream sectors were dominated by Proteobacteria. We observed the presence of the functional genes Nif H, Amo A bacteria, nrf A and nir S in both seasons, however, nir S was only present in the stream with high glacility influence during summer. Our results showed that changes in glacial retreat would affect the structure of these microbial communities and the potentiality for N metabolism.

EP065

The effects of multiple stressors on biotic interactions in riverine ecosystems: A case study on predator-mediated shifts induced by fish

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Biotic interactions in freshwater ecosystems are frequently modulated via chemical compounds. This is particularly well known for predator-prey interactions, e.g. recognition of fish predators by insects. However, anthropogenic stressors in aquatic ecosystems are suspected to hinder predator recognition. One of the suspected causes is the impairment of the prey physiology or sensory system, resulting in their inability to respond appropriately to predator signals, yet data on the impacts are rare. Therefore, we studied the influence of stressors on these interactions in a stream macroinvertebrate community within a large experimental setup. Using a highly replicated field-mesocosm setup (the so-called ExStream System), we aimed to investigate how single and multiple stressors can affect chemical information transfer networks of predator-prey interactions as well as classical food webs in a full factorial design. The study site is a river section of the Boye, a tributary of the Emscher River, which has been restored since 2017. It was used to test how the increase and release of anthropogenic stressors i.e. increased salinity, reduced flow velocity and increased temperature influence the biotic community. With these experiments, we want to elucidate the influence of stressors on indirect and direct predation effects on macrozoobenthos by introducing kairomone-enriched water or fish predators into the mesocosms. Macrozoobenthos responses will be related to different stressor combinations and may be influenced by already existing resistances due to the years of stressor exposure history of the Boye communities.

EP150

Digital microscopy for diatom-based ecological status assessment – case study two international rivers (Sava and Tisa rivers, Serbia)

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Most international institutions, like the UN, have set the importance of water availability, management and conservation of water resources into focus. Improving ecological research and monitoring of aquatic habitats is undoubtedly a top priority. Diatoms respond quickly to human pressures and have been used for decades as powerful indicators in the assessment of water quality around the world. However, routine biomonitoring is hindered by the time-consuming and challenging nature of taxonomic identification of diatoms. Digital variants of the light microscopy workflow represent an innovative approach to diatom analyses. Digitally controlled light microscopes and collaborative web-based virtual slide annotation are being applied which will allow the processing of large data sets in a shorter period of time, and also create an image archive.

Samples were collected along the Sava and Tisa rivers, from the point of entry into the territory of Serbia to the flows into the Danube (20 localities per river). Diatom samples were collected from different substrates, mud, sand, stones, and macrophytes. Permanent microscopic slides have been scanned at high optical resolution with an Olympus VS-200 slide scanner. The resulting virtual slides were uploaded into BIIGLE 2.0 image annotation system and annotated manually by marking the outlines of individual diatoms and labeling them with a taxonomic name.
The first results of ongoing project show high diatom diversity in both rivers. Some of dominant genera in Sava River were *Achnanthidium*, *Cocconeis*, *Gyrosigma*, *Navicula*, while in Tisa River mostly centric diatoms (*Cyclotella*, *Stephanodiscus*, *Aulacoseira*,...) were dominant.
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EP159

Applicability of advanced molecular tools for river benthic diatom biomonitoring in southern Europe

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The use of bioindicators in river monitoring by morphological identification-based methods has been well developed during the last decades and implemented by European environmental agencies. However, during the last years, the use of molecular techniques based on high throughput sequencing (HTS) for river biomonitoring has become a reliable and cheaper alternative method. Nevertheless, the application of these methods in southern Europe include a very small number of studies applying these molecular techniques. In the framework of the European WATDIMON project, we present the results of DNA metabarcoding for benthic diatoms from rivers of the Açores Islands, as well as from Spanish and Cypriot rivers as part of a West-East Mediterranean gradient, covering four biogeographic regions. Our results show highly similar values of the IPS index when using traditional morphological and molecular approaches reinforcing the feasibility of the proposed molecular methods. However, some problems still need to be addressed prior its implementation as routine method. In some cases, the taxonomy of barcodes in databases is not accurate, the identification at species level shows discrepancies, or some barcodes are missing. Additionally, some problems arise for big-sized diatoms, that resulting in important discrepancies in relative abundance estimations, though this problem could be overcome with the application of biovolume correction factors. This way, metabarcoding approaches using diatoms as bioindicators seems to display less problems for its use than other bioindicators mainly due to well stablished diatom barcode databases, which in some cases includes more than 70% of the most important species used in biomonitoring.

EP028

Impact of climate change on the water column anoxia in a small urban lake

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Urban lakes provide essential ecosystem services (biodiversity, flood attenuation, recreational activities ...). Results presented here relate to anoxia events which occurred during the late summer and autumn 2021, in a small urban lake. This sandpit lake located in the Great Paris region is principally fed by groundwater from the nearby Marne River. It is equipped with underwater continuous sensors (Temperature, Oxygen, Chlorophyll-a, Nitrate). A meteorological station is implemented on a buoy, above the sensor chain. Three whole-lake anoxia were observed from end of August to October. Oxygen dropped from supersaturation to

0% within a few days, leading to massive fish kills. The anoxia events occurred following high peaks of phytoplankton biomass. Over the studied period, the level of the Marne River was higher than usually in late summer. We propose the following scenario to explain the observed anoxia events: (1) a high level of the Marne River sustained a massive phytoplankton production through the groundwater nutrient loading; (2) anoxia was then caused by the oxygen uptake for the mineralization of the phytoplankton organic carbon. This hypothesis is tested using a one-dimensional thermal-biogeochemical model. These results highlight that, beside the impact caused by warmer water temperature and increased thermal stratification, hydrological change can also affect drastically lake ecosystems. More chronic occurrences of this type of hydrological episodes would impair conservation or restoration actions of the ecological status of lake ecosystems.

EP118

The effect of buffer strip size on the ecological state of small ponds in agricultural areas in Belgium and Germany

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Small lentic waterbodies such as ponds have a disproportionally strong contribution to regional biodiversity and provide multiple vital ecosystem services. Yet, they are increasingly exposed to human induced ecosystem alteration, which profoundly undermines their ecological integrity. A large number of ponds in Europe is located in densely populated regions with intensively managed agricultural land. Previous studies have shown that agricultural activities in close proximity of ponds can have strong detrimental impact on the ecological quality of ponds by increasing nutrients loads and favoring phytoplankton at the expense of macrophyte communities. The present study explores the potential of buffer strips to reduce the detrimental impact of agriculture on pond trophic state and biodiversity. More specifically, we investigate the effect of buffer strip size on major pond local environmental conditions, including nutrient concentrations, and the diversity and community characteristics of aquatic plants. We combine data from a stratified survey on 30 ponds along a gradient of land use intensity in both Belgium and Germany. Our preliminary results suggest that even relatively small buffer strips can already be effective in reducing the negative effect of intensive agriculture in close proximity of ponds. This research is part of the EU funded project PONDERFUL in which the role of ponds as nature-based solution for climate change adaptation and mitigation is investigated.

EP106

Climatic and human induced vegetational changes recovered by sedaDNA from Lake Tiefer See, Germany

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Anthropogenically caused climate change strongly affects north-eastern (NE) Germany, resulting in a drier climate affecting the landscape and threatening freshwater ecosystems. Investigating past biodiversity changes in lake sediment cores helps to elucidate effects of former climatic and anthropogenic impacts on the landscape and lakes and supports predictions. This study investigates sedaDNA (sedimentary ancient DNA) as a proxy to unveil past vegetation shifts of lake Tiefer See (Klocksin lake chain, TSK, Germany) throughout the last 11000 years. A combined approach of plant metabarcoding and metagenomic shotgun sequencing revealed an increase in plant richness towards recent times and changes in plant composition. In the early Holocene, plant composition was mainly characterised by herbaceous plants, grasses, and ferns, followed by a shift over rather shrubs towards trees. The first detected tree taxon is *Quercus*, followed by a simultaneous rise of *Tilia* and *Alnus*, supporting earlier findings from palynological studies in NE Germany. Contrary to other studies, *Fagus* only seems to have reached the TSK area in the late Holocene. The rising relative abundance of certain human indicator plants revealed an impact of human activity on the plant composition since the Bronze Age, coinciding with reported phases of higher vegetation openness through deforestation which led to an increased lake circulation. Both sedaDNA approaches show similar results, but metabarcoding revealed higher taxonomic resolution, while metagenomics was more informative in specific plant families, revealing the presence of *Corylus* and *Quercus*. Thus, shifts in the local plant biodiversity could be related to climatic changes and anthropogenic impacts.

EP116

The effect of land use intensity on pond biodiversity and GHG emissions

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Small ponds are important for regional biodiversity and they play a key role in global carbon cycles. In addition, they are abundant ecosystems with well-delineated habitat boundaries, which makes them excellent study systems for metacommunity ecology. Despite their high importance, ponds are increasingly exposed to a variety of human-induced stressors, including land use intensification and pollution. This undermines their ecological state, biodiversity, and their potential role to mitigate and adapt to climate change. Identifying the factors underpinning variation in community composition and C-fluxes in ponds and determining how these relate to land use characteristics at multiple spatial scales are important for the development of effective management strategies. The present study takes a first step in investigating the effect of land use intensity on biodiversity and GHG emission in farmland ponds. Using data from a stratified survey with six ponds along a gradient of land use intensity, replicated over five different regions in Flanders (Belgium), we assess the impact of land use on local environmental pond conditions and cladoceran community characteristics at local and regional spatial scales, quantify spatio-temporal dynamics of greenhouse gas emissions in relation to land use, and explore the association between pond biodiversity and the extent of greenhouse gas emissions. This study is part of the EU project PONDERFUL.

EP177

Comparisons of heliozoan abundance between deep and shallow basins of Lake Biwa with special reference to optimal growth temperature, food resource and habitat use

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The protist heliozoan is an ambush-type predator, ubiquitously distributing in many limnetic systems. However, the ecological information about heliozoans is still limited. In the present study, we followed seasonal changes in heliozoan abundance in deep northern and shallow southern basins of Lake Biwa at pelagic stations between August 2020 and December 2021, compared heliozoan abundance between the two basins and examined the relationship between heliozoan abundance and some environmental variables. We collected water samples twice a month from deep chlorophyll maximum and hypolimnion in the north basin and from the surface in the south basin. In addition, we examined vertical distribution of heliozoans in the north basin by collecting water samples from multiple depths during their blooms in the fall of 2020 and 2021. In both basins, high heliozoan abundances were detected in fall, winter and spring, found in the temperature range between 11°C and 16°C. In the south basin, there was a

significant positive correlation between heliozoan abundance and two-weeks-earlier chlorophyll-a concentration. For the vertical distribution in the north basin, heliozoan abundances were high in the epilimnion and thermocline both of where high chlorophyll *a* concentrations were detected. Those results suggest that phytoplankton are important food resources for heliozoans. Heliozoan abundances in the south basin were higher than those in the north basin, and this may be due to the presence of heliozoan using waterweeds as habitat and the supply of heliozoan through resuspension from lake bottom sediments.

EP011

Diel variation of water column CH_4 and emission fluxes in a eutrophic lake

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Recently, a large amount of methane has appeared in more and more surface aerobic water bodies, but its source is still controversial. This paper provides high-frequency continuous monitoring of CH_4 and $\delta^{13}C\text{-}CH_4$ in stratified lakes during diel variation. The results show that CH_4 is produced in both anaerobic and aerobic environments, but from different sources. For surface aerobic water, phosphorus restriction is the main factor affecting surface CH_4, and the generation of CH_4 may be related to the degradation of MPn. At the same time, we also evaluated the surface CH_4 budget by mass balance, and the results showed that more than 80% of the methane emission in the nutrient-rich Gaoyang lake was caused by surface oxic methane production. For deep anoxic water, POC is the main factor affecting CH_4, which may be related to the traditional methanogenic archaea pathway. In addition to wind speed, we also found that DO was an important driving factor affecting CH_4 emissions from lakes. High concentration of DO inhibits the oxidation of surface CH_4 and promotes the accumulation of CH_4, which explains the phenomenon that the maximum values of chlorophyll a, CH_4 and chlorophyll a are located in the same water layer in many lakes.

EP115

Microcystin-LR accumulation in fish and agricultural crops: implications on public health

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Assessments of the impact of microcystins on human health are mainly focused on acute poisoning from water drinking. However, there are indirect routes such as consumption of agricultural products irrigated with water containing cyanotoxins or eating fish from areas where toxin-producing cyanobacteria are dominant. This work was aimed at to evaluate the dissolved, particulate, and accumulated concentrations of microcystin equivalents-LR in fish and surrounding crops collected from a high altitude waterbody, Lake Zumpango (Mexico City). We further tested whether the microcystin concentrations exceed the permissible limits established by the World Health Organization (WHO) of 0.04 µg/Kg/d for tolerable daily consumption (TDC). Homogenized samples, and microcystins were extracted using a solvent mixture of methanol, water, and trifluoroacetic acid (80/19.9/0.1, v/v/v/v). Microcystins were quantified by the ELISA method after extraction. Dissolved microcystin concentrations ranged from 0.17 to 28.3 µg L^{-1} in the water; however, intracellular concentrations fluctuated from 1.22 to 125 µg L^{-1}. On the other hand, concentrations recorded in the edible musculature of *Oreochromis niloticus* reached contractions of up to 21.2 µg kg^{-1}. The concentrations in tomatoes and beans were 7.6 to 28.9 µg kg^{-1}(wet weight), indicating that more than 72% of the samples exceeded the TDC value, thereby posting a human health risk. The significance of providing evidence to promote the ongoing management of water bodies through permanent monitoring in Mexico is discussed, as well as data on the health risks posed by exposure to cyanotoxins through food.

EP059

Glacier melt-down changes habitat characteristics and unique microbial community composition and physiology in Alpine lakes sediments

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Glacial melt-down alters hydrological and physicochemical parameters in downstream aquatic habitats including lakes and streams. In this study we tested if sediment associated microbial communities respond to the decrease of glaciers and associated meltwater flows in high-alpine lakes and whether the “microbial approach” can serve as an indicator for climate change impacts. We analysed physicochemical and biological parameters of 16 lakes in forefield catchments of three glaciers in the Eastern Swiss Alps. We compared lakes fed by glacier meltwater with hydrologically disconnected lakes, as well as “mixed” lake types. Glacier-fed lakes had a higher turbidity (94 NTU) and conductivity (47 µS/cm), but were up to 5.2°C colder than disconnected lakes (1.5 NTU, 26 µS/cm). Nutrient concentration was low in all lake types (TN <0.05 mg/L, TP <0.02 mg/L). Bacterial diversity in the sediments decreased significantly with altitude. Bacterial community composition was distinctly different between glacier-fed compared to disconnected and mixed water lakes, but not between catchments. Chemoheterotrophic processes were more abundant in glacier-fed compared to disconnected and mixed water lakes where photoautotrophic processes dominated. Our study suggests that the loss of glaciers will change sediment bacterial community composition and physiology that are unique for glacier-fed lakes in mountain and polar regions.

EP069

Do invasive quagga mussels grow faster than zebra mussels? Growth rates of dreissenids under multiple simulated field conditions

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Invasion success is influenced by the traits of the invasive species and the characteristics of the invaded habitat. Invasive organisms often share common traits that make them successful invaders compared to native species and they generally have higher growth rates. To better understand the relationship between growth rates and invasion success of invaders, systematic comparisons between invasive species from the same system are essential, ideally involving species invading the same environment and simulating different habitat conditions. We tested how growth rates differ between two highly invasive dreissenids: quagga mussel (*Dreissena rostriformis bugensis*) and zebra mussel (*D. polymorpha*). We conducted lab experiments by culturing individual dreissenids for around 3 months with *Chlamydomonas reinhardtii* as food, with food obtained from Lake Constance (natural seston) simulating epilimnion or hypolimnion conditions. At multiple time points during the experiments, we measured individual mussel shell length and wet weight. Irrespective of the three simulated environmental conditions, quagga mussels exhibited a significantly higher growth rate than zebra mussels. With green alga as food, quagga mussels‘ growth rate was particularly pronounced, and individual quagga mussel grew more than twice faster than zebra mussel (0.41 ± 0.05 D^{-1}vs 0.18 ± 0.04 D^{-1}, respectively). Under epilimnion and hypolimnion conditions, quagga mussels also grew faster than zebra mussels ($p < 0.001$). Results illustrate differences in biological traits that might contribute to the high competitive ability of quagga mussels, facilitate their invasion success and severity of impacts than the congeneric zebra mussels.

EP122

Lake surface water temperature is a good indicator to evaluate the warmer trend in ice-covered lakes in Tibetan plateau?

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The Tibetan plateau (TP) has the highest alpine lake concentration in the world and contributes more than 50% of the total lake coverage in china. Such a lake-rich region has a significant impact on the regional weather and climate.An obvious warmer trend in lake surface water temperature (LSWT) has been investigated worldwide by numerous studies based on in-situ and satellite-derived lake data.LSWT can show a rapid response of lakes in solar radiation and air temperature.However, lake warming is not only referred to the surface water temperature warming but in fact strongly linked to the total heat content, especially for the ice-covered lake.The lake-ice-atmosphere interaction influencesthe heat content under ice-covered season, and then plays an important role in determining the heat content in subsequent summer. In this study,wefocus on three typical ice-covered lakes inTP(different in the lake area, depth, and salinity), simulated byan ensemble of five vertical one-dimensional hydrodynamic lake models (named LakeEnsembleR including Flake, GLM, GOTM, Simstrat, MyLake), forced by meteorology data from the nearby weather stations, combined MODIS-derived LSWT and observed water temperature profile,to investigate the impact of the ice-covered process on the annual cyclin of energy, and evaluateif LSWT is a good indicator to infer climate-induced lake warming.

EP029

Římov Reservoir dataset – the family silver of the Czech long-term limnological research

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Římov Reservoir is a small, canyon-shaped and meso-eutrophic reservoir that has been sampled at three-week intervals since it was built in the late 1970s. Analysing a multitude of environmental variables, we detected underlying trends, trend reversals and regime shifts. Most of the trend reversals in reservoir hydrochemistry occurred in the late 1980s and early 1990s as a consequence of dramatic socioeconomic changes in the Czech Republic. After a series of heavy rains in the late 1990s, an administrative decision to increase the flood-retention volume of the reservoir resulted in a significant regime shift in reservoir hydraulic conditions in 1999. In the next step, we examined if and how phytoplankton responded to these abrupt changes. We found significant differences in phytoplankton composition among the three periods delimited by these changepoints. Phytoplankton underwent a substantial compositional shift towards a dominance of pennate diatoms. Changes in overall phytoplankton assemblage were driven mainly by hydrochemical (total nitrogen) and hydrodynamic variables (inflow rate, surface level and mixing depth) and less by zooplankton dynamics. Notably, both nutrient input and water regime can be appropriately managed to support valuable ecosystem services provided by phytoplankton in freshwater reservoirs. We also evaluated the impact of extreme weather events on reservoir conditions that resulted in compositional, structural and functional changes and phenological shifts in plankton. We were particularly interested in the differences between dry and rainy years and the impact of flood events on the reservoir ecosystem.

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