SEFS14

14th Symposium for European Freshwater Sciences

July 20-25, 2025, Bolu, Türkiye

ABSTRACT BOOK

Dear Colleagues,

We are pleased to present the Abstract Book of the **14th Symposium for European Freshwater Sciences (SEFS14)**, held at **Bolu Abant İzzet Baysal University, Türkiye, from 20–25 July 2025**.

This volume brings together the abstracts of plenary lectures, oral presentations, and posters that reflect the diversity and depth of current research in freshwater sciences. We thank all contributors for their valuable input, and we are confident that this collection will serve as a lasting record of the stimulating discussions and collaborations that took place during the symposium.

We are grateful to all participants, session organizers, sponsors, and volunteers who made SEFS14 possible.

Best regards,

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Plenary Speakers (A-Z)

Hydrological stress: how and are aquatic invertebrates and ecosystems coping?

Vesela Evtimova[1]

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Abstract

In the age of the so-called Anthropocene, natural hydrological regimes are often modified by numerous factors. In turn, such changes may cause deterioration of habitats, fragmentation of the physical environment, shore instability, decline of food resources or even facilitate degradation of ecosystem integrity and affect various levels of community organisation in aquatic and nearby terrestrial ecosystems. Owing to the projected increase of frequency and magnitude of extreme climatic events, freshwater ecosystems, already damaged by the overuse of water, stand to be affected even further by global changes. This explicates the increased research effort on the responses of aquatic systems to hydrological stress from the second half of the 20th century and even more so over the last decades, the output of which efforts I will briefly review during my talk. I will also present some case studies on the relationships among hydrological regimes/stress, aquatic habitats and invertebrate biota. We will see examples of tools we could employ to better understand the acting mechanisms.

Pattern, process and purpose: Freshwater science and the plight of freshwater ecosystems

Steve Ormerod[1]

[1]Water Research Institute, Cardiff University, Wales, United Kingdom

Abstract

The growing global plight of freshwater ecosystems has brought explicit recognition of the importance of inland waters through the UN Global Biodiversity Framework. Simultaneously, recent decades have seen a progressive shift in the activities of freshwater scientists from fundamental research towards the need to understand and address the many stressors that now affect freshwater ecosystems. This brings challenges, however, because of the large- and long-term nature of the problems we must address. In this contribution, I reflect on four decades of research into global change pressures on fresh waters ranging across pollution, climate change and intensifying land use. I draw to attention to the importance of combining process studies, experiments at varying scales, big data and models to enhance understanding and underpin action. Collaboration across disciplines, sectors and nations offer some of our greatest hopes for safeguarding freshwater ecosystems and their biodiversity for future generations.

Restoration Needs and Challenges in European Rivers: A Bird's-Eye Perspective

Maria Teresa Ferreira[1]

[1]School of Agriculture, University of Lisbon, Portugal

Abstract

Since its inception in the early 2000s, the Water Framework Directive has outlined ambitious goals for improving freshwater ecosystems across Europe. These goals are benchmarked against least-disturbed conditions and rooted in the natural ecological processes and interactions between biological communities and their abiotic drivers. Over the past 20 years, efforts have been made to create a unified approach across member states to characterize biological communities, assess abiotic conditions, monitor relevant indicators, and identify sources of disturbance. Despite these efforts, indicators for target species and habitats continue to reveal a progressive decline. Empirical and predictive trends show only modest improvements in ecological quality across Europe. A key factor behind this limited progress is the failure to adopt a comprehensive riverscape perspective for river restoration. River connectivity improvement in its different dimensions is at its infancy. Additionally, the inability to effectively address socio-ecological systems and human-driven pressures hampers the restoration of ecological processes, making it rare to achieve meaningful restoration at scale despite continuous efforts. The limited capacity of many socio-ecological systems to revert to natural conditions must be factored into quality objectives. Mitigating the impact of human activities should go hand in hand with restoration initiatives to drive transformative changes in landscapes and human behavior. Only by addressing these challenges holistically can significant and lasting improvements in freshwater ecosystems be achieved.

Urban ponds and where to find (and sample) them: using citizen science to survey urban biodiversity

Zsófia Horváth[1]

[1] HUN-REN Centre for Ecological Research, Hungary

Abstract

Globally increasing urbanisation results in rapid environmental changes, including the disappearance and fragmentation of natural habitats. At the same time, urban citizens create green spaces and aquatic habitats for recreational purposes in gardens and city parks. The resulting anthropogenic aquatic habitats such as urban ponds are increasingly considered valuable for biodiversity, but at the same time, systematic large-scale studies that address the ecological role of these secondary habitats are still scarce. Among urban ponds, small garden ponds have been especially neglected, even though they are expected to be the most numerous representatives of urban aquatic habitats. In my talk, I will explore the so-far hidden potential of urban (public and garden) ponds in contributing to urban biodiversity and how we can explore this with the help of citizen science.

Wetlands, our climate allies, and vice-versa?

Antonio Camacho[1]

[1] University of Valencia, Spain

Abstract

Wetlands are strongly active ecosystems from the biogeochemical point of view as the permanent or temporary presence of water allows intense biological processes. Among the biogeochemical processes, carbon fixation and respiration, the later both by aerobic and anaerobic processes, generate fluxes of greenhouse gases (GHG) between wetlands and the atmosphere, thus determining the carbon balances (C-sequestration/releasing) and fluxes of GHG from/to the atmosphere. Originally, and depending on their nature, diverse types of wetlands display different balances, which are mediated by their own ecological features and their interplay with catchment processes, also including groundwater. The rates of these processes may follow a seasonal pattern, since these processes are very much dependent on the temperature and the hydrological conditions. Further, when the natural ecological features are altered, shifts in both the patterns and the processes' rates may occur, usually worsening the climate change regulating service of wetlands. These changes can be better understood by using complementary –omic approaches. Specific active restoration actions, both in the catchment and the wetland itself, can help to recover the natural conditions that emphasize the GHG emissions abatement in wetlands, thus enhancing this ecosystem service. Moreover, the biogeochemical role of wetlands is likely to change under different climate scenarios, which can be modelled to forecast how they could behave in the future. In this talk I shall use this framework to offer an integrative view on how humans and our behaviour towards wetlands (e.g., conservation, restoration) and climate change (e.g. decarbonisation of the economy) can convert these ecosystems in our climate allies.

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Abstracts (Oral & Poster, A–Z)

A century of presence of the invasive catfish (*Silurus glanis*) in the Italian peninsula: a genetic perspective

Antognazza Caterina Maria[1], Čech Martin[2], Nocita Annamaria[3], Baer, Jan[4], Puzzi Cesare[5], Zaccara Serena[1]

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Presenting Author: Antognazza Caterina Maria

Status: Poster presentation

Session Number & Date:

Abstract

Biological invasions are a major component of global change worldwide. In Italy, European catfish Silurus glanis is considered a top-priority invasive fish, with significant management efforts starting to be done only recently. Furthermore, little to no, genetic knowledge is available, although its presence and invasiveness is well documented since its first case in the1930s in the Po River basin, and subsequently it spread throughout the Italian peninsula. Considering the paucity of knowledge on the genetic status of the S. glanis and the urge for focused management plans for controlling the widespread of S. glanis, understanding its introduction dynamics, the population's genetic status and the impact on the local fish community are essential. Knowledge of the population's genetic health of the invasive S. glanis is, therefore, pivotal to help inform both conservation actions targeting native populations and invasive alien species (IAS) management actions targeting specific non-native introduced populations. In this study, the genetic information of non-native populations of S. glanis, both inhabiting lakes and rivers, of four Italian basins was retrieved through the application of two different approaches: i) sequencing of the mitochondrial control region (D-Loop) and ii) genotyping of nuclear DNA at 10 microsatellite loci. Specifically, 11 populations from the Po River basin, one population from the Arno River basin, 2 populations from the Serchio River basin and one population from the Volturno River basin have been sampled in the Italian peninsula, representing invasive populations. Additionally, three populations from non-invasive (native) areas of S. glanis in central Europe (Elbe and Rhine River basins) have also been added to the dataset. Haplotype diversity detected within the analysed basins was high, but with only 3 of the 13 haplotypes detected being shared between the invasive and native areas.

Analysis of molecular variance showed significant genetic differentiation within the populations (FST =0.55; P<0.01). The mismatch distribution indicated a bimodal distribution both considering all populations and the single basins, except for the Serchio River basin which showed a unimodal distribution. Genotyping at 10 microsatellite loci suggested a high genetic variability in all populations, with the level of observed heterozygosity (HO) ranging from 0.98 to 1, and a significant negative value of the inbreeding coefficient (FIS). Genetic clustering analysis, performed to determine the genetic structure of multiple S. glanis populations across Italy and the non-invasive areas, highlighting their potential link, suggested the presence of two main clusters, where the populations sampled in the native areas clustered with the populations from the Serchio and Arno basins. The level of genetic differentiation among the populations was low, both intra- and inter- basin (maximum pairwise FST estimates being 0.20,P<0.01). Overall, the data suggested that the populations of S. glanis in the invasive areas have a good level of variability, a favourable trait for a high potential of colonization. These results contribute to extend the knowledge of the populations of the invasive S. glanis from a genetic perspective. This knowledge is crucial for implementing focused and effective management actions.

A global meta-analysis on using stream ecosystem functioning to quantify restoration success

Mario Brauns[1], Ulrike Haase[2]

[1]Helmholtz Centre for Environmental Research – UFZ

[2]Technical University Dresden

Presenting Author: Mario Brauns

Status: Oral presentation

Session Number & Date: Novel approaches to assess the success of freshwater ecosystem restoration, 16:30-16:45, Thursday 24 July

Abstract

Ecosystem functioning may be a promising tool for evaluating stream restoration success, as it complements existing monitoring and evaluation schemes based on species diversity and community composition. However, we currently lack a systematic comparison of the effect size and effect direction at which functions respond to restoration. Here, we present a meta-analysis of the peer-reviewed literature of direct measurements of nutrient cycling, organic matter dynamics, ecosystem productivity, and food web interactions and the responses of these ecosystem functions to stream restoration. We aim to rank ecosystem functions by their sensitivity to detect changes following stream restoration. By doing this, we improve the development of a comprehensive assessment system to assess restoring success that combines biodiversity and functionality of the stream ecosystem. Additionally, enhancing our understanding of how stream restoration improves ecosystem functionality can assist decision-makers in adapting stream management strategies or planning restoration.

A wet worm is a sad worm: Lumbricid distribution in buffer zone soils in response to water level rise

AM Bakker[1,2], TV van der Meer[1], MHS Kraak[2], PFM Verdonschot[1,2]

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[2]Freshwater and Marine Ecology, IBED, University of Amsterdam

Presenting Author: Annalieke M Bakker

Status: Oral presentation

Session Number & Date: Wetland ecology and management, 15:15-15:30, Tuesday 22 July

Abstract

Riparian buffer zones are proposed as a measure to protect freshwater ecosystems from nutrient influxes from agriculture. Yet, the effectivity of nutrient retention and removal varies greatly between buffer zones. Invertebrates are known to mediate nutrient dynamics of both terrestrial and aquatic ecosystems, but their impact on buffer zone nutrient dynamics is largely unknown. The first step in understanding their role, would be to assess the distribution of the different invertebrate species in riparian buffer zones. Semi-aquatic lumbricid worms are commonly occurring in these temporally variable, and hydrologically dynamic systems. However, little is known about their species composition and burrowing responses to changes in water level and their subsequent effects on nutrient dynamics. Therefore, this research aimed to elucidate how specific worm species respond to the flooding of riparian buffers. To this end, in a mesocosm experiment, we assessed the effects of flooding on worm and burrow distribution. The mesocosms had a small width (1.5 cm), but a large height (50 cm) and length (100 cm), with the front consisting of a glass pane. This allowed for an easy observation of worms and burrows in the mesocosms. The mesocosms were filled with sandy soil taken from buffer zones at an angle, providing a terrestrial-aquatic gradient. A field collected worm community of adults (4 species) was added to the mesocosms. Over a period of two weeks the water level was increased, and worm and burrow position were recorded daily. All worms, even those considered to be semi-aquatic, avoided being submerged and moved upwards as a response to water level rise. Therefore, densities increased in the upper soil layer, but previously constructed burrows appeared to remain intact below the water line. Hence, water level rise induces movement and increases worm density and activity in the upper soil layers, potentially affecting their contribution to nutrient dynamics in riparian buffer zones.

Advances towards the monitoring (MoSTFun) and conservation (FUNACTION) of aquatic fungi

Kristel Panksep[1,2,3], Jennifer Anderson[3]

[1]Estonian University of Life Sciences

[2]University of Tartu

[3]Swedish University of Agricultural Sciences

Presenting Author: Jennifer Anderson

Status: Oral presentation

Session Number & Date: Aquatic fungi and microorganisms in a changing world, 11:15-11:30, Friday 25 July

Abstract

Broadening the evaluation frameworkAquatic fungi (AF) are diverse and important drivers of ecosystem health, but their biodiversity and functional roles remain largely unknown and excluded from mainstream conservation and monitoring efforts. Two multinational initiatives, MoSTFun and FUNACTION, address these gaps. FUNACTION tests the efficacy of existing nature protections and builds the necessary knowledge, tools, and networks to protect AF. By using eDNA metabarcoding and metagenomics approaches, rich metadata, and pan-European sampling, FUNACTION maps and models AF biodiversity in relation to environmental and anthropogenic drivers. Sampling for AF in watersheds from above the Arctic Circle, to northern Portugal, and across a year at a subset of sites, as well as a multinational coordinated decomposition study have now been completed. A 'hot off the press' view of AF diversity and function in Europe will be presented. MoSTFun focuses on developing a comprehensive, cost-effective monitoring framework for AF. It leverages existing resources like DNA archives, integrates cutting-edge -omics technologies, and uses earth observation data to generate standardized biodiversity data and model patterns across space and time. New sampling campaigns for understudied ecosystems (glaciers and estuaries) and deep dives into freezer archives are underway. Both projects emphasize stakeholder engagement, interdisciplinary collaboration, and the training of early-career researchers (ECR). Highlights of these efforts will be presented, including the project's Webinars, collaborative survey, and ECR teams. These projects are generating critical knowledge on AF by utilizing advanced molecular techniques and data integration, ultimately aiming to include AF in routine monitoring programs and develop effective conservation strategies for these vital, yet overlooked, components of aquatic ecosystems. Updates on progress in both initiatives will be presented.

Advancing Fish Monitoring by use of Using Underwater Cameras: Challenges and Insights from Two Case Studies

Zoeter Vanpoucke M.[1], Boets P.[1]

[1]Provincial Centre for Environmental Research

Presenting Author: Zoeter Vanpoucke M

Status: Oral presentation

Session Number & Date: Advances in data analysis and technologies to support freshwater science, 10:45-11:00, Monday 21 July

Abstract

The use of Artificial Intelligence (AI) is increasing rapidly and a multitude of potential uses in biological research seem promising. This is especially the case for the monitoring of fish migration and to assess the effectiveness of fishways, but also to determine the efficacy of fish repelling systems. Automated methods such as fish counters and camera systems that monitor fish movements continuously, combined with automated analysis through AI, seem to be the way forward. Although these methods obtain promising results in controlled laboratory conditions, their in-situ use in natural conditions is more challenging. This study presents insights from two test cases in Flanders (Belgium) where we attempted to combine underwater cameras with AI-driven image analysis to assess fish movement under different ecological conditions. The first case investigated the effectiveness of a nature-based fishway, comparing traditional fyke net sampling with camera monitoring. Results highlight differences in species detection rates and behavioural observations, yet challenges such as image quality under changing natural circumstances, species misclassification, and data processing complexity hindered full automation. The second case study investigated the potential of AI-based analysis to assess the effectiveness of a strobe-light deterrent system to temporarily guide fish away from hydraulic pumps when water levels require their activation. These two case studies illustrate both the potential and the current limitations of AI-driven fish monitoring in the field. Automated image analysis has the capacity to revolutionize freshwater monitoring by reducing manual workload and stress for the observed species, whilst simultaneously increasing data quality and quantity. However, field conditions introduce complexities that require further technological refinement. This presentation will discuss the results, key obstacles and lessons learned. By sharing these experiences, we aim to contribute to the broader discussion on the role of AI in freshwater science and explore pathways for overcoming technical and ecological challenges in automated monitoring.

Advancing Freshwater Conservation in Oil Palm Landscapes: Disentangling Drivers and Identifying Indicators of Stream Health

Jake Dimon[1], Alexandra Zieritz[1], Matthew Johnson[1], Sarah Luke[2], Simon Creer[3], Sivathass Bannir[4], Kashmeetha Pillai[4], Christopher Gibbins[4]

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Presenting Author: Jake Dimon

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 11:00-11:15, Monday 21 July

Abstract

Globally, biodiversity loss is greatest in freshwaters, where multiple stressors act synergistically on species-rich ecosystems. Tropical freshwaters experience particularly high rates of biodiversity loss, with an extraordinary concentration of endemic species being subject to rapid rates of habitat loss and degradation. The situation is particularly severe in Sundaland, spanning the Malay peninsula, Borneo, Sumatra, Java and several smaller islands, where large-scale replacement of tropical rainforest to Oil Palm Plantations (OPPs) arguably presents one of the main drivers of freshwater biodiversity loss. Existing research indicates that impacts of OPPs on streams and rivers include increased sedimentation, temperature and input of pollutants, ultimately altering and reducing freshwater biodiversity and population sizes. Whilst riparian buffer zones are now a legal requirement within OPPs to mitigate these impacts, many OPP rivers and streams still lack appropriate buffer zones. In addition, it is currently poorly understood how other aspects of management and characteristics of OPPs and the wider river catchment affect OPP stream health. This study aims to fill this research gap by elucidating the relationships among catchment land-use types, riparian and aquatic habitat characteristics (including vegetation cover and anthropogenic modifications), indicators of water quality (including nutrient concentrations), and benthic biodiversity. By generating and analyzing data from 43 sites across Peninsular Malaysia at different spatial scales, our study quantifies the relative importance of catchment, riparian and in-stream characteristics in determining different aspects of stream ecological health. To overcome current challenges with morphology-based taxonomic identifications of invertebrate species in the region owing to a lack of taxonomic research and expertise, here, we use a DNA bulk metabarcoding approach to describe benthic biodiversity; this approach generates extensive, high-

resolution community datasets, including meiofauna not identifiable under a light microscope. Finally, acknowledging the importance of future research and monitoring of OPP streams, we assess the capacity of Odonata (dragon- and damselfly) nymphs – which are relatively easy to identify and ubiquitous across OPP streams – as bioindicators of tropical OPP stream health. Our findings may contribute to the field of evidence informing sustainable certification schemes, such as the Round Table on Sustainable Palm Oil (RSPO), and provide an evidence base for a rapid and scalable biomonitoring technique in OPP streams, imperative under increasing international pressure to reduce the environmental costs of palm oil production. Findings may provide a baseline for the development of a reliable and cost-effective bioindicator protocol, for which odonate specimens can be sampled and identified with relatively low effort and without specialist knowledge or resources. Such a bioindicator could be particularly useful for smallholder plantations lacking financial resources.

Allelopathic interactions between *Cladophora glomerata* and *Lemna minor*: a model of competition in an aquatic environment

Julia Gostyńska[1], Beata Messyasz[1]

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Presenting Author: Julia Gostyńska

Status: Oral presentation

Session Number & Date: Aquatic and riparian vegetation, 16:30-16:45, Thursday 24 July

Abstract

Competition is a complex mechanism resulting from variability of access to resources across space, time, and between species, as well as from different properties of these resources. It is widely acknowledged that allelopathic interactions contribute to resource competition and can also be a defense mechanism among species in aquatic ecosystems. However, the mechanisms of species coexistence remain poorly understood, particularly in in situ studies. The aim of this study is to investigate the interactions between the macroalgae Cladophora glomerata (L) Kütz. and the macrophyte Lemna minor L. in an aquatic ecosystem, with particular emphasis on allelopathic interactions. We examined the total phenol content from water and extracts of the studied species, the size of mats of the studied species, and physicochemical variables over two growing seasons 2022-2023. This study revealed allelopathic interaction, with *C. glomerata* dominating from May to mid-July (mean mat size 0.28-0.75 m^3) with the highest mean phenolic concentration (17.15 mg GAE g^{-1}). As macroalgae populations aged and phenolic concentration decreased, L. minor gained competitive advantage and dominated from late July to September (mean mat size 0.26-0.70 m^3). The SEM model showed that phenolic compounds contained in water played a pivotal role in this interaction, showing a strong positive effect (0.763) on macroalgae mat size and a strong negative effect on macrophyte mat size (-0.52). The studied species showed differential responses to environmental parameters: chlorophyll-a stimulated *C. glomerata* growth, while N-NH4+ positively influenced L. minor development. These findings suggest a model of chemical-mediated temporal niche partitioning, in which allelopathic interactions enable stable coexistence of competing species. The inverse relationship between dominance models and contrasting responses to phenolic compounds provides new insights into how aquatic plants adapt their growth strategies to minimize direct competition through temporal separation of peak growth periods.

An empirically derived riparian forest preference index for lowland stream macroinvertebrates

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Presenting Author: Leon A.H. van Kouwen

Status: Poster presentation

Session Number & Date:

Abstract

Over the past centuries, many of the forests that once dominated lowland stream watersheds have been degraded or were replaced by agriculture. This has reinforced multiple stressors, like nutrient enrichment, hydromorphological degradation, and toxic pressure, which in turn caused severe biodiversity losses. Stressor-specific macroinvertebrate indices are frequently based on expert-judgement, and linked to in-stream environmental conditions, while an empirically derived index that directly assesses forest cover and quality in the riparian zone, is currently lacking. Therefore, we derived a riparian forest preference (RFP) index for lowland streams, focusing on the orders of Ephemeroptera, Plecoptera, and Trichoptera (EPT), well-studied groups due to their sensitivity to a variety of stressors. We collected EPT presence-absence data from 1,993 sites in the Netherlands, spanning the period from 2010 to 2022, and linked the data to land use at spatial scales ranging from 15 to 500 m around 125 m stream segments. Boosted regression trees (BRTs) showed that riparian forest was the strongest predictor of species presence, especially at the smallest spatial scale of 15 m around the stream segment. We then derived species-level RFP (RFPspec) values for 47 of the species. Of these species, 70 % exhibited positive RFPspec values, indicating a preference for forested riparian zones. Subsequently, assemblage-level RFPasbl index values were calculated for 1,420 validation samples, using an absence-presence and weighted abundance method. The RFPasbl index values strongly increased with increasing forest cover for both methods, underscoring the importance of restoring riparian zones close to the stream. Classical indices related to in-stream conditions responded less strong, as they are only indirectly linked to forest cover. It is concluded that the RFP index can be used well to guide and monitor lowland stream riparian forest restoration measures to restore biodiversity, partly bypassing the complications that accompany single stressor diagnosis in a multiple stressor environment.

Annoted checklist of non-native fish in Hungary: the rise of aquarium species

Péter Takács[1, 2], Bálint Bánó[1, 2, 3], István Czeglédi[1, 2], Réka Pallos[1, 2, 4], Tibor Erős[1, 2], András Weiperth[5, 6, 7]

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Presenting Author: Péter Takács

Status: Poster presentation

Session Number & Date:

Abstract

In our work the updated checklist of non-native fish species occurring in Hungarian natural waters is presented. For the database compilation, literature reports, validated occurrence data published by citizen science contributors (e.g., anglers), and our own unpublished faunistic data were used. In addition, by analyzing the taxonomic, original range, and spatial occurrence data of the species in question, we also present current invasion trends and distribution patterns. The occurrence of species shows an exponentially increasing trend, with 89 out of the 130 registered species and hybrids appeared in the last 24 years. Most of the new species are thermophilic aquarium species, belonging to the orders Cichliformes (39%) and Siluriformes (29%). Recently, five species from the Anabantiformes order have emerged, posing a significant threat to the native fish fauna of Hungary. Spatial data analysis indicates that the most important introduction hotspots are currently found in some thermal habitats (mostly spa outflows), especially in the capital of Hungary (Budapest), and Lake Hévíz. Due to ongoing global warming, heat-impacted stream and river stretches may serve as starting points for new invasions in the near future. This assumption is supported by the recent distribution of toothcarps (Cyprinodontiformes), as acclimatized stocks released from warmwater habitats are likely to overwinter in temperate water bodies as well.

Aquatic–terrestrial linkages drive contrasting biodiversity patterns in tropical and temperate forests

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Presenting Author: Pavel Kratina

Status: Oral presentation

Session Number & Date: Emerging aquatic insects in terrestrial landscape, 15:45-16:00, Thursday 24 July

Abstract

The impact of aquatic resource -inputs on terrestrial communities is poorly understood, particularly in the tropics. We used stable isotopes to track aquatic prey use and quantify impacts on trophic structure in 240 riparian arthropod communities in tropical and temperate forests. We then linked these data to changes in riparian community composition and biodiversity patterns. Riparian predators consumed more aquatic prey and were more trophically diverse in the tropics than temperate regions, indicating tropical riparian communities are both more reliant on, and impacted by, aquatic resources than temperate communities. Although aquatic resource use declined strongly with distance from water, we observed no correlated change in trophic structure, suggesting trophic flexibility to changing resource availability within riparian predator communities in both tropical and temperate regions. We did observe distinct, systematic shifts in riparian community composition with distance from water. This was driven by predatory spiders in the tropics, reflecting their greater reliance on aquatic prey, but by non-predatory taxa in temperate sites, reflecting an aquatic influence other than resource -inputs. Our findings suggest aquatic resource -inputs are more important for riparian communities in the tropics, making them more vulnerable from disruptions to aquatic-terrestrial linkages caused by future environmental change.

Are quagga mussel invasion effects on ecosystem functioning exacerbated by heatwaves?

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Presenting Author: Mandy Velthuis

Status: Oral presentation

Session Number & Date: Invasive species in freshwater ecosystems, 11:30-11:45, Friday 25 July

Abstract

Lake ecosystems are sentinels to environmental changes. With the projected climatic changes, heatwave occurrence is expected to increase in the coming decades. Simultaneously, dreissenid mussels are one of the most troublesome freshwater invasive species, causing a variety of issues and affecting lake ecosystem functioning. While the knowledge on either single-stressor effects is well embedded in literature, the combined impacts of dreissenid mussels and heatwaves are less often studied. Thus, studying their combined potential impacts improves our understanding of these ecosystems in a changing world. In a 3-week mesocosm experiment, we therefore investigated the individual and combined effects of the introduction of an invasive mussel species (Dreissena bugensis) and a +7 degrees heatwave on freshwater ecosystem functioning. A combination of high-frequency measurements of oxygen concentration and daily measurements of GHG emissions and chlorophyll-a concentration was carried out. Throughout the experimental duration, chlorophyll-a concentrations were low (<15 µg/L), and no effects of mussel or heatwave treatment on chlorophyll-a dynamics were detected. During the heatwave period, both CO_2 and CH_4 emissions significantly increased, while oxygen concentrations decreased drastically. Due to temperature-induced mussel die-off, anoxic conditions were reached in the dreissenid treatment at the end of the heatwave. These results suggest that both invasive species as well as heatwaves can have strong effects on freshwater ecosystem functioning. In a changing world, these results may imply temperature-driven increases in GHG emissions from lake ecosystems, as well as prolonged hypoxic periods.

Assessing benefits of freshwater ecosystem restoration with an integrated biophysical – economic modelling framework

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Presenting Author: Sien Kok

Status: Oral presentation.

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 16:15-16:30, Tuesday 22 July

Abstract

Freshwater ecosystems are rich in biodiversity and provide essential ecosystem services. Their degradation affects species' habitats and the delivery of these services. Nature-based solutions (NBS) offer ways to restore ecosystems and/or mitigate issues like flood, poor water quality and drought risks. To scale up and finance NBS, it is crucial to quantify their benefits in both biophysical and monetary terms. Cost-Benefit Analysis (CBA) is often embedded in planning frameworks in water management and allocation of (public) funds or loans may be subject to criteria related to CBA results. As such, CBA can be fundamental to developing implementable investment programs or projects. However, quantifying the wide array of benefits delivered by NbS is challenging due to complex biophysical and social processes and the lack of accessible modelling tools and data. As a result, CBAs often fail to capture the full range of ecosystem services and benefits, putting NBS at a disadvantage compared to traditional grey infrastructure solutions. The MERLIN project (Mainstreaming Ecological Restoration of freshwater-related ecosystems in a Landscape context: INnovation, upscaling, and transformation) showcases NBS for freshwater ecosystem restoration through 18 European case studies. Within this project, a framework was developed that combines biophysical and economic modelling to provide an accessible solution for quantifying and monetizing the benefits of freshwater ecosystem restoration at the catchment/ landscape level. This framework is designed for easy applicability across Europe, using continent-wide datasets to provide default values. It integrates the latest version of the Soil and Water Assessment Tool (SWAT+) with a set of ecosystem service valuation models based on hydrological model results. Currently, the framework allows for the quantification of economic benefits from flood risk mitigation and water purification resulting from various restoration measures such as peatland rewetting, river restoration, and floodplain reconnection.

In this presentation, we introduce this modelling framework and demonstrate its application in the MERLIN case study of peatland rewetting in the Forth catchment (Scotland, UK). A SWAT+ model of the catchment is created in which restoration measures are simulated. The resulting output variables are used to model the economic benefits of flood risk mitigation and water purification and carbon sequestration, compared against the costs. The results highlight the economic benefits of restored peatlands, underscoring the value of NBS in ecosystem restoration. To test the framework's robustness, the sensitivity of outputs to different data sources (local vs. EU-wide) is examined.

Assessing coastal wetland restoration through DNA-based microbial indicators of carbon-related functions

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Presenting Author: Antonio Picazo

Status: Poster presentation

Session Number & Date:

Abstract

European coastal wetlands play a key role in carbon storage and greenhouse gases (GHG) regulation, but many of them have been degraded by human activities such as land-use change, hydrological alteration, and organic pollution. Wetland restoration is increasingly promoted as a nature-based solution to enhance carbon sinks. However, evaluating restoration outcomes remains challenging due to the wide variety of wetland types, limited ecological data, and the absence of broadly applicable, reliable indicators. As part of the RESTORE4Cs project, we investigated how conservation status influences microbial communities and their potential metabolic functions across six European coastal wetlands, selected as pilot sites for their contrasting climatic, geomorphological, and

ecological characteristics. Each wetland included study subsites representing different managemen and status conditions: well-preserved, altered, and restored. Water and sediment samples were collected seasonally from these subsites. Microbial community composition was analysed using 16S rRNA gene sequencing (Illumina MiSeq), and potential functional profiles were inferred based on the resulting assemblages. Preliminary analyses reveal clear inter-wetland differences in microbial community structure, primarily reflecting the distinct typologies and ecosystem functioning of each studied wetland, regardless of the conservation status of individual subsites. Another general pattern observed was that sediment communities exhibited greater stability and site specificity than those in the water column, which appeared more influenced by seasonal dynamics. Still, intra-wetland differences were, in some cases, associated with subsite conservation status and were further reflected in the predicted metabolic pathways involved in carbon processing and turnover. This study highlights the potential of DNA-based data on microbial communities as sensitive indicators of wetland condition, ecosystem functioning, and their capacity to act as carbon sinks. Based on our findings, we propose candidate microbial indicators to support the assessment of restoration progress and ecosystem health. These indicators are particularly relevant for evaluating climate-related functions within the RESTORE4Cs project, especially those linked to carbon sequestration, which were contrasted with direct measurements of GHG fluxes conducted in parallel. They may also be applicable to broader wetland monitoring and restoration efforts across Europe. While this approach appears useful, we also acknowledge certain limitations, which we aim to help clarify through this study.

Assessing impacts of small stream restoration with Nature-based Solutions, a Scottish case study

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Presenting Author: Justyna Olszewska

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:30-11:45, Tuesday 22 July

Abstract

River engineering activities and alterations of rivers and their floodplains have resulted in the widespread decline in river habitats and modifications to the natural hydromorphology of riverine ecosystems across Europe. Allan Water is a small river in a Forth catchment in central Scotland, which was heavily modified to support a growing number of farms and mills. The restoration of Allan Water scheme has used a range of Nature-based Solutions to restore connections between the river and its floodplain, to contribute to natural flood management and the restoration of valuable wetland habitats, enhancing biodiversity and resilience to climate change. The restorations measures included woody debris installation in the river channel to slow the water flow and create diverse habitats for wildlife, and a removal of an engineered "bank protection" to reconnect the floodplain. The restoration of the floodplain focused on re-directing and blocking historic drainage ditches to increase the retention of water in the floodplain and creating wetland scrapes to boost biodiversity. A key aspect of freshwater restoration projects is to monitor and evaluate the broad effects of restoration actions. The ability to demonstrate effectiveness of natural flood management measures is vital in encouraging further investments in natural flood management and in informing other projects which aim to upscale the restoration across the Forth region. However, despite a growth in interest in freshwater ecosystem restoration, assessing effectiveness of restoration projects continues to prove a challenge. Our study aims to investigate the effects of the restoration measures applied in the Allan Water catchment. We use a monitoring framework developed as part of the European project MERLIN to evaluate environmental, social and economic impacts of the implementation of nature-based solutions. The monitoring strategy included an evaluation of biodiversity net gain, flood resilience, climate change mitigation and inclusivity, which are the main European Union Green Deal (GD) goals. The use of the MERLIN shared monitoring framework indicators enhanced the degree of comparability with other

freshwater restoration case studies in Europe, allowing us to investigate how the geographical or political contexts and the scale of the restoration measures can affect impact.

Assessing nutrient pressures in non-perennial rivers and streams using dry-phase plant communities

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Presenting Author: Rachel Stubbington

Status: Oral presentation.

Session Number & Date: Science and management of non-perennial rivers and streams, 15:15-15:30, Thursday 24 July

Abstract

Non-perennial rivers and streams (NPRS) are diverse and widespread in cool, wet temperate countries including England. Here and around the world, NPRS are exposed to multiple anthropogenic pressures including enrichment by inorganic nutrients. Regulatory agencies therefore need to collect data enabling assessment of nutrient pressures in both wet and dry NPRS channels. While aquatic plant communities are routinely used to monitor nutrient pressures, their species die back during dry phases, while terrestrial plants colonize. We therefore developed a method using dry-phase plant communities—comprising persisting aquatic taxa and colonizing terrestrial taxa—to assess nutrient pressures across England's NPRS, including sites spanning alkalinity, altitude and nutrient-pressure gradients. We investigated the responses of metrics representing community richness, cover, diversity and nutrient tolerance to predictors based on nitrogen and phosphorus concentrations, and their interactions with alkalinity, altitude and shade. Our aim was to identify metrics with consistent, strong, non-interacting responses to nutrient-based predictors. Nutrient-tolerance scores were particularly responsive to nutrient concentrations, although alkalinity affected many relationships. We recommend considering a cover-weighted nutrient-tolerance score alongside a metric of taxonomic richness (as a measure of confidence) in dry-phase nutrient-pressure assessments. Our results also demonstrate the considerable contribution that terrestrial plants make to the total biodiversity of NPRS. As these dynamic ecosystems increase in extent due to global change, our methods could enhance programmes that support biomonitoring of their ecological health.

Assessing River Restoration Support in the 2023-2027 CAP: An Analysis of Conditionalities, Eco-Schemes, and Agro-Environmental Measures Across 28 EU Member States

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Presenting Author: Teresa Ferreira

Status: Oral presentation

Session Number & Date: Integrating international policies to support achievement of environmental quality objectives, 11:15-11:30, Thursday 24 July

Abstract

The 2023-2027 Common Agricultural Policy (CAP) reform was introduced with an increased focus on environmental sustainability, biodiversity conservation, and climate resilience. At the same time, the EU Restoration Law (2024) has set ambitious targets for restoring degraded ecosystems, including freshwater environments. Given that agriculture significantly impacts river systems, CAP funding could play a crucial role in supporting river restoration. This study systematically examines the 28 CAP Strategic Plans, assessing whether conditionalities, eco-schemes, and agro-environmental measures (AEMs) provide targeted support for key river restoration activities, including bank stabilisation, channel reconfiguration, hedgerow planting, ditch management, pond creation, river plant management, river area exclusion, passive restoration, floodplain reconnection, dam removal/retrofit/fish passage, and minimum flow requirements. Our analysis finds that direct support for river restoration is minimal across CAP mechanisms. Eco-schemes, designed as annual voluntary payments for climate and environmental benefits, rarely include measures explicitly linked to river restoration. While some eco-schemes encourage hedgerow planting, permanent grass strips, or wetland conservation, they do not systematically target riparian restoration, floodplain reconnection, or fish passage improvements. Agro-environmental measures offer slightly more relevant support, particularly through riparian buffer zones, water retention measures, and wetland restoration, but these interventions remain underfunded and lack a coherent EU-wide approach. Conditionalities and GAEC (Good Agricultural and Environmental Conditions) standards provide only indirect benefits, such as fertilizer restrictions, soil protection measures, and wetland preservation, but do not require or incentivize active river restoration. This limited CAP support is concerning given the ambition of the EU Restoration Law, which mandates large-scale restoration of freshwater ecosystems, including the removal of significant barriers to fish migration and floodplain reconnection. The results highlight a policy gap between agricultural funding and

environmental restoration targets. Without stronger CAP alignment with EU environmental objectives, key restoration efforts will remain underfunded and fragmented. To address this, we propose: (1) expanding eco-schemes to explicitly include river restoration measures, such as riparian buffer rehabilitation, floodplain reconnection, and fish passage restoration; (2) increasing financial support for AEMs targeting wetland restoration, bank stabilization, and natural water retention measures; and (3) improving policy coordination between the CAP and the Water Framework Directive (WFD) to ensure agricultural subsidies contribute to achieving freshwater restoration goals. These adjustments would allow the CAP to better align with EU ecological restoration objectives while maintaining its role in supporting sustainable agriculture.

Assessing the effectiveness of restoration measures in Batata Lake - Amazon, Brazil

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Presenting Author: Caio Graco-Roza

Status: Poster presentation

Session Number & Date:

Abstract

Batata Lake, located in the Amazon floodplain of the Trombetas River basin in Brazil, was subjected to a decade-long influx of bauxite tailings from 1979 to 1989, covering approximately 30% of its area and causing significant alterations to its limnological and ecological dynamics. This anthropogenic disturbance resulted in a thick, compacted sediment layer, reduced water transparency, and changed nutrient cycling and biotic communities, including benthic invertebrates, plankton, and riparian vegetation. Over the past 35 years, a Long-Term Ecological Research program has systematically monitored the lake's physical, chemical, and biological variables to elucidate its ecological trajectory and assess environmental recovery. Comparisons have focused on a reference and impacted stations where periodic resuspension of tailing particles still elevates turbidity, particularly during distinct hydrological phases (flood, high-water, ebb, and low-water). Notably, evidence of ecological recovery has emerged, such as the gradual increase of organic matter in sediments and partial reestablishment of benthic and planktonic assemblages. Nevertheless, residual impacts persist, as the compacted tailing layer continues to impair habitat complexity and inhibit the full return of native vegetation. To quantify how impacted stations approximate reference conditions, we developed a framework to calculate the Ecological Recovery Index (ERI). This index integrates key limnological variables across a moving window from 1989 to 2023. The index is based on probabilistic hypervolumes built from Principal Coordinates Analysis. From these hypervolumes, we extracted the minimum distance between the hypervolumes before overlap, the amount of overlap whenever occurs and the distance from the hypervolumes centroids. These values fed into a specialized formula that computes the ERI, reflecting the convergence of impacted stations toward reference conditions. The results reveal a clear trend of partial recovery over consecutive five-year intervals. However, episodic resuspension and increased turbidity driven by hydrological variability and extreme weather events still influence the lake's dynamics. An interactive R Shiny application was developed to visualize and analyze these results, enabling users to select specific variables for evaluation. Continued monitoring efforts remain essential, particularly in light

of ongoing mining activities in the Amazon region and broader challenges such as climate change. Ultimately, this study highlights the resilience of floodplain ecosystems and underscores the complexity of restoring them to pre-impact states under extensive anthropogenic pressures.

Assessing trends in aquatic biodiversity: the UK example of repurposing monitoring data to measure biodiversity change against legally binding targets

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Presenting Author: Iwan Jones

Status: Oral presentation

Session Number & Date: Integrating international policies to support achievement of environmental quality objectives, 11:30-11:45, Thursday 24 July

Abstract

In 2021 the UK government passed the Environment Act. This ground-breaking legislation made the UK the first country in the world with a legally binding commitment to halt biodiversity loss. Under the Act, government must halt the decline in biodiversity by 2030 and increase biodiversity by at least 10% by 2042. To measure progress against these commitments, a robust measure of biodiversity change is required. Change in species populations is the most sensitive measure of biodiversity. Until recently, our understanding of change in species populations in the UK was constrained to relatively few taxonomic groups and habitats, presenting a biased view of change in the British countryside. In order to understand long-term trends in populations of native, aquatic species we examined biological data collected from rivers, estuaries, and coastal waters by the regulatory environmental authority as part of their efforts to monitor pollution. By screening data to select sites that had been repeatedly sampled we were able to identify 235 species of native aquatic invertebrate and 37 native species of fish for which robust data on change in abundance over time were available (since 2013 for invertebrates, and since 2000 for fish). These data indicate that biodiversity in English rivers has improved over time (since a probable low in the 1980s). More species of native aquatic invertebrates are increasing in abundance than are declining. However, although resident fish species are increasing in abundance, migratory fish species are declining in abundance. Trends in these aquatic species are now included in the overall measure of biodiversity, the D4 indicator, an official statistic in development and the statutory instrument to measure biodiversity change against the targets of the Environment Act 2021. This example from the UK is presented as potential way to repurpose monitoring data collected for the WFD and similar obligations in order to determine change in aquatic biodiversity across Europe.

Assessment of the influence of species traits-environmental variables associations on the non-marine ostracods (Crustacea) occurrence and abundance

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Presenting Author: Mehmet Yavuzatmaca

Status: Oral presentation

Session Number & Date: Freshwater biodiversity - status, advances & future priorities, 15:30-15:45, Monday 21 July

Abstract

The relationship between species' traits and environmental variables is essential for assessing species-environment associations. In this study, 122 aquatic sites across eight habitat types were sampled between April 29 and May 4, 2023, to investigate trait-environment interactions affecting ostracod abundance in Manisa Province. From 86 of these sites, 62 taxa were recorded: 42 extant species, four unclassified living forms, and 16 subfossil taxa. Canonical Correspondence Analysis identified manganese (Mn^{2+}), electrical conductivity (EC), and potassium (K^{1+}) as the top three among 13 influential environmental variables. Trait-abundance analyses showed that the combination of three biological traits, swimming setae on the second antennae (A2), furca, and carapace length, explained a significant portion of the abundance variation, with a Fourth Corner correlation of 60%. The first axis of double-constrained correspondence analysis (dc-CA) explained 35.7% of trait-environment variance. All traits and 13 environmental variables explained an equal share (23.7%) of the total inertia in ostracod abundance data. The first dc-CA axis indicated that lotic habitats favored species with reduced A2, while smaller-bodied species were associated with gradients of pH, x53 grain size, Mn^{2+}, and x1000 grain size. A negative binomial (NB) model showed strong associations between species abundance and Mn^{2+}, pH, habitat type, and water temperature. Fourth Corner analysis using a NB Generalized Latent Variable Model (NB-GLLVM) revealed that flagelliform furca was negatively correlated with EC and dissolved oxygen, but positively with K^{1+}. A2 was positively correlated with habitat type and EC but negatively with x250 grain size. Body length showed a negative correlation with Mn^{2+} and a positive one with x1000 grain size. Among all traits, body length was the most influential in explaining ostracod abundance, followed by A2 and furca. These results emphasize the importance of functional traits in understanding ecological preferences and guiding biological monitoring.

Australian lungfish, a prehistoric fish with modern day problems

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Presenting Author: Colin L Burke

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 15:15-15:30, Tuesday 22 July

Abstract

The Australian lungfish, an endangered species and one of the oldest extant vertebrates, is critically dependant on macrophyte habitats for foraging, spawning sites, and juvenile refuge. Macrophyte habitats are increasingly under threat by river fragmentation, impoundments, and variable extreme climate events. Frequent and intense floods can scour the riverbed, removing all plants and disrupting seedbanks with recovery dependant on unimpeded hydrochory (the dispersal of propagules through flow) from upstream river reaches. Dams can inhibit macrophyte recovery by disrupting natural hydrochory by limiting the dispersal of propagules along the river network, retaining them within the impoundment. The mid-Brisbane River is a critical section of habitat that historically contained abundant macrophyte habitat for the Australian lungfish. In more recent times this section has experienced dramatic declines in macrophyte habitat following major flood events in 2011 and 2022. To assess the recovery of macrophyte habitat we conducted annual quantitative surveys of macrophyte distribution and abundance across the Brisbane River system from 2022–2024 and compared this to historical coverage datasets. We also assessed the effect of the dam on macrophyte dispersal and recovery downstream, by monitoring macrophyte propagule dispersal rates above and below the dam over the course of a year. From our surveys, we determined that macrophyte cover remains low downstream of the dam and macrophyte abundance has not returned to pre-flood coverage at any of the monitored locations. Propagule dispersal rates indicate that under baseflow conditions, propagule transport rates upstream of the dam are limited, with Vallisneria nana and Potomageton crispus dominating. In contrast, we did not collect any macrophyte propagules downstream of the dam, suggesting that the impoundment impedes macrophyte recovery via trapping and storage of propagules. In response, we actively transplanted six 60-m2 fenced exclosures of V. nana to aid in restoration below the dam by providing a source of propagules. These plots successfully established within 5 months, however, aquatic grazers significantly reduced cover upon removal of the exclosure fencing to negligible levels. Collectively, these results highlight the challenges

of achieving macrophyte recovery in the face of repeated and persistent disturbance events and the loss of river connectivity due to dams. Further research is required to identify effective habitat restoration strategies to support the conservation of the Australian lungfish.

Balancing navigation and habitat conservation: The role of islands and their restoration possibilities in the River Danube

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Presenting Author: Tibor Erős

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 15:15-15:30, Tuesday 22 July

Abstract

Islands play a crucial role in maintaining the hydro-morphological diversity of the main channel in large river systems. They also serve as keystone structures that support a variety of aquatic, semi-aquatic and terrestrial species. Their geodiversity fosters habitat heterogeneity, which is essential for the persistence of ecologically valuable taxa. However, river regulation practices, including the construction of groynes, embankments, and other navigation-facilitating structures, pose a significant threat to these islands. These interventions accelerate island succession, promote the siltation of side arms, and ultimately lead to the integration of islands into the riverbanks, thereby reducing channel width and altering natural flow dynamics. To address these challenges, restoration strategies must be carefully designed to reconcile the needs of both navigation and biodiversity conservation. In this study, we give case study examples about the geomorphological evolution of Danube islands, their role in maintaining geodiversity, and their ecological significance through the analysis of fish assemblage-habitat relationships. By assessing species composition and habitat preferences, we provide insights into how island loss affects aquatic biodiversity. Furthermore, we present lessons learned from a prior island restoration project, highlighting the potential for nature-based solutions that

preserve both navigation efficiency and ecological integrity. We explore restoration measures such as controlled sediment management, reactivation of side arms, and engineered structures that enhance habitat complexity without compromising navigation routes. These strategies offer practical implications for river management, demonstrating that island conservation and restoration can be integrated into broader river regulation frameworks. This study underscores the importance of maintaining hydro-morphological diversity in large rivers like the Danube and offers a pathway towards more sustainable river governance that supports both biodiversity and navigation interests.

Behavioural responses of the European mudminnow to competition and predation in a habitat invaded by Amur sleeper

Bálint Preiszner[1], Bálint Bánó[1], István Czeglédi[1], Tibor Erős[1], Tomasz Kakareko[2], Jaroslaw Kobak[2], Péter Takács[1], Mateusz Augustyniak[2]

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Presenting Author: Bálint Preiszner

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 15:45-16:00, Thursday 24 July

Abstract

The European mudminnow (*Umbra krameri*), a globally threatened fish species, is increasingly forced to coexist with the invasive Amur sleeper (*Perccottus glenii*), its competitor and potential predator. Invasive species often disrupt native ecosystems by altering habitat use, competition dynamics, and predation pressures. To better understand the behavioural implications of this invasion, we conducted a series of aquarium experiments comparing both species. Behavioural differences along the boldness–shyness continuum between individuals can influence competitive outcomes and survival strategies. Our first objective was to assess whether European mudminnows and Amur sleepers differ in boldness and whether prior experience with the invasive species affects the behaviour of the mudminnow. We tested individuals from populations with and without prior exposure to Amur sleepers, measuring boldness through standardised behavioural assays. Additionally, we evaluated the hormonal stress response of the populations to determine whether the invasive species imposes a physiological burden on the native fish. Beyond individual traits, direct interactions between the species may shape the invasion outcome. The Amur sleeper is considered as a facultative piscivore, and the literature describes cases where it has preyed on the European mudminnow individuals. Therefore, our second set of laboratory experiments investigated whether the mudminnow recognises the invasive species as a potential predator. We focused on the anti-predator behaviours without physical contact between predator and prey. To ensure that observed prey behaviours were predator-avoidance responses, we compared their behaviours in the presence of an obligate predator, the northern pike (*Esox lucius*). By arranging prey in homo- and heterospecific pairs, we tested whether the presence of an Amur sleeper competitor influences the mudminnow's anti-predator behaviour. Furthermore, using naïve and experienced mudminnow individuals, we examined whether prior exposure to the invader leads to behavioural adaptations that improve survival in invaded habitats. Our

results will provide insight into the consequences of Amur sleeper invasion for endangered native species, offering valuable information on resource utilization and competition outcomes, especially for limited resources. The results from our predation-related experiments will shed light on how the invader’s presence influences predation pressure on native fish. Understanding these behavioural interactions is essential for assessing the long-term impact of Amur sleeper invasions on European mudminnow populations. Our study has potential conservation implications, emphasising the need for targeted management strategies to protect the European mudminnow in the face of biological invasions.

Benthic macroinvertebrate communities in small water bodies in an agricultural landscape – examining structural and functional indicators

Fee Nanett Trau[1], Lena Charlotte Ruf[1], Kathrin Fisch[1], Stefan Lorenz[1]

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Presenting Author: Fee Nanett Trau

Status: Oral presentation

Session Number & Date: Small water bodies: from assessment to impact mitigation, 10:45-11:00, Tuesday 22 July

Abstract

Small standing water bodies (ponds, kettle holes) are extremely abundant in the northeast German lowlands. They can cover an area of 5% in a landscape otherwise dominated by agriculture and therefore act as biodiversity hotspots and stepping stone elements. They harbour a high species diversity and a high number of endangered species. Particularly semi-aquatic insects such as mayflies (Ephemeroptera), caddisflies (Trichoptera), dragonflies (Odonata) and others strongly depend on those unique habitats. Due to their size and location, ponds are particularly susceptible to the negative impacts of agriculture such as fertilisation and pesticide use. Despite their importance, they are given little or no consideration in national and international monitoring programmes. We examined the chemical status (water quality) and the biological status of more than 100 small water bodies and tested structural and functional indicators to detect effects of stress on benthic macroinvertebrate communities in ponds. We found a widespread contamination of pesticides and exceedances of regulatory accepted pesticide concentrations as well as a constant presence of specific substances, mostly herbicides. This is expected to cause adverse effects on habitats and ecosystems and to have cascading ecosystem level effects. However, we also found that classical structural community indicators do not perform well to detect stress in a landscape characterized by ubiquitous and long-term stress. Thus, functional approaches (functional feeding groups, isotopic niches) were also tested to see if they can perform better to detect stressed communities. We analysed seven water bodies (ponds and ditches) via the method of stable isotopes.

Biodiverse Urban Waterfronts

M.V. Verweg[1], H.G. van der Geest[1], E.H. Krueger[2], M.H.S. Kraak[2], A.P. van Wezel[3]

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Presenting Author: M.V. Verweg

Status: Poster presentation

Session Number & Date:

Abstract

Amsterdam faces the challenge of restoring 600 km of quay walls by 2050. Yet a comprehensive understanding of aquatic biodiversity in urban waterways and associated with urban quay walls remains lacking, especially how to enhance ecological value in restoration plans. As the city experiences more extreme weather events and rising salinity, a conceptual framework is needed to halt biodiversity loss in urban areas and to reverse the trend of loss toward recovery. Current community theory suggests that biodiversity in urban environments is primarily driven by anthropogenic factors, rather than natural processes (Swan et al., 2021, Ecosphere). In contrast, Humboldt and Bonpland (1805) proposed that environmental conditions govern biodiversity. This discrepancy requires an integrated understanding of how abiotic factors and human-driven dynamics jointly influence urban biodiversity. Therefore, this research aims to unravel the impact of these combined drivers on benthic macrofaunal and macrophyte biodiversity in urban waterways. The research follows three key steps: 1.Spatial analysis of current aquatic biodiversity; 2. Experimental verification of the spatial analysis; and 3. Experimental sampling and classification of macrofauna and macrophytes in urban waterways. The spatial analysis will be based on publicly available datasets of macrofauna and macrophytes, including those from Rijkswaterstaat (a government agency) and for Water Framework Directive monitoring. These datasets will be analyzed to calculate alpha, beta, and gamma biodiversity, as well as community similarities. By mapping these parameters, we aim to identify shifts in ecological traits and delineate boundaries of benthic macrofauna communities. Moreover, the analysis will trace the influence of urban areas on communities within urban waterways. An experimental campaign will be conducted using Hester Dendy sampler plates coupled with artificial plant substrates. A spatially explicit sampling design across the city and surrounding areas will enable a detailed analysis of changes in community composition and dispersal patterns. The final phase of the research will focus on understanding benthic macrofauna dispersal within urban aquatic environments. Using a community theory framework and land use and landscape analysis, waterways will be classified and experimentally sampled in the same manner as

the spatial analysis. In addition to assessing ecosystem structure, we aim to quantify ecosystem functioning by deploying oxygen sensors to quantify photosynthesis and respiration in these waterways. This approach will allow us to link ecosystem structure and functioning in urban waterbodies, informing the restoration of urban aquatic biodiversity.

Biodiversity Effects of Fen Peatland Rewetting

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Presenting Author: Ralf C.M. Verdonschot

Status: Oral presentation

Session Number & Date: Wetland ecology and management, 15:45-16:00, Tuesday 22 July

Abstract

Many wetlands in northwestern Europe have been drained and converted into agricultural land in the last century. This has led to a decline of specialist wetland species, and the loss of its hydrological and physical-chemical functions providing, amongst others, ecosystem services as water retention, transformation and removal of nutrients and other substances, and storage of carbon. Given the importance of these ecosystems, restoration of degraded sites has become widespread. Many restoration measures could be applied, but not all are effective for different wetland ecosystem functions. Hence, the challenge is to apply measures that optimize multiple wetland ecosystem functions, such as combining biodiversity improvement with decreasing greenhouse gas emissions. The EU funded project REWET (REstoration of WETlands to minimise emissions and maximise carbon uptake – a strategy for long term climate mitigation) focuses on determining how the restoration and management of wetlands can be optimized. The goal is to maximize maximise wetland carbon uptake while at the same time there should be a balance with type-specific natural processes and biodiversity. This is investigated in seven Open Labs (OLs) across Europe covering different wetland types. One of the projects OLs is the fen peatland Kiersche Wijde in the Weerribben-Wieden national park in the Netherlands. Here, a former agricultural grassland complex is being transformed into fen peatland, wet meadows and marshland, with measures targeting excess nutrient removal and increasing acid neutralizing capacity through vegetation mowing and water level manipulation. Over time the measures have led to gradients in wetness and soil phosphorus concentrations in the OL, which could be used to determine the effects of the restoration extent. We investigated the biodiversity response to these measures of different wetland organism groups which are known for their indicator value. Occurrence and abundance patterns of plants, aquatic and (semi-)terrestrial invertebrates, and birds were determined based on visual counts and trapping techniques at twelve sampling locations. Species ecological traits were used to distinguish between generalists and wetland specialist species. Strongest positive effects of the restoration measures were observed for ground beetles, with an increase in wetland specialists in the wettest sites with the lowest soil nutrient concentrations. Dragonflies and birds also showed positive

responses, but these were more strongly related to factors not directly linked to the restoration, such as the vegetation structure on a scale exceeding that of the individual plots. Patterns for butterflies and plants were less clear. Our results showed that not all measured organism groups are equally suitable for assessing the effects of wetland restoration on the biodiversity. As the best selection of indicators could not always be determined beforehand, multiple biodiversity indicators should be considered in future assessments.

Both the aquatic habitat gradient and land cover are important for the conservation of aquatic bird communities in a large Central European floodplain

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Presenting Author: Ónodi, Gábor

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 15:30-15:45, Tuesday 22 July

Abstract

There has been a limited amount of research which comparatively examines the local and landscape scale ecological determinants of the community structure of aquatic bird communities in floodplain ecosystems. Here, we quantified the contribution of local habitat structure, land cover (measured in the scales of 500, 250 and 125 m radii) and spatial configuration of the sampling sites to the structuring of aquatic bird communities in a relatively intact floodplain of the River Danube, Hungary. We used the relative abundance of species as response variables in the forward selection models to find the contributing significant variables and in partial redundancy analyses to determine the relative importance of each variable group. The lateral hydrological connectivity gradient from the main river to the most secluded backwaters proved important among local scale water body characteristics, but its importance decreased towards the smaller scale. Land cover types contributed differently at the different scales: at the 500 m scale the cover of transitional woodland-shrub areas, at the 250 m scale, the cover of wetlands and at the 125 m scale the cover of forests and wetlands affected taxonomic structure significantly. Lateral hydrological connectivity proved to be less influential than land cover and spatial variables for aquatic bird communities. Purely spatial variables were important determinants, besides purely environmental and the shared proportion of variation explained by environmental and spatial variables. The predictability of community structuring generally increased towards the lowest land cover measurement scales (i.e., 500, 250 or 125 m radius buffers). These results indicate the relatively strong responses of floodplain bird communities to land cover and spatial configuration. They also suggest that dispersal dynamics and mass-effect mechanisms are critically important for understanding the structuring of floodplain bird communities, and should therefore be considered by conservation management strategies. Learning from the local scale measurements, it is crucial to preserve a network of laterally hydrologically connective floodplain water bodies . At the landscape scale it is essential to have shrublands, forests,

and wetlands as dispersal matrix, roosting, nesting and foraging microhabitats for aquatic bird communities.

Broadening the evaluation framework of river management strategies by embedding ecosystem services: the case of the river Rhine in the Netherlands

Sien Kok [1,2], Hein, Lars[1], le Clech, Solen[1], Penning, Ellis[1], Buijse, A.D[1,2]

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Presenting Author: Sien Kok

Status: Oral presentation

Session Number & Date: Novel approaches to assess the success of freshwater ecosystem restoration, 15:30-15:45, Thursday 24 July

Abstract

Rivers in Europe and beyond are under increasing pressure from climatic and anthropogenic threats, which has led to a widespread recognition of the need for integrated river management and ecologic restoration in various EU-directives. (Ex-ante) evaluation of project options often play an important supporting role in river management decision-making processes. However, existing studies often lack a wide, multi-functional scope in terms of benefit assessment, focusing on e.g. flood risk mitigation or ecological restoration benefits. This narrow focus can set multi-functional solutions like NbS at a disadvantage compared to grey or mono-functional alternatives. As such, assessment of a wider scope of impacts is essential to gain insight in the various benefits and trade-offs of implementing multi-functional (nature-based) solutions in river – and floodplain management. In our study, we analyzed the supply of 13 ecosystem services (ES) under four strategies representing conventional, mono-functional vs. integrated, nature-based river-floodplain management strategies for the river Rhine in the Netherlands. The strategies are designed to address flood risk, drought risk and riverbed incision. In order to quantify ES supply, we modelled biophysical and hydrological changes (including elevation, land use, stage-discharge relationships, inundation duration and expected land cover), using a range of modelling tools. Resulting biophysical outputs were linked to ES indicators spanning provisioning, regulating and cultural services. After reviewing trade-offs of these services under the strategies, the socio-economic implications were assessed by monetizing the ecosystem services and comparing them against strategies' investment costs in a cost-benefit analysis (CBA). Results show that ES supply is connected to changes in hydrological conditions and/ or changes in land use and vegetation management. Strongly regulated, mono-functional river - and floodplain management has overall lower ES supply than more integrated, nature-based management strategies. Due to the stronger need for land use change when embedding

nature-based solutions, there is a trade-off with agricultural production in the floodplains. In our subsequent economic analysis, results illustrate that the scope taken in benefit assessment has strong implications on the economic justification of investment (net-present value: do benefits outweigh costs?) and the preferred alternative. With a narrow scope in benefit assessment, the alternative with least positive impact on ecological quality comes out best, whereas with a wide scope, the strategy with most positive impact on ecological quality is preferred. Our approach and results can be used to align policy appraisal in river-floodplain management with ambitions to increase integrated management and ecological restoration– for example in (quantified) multi-criteria analysis, or extended cost-benefit analysis. Additionally, the results can be used to inform and/ or optimize formulation of strategies, and support stakeholder dialogue.

Bryophytes as integral part of aquatic vegetation

Krister Karttunen[1], Jukka Aroviita[1], Annika Vilmi[1]

[1]Finnish Environment Institute

Presenting Author: Krister Karttunen

Status: Oral presentation

Session Number & Date: Aquatic and riparian vegetation, 16:15-16:30, Thursday 24 July

Abstract

Bryophytes are an often neglected but important part of aquatic vegetation, especially in mountainous areas and the whole boreal region. We compared the capacity of angiosperms and bryophytes in river pools and riffles to indicate the ecological status of flowing waters. We used a RIVPACS-type method to analyse indices representing ecological status based on approximately 50 bryophyte and 150 angiosperm taxa from 295 reference and impact sites across river basins with various characteristics. Specific river typologies were more informative than particular sites, and modelling taxonomic completeness (observed/expected taxa) and percent model affinity (PMA) indices were more informative than taxonomic composition. For river pools models using angiosperms performed best, and for riffles the performance of models including bryophytes alone or in combination with angiosperms was comparable. Use of aquatic bryophytes in evaluation of ecological status and in other contexts is assessed.

Can induced-drying modulate the response of fungal communities and their decomposition capacity to wastewater effluents in permanent streams?

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Presenting Author: Manuel Pinilla-Rosa

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 14:30-14:45, Monday 21 July

Abstract

Rivers and streams receive multiple human stressors with different origins and intensities that alter biological communities and produce ecological surprises. Water intermittency is increasing in permanent watercourses, and the prevalence of wastewater treatment plants (WWTP) poses an additional risk due to the lower dilution of their effluents. Leaf litter decomposition is a key ecosystem function, especially in low order streams, where aquatic hyphomycetes play a crucial role. We conducted a field experiment to assess the effects of induced drying and WWTP effluents on fungal communities and their associated leaf-litter decomposition in two 3rd-order permanent Mediterranean streams. After placing leaf litter bags for microbial colonization, we simulated two intensities of drying (pulses: short drying periods with short periods of rewetting; press: long and continuous drying) moving bags in/out the riverbed and, finally, downstream to a WWTP effluent. We analysed the individual and joint effects of these two stressors on mass loss, CN ratio, fungal biomass, and fungal diversity using DNA sequencing. Although drying led to the colonization of a diverse group of fungal terrestrial species in the leaves, it clearly reduced decomposition, indicating that the increase in richness is not enough to compensate for the well-known loss in microbial activity due to dehydration. There were no differences between drying intensities. Leaves previously exposed to drying exhibited long-lasting legacy effects on both decomposition and species richness. Finally, WWTP effluents altered fungal community composition by reducing terrestrial species and promoting the replacement of more tolerant aquatic species. These alterations may be more pronounced under future conditions of water scarcity promoting drying and limiting the dilution of WWTP inputs.

Challenges in the innovative restoration of degraded lake complex (Kartuzy lakes, Kashubian Lakeland, Poland)

Renata Augustyniak-Tunowska[1], Jolanta Grochowska[1], Michał Łopata[1], Renata Tandyrak[1]

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Presenting Author: Renata Augustyniak-Tunowska

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 15:45-16:00, Tuesday 22 July

Abstract

The restoration of flowing lakes, which are elements of river-lake systems, is, in principle, more difficult than the renovation of seepage lakes. In such cases, the inflow of pollutants takes place from a large area of the indirect catchment, while the lakes themselves can act as a source of nutrients (from bottom sediment) for the next parts of the system. The object of the study was a river-lake complex located in Kartuzy (Kashubian Lake District, northern Poland). The complex consists of four municipal lakes: Mielenko (area 7.8 ha, max depth 1.9 m), Karczemne (area 40.4 ha, max depth 3.2 m), Klasztorne Małe (area 13.7 ha, max depth 20.0 m) and Klasztorne Duże (area 57.5 ha, max depth 8.5 m), arranged in a cascade on the Klasztorna Struga River. To properly plan the restoration, the external load and hydrochemical conditions of water and bottom sediments of all water bodies were analyzed. Based on the obtained results, innovative, comprehensive protective and restoration activities for the Kartuzy lakes were designed, consisting in the use of several methods (reduction of external load, phosphorus inactivation, dredging, biomanipulation). Including the entire river-lake system together with the drainage area for comprehensive activities allowed us to obtain positive effects. Properly designed and carried out the procedure of the heavily degraded lakes renewal enabled recovery of the lost ecosystems' services. Lakes were brought back for society and became a tourist attraction and a place where the local community can relax, and experience contact with nature. On the outskirts of the lakes, the service sector is developing, which can leads towards the creation of new jobs and generating income for the local community. The project was funded by the European Union through a Horizon Europe Innovation Action for the Mission Restore our Ocean&Waters under Grant Agreement Number 101156425 (FutureLakes project).

Changes in thermal tolerance of diatom *Mayamaea permitis* after 3 years of exposure to warming

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Presenting Author: Maria Nicoară

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 15:45-16:00, Tuesday 22 July

Abstract

Climate change is one of the main threats aquatic ecosystems are facing at present. It is thus crucial to understand how aquatic organisms will be affected by stressors associated with climate change. In order to predict how certain groups of phytoplankton would respond to climate change, it is expose of the organisms for several generations to the conditions of interest is required to reveal their adaptive potential. However, when investigating "adaptation", the number of required generations is still unknown and is supposed to vary within and between species. Here, we investigated whether 3 years of exposure to warming led to changes in growth rates or shifts in optimum temperature (Topt) for one diatom strain isolated from the Danube Delta, Romania (Mayamaea permitis – AICB 1655). Our aim was to determine the minimum number of generations for which changes in growth parameters are visible, therefore we conducted thermal performance tests (in the range of 20-40°C) for the heat-"adapted" strain (exposed for 3 years to 26°C), the ambient-adapted strain (exposed only to 22°C) and some intermediary-"adapted" strains (exposed for 2,4 and 8 weeks to 26°C). Our results indicated the thermal niche of the diatom strains to be between 20°C and 32°C, with maximum growth rates acquired between 20-28°C for the ambient-"adapted" and 28-34°C for the heat-"adapted" strain. These suggest that the 3 years of exposure to warming resulted in an increase in the Topt with +2°C. We believe our findings bring valuable insights regarding the physiological responses of freshwater diatoms to warming and help understanding the possible impact of global change on aquatic communities especially during extreme events (heatwaves).

Chasing bubbles: towards a standardized approach for quantifying methane ebullition in streams and rivers

Adam Bednařík[1], Eva Darenova[1], Helena Cvetkovic[2], [2], Charlotte Doebke[3], Clemens Karwautz[2], Lukas Kokrda[1], Natalia Kowalska & 2[1], Katrin Attermeyer[3]

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Presenting Author: Katrin Attermeyer

Status: Oral presentation

Session Number & Date: Greenhouse gas (GHG) exchanges and biogeochemical processes, 11:15-11:30, Friday 25 July

Abstract

Inland waters are significant sources of greenhouse gases, releasing substantial amounts of carbon dioxide (CO2) and methane (CH4) into the atmosphere. While CH4 emissions from lakes and reservoirs have been relatively well studied, there are still major knowledge gaps regarding CH4 dynamics in streams, particularly in terms of emission rates, controlling factors, and spatial variability. Ebullition thereby plays a crucial role in releasing significant amounts of the potent greenhouse gas CH4 from stream sediments into the atmosphere. However, this process is highly unpredictable and varies across several orders of magnitude. The diversity of sampling designs, each with different spatial and temporal coverage, makes it challenging to compare studies and accurately extrapolate CH_4 emissions from streams. To address these challenges, a standardized and robust sampling design is essential for improving methane emission estimates. In our study, we first conducted a systematic review of the sampling designs used in the past for assessing fluvial CH4 ebullition rates. Secondly, we conducted field campaigns with the aim of obtaining robust estimates for the optimal number of bubble traps and the length of the sampling period. Finally, we also performed additional tests to clarify the risks for the determination of CH4 content in the emitted bubbles by manually stirred sediments compared to sampling the gas collected in the bubble traps. The proposed sampling framework results from a mathematical simulation of various sampling regimes based on data from a standardized sampling design of sets of 20 bubble traps deployed for 30 days in three streams in Czechia (two streams) and Austria (one stream). Our results show huge variability in the sampling designs used so far for ebullitive CH4 fluxes from streams. Furthermore, the field campaigns revealed a high spatial variability in bubble fluxes and small temporal variability within one month across all three streams. In addition, our results show very high small-scale variability of CH4 content in the bubbles (0.01–67%),

highlighting the need for trap-specific gas sampling, but with the high risk of CH_4 concentration bias over time given by a rapid CH_4 concentration decrease in accumulated bubbles related to CH_4 oxidation, as supported by $\delta^{13}C$-CH_4 analysis. For a robust estimate of fluvial CH_4 ebullition, our tests recommend the deployment of at least 18 bubble traps over a period of two to three weeks. We believe that our standardized way for future quantifications of fluvial CH_4 ebullition will help to minimize the uncertainties of estimates of CH_4 ebullition in streams and rivers, and thus accurately assess human impacts and restoration efforts on the release of greenhouse gases in these ecosystems.

Chemical state of groundwater and its main explanatory drivers in Ialomița County, Romania

Elena Mădălina Ursache[1], Geta Rîșnoveanu[1], Corina Bradu[1]

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Presenting Author: Elena Mădălina Ursache

Status: Poster presentation

Session Number & Date:

Abstract

In Romania, depending on the region, between 31% and 42% of drinking water sources are groundwater bodies that are exploited in centralized, decentralized, or individual systems. However, these water sources are often impacted by human activities such as intensive agriculture (which entails excessive use of fertilizers and pesticides), industrial and household activities (which leads to contamination from wastewater and solid waste leakage due to inadequate waste management systems). This work aims to provide an overview of nitrogen-based nutrient (N-nutrient) pollution in groundwater in one of the most impacted regions, presenting the dynamics of the chemical state of the water in shallow wells in the north-central part of Ialomița County over a 12-month period (November 2023 – October 2024). Thirty public shallow wells from three different rural areas of the county were selected. Results revealed that in most wells, the maximum allowable concentrations (MAC) of N-nutrients were frequently exceeded, in particular NO_3^-. Only 16.7% of the collected samples were within the NO_3^- MAC limit for drinking water (50 mg NO_3^- /L), with values occasionally exceeding 900 mg/L. Higher concentrations of $NO2^-$ were recorded in spring and summer (up to 5.56 mg/L), when water temperatures increase and dissolved oxygen and redox potential decrease. In the cold season (December–March), the concentration of nitrite ions was lower, falling within the MAC (0.5 mg NO_2^-/L). The primary drivers of N-nutrient loads in the groundwater of the studied area are discussed to provide science-based support for informed decision-making in regional management.

Classifying Water Quality in Hydropower-Used Rivers: A Cross-National Method Comparison for the Bóbr River in Poland

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Presenting Author: Paweł Tomczyk

Status: Poster presentation

Session Number & Date:

Abstract

Numerous studies have highlighted the diverse effects of hydropower plants, including their impact on water quality in terms of thermal, oxygen, physical, and trophic conditions. These impacts are significant, particularly in relation to the Sustainable Development Goals (SDGs), specifically SDGs 6 and 7. This study aims to evaluate the spatio-temporal variations in physicochemical parameters across selected small run-of-river hydropower plants along a 126 km segment of the Bóbr River in southwestern Poland, utilizing multivariate statistical techniques. Additionally, the study seeks to categorize water quality at 19 sampling sites using reference methods from Poland, Portugal, China, and the United States, assessing their suitability for the given dataset. This approach is innovative in that it combines classifications from multiple global regions, rather than relying solely on data from the river's country. Our results reveal that spatiotemporal changes in physicochemical parameters along the Bóbr River are largely influenced by human activities unrelated to hydropower operations, such as urbanization and agricultural development in the surrounding area. Analysis of variance (ANOVA) confirmed the statistical significance ($p < 0.05$) of 8 out of 16 physicochemical parameters (EC, temperature, pH, DO, NO2-N, TDS, NH4-N, and COD). Hierarchical cluster analysis (HCA) further indicated that factors beyond hydropower plants have a stronger impact on water quality. The average compliance with standards, based on selected water quality classifications, was 76.9%, with minimal influence from hydropower plants. The Polish classification system was found to be the most suitable for assessing the physicochemical state of the Bóbr River, as it considers local climatic, hydrological, and hydrographic conditions. The findings of this study offer valuable insights that can inform sustainable water management strategies in hydropower catchment areas, guide the planning of new hydropower plants, and help develop operational guidelines for existing plants.

Combined Effects of Acute Exposure to Nano Zinc Oxide (nZnO) and Elevated Carbon Dioxide (CO_2) Levels in Zebrafish

Irmak Bilgiseven[1], Özlem Dönder[1], Elif Refika Kısa[1], Rabia Başer[1]

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Presenting Author: Irmak Bilgiseven

Status: Poster presentation

Session Number & Date:

Abstract

The increasing industrialization, fossil fuel consumption, population growth, and the overpopulation of livestock have led to elevated carbon dioxide (CO_2) levels, driving climate change and significantly altering the physicochemical properties of aquatic environments. Currently, atmospheric CO_2 levels are around 423 µatm, with projections indicating further increases. Rising CO_2 concentrations lead to lower water pH, contributing to acidification, which disrupts ion regulation, increases energy demands for acid-base balance, and may divert energy from essential physiological processes such as growth, reproduction, and detoxification. This, in turn, can reduce the ability of aquatic organisms to cope with additional stressors, including toxic substances. Beyond these climate-driven changes and anthropogenic pollutants further threaten aquatic ecosystems. The widespread use of metal nanoparticles, particularly nano zinc oxide (nZnO), raises concerns about their ecotoxicological impact due to their accumulation in aquatic environments. While the individual toxic effects of CO_2 and nZnO have been studied, their combined impact remains largely unexplored. This study aimed to evaluate the potential combine effects of elevated CO_2 levels and nZnO exposure on Danio rerio. Experimental groups were exposed to a CO_2-induced pH reduction of 0.2 units under normal water conditions, reaching pH 8.0 (~660 µatm), while another group experienced a reduction of 0.4 units, reaching pH 7.8 (~1050 µatm). Exposed groups were subjected to environmentally relevant concentrations of nZnO (50 µg/L and 200 µg/L) for 48 hours. Genotoxicity was assessed through comet and micronucleus assays using blood samples, while histopathological alterations in gill tissues were examined. The comet assay results revealed significant DNA damage associated with both elevated CO_2 and nZnO exposure. % Tail DNA increased with nZnO concentration, indicating a dose-dependent genotoxic effect. However, Olive Tail Moment exhibited a notable increase in the 50 µg/L nZnO group, while other concentrations showed relatively stable values. Similarly, micronucleus analysis of erythrocytes indicated greater DNA damage at pH 7.8 compared to pH 8.0. These findings suggest that CO_2-induced acidification and nZnO exposure contribute to DNA damage and may interact in non-linear ways, emphasizing the need for further

investigation into their combined effects on genomic stability. Histopathological examinations showed significant gill tissue alterations, suggesting potential damage pathways linked to CO_2 and nZnO exposure. These findings underscore the need to monitor nanoparticle pollution in the context of climate change-induced acidification and highlight potential risks to aquatic ecosystems.

Comparative analysis of bacterial assemblages in shredder-derived particles and the gut reveals taxa-specific differences

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Presenting Author: Pratiksha Acharya

Status: Oral presentation

Session Number & Date: Aquatic fungi and microorganisms in a changing world, 11:30-11:45, Friday 25 July

Abstract

Leaf breakdown is a key process that drives nutrient and energy flow in forested headwater streams. In this process, invertebrate shredders contribute large amounts of fine particles inhabited by a diverse bacterial community to stream food webs. Yet, little is known about the gut microbiome of different shredder taxa and their ontogenetic stages, and the extent to which gut bacteria contribute to faecal-pellet and fine-particle bacterial communities. We hypothesized that the bacterial communities in the shredders' gut and on the faecal pellet would be similar – irrespective of shredder identity – and that bacterial community turnover in the gut would occur with ontogenetic shifts.To test these hypotheses, we performed a sequential laboratory experiment with three shredder taxa (Trichoptera: Allogamus, Potamophylax, Sericostoma) that were given oxic-conditioned alder leaves at two time points representing different ontogenetic stages. We investigated the bacterial communities on shredder-derived leaf particles and faecal pellets and compared these communities to the shredder gut microbiome. Each experiment lasted for one week and used freshly collected shredders from wild populations. We sampled conditioned alder leaves at the beginning of each experiment, and faecal pellets and fragmented leaf particles at the end; additionally, we sampled larvae of the target taxa from wild populations as control and experimental animals. Bacterial communities were then assessed through 16S amplicon sequencing of the shredder-derived leaf particles and faecal pellets, and shredder gut contents. Bacterial community composition differed significantly between leaves, guts, and faecal pellets, indicating distinct microbial assemblages across these substrates and environments. We found less shared bacterial

taxa between gut and faecal pellets (14%, 6%, and 10%) compared to leaves and faecal pellets (43%, 37%, and 47%) in Allogamus, Sericostoma and Potamophylax, respectively. However, Sericostoma exhibited a unique pattern as its gut microbiome were more similar to the leaf-associated bacterial communities. Ontogenetic stage had a minimal influence on the bacterial community composition of both faecal pellets and gut microbiomes. Our findings on the turnover of leaf and fine particle-bound bacterial communities highlight the significant influence of shredder taxa on microbial community dynamics. Yet, ontogenetic stage appears to have no role in shaping faecal pellet bacterial communities. Understanding these microbial dynamics is crucial for assessing the role of shredders in shaping bacterial communities and their potential influence on organic matter processing in stream ecosystems.

Comparative analysis of eDNA and traditional methods for fish stock aassessment in Lake Võrtsjärv (Estonia)

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Presenting Author: Kristel Panksep

Status: Poster presentation

Session Number & Date:

Abstract

Accurate assessment of fish stocks is crucial for sustainable fisheries management. This study developed and evaluated an eDNA-based methodology for assessing commercially important fish stocks in Estonia, using Lake Võrtsjärv as a case study. We compared eDNA-derived fish abundance and community composition with data from bottom-trawl and fykenet surveys. Results demonstrated significant correlations between eDNA assessments and traditional methods, with eDNA showing higher sensitivity for most species. Bream and pikeperch detection frequency was 100% across methods, while eDNA generally exhibited higher sensitivity for other species. eDNA analysis indicated a consistent distribution of fish across the lake, though detection of rare species (burbot, ide, chub) from individual fykenet catches was limited. To improve rare species detection, we recommend implementing species-specific quantitative PCR. In conclusion, eDNA is a powerful tool for rapid and comprehensive fish monitoring. Integrating eDNA with traditional methods will enhance fish stock assessments and environmental management.

Comparative Evaluation of Ostracoda (Crustacea) Fauna in Selected Lakes and Ponds of Bolu (Türkiye): Species Diversity, Pseudo-Richness, and Seasonal Patterns Based on the Ostracod Watch Model

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Presenting Author: Emircan Altun

Status: Poster presentation

Session Number & Date:

Abstract

Freshwater ecosystems are dynamic environments significantly shaped by seasonal variation and anthropogenic influences. In this study, we investigated the structure, species diversity, and temporal distribution of non-marine ostracods (Crustacea) across five selected lentic habitats in Bolu, Türkiye—Yeniçağa Lake, Abant Lake, Karagöl Lake, Gölcük Pond, and Hıdırşeyhler Pond—and compared them to Yumrukaya Pond. Monthly sampling was conducted over a one-year period (April 2023 to March 2024) from four sites around Yumrukaya Pond to assess ostracod assemblages and their ecological responses. In addition to this primary aim, we tested three hypotheses across the six sites: There is no difference in the monthly/seasonal distribution of species among the sites, there is no statistically significant difference in the water quality of the pond before and after the anthropogenic impact, and species diversity does not differ among these six habitats. Species diversity was evaluated using standard biodiversity indices (e.g., the Shannon-Wiener Index), and the concept of pseudorichness was applied to correct for overestimations caused by seasonal overlap and transient taxa. To understand temporal occurrence patterns and trends in dominant species, we used the Ostracod Watch Model which enabled the identification of phenological patterns and periodicity in species emergence. Preliminary results indicated that although some habitats displayed relatively high apparent diversity, the pseudorichness analysis provided a more conservative and ecologically realistic estimate of true biodiversity. Natural habitats (i.e., lakes) tended to host fewer cosmoecious or cosmopolitan species compared to artificial habitats. Some species showed clear habitat preferences and seasonal occurrences. For example, Cypridopsis vidua, Heterocypris incongruens, and Ilyocypris bradyi were among the most frequently encountered species, consistently appearing across multiple habitats in specific seasonal windows. Our findings underscore the value of integrating time-based diversity models and pseudorichness analysis with traditional faunistic approaches. This combined methodology enables more accurate ecological assessments of ostracod communities and enhances our understanding of freshwater biodiversity in inland aquatic ecosystems.

Comparing AI Supported Imaging Flow Cytometry with Classical Microscopy to Quantify Phytoplankton Responses to Experimental Salinization

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Presenting Author: Zeynep Dilbe Uyar

Status: Oral presentation

Session Number & Date: Impacts of freshwater salinisation on aquatic ecosystem structure, function and biodiversity, 15:45-16:00, Tuesday 22 July

Abstract

Phytoplankton are essential primary producers in aquatic environments. Identification with traditional microscopy is time-consuming and requires extensive taxonomic knowledge. The time required to analyse phytoplankton might be significantly decreased with the use of high-throughput, image-based flow cytometry techniques, which would also enable the analysis of live plankton. Immediate analysis of live plankton is a major advantage to classical approaches, as it allows researchers to quantify organisms that do not fix well (or at all), such as naked ciliates, and delicate structures like colonies that otherwise escape detection, but are often critical for understanding the systems they exist in. Even if the offered Visual Spreadsheet software is utilized, the substantial amount of image data produced by imaging flow cytometry, such as by the FlowCam (YOKOGAWA) utilized in our study, requires a substantial post-processing time investment. By incorporating artificial intelligence (AI), we expect to enhance the precision and uniformity of phytoplankton classification by facilitating fast, high-throughput, and AI-supported analysis. In comparison to microscopy identification, this study aims to (i) assess the efficacy and accuracy of the FlowCam technique, (ii) integrate AI for classification, and (iii) confirm the latter using microscopy identification and quantification data. For that purpose, phytoplankton samples were collected from a mesocosm experiment conducted within the EU H2020-INFRAIA project AQUACOSM-plus (No. 871081) and TUBİTAK 232 programs in 2021 at the METU Mesocosm System II, Türkiye, where the effect of 16 salinity

concentrations was tested on the structure and function of lake ecosystems. To compare taxonomic groups and morphological characteristics, phytoplankton samples were analysed using FlowCam and conventional microscopy. Using several sets of annotated FlowCam data from the experiment, we constructed a machine-learning model to automate taxonomic identification from FlowCam images. Using high-throughput imaging technologies, imaging pipelines, and AI models and comparing the results with traditional microscopy, our study confirms phytoplankton identification using FlowCam and opens the door for an open-source, easily accessible imaging technique.

Comparison of phytoplankton community structure of 2 ponds in Kapıdağ Peninsula (Balıkesir, Türkiye)

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Presenting Author: Uğur GÜZEL

Status: Poster presentation

Session Number & Date:

Abstract

Peninsulas are considered biodiversity hotspots as habitat fragments partially separated from the adjacent land and isolated by the surrounding waters. Kapıdağ Peninsula (Balıkesir, Türkiye) is located in the south of the Marmara Sea and extends towards the Marmara Sea between Erdek Bay to the west and Bandırma Bay to the east. In two eutrophic ponds in Kapıdağ Peninsula, phytoplankton communities and environmental variables were analyzed using samples collected seasonally-once in fall, winter, spring, and summer- between 2023 and 2024. The study aimed to compare both environmental factors and phytoplankton community structure. The electrical conductivity, silica, and nitrate nitrogen values were significantly different among ponds ($p < 0.05$). A total of 133 taxa were identified in phytoplankton, including 21 Heterokontophyta (Bacillariophyceae), 5 Charophyta, 53 Chlorophyta, 9 Cyanobacteria, 36 Euglenozoa, 5 Dinoflagellata, and 4 Heterokontophyta (Chrysophyceae). 87 taxa were determined in Şahinburgaz Pond, while 75 taxa were recorded in Yukarıyapıcı Pond. Aulacoseira granulata (Ehrenberg) Simonsen, Aulacoseira subarctica (O. Müller) E.Y. Haworth, Ulnaria acus (Kützing) Aboal, Ulnaria ulna (Nitzsch) Compère, Tetradesmus lagerheimii Wynne & Guiry, Coelastrum astroideum De Notari, Stephanocyclus meneghinianus (Kützing) Kulikovskiy, Genkal & Kociolek, Chroococcus dispersus (Keissler) Lemmermann, Phormidium hamelii (Frémy) Anagnostidis & Komarek, Gomphosphaeria aponina Kützing, Trachelomonas acanthostoma Stokes, Trachelomonas volzii var. intermedia Playfair, and Trachelomonas sp. were detected as dominant taxa. The two ponds were different in terms of species composition, dominant species, species richness, and Shannon diversity index. The spatial differences in nitrate-nitrogen, silica and electrical conductivity and the temporal differences in nitrate-nitrogen, ordo-phosphate, sulfate, silica, temperature, and dissolved oxygen also affected the dominant species. The nitrate-nitrogen, ortho-phosphate, sulfate, silica, and electrical conductivity were the main parameters affecting the spatial and temporal variation of the Shannon diversity index and species richness. As a result, it was determined that these two eutrophic ponds in Kapıdağ Peninsula, which are located close

to each other, are different in terms of both environmental parameters and phytoplankton community structure.

Composition, divergence and variability: A comprehensive analysis of fish trait responses to connectivity

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Presenting Author: Kai Feng

Status: Oral presentation

Session Number & Date: Reconnecting fragmented river networks, 11:30-11:45, Monday 21 July

Abstract

Connectivity, a fundamental concept in ecology, refers to the extent to which different habitats or ecosystems are interconnected through the movement of organisms, nutrients, and energy. Lateral hydrological connectivity (LHC) plays an especially critical role in shaping aquatic community organization in river-floodplain systems. However, a comprehensive understanding of various trait responses to LHC remains elusive. We characterized how attributes of fish community traits, specifically composition, divergence, and temporal variability respond to LHC in the Austrian-Hungarian floodplains of the Danube River using environmental DNA (eDNA) metabarcoding. Trait composition was quantified by community-level weighted means (CWM) as the degree of change in trait responses along the LHC gradient from isolated oxbows to the main river. Divergence was measured using Rao's quadratic functional diversity index, and a null model approach was used to calculate standardized effect sizes (SES), with larger SES values indicating greater divergence and smaller values indicating convergence. Temporal variability, representing the degree of instability in community traits over time, was calculated using a functional beta diversity measure for multiple communities. Our findings revealed apparent compositional changes for many trait variables, highlighting the significance of LHC in shaping community functional diversity. Divergence patterns indicated that isolated habitats foster trait convergence, presumably due to habitat filtering, whereas more connected areas promote trait divergence due to higher species richness and habitat availability. Temporal variability of traits associated with flow preference exhibited a hump-

shaped relationship with LHC, suggesting intermediate connectivity zones are hotspots of ecological dynamism. The study suggests that examining composition, divergence, and temporal variability together provides a more complete understanding of trait responses to connectivity, stressing the importance of maintaining diverse connectivity levels in river-floodplain systems for effective conservation and ecosystem management.

Constructed wetlands as providers of ecosystem services in a protected Mediterranean Natural Park

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Status: Oral presentation

Session Number & Date: Last-ditch efforts? The science and management of artificial waterbodies, 14:45-15:00, Monday 21 July

Abstract

Artificial aquatic systems, such as constructed wetlands, can provide key ecosystem services similar to those of natural wetlands. In the Albufera de València Natural Park (Spain), two surface-flow constructed wetlands, Tancat de la Pipa and Tancat de L'Illa, were created in 2009 and 2011, respectively, to, among other objectives, improve water quality before it reaches the hypertrophic Albufera de València lagoon, one of the largest Mediterranean coastal lagoons. The Natural Park (and mainly the water quality) has been deteriorated since the 1970s due to intensive agriculture, urbanization and industrial activities, and this problem still persists nowadays. 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 environmental protection (Ramsar List and Natura 2000 Network). To assess the effectiveness of these constructed wetlands in improving water quality, we analyzed long-term plankton data (almost 15 years) and pollutant concentrations (pesticides and heavy metals/metalloids for 5 years) in water and sediments, comparing samples from outside the constructed wetlands (before entering), within the system, and at the outlets. Our results show that sestonic chlorophyll-a concentrations are lower at the outlets, reflecting a decrease in phytoplankton biovolume, particularly of potentially toxic cyanobacteria. At the same time, zooplankton communities shift towards a dominance by large filter-feeding cladocerans, such as Daphnia magna, which contribute to top-down control of phytoplankton, helping to mitigate eutrophication. These positive effects have been enhanced by seasonal drying (implemented by the managers) in Tancat de la Pipa since 2019, which promotes the hatching of cladocerans diapause eggs, reduces planktivorous fish populations, and facilitates the spontaneous recovery of submerged vegetation, particularly charophytes. These charophytes further stabilize water quality by reducing nutrient availability in the water column and, thus, improving light conditions. Beyond the biological perspective, despite a high number of pesticides (herbicides, insecticides and fungicides) that have been detected in both constructed wetlands, a general reduction of these pollutants concentrations between inlets and outlets has occurred. Regarding heavy metals, while many elements such as

zinc and copper were efficiently reduced as water flowed through the constructed wetlands, others, including arsenic, boron, and chromium, exhibited an increasing trend. These elements are naturally present in the environment and can persist in aquatic systems due to their properties, making their removal more challenging compared to other compounds. However, the capacity of constructed wetlands to significantly decrease a wide range of contaminants underscores their efficient role as filter systems, reducing pollutant loads before they reach the Albufera de València lagoon. This study highlights how artificial aquatic systems, such as constructed wetlands, can effectively complement natural wetlands by providing essential ecosystem services. Therefore, we recommend promoting their implementation within protected areas, as they contribute to improving water quality and supporting ecological processes, making them a valuable tool for maintaining and enhancing natural aquatic environments.

Contributions to the Zooplankton Fauna of Manyas Dam Lake (Balıkesir-Türkiye)

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Presenting Author: Meral Apaydın Yağcı

Status: Poster presentation

Session Number & Date:

Abstract

Zooplanktonic organisms are closely related to water quality parameters and are used as indicator species in aquatic ecosystems. It is reported in research that eutrophication and water pollution cause the species composition of zooplanktonic organisms to change, therefore zooplankton studies in inland water ecosystems are important. In this study, the zooplankton of Manyas Dam Lake (Balıkesir-Türkiye) was examined in a one-time study conducted on 28.06.2022. Manyas Dam is a dam built on Kocaçay in Balıkesir between 1993 and 2001 for irrigation, energy and flood control purposes. The lake area is 16.80 km². Its height from the river bed is 90 m. The study was carried out at 3 stations in the dam lake. Physicochemical properties of water in the dam lake such as water temperature, pH, dissolved O2, salinity, electrical conductivity were measured in the field with the YSI Professional Plus multiparameter field measurement set. Secchi disc visibility was taken with a secchi meter and depth was taken with a sounder. A plankton net with a 55 µm mesh opening was used for horizontal gravity zooplankton sampling, and samples were fixed with 4% formaldehyde in 250 ml sampling containers. . A total of 19 zooplankton species have been determined. The group consisted of 47% Rotifera, 32% Cladocera and 21% Copepoda. Water temperature in the lake was 21.8-21.9°C, pH 8.44-8.44, dissolved oxygen 8.30-8.33mg/L, conductivity 364.1-364.4 µS/cm, salinity %0 0.17, chlorophyll-a 11.34-12.46 µg/L, secchi disc measurement 1.5-1.7m, and depth values varied between 45-48 m. Trichocerca bicristata, Diaphanosoma birgei, Leptodora kindtii, Pleopis polyphemoides species have been reported from the lake for the first time. The most dominant species were Keratella quadrata (Rotifera) and Daphnia cucullata (Cladocera).

Correlating 44 years of Macroinvertebrate Diversity Data in Lowland Streams with Periods of Drought: A Data Standardization Approach

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Presenting Author: Caixia Wei

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 16:15-16:30, Tuesday 22 July

Abstract

Freshwater ecosystems are among the most vulnerable to climate change, with increasing droughts leading to reduced stream discharge, fluctuating groundwater levels, and altered hydrological regimes. These environmental shifts pose a significant threat to aquatic biodiversity, particularly macroinvertebrate communities, which play a crucial role in nutrient cycling, organic matter decomposition, and serving as a key food source within freshwater food webs. Macroinvertebrates are widely used as bioindicators for assessing aquatic ecosystem health, making long-term biodiversity data invaluable for understanding the impacts of climate-driven changes on freshwater environments. However, analyzing historical monitoring data presents challenges due to inconsistencies in sampling methods, (levels of) taxonomic classification, and data reporting across different monitoring programs. This study aims to correlate long-term macroinvertebrate diversity in lowland streams with periods of drought, using a standardized approach to ensure data reliability. We analyzed a nationwide dataset of freshwater macroinvertebrate records collected in the Netherlands from 1979 to 2022. These records, sourced from 21 regional water authorities as part of Dutch ecological water quality monitoring programs, exhibited inconsistencies in river type classification, taxonomic resolution, and biological nomenclature. To address these issues, we applied a rigorous data standardization process, including: (1) ensuring uniformity in river type classification by referencing geographic coordinates, and (2) refining taxonomic records by correcting nomenclature discrepancies and removing extraneous symbols (e.g., slashes, brackets, and suffixes). The curated dataset comprises 782,521 biological records from 4,149 unique sampling sites across 17 distinct river types, forming an extensive macroinvertebrate biodiversity dataset for lowland stream ecosystems over 44 years. To assess macroinvertebrate diversity changes over 44 years, we derived three diversity indices: (1) the numbers of genera and species, (2) the Shannon diversity index, and (3) the Ecological Quality Ratio (EQR), a key metric used in the European Water Framework Directive (WFD) to assess aquatic ecosystem health. By integrating these biological data with climate records and historical drought events, we aim to identify long-term patterns in biodiversity shifts and

assess how drought-driven changes influence macroinvertebrate assemblages. Preliminary outcomes of our analyses will be discussed, offering insights into potential biodiversity responses to drought. This will help to define safe operating spaces for river hydrological regimes, contributing to more effective water management strategies for the conservation of river macroinvertebrate diversity.

Dammed Europe, more than just dams

Gonçalo Duarte[1]

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Presenting Author: Gonçalo F Duarte

Status: Oral presentation

Session Number & Date: Reconnecting fragmented river networks, 11:45-12:00, Monday 21 July

Abstract

The fragmentation of river networks across Europe poses a significant threat to freshwater biodiversity, particularly for migratory fish species that rely on longitudinal connectivity to complete their life cycles. Artificial structures, like dams and reservoirs, disrupt river continuity by impeding fish movement and altering ecological conditions. Despite growing efforts to restore river connectivity, existing assessments fail to include the compound effects of natural and artificial barriers, barrier reservoirs and ecological status. We analysed river network fragmentation across Europe using the Dendritic Connectivity Index (DCI), incorporating all these components. Overall, natural fragmentation plays a role in defining the connectivity baseline, with around 20% of river network fragmentation being attributable to waterfalls. Reservoirs, often neglegted in connectivity assessments, emerge as a relevant ecological and behavioural barrier by adding an additional 10% of connectivity loss to that associated exclusively with barriers. Furthermore, freshwater connectivity values drop sharply when habitat quality declines. Even in scenarios simulating improved barrier permeability and selective barrier removal, overall gains in connectivity remain modest unless ecological condition is concurrently enhanced. Spatially, the Iberian Peninsula and the Danube Basin exhibit the lowest connectivity scores due to dense dam networks and challenging climatic conditions. Regions like the United Kingdom show relatively higher connectivity despite a high number of barriers. Anticipated future dam development, especially in the Balkans, threatens to exacerbate connectivity loss, particularly for diadromous species. Our findings stress the urgent need to integrate river management strategies that align connectivity restoration with habitat quality improvements and EU conservation objectives. Prioritizing restoration in ecologically valuable areas and re-evaluating the trade-offs associated with future dam construction can significantly enhance the effectiveness of conservation efforts. As pressures from climate change and hydropower expansion mount, a holistic approach to restoring river connectivity is vital to safeguarde Europe’s freshwater ecosystems and biodiversity.

Dammed Fish - Impact of structural and functional river network connectivity losses on fish biodiversity – Optimizing management solutions

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Presenting Author: Paulo Branco

Status: Oral presentation

Session Number & Date: Reconnecting fragmented river networks, 11:00-11:15, Monday 21 July

Abstract

The Dammed Fish project aims at assessing and proposing solutions and tools to inform the management of river network connectivity to improve fish biodiversity and enhance biotic quality in European rivers. To achieve this aim, the management of river network connectivity requires guidance to select the most appropriate options within the context of ongoing human activities. Dammed Fish adopts a European-wide basin scale approach to connectivity management for three different time periods, namely the past, present, and future. The project is structured around five interconnected tasks: (1) setting the scene by managing river network data and tools; (2) quantifying river network connectivity and disconnection; (3) assessing the impact of dams on freshwater fish distribution and biotic quality; (4) developing the RivOpt barrier connectivity enhancement management tool; and (5) promoting outreach and scientific literacy. These tasks are designed to evaluate how dams, both individually and in conjunction with other pressures, affect river network connectivity, biodiversity loss, species range contraction, and species turnover in riverine fish. We also assess how the impairment of connectivity due to barriers can interfere with environmental practices aimed at achieving the goals set forth in legislative drivers such

as the Water Framework Directive. Our results will contribute to further studies and improved management of river network connectivity by developing three free tools: RivFish – which links fish data and river networks; RivConnect – which calculates basin-wide network connectivity; and RivOpt – which optimizes basin-wide connectivity management solutions while considering conflicting management goals.

Delivering successful and sustainable freshwater restoration to benefit nature, society and the economy

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Presenting Author: Laurence Carvalho

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:30-11:45, Thursday 24 July

Abstract

The challenges for delivering successful and sustainable freshwater restoration have never been greater. Recognition that restoration needs to address both the climate and biodiversity crises and support a shift to an inclusive blue economy highlight the need for innovations in freshwater restoration. New innovations in nature-based (NbS) and circular economy solutions, as well as in freshwater governance and financing, lie at the heart of strategies to support this “Great Transformation”. As a contribution to this, there is wide recognition of the need for upscaling of restoration measures, yet progress in implementing innovations in freshwater restoration has been slow. To support this transformation, strong evidence is needed of successful restoration projects that demonstrate the environmental benefits of innovative restoration measures, alongside co-benefits to society and the economy. Large-scale demonstration sites provide a pivotal role here in documenting this evidence and are key to making innovative measures more mainstream and scaled-up across Europe. Here we summarise a number of lessons learned from 18 freshwater and wetland restoration case-studies that have been documenting the benefits of restoration and developing regional plans for further scaling-up of restoration measures. Firstly, restoration programmes benefited from following the IUCN Gold Standard framework to implement strong, effective and sustainable NbS. Secondly, a broad monitoring programme helps document the wide co-benefits of nature restoration on biodiversity, pollution and climate policy goals as well as much needed evidence on the co-benefits to society and the blue economy. Documenting impacts on economic sectors, such as agriculture, energy and tourism is also important to ensure synergies are maximised and trade-offs are transparent and not ignored. To be successful, restoration programmes need good co-development and agreements with relevant stakeholders, who can help speed up implementation of measures and help minimise opposition. Multi-disciplinary teams are essential to plan, implement and maintain restoration activities as knowledge of the ecosystem must be combined with

knowledge on cultural and socio-economic aspects, financial and policy opportunities and enhancing water governance. Development of the regional plans for upscaling freshwater ecosystem restoration does not only involve multiplying technical measures on the ground, it also requires developing new approaches to financing and water governance, policy cohesion and awareness and commitment raising with stakeholders. Diversification of funding towards the private sector is essential to cover the large funding gap that exists for restoring freshwater ecosystems to meet current EU policy targets. All these new approaches to freshwater restoration are illustrated and show the way for Member States developing National Restoration Plans for the new EU Nature Restoration Regulation and for supporting the planned new European Water Resilience Strategy.

Dendrotelms as sentinels of multi-decadal atmospheric pollution by metals and their ecological legacy in old-growth forests

Thibaut Rota[1,2], Nabil Majdi[1], Manuel Henry[3], Francesca Cerroti[2], Red Calore[1], Fahis K.T.[4], Félix Perez[3], Nicolas Cros[1,3], Amal Dev J.[5], J. Kallukalam Tomson[5], Jérôme Chmeleff[6], Joseph Garrigue[7], Diane Sorel[7], Laurent Larrieu[8], Francisco Valente[9], Jean-François Arnoldi[10], Thomas Zambardi[11], Pieter van Beek[11], Karumampoyil Sakthidas Anoop Das[4], Gustavo Q. Romero[9], Martin M. Gossner[2], Dominique Aubert[3], Andreas Bruder[1]

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Presenting Author: Thibaut Rota

Status: Oral presentation

Session Number & Date: Ecotoxicology: Ecological responses to chemical stress in freshwaters, 11:30-11:45, Thursday 24 July

Abstract

Atmospheric pollution is a pervasive threat to human and ecosystem health, yet assessing its impact on heterogeneous landscapes like old-growth forests remains challenging. These forests have increasing conservation value due to their high diversity and the essential goods and services they provide, including their aesthetic value. Various models, including lichens, mosses, and dendrochronology, have been used to monitor atmospheric pollution, but none simultaneously achieve two key objectives: (i) accurately tracking pollution in space and time, and (ii) assessing its ecotoxicological effects on entire communities. We introduce a promising freshwater model and validate it using potentially toxic elements (PTEs) as a proof-of-concept. Water-filled tree cavities, or dendrotelms,

are natural aquatic microcosms forming in branch forks or stem wounds. These contained environments support diverse aquatic communities that process allochthonous organic detritus. Trees, with their fractal-like architecture at the interface with the atmosphere, intercept atmospheric pollutants in dust or dissolved forms, which then accumulate in dendrotelms via runoff along branches and trunks. We found concerning levels of ~15 PTEs in dendrotelm sediments from three European old-growth beech-dominated forests (Massane Forest, France, UNESCO World Heritage site; Sihlwald and Morcote Forest, Switzerland), whereas concentrations in the Amazonian rainforest (Mato Grosso, Brazil) were at trace levels. In European but not Amazonian forests, PTE concentrations showed a strong positive covariation, i.e. a multi-contamination gradient. Although dendrotelms hosted by larger trees might accumulate more PTEs due to their larger crown surface area, we found that the differential multi-decadal deposition pattern among elements was a strong driver of the spatial gradients in PTE multi-contamination, with young trees hosting less polluted dendrotelms than old trees. When dating sediment layers from sediment cores using radioelements (^{137}Cs and ^{241}Am), we showed that some element peaks were linked to historical pollution events. Among the forest compartments, dendrotelm sediments and resident aquatic invertebrates exhibited the highest lead (Pb) concentrations, a signature of the inheritance of leaded gasoline emissions that peaked in the 1980s. In European but not Amazonian forests, the multi-contamination gradient reduced invertebrate densities. Beyond introducing a new indicator of old-growth forest health under atmospheric pollution, we highlight how multi-decadal pollution continues to exert legacy effects on their natural communities.

Detecting Change and Assessing the Effectiveness of Measures to Protect and Restore High Status Objective River Waterbodies (The RESTORE project)

Fiona Kelly[1], Mary Kelly-Quinn[2], Jonathan Turner[2], John O'Sullivan[2], Md Salauddin[2], Emma Drohan[1]

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Presenting Author: Emma Drohan

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 16:30-16:45, Tuesday 22 July

Abstract

High ecological status is assigned to water bodies that show no or only minor anthropogenic impacts on physio-chemical, hydro-morphological and biological quality elements under the EU Water framework Directive (WFD). Ireland hosts 2% of the EU's rivers classified at high ecological status. However, recently published water quality reports indicate a significant decline in high status (HS) river waterbodies nationally, from 31.6% (1987-1990) to 18.4% (2019-2021). Declines in high status sites have led to the designation of 319 rivers with a High-Status Objective (HSO) through the 2018-2021 River Basin Management Plan. However, only 43% achieved this target up to 2021. The protection and restoration of these waterbodies is a key environmental objective of the EU WFD. High status waterbodies are important in conserving national and regional biodiversity as well as supporting a range of ecosystem services. Notably, they provide refugia for species sensitive to a range of anthropogenic stressors including the endangered freshwater pearl mussel (Margatifera margaritfera) and have a strategic role in sustaining species for recolonisation of sites where pollution and other pressures have been reduced. These waterbodies are critical to efforts to achieve the WFD targets of at least good status. Research is essential to design and implement a monitoring program capable of assessing the status of HSO river water bodies, for identifying environmental stressors that prevent HS, and for evaluating the effectiveness of measures. The RESTORE project is developing a bespoke, multi-disciplinary monitoring programme to detect change and assess the effectiveness of measures to protect and restore HSO in six river waterbodies in Ireland as part of an EU Life funded project (Waters of Life) using the pressure, stressor, response framework. Assessing the status of HSO waterbodies and detecting the stressor causing degradation or the effectiveness of mitigation measures in these catchments has several challenges which will influence the design of any effective monitoring programme. Typically, most river catchments in Ireland and

across Europe are affected by combinations of pressures yielding variable cocktails of stressors, the location, types, intensity and interactions of which result in differing impacts along river channels and through time. Furthermore, linking ecological responses to restoration measures is equally difficult in multiple stressor environments. Therefore, the design and implementation of monitoring for detection of causal effects of degradation, or for assessing the efficacy of different restoration measures must take a multi-stressor perspective. The RESTORE project is using a multidisciplinary sampling approach integrating existing data, field sampling, high-frequency continuous monitoring alongside a tailored monitoring programme combining expertise in hydrology, biology and hydro-morphology at different spatio-temporal scales (targeted and broad scale) across five HSO demonstration catchments and one control catchment. The project will generate a suite of Key Performance Indicators (KPIs) to evaluate the efficacy of mitigation measures. The BACI design, that is being applied above and below pressure points, will identify pollutant sources and areas needing protection, setting a new standard for evidence-based water management in Ireland. Initial results from the baseline (gap filling) sampling programme (including macroinvertebrates, water chemistry and sediment) will be presented in this paper, illustrating how these baseline data have informed the bespoke monitoring programme's design.

Detection and comparison of four metal nanoparticles in the muscles of two freshwater fish species from Bobovica Lake using SP-ICP-MS

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Presenting Author: Zoran Kiralj

Status: Oral presentation

Session Number & Date: Advances in data analysis and technologies to support freshwater science, 11:00-11:15, Monday 21 July

Abstract

Nanoparticles (NPs) are particles <100 nm and are characterized by physicochemical properties such as a high surface-area-to-volume ratio, enhanced reactivity, and distinctive optical behaviors. These characteristics have led to their extensive application across sectors including medicine, energy, and agriculture. Despite their benefits, the growing use of NPs has raised concerns about their environmental impact, particularly their potential to accumulate in aquatic organisms. This study aimed to investigate the presence of metal (Ag, Ce, Cu, and Fe) NPs in the muscle tissues of two fish species, Ameiurus nebulosus (brown bullhead) and Lepomis gibbosus (pumpkinseed), sampled from the freshwater lake Bobovica (in Croatia), which is potentially influenced by nearby agricultural activities. We used single particle inductively coupled plasma mass spectrometry (SP-ICP-MS), and measured dissolved metal concentrations in the lake water and total metal content in the fish muscle tissue. Levels of all four metals in the Bobovica Lake water, placing this freshwater lake in category of pristine waters. Higher metal concentrations were found for all four elements in A. nebulosus compared to L. gibbosus muscles, significantly higher for Fe, and up to four times higher, although not significantly, for Ce and Cu. Similarly, the number of detected events (DE), reflecting the quantity of metal NPs, was higher for all metals in A. nebulosus compared to L. gibbosus muscle (Ag: 1.1 DE/sec and 0.7 DE/sec, respectively; Ce: 1.8 DE/sec and 1.0 DE/sec, respectively; Cu: 1.7 DE/sec and 0.9 DE/sec, respectively; and Fe: 1.8 DE/sec and 1.3 DE/sec, respectively). These differences could result from higher total metal concentrations in A. nebulosus which may reflect its benthic feeding habits and omnivorous diet, likely consuming sediments or benthic prey where metal NPs tend to settle and accumulate. In contrast, L. gibbosus primarily feeds in the water column, reducing its exposure to sediment-bound NPs. Average diameters of detected NPs were found in the following decreasing order: Fe, ~250 nm > Cu, ~60 nm > Ag, ~55 nm > Ce, ~25 nm and were, for all metals, generally similar in the two fish species. Finally, wide NP

size ranges were observed for all studied metals, which possibly indicates naturally occurring NPs. However, further investigation would be necessary to distinguish between natural and anthropogenic origins of the NPs. The study highlights the potential for metal NPs accumulation in fish muscles, with certain interspecies differences probably influenced by feeding habits, ecological niches, and biological characteristics. Despite growing use of NPs across industries, the measurement of NPs in environmental studies remain underexplored compared to traditional pollutant monitoring. Integrating NP analysis into future environmental research could greatly enhance our understanding of pollutant dynamics, bioaccumulation pathways, and their implications for ecological and human health.

Determinants of metacommunity diversity across organism assemblages in European drying river networks

Mathis Loïc Messager[1,2], Annika Vilmi[3], Henna Snåre[3], Heikki Mykrä[3], Núria Bonada[4], Miguel Cañedo-Argüelles[5], Loïc Chalmandrier[6], Zoltán Csabai[7], David Cunillera-Montcusí[8,4,9], Arnaud Foulquier[10], Naiara Lopez-Rojo[10], Petr Pařil[11], Luka Polović[11,12], Romain Sarremejane[1], Delphine Rioux[10], Christian Miquel[10], Stephen Mulero[10], Clément Lionnet[10], Bernadett Boóz[7], Dorottya Hárságyi[7], Balázs Berta[7], Anita Szloboda[7], Arnold Móra[7], Bálint Pernecker[7], Patrik Kis[7], Zsolt Kovács[7], Bea Bartalovcs[7], Éva Tihanyi-Horváth[7], Zsuzsanna Pap[7], Khouloud Sebteoui[7], Annika Künne[13], Louise Mimeau[1], Thibault Datry[1]

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Presenting Author: Mathis Loïc Messager

Status: Oral presentation

Session Number & Date: Science and management of non-perennial rivers and streams, 10:45-11:00, Thursday 24 July

Abstract

Non-perennial rivers and streams are the most prevalent type of watercourse on Earth, yet our understanding of how flow intermittence shapes metacommunity structure across climates and assemblages remains limited. As part of the Horizon 2020 DRYvER (Drying River Networks and Climate Change) project, this study investigates factors influencing

diversity patterns of aquatic metacommunities in drying river networks (DRNs). It specifically focuses on the interplay between local hydro-environmental factors and network-scale connectivity. We analyzed diatom, fungal, bacterial, macroinvertebrate, and fish metacommunities sampled six times over the course of a year across 126 reaches with perennial and non-perennial flow in six European DRNs. These DRNs represent a gradient of hydroclimatic conditions: the Albarine (France), Butižnica (Croatia), Bükkösdi-víz (Hungary), Genal (Spain), Lepsämänjoki (Finland), and Velička (Czech Republic). Each site was comprehensively characterized in terms of local environmental conditions, including water chemistry and habitat characteristics. We also leveraged a novel hybrid model custom-developed for each DRN to predict daily flow and intermittence in each reach of the network. This enabled us to test the influence of a suite of hydrological metrics (e.g., drying duration, frequency, flood occurrence) and drying-induced network fragmentation on aquatic biodiversity in space and time. We used these data to model the relationships between hydrologic metrics, environmental factors, connectivity and the taxonomic diversity of each assemblage with spatially explicit statistical models. This approach allows us to assess the relative importance of local versus regional drivers, and determine how specific aspects of the drying regime (e.g., duration, frequency, timing) influence metacommunity patterns. By examining multiple organism groups with diverse life histories and dispersal abilities, we highlight previously underestimated variability in the local and regional factors governing metacommunity diversity in DRNs across assemblages and climates. This comparative study provides a comprehensive understanding of how flow intermittence shapes metacommunity structure in DRNs. The results will provide critical insights that can inform management and conservation strategies for these increasingly vulnerable ecosystems, particularly regarding flow regime management to support community persistence under changing climatic conditions.

Determination of optical properties in lake ecosystems: Assessing the role of light scattering through total suspended solids

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Presenting Author: Pınar Gürbüzer

Status: Oral presentation

Session Number & Date: Advances in data analysis and technologies to support freshwater science, 11:15-11:30, Monday 21 July

Abstract

In lakes ecosystems, the underwater light environment is fundamentally governed by optical properties such as absorption and scattering in addition to solar irradiance. Modelling these phenomena can enhance understanding and monitoring of ecological process including primary productivity, turbidity, particle concentration and underwater habitat availability. Accurate characterization of optical properties is also essential for the calibration of remote sensing algorithms, the modelling of phytoplankton and zooplankton distribution and the estimation of euphotic depth. Despite broad application areas, optical studies in shallow inland water bodies remain limited compared to marine ecosystems, mainly due to the greater complexity of optical signals in lakes. Factors such as shallow depth, variable bottom reflectance, rapid temporal changes in biological activity and most notably the high and heterogeneous concentrations of total suspended solids with a very large dynamic range, contribute to this complexity. As such, lake-specific, real-time optical measurements that can capture the dynamic interplay of biotic and abiotic components influencing underwater light fields are needed. We developed a prototype optical device capable of performing angular scattering measurements across visible spectrum (400–700 nm) and extending into the near-infrared (700–800nm), with 5° resolution between 20 and 180 degrees. This system was applied to water samples collected from the limnetic zone of Lake Mogan, a shallow eutrophic lake located in Ankara, Türkiye. Due to the lake's shallow waters, the behavior of light varies rapidly, directly affecting its optical properties and water quality dynamics. The measurements focused on capturing the spectral scattering behavior of suspended particles. The results provide detailed insight into environmental variability in underwater optical properties. Our findings could inform the development of freshwater-specific remote sensing algorithms, providing a useful tool to improve environmental monitoring and aquatic ecosystem assessment in complex inland waters.

Developing a Safe Operating Space framework for water resources in the Danube River basin

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Presenting Author: Silvia Artuso

Status: Oral presentation

Session Number & Date: Defining ecological boundaries and tipping points: Establishing ‘safe operating spaces’, 16:00-16:15, Thursday 24 July

Abstract

The Danube River Basin, spanning 19 countries and covering 801,000 km², is the most international river basin in the world. This region faces diverse challenges related to water quantity, quality, groundwater management, and biodiversity, all of which are expected to intensify due to climate change. To address these challenges, a holistic and sustainable water management approach is needed—one that integrates environmental, social, and economic dimensions, ensures stakeholder involvement, and aligns with regulatory frameworks. Building on the Planetary Boundaries framework, the concept of Safe Operating Space (SOS) has emerged in the last decades to assess sustainable resource use within the Earth’s carrying capacity while maintaining human well-being. Within the Horizon Europe SOS-Water project, we are working to define the SOS for water resources in four case study sites across Europe and beyond (Danube, Rhine, Jucar and Mekong basins) using integrated modeling, monitoring, advanced indicators, and an inclusive and iterative participatory approach that actively engages stakeholders to co-define visions, water values, and management options. A key component of this effort is the improvement of the Community Water Model (CWatM) developed by IIASA. Current developments include calibrating the model at a high resolution (1-arcminute) for the Danube Basin, refining biophysical process representation (e.g., snowmelt), and incorporating dynamic human-water interactions (e.g., water allocation schemes and crop modeling). Using scenarios based on Shared Socio-economic Pathways (SSPs) and Representative Concentration Pathways (RCPs), the model will be used to assess how climate and socio-economic changes will impact water resources in the Danube basin. These results will be linked to Impact Models addressing biodiversity and ecosystem services, creating an Integrated Water Modelling System (IWMS) for the basin. The resulting co-created SOS framework will inform the design of sustainable water management pathways that address current and future challenges. It aims to maximize the socio-economic and ecological value of water while promoting resilience and sustainability across the Danube River Basin. This proposed talk will showcase the application of the SOS framework to the

Danube Basin, highlighting its capability to integrate all the different aspects of the water dimension with stakeholder engagement and co-development of management pathways. We will present the preliminary framework co-designed with stakeholders for the Danube Basin, share insights from the improved modeling efforts, and illustrate how these advancements can inform sustainable water management practices. Ultimately, the work aims to provide valuable insights for addressing critical water challenges in the Danube Basin and other transboundary regions worldwide.

Developing adaptable methodologies to assess carbon fluxes in Mediterranean wetlands for integrate climate mitigation strategies into management

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Presenting Author: Carlos Rochera

Status: Oral presentation

Session Number & Date: Greenhouse gas (GHG) exchanges and biogeochemical processes, 11:30-11:45, Friday 25 July

Abstract

Wetlands play a significant role in regulating greenhouse gas (GHG) exchanges, influencing climate change mitigation and adaptation strategies. This study presents ongoing work from the Wetland4Change project (Interreg Euro-MED), focused on applying standardized yet flexible methodologies across Mediterranean wetlands to inform sustainable management practices. The project includes multiple pilot sites across the Mediterranean region: Albufera of Valencia (Spain), Kerkini Lake (Greece), Chokliovo Marsh in the Struma catchment (Bulgaria), Marceddì and San Giovanni ponds (Italy), and the Camargue wetlands (France). The diversity of these sites in terms of hydrological regimes, ecological conditions, and conservation status presents a challenge in developing methodologies and solutions that can be effectively applied across different wetland types. Our research applies a multi-tiered methodological framework to assess carbon sequestration and fluxes, ranging from basic estimates using default values to carbon modelling approaches. Default values can still be adapted to specific wetland types, which determine the magnitude and nature of carbon exchanges, while their ecological status modulates these processes, potentially shifting the carbon balance from a sink to a net emitter. The choice of methodological complexity directly depends on data availability at each site, defining the accuracy of estimates. Identifying key environmental factors such as hydrology, temperature, and vegetation dynamics will contribute to refining predictive models. Spatial mapping approaches are employed to delineate distinct functional compartments within wetlands (e.g., flooded zones, vegetated areas, bare soils), recognizing that carbon dynamics differ significantly among these compartments. Preliminary results indicate the feasibility of applying adaptable methodologies to optimize carbon sequestration assessments and enhance informed decision-making processes. Efforts are underway to obtain direct measurements from all study sites, as data are currently available only for some locations. This will allow for the validation and refinement of model parameterization in areas where indirect estimates are currently used. This

integrative approach aims to enhance methodological adaptability and account for variability in data availability, supporting the development of tailored management decisions for diverse Mediterranean wetlands.

Diel feeding pattern of arctic grayling (*Thymallus arcticus*, Pallas 1776) in relation to stream benthic community under natural condition

Purevdorj Surenkhorloo[1]

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Presenting Author: Purevdorj Surenkhorloo

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 16:00-16:15, Tuesday 22 July

Abstract

Fish species and their communities play an important role in freshwater ecosystems. The predation and feeding of fish on macroinvertebrates, phyto-benthos, and macrophytes have considerable top-down effects on the respective taxa in terms of abundance, biomass, and distribution. Drift-feeding fish often experience predictable diel fluctuations in food availability in the form of drifting invertebrates (Elliott, 1967). As a result, they encounter different periods of optimal feeding times throughout each 24-hour cycle. Studies of food consumption, when combined with information on fish diets, allow us to determine the predation pressure exerted by fish on their prey and describe aquatic food webs (Temming et al., 2002). Most regional studies have focused on the taxonomic and zoogeographical aspects, and there is no information available on diel feeding periodicity, with even less on natural feeding habits and ecological relationships in the country. Despite being economically important, this fish species plays a key role in the ecological niches of open waters. In the present study, we investigated the diel feeding periodicity and prey selectivity of drift-feeding Arctic grayling in the Kharaa River of Northern Mongolia, based on 24-hour surveys conducted during consecutive autumn sampling periods in 2007 and 2008. Our sampling results indicate that the investigation over a 24-hour period across two sequenced autumn seasons showed that drift-feeding Arctic grayling exhibited an active feeding periodicity on benthic communities, with a distinct peak at dusk (18:00) in both seasons and years. Our investigation of prey selection by Arctic grayling during the day demonstrated the selection of different dominant prey taxa, namely mayfly larvae (Baetis sp.), dipteran larvae (Chironomidae), and caddis larvae (Ceratopsyche sp.), with no significant effect of predation. Caddis larvae and adults dominated approximately 50 to 90 percent of the diet from the night period (22:00) until daylight (14:00), while chironomids dominated more than 50 percent during the daylight and dusk periods. Mayfly larvae were predominant, comprising up to 37 percent of the diet between daylight and night periods. These results indicated that the dominant aquatic insects consumed depended on the peak period, which may relate to the invertebrate life stages and the abundance of taxa.

Diel vertical migration of zooplankton and their effects on the nutrient fluxes in Lake Geneva

Nischal Devkota[1], M. Jake Vander Zanden[1], Marie-Elodie Perga[1]

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Presenting Author: Nischal Devkota

Status: Oral presentation

Session Number & Date: Plankton ecology, 15:15-15:30, Thursday 24 July

Abstract

Zooplankton Diel Vertical Migration (zDVM) is a widespread phenomenon across different aquatic environments. Vertically migrating zooplankton actively transport matter and nutrients from the epilimnion to deeper layers, contributing to the nutrient flux dynamics. Although, various modeling studies have attempted to quantify the regional or global contribution of zooplankton to the nutrient fluxes, most of these studies have been based on simplified assumptions of zooplankton migration and have almost exclusively focused on marine environments. The biogeochemical effects of zDVM are understudied in freshwater systems. To improve the understanding of the effects of zDVM on the nutrient dynamics in lakes, we first characterized the vertical distribution and migration patterns of major zooplankton taxa in Lake Geneva and then quantified the contribution of vertically migrating meso-zooplankton (≥200μm) to the fluxes of total phosphorus, nitrogen and carbon. From July to November 2024, we conducted four round-the-clock zooplankton sampling campagins at various times of day and night and at different depth ranges (0-100m) from the LéXPLORE floating platform on Lake Geneva. Samples from all campaigns were analyzed for zooplankton diversity, abundance and size structure. Samples taken from August to November were analysed additionally for total phosphorus, carbon and nitrogen content of zooplankton from the epilimnion, metalimnion and hypolimnion. We found zooplankton populations distributed throughout the water column at the sampling location i.e., 0-100m. Clear patterns of zDVM were observed from 0-50m, where copepods were the dominant migrators. We also provide new insights into the total phosphorus and nitrogen flux dynamics, which have been comparatively less studied than carbon fluxes, even in marine systems. The obtained data would enable quantitative parameterization of zooplankton contribution to the nutrient fluxes at the plankton interface, which may be beneficial for better mechanistic understanding of the role of zooplankton in the biogeochemistry in both marine and freshwater systems.

Diet composition and food niches of large avian piscivores in rivers and reservoirs during the wintering period

Robert Gwiazda[1]

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Presenting Author: Robert Gwiazda

Status: Poster presentation

Session Number & Date:

Abstract

The diet of piscivorous avian predators depends on fish structure assemblages and varies in different habitats. The population of Great Cormorant (Phalacrocorax carbo) has increased rapidly in the last decades in Europe. Greater numbers of this species were observed also in winter. The aim of the study was to compare the diet of the Great Cormorant and to determine its food niche in different habitats in the wintering period. The study was carried out in a submontane river, two lowland rivers, and two submontane reservoirs in southern Poland (Central Europe). Material consisted of collected pellets on roost in lowland rivers and reservoir 1 and stomachs of shot birds on submontane river and reservoir 2 in the migrating or wintering period (November-February). Pellet analysis and stomach contents were studied. Species composition and fish size were estimated. The diet of Great Cormorants included from 8 to 12 species in the studied sites. The most numerous species in the cormorant's food were perch (Perca fluviatlis) in lowland rivers and one submontane reservoir, roach (Rutilus rutilus) in another submontane reservoir and chub (Squalius cephalus) in the submontane river. A significantly greater proportion of piscivorous fish was found in the diet of the Great Cormorant in submontane rivers than in other studied habitats. Fish consumed by cormorants were greater in the submontane river (mean length = 24 cm) than in lowland rivers and submontane reservoirs (mean length = 11-13 cm). Cormorants hunted greater single prey in submontane river, while in other habitats they hunted small fish that gathered in flocks. Cluster analysis showed a great similarity of the diet of Great Cormorant in lowland rivers. Diet in the submontane river was a separate group from the diet in other habitats. The breadth of the food niche (standardized Levin's index) of the Great Cormorant was the highest in a submontane river (B=0.50). This index was significantly lower for reservoirs and for lowland rivers. The low values of the indexes showed a limited trophic spectrum in the diet of this species. Great Cormorants show different dietary patterns depending on their habitat. Their foraging on fish of economic value can lead to conflicts with fishermen or anglers, especially in submontane rivers.

Do 2-mercaptobenzothiazole and 6-PPD-quinone impact freshwater microbiota? An indoor channel approach

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Presenting Author: Itxaso Martinez-Sanz

Status: Oral presentation

Session Number & Date: Ecotoxicology: Ecological responses to chemical stress in freshwaters, 11:00-11:15, Thursday 24 July

Abstract

Climate change is expected to increase the frequency of extreme events, including long dry periods followed by intense storms and heavy rainfalls. These episodes cause intense urban runoff carrying high concentrations of contaminants, including industrial compounds, which then reach freshwater ecosystems. Contaminants 2-mercaptobenzothiazole (MBT) and 6PPD-quinone (widely used as tyre rubber vulcanizers) have been detected in urban stormwater runoff. Recent studies indicate that 6PPD-quinone causes mortality in coho salmon, while MBT exhibits toxicity to aquatic organisms including algae and zooplankton. However, their effects on aquatic microbiota and potential implications for food webs remain unknown. Aquatic hyphomycete fungi and biofilms play a crucial role in organic matter decomposition and nutrient cycling, and alterations in their composition and functionality could alter entire food webs. To address this knowledge gap, we conducted an indoor channel experiment to investigate the effect of these contaminants on biofilms and leaf litter processing. Poplar leaf litter was conditioned in the Tordera stream (Spain) for 10 days before the experiment, and biofilms were collected from the same stream and allowed to colonize glass substrates in experimental channels for 30 days. We introduced biofilm and leaf-litter consumers (the invertebrates Physa sp. and Gammarus sp.) to evaluate the contaminants' potential effects on the food web. Twelve channels were assigned to 4 treatments: exposure to 60 µg/L MBT, 30 µg/L 6PPD-quinone, a mixture of the two, and control. The experiment lasted 14 days, with sampling before exposure, after 7 days, and after 14 days. We analyzed the potential impact of the C:N ratios, fungal biomass, leaf litter decomposition, lipid content, biofilm biomass, photosynthetic activity (PAM), bacterial density, enzymatic activities and resource consumption by invertebrates. We hypothesized that the two contaminants would negatively affect the microbiota, leading to alterations in resource consumption. Preliminary results indicate that MBT and its interaction with 6PPD-quinone, accelerated decomposition during the first week of exposure. Additionally, MBT exposure

reduced photosynthetic yield in biofilms, but when both MBT and 6PPD-quinone were present the negative effect of MBT was counteracted.

Do we need holistic restoration schemes to be successful in river restoration? Having a look on Austria with the MERLIN Regional Scalability Plan

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Presenting Author: Silke-Silvia Michelitsch

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:00-11:15, Thursday 24 July

Abstract

River restoration is a critical aspect of environmental conservation aimed at improving the ecological health of rivers and the surrounding landscapes. Over the past century, human activities such as industrialization, agriculture, urbanization, and dam construction have significantly altered the natural flow of rivers. These changes have led to habitat loss, water quality degradation, reduced biodiversity, and the disruption of essential ecosystem services that rivers provide. Therefore, restoring rivers to a more natural state is crucial for both environmental sustainability and the wellbeing of local communities. However, river restoration is not a simple task. It requires careful consideration of multiple factors - hydrological, ecological, social, and economic - particularly when aiming to scale up restoration efforts. This is where holistic concepts become essential. Within the H2020 funded MERLIN project (grant agreement No 101036337) European case studies showcase successful freshwater restoration measures to derive the frame for large scale restoration schemes. Each case study worked on a Regional Scalability Plan (RSP) describing local restoration efforts to be scaled up within the next 10 to 30 years. Responsibilities and relevant sectors to be included in the planning process were identified as well as specific steps of implementation. The Austrian Danube stretch is characterized as heavily impacted ecosystem with 10 hydropower plants up to Vienna and two remaining free-flowing sections in “Wachau” (35 km length) and east of Vienna (48 km length) which accommodates the last large riverine wetlands in central Europe. Since the 1990s river

restoration is ongoing in an interactive and integrative manner east of Vienna through removing river embankments, reconnection of side channels, sediment management etc. as well as by involving stakeholders from several sectors into the process. To achieve restoration large-scale efforts, the whole Austrian Danube stretch was evaluated for its options by following a given frame within the RSPs and answering the questions WHY, WHERE, WHAT, HOW and WHO contributes to freshwater restoration. Analysis shows that there is a clear difference in stakeholder involvement west and east of Vienna and the focus of restoration is also different in both stretches influenced by protection status. But for developing systemic restoration schemes an early integration of all relevant stakeholders is highly recommended.

Dry and uncovered: Effects of riparian vegetation on abiotic and biotic characteristics of intermittent streams

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Presenting Author: Michal Straka

Status: Oral presentation

Session Number & Date: Science and management of non-perennial rivers and streams, 15:30-15:45, Thursday 24 July

Abstract

Riparian vegetation forms the interface between the terrestrial and aquatic ecosystems and affects many structural and functional stream processes. It can moderate the flow regime, stabilise stream channels, reduce inputs of fine sediments from farmland, and mitigate excessive input of nutrients and micropollutants. Therefore, revegetating riparian zones is a common management action to improve stream conditions. Recently, the flow regime in many streams in the extensive Central Europe region has shifted from perennial to intermittent. The loss of surface water has a dramatic impact on freshwater biota. Species inhabiting intermittent streams require adaptation to survive dry periods. Some of the environmental parameters that are critical for survival in a dry streambed (e.g. temperature, unclogged substrate) can be significantly affected by the presence of riparian buffer strips. Our study investigated the effect of stream bank vegetation on intermittent stream ecosystem structure. We hypothesized that riparian vegetation would stabilise temperature regimes, reduce nutrient inputs, improve channel morphology, and ultimately mitigate the impacts of stream drying on benthic diatom and macroinvertebrate communities. Paired-stream comparisons were conducted between sites with and without well-developed riparian buffer strips. The results showed that streams with riparian vegetation exhibited slightly lower water temperatures, lower total phosphorus concentrations, and significantly higher dissolved oxygen levels. Unbuffered streams received a much higher amount of solar radiation; wetland vegetation was more developed in the streambed, and the bed substrate was covered with a higher amount of fine sediment. Diatom communities from buffered and unbuffered streams largely overlapped. In contrast, macroinvertebrate assemblages displayed distinct differences, with shifts in functional traits reflecting adaptations to temperature, sediment, and flow conditions in streams with riparian buffer strips. Contrary to our hypothesis, riparian buffer strips did not significantly mitigate the impact of stream drying on macroinvertebrate communities. We believe this is due to the overall degradation of unbuffered sites, in which community diversity was already ‘a priori’ limited. Sites with buffer strips are inhabited by species-rich

communities experienced more pronounced declines during the dry period than generally uniform communities of unbuffered streams. These findings highlight the importance of riparian vegetation in shaping stream habitats and biodiversity, even though its role in mitigating the effects of stream drying was not supported. The research was supported by Technology Agency of the Czech Republic SS06010258 project.

Early warning signals have limited applicability to empirical lake data

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Presenting Author: Duncan A. O'Brien

Status: Oral presentation

Session Number & Date: Defining ecological boundaries and tipping points: Establishing 'safe operating spaces', 16:15-16:30, Thursday 24 July

Abstract

Research aimed at identifying indicators of persistent abrupt shifts in ecological communities, a.k.a regime shifts, has led to the development of a suite of early warning signals (EWSs). These EWSs exclusively quantify the phenomenon of critical slowing down (CSD), a phenomenon that occurs when a system approaches a tipping point and its return rate/speed of recovery from perturbations worsens. However, regime shifts can occur via multiple mechanisms, with tipping points (e.g. critical transitions) often assumed to be the dominant process. As EWSs often perform inaccurately when applied to real-world observational data, it remains unclear whether tipping points/critical transitions are the dominant mechanism of regime shifts and, if so, which EWS methods can predict them. Here, using multi-trophic planktonic data on multiple lakes from around the world, we classify lake time series into abrupt and non-abrupt dynamics, and sub-classify these further to describe the likely process of change. We then assess the reliability of classic and second generation EWSs methods to predict whole-ecosystem change given the lake dynamics classifications. Specifically, we use univariate EWSs which are applied to single taxa, multivariate EWSs which represent a single indicator for the entire ecosystem, and machine learning models which make predictions without requiring CSD. We find few instances of tipping points, with different trophic levels often expressing different forms of abrupt change. The ability to predict these abrupt changes is highly data processing dependant, with most indicators not performing better than chance, multivariate EWSs being weakly superior to univariate, and the machine learning model performing poorly. Our results suggest that predictive ecology should start to move away from the concept of critical transitions, developing methods suitable for predicting resilience loss not limited to the strict bounds of bifurcation theory. Abrupt shifts are not necessarily tipping points, and it limits our ability to proactively manage vulnerable aquatic ecosystems to assume otherwise.

Ecoflux Bretagne: participatory observation of the effects of climate change on water quality and biodiversity and biodiversity along the land-sea continuum

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Presenting Author: Christophe Piscart

Status: Poster presentation

Session Number & Date:

Abstract

The aim of the ECOFLUX-Bretagne project is to set up a participatory observatory in Brittany to monitor the relationship between water quality and biodiversity along the land-sea continuum, in the context of climate change. The challenges of the project are (1) scientific, with the long-term acquisition of environmental data along the land-sea continuum; (2) educational, with a contribution to the co-production of this knowledge in conjunction with students and teachers from agricultural high schools; and (3) territorial, with the aim of improving water quality and maintaining biodiversity along the land-sea continuum, while enabling local authorities to better adapt to the effects of climate change. To achieve these objectives, six pilot sites will be following a basic set of parameters to compare areas with different characteristics, whether 'natural' (geology, soil, geomorphology) or social (urbanisation, agricultural practices), and to derive decision-making rules at a general level, transcending local particularities. This fundamental base will also be combined with monitoring of parameters specific to each site, to take account of the issues specific to each. The parameters selected primarily concern the impact of climate change (temperature, flow, weather), water quality (nutrients, oxygen, conductivity, pH, turbidity), and have been defined in consultation with secondary school teachers, scientists and catchment managers. By combining long-term data acquisition and integrated modelling along the land-sea continuum of water quality, our project will provide a better understanding of how Brittany's hydrosystems respond to climate change and the solutions put in place to mitigate its impacts. This project also aim to promote dialogue and action between stakeholders with often divergent interests, to tackle together the complexity of socio-ecosystems.

Ecological functions and interactions of leaf and litter fungal communities dispersed by streams (ELICOS project)

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Presenting Author: Nabil Majdi

Status: Oral presentation

Session Number & Date: Aquatic fungi and microorganisms in a changing world, 11:00-11:15, Friday 25 July

Abstract

Leaves host diverse fungal communities – the phyllosphere mycobiome – yet their metabolic functions and ecological roles remain poorly known. Notably, mycobiome composition changes during leaf senescence and decomposition, but also along during their journey from terrestrial to aquatic biotopes. Given the potential long-distance dispersal of leaves, particularly in streams, leaf-associated mycobiota may play a major role in shaping ecological processes along river continua and in downstream ecosystems. The ELICOS project is investigating the spatio-temporal dynamics of leaf-associated mycobiomes as they disperse from a protected old-growth forest in the eastern fringe of the Pyrénées to the Mediterranean Sea via the Massane river, from spring to winter 2024. The Massane river (22 km total length) emerges at 1,000 m elevation, then flows through a 6-km stretch of old-growth beech forest before transitioning to Mediterranean riparian vegetation below 500 m, where alder, green oak and cork oak dominate. As it progresses into the floodplain, the river encounters increasingly anthropized sections with non-native trees, including the silver wattle (Acacia dealbata), which significantly alters stream communities and ecological processes in the riparian zone. To assess fungal contributions along this continuum, we quantified litter fluxes, leaf decomposition rates, fungal diversity, spore production, biomass via ergosterol content and the leaf-associated metabolome. By integrating standard analyses and "-omics" approaches, we revealed an intriguing succession of leaf-associated fungal and chemical "landscapes" associated with leaf

decomposition in the stream. We also isolated and cultivated aquatic and phyllospheric fungal species to further explore the connections between mycobiomes and metabolomes, and between terrestrial and aquatic ecosystems. We identified 41 morpho-species of aquatic hyphomycetes in the stream, from which 14 strains were succefully cultivated. Furthermore, 20 fungal endophytes from beech and alder trees were cultured, classified by sequencing their ribosomal internal transcribed spacer and vouchered. In the field, when beech leaves entered the stream, we observed that a substantial amount and diversity of hydrophilic compounds were washed away within few days. Then, sporulation rates and hyphal biomass (ergosterol content) peaked after 50 to 75 days in the stream. Finally, the experiment stopped after 200 days, beech leaves being largely degraded, but overall we observed a coherent evolution of the leaf-associated communities and of the metabolome throughout the aquatic decomposition process. However, downstream reaches that dried out in summer had different leaf litter inputs, altered decomposition rates, fungal successions and metabolomic profiles. These findings underscore the need for comprehensive evaluations of mycobiomes through space and time and using complementary tools such as laboratory isolations, morpho-taxonomy, metabarcoding and metabolomics, to better understand the role of fungi in terrestrial-aquatic linkages in a changing world.

Ecological quality drives an increased abundance of malaria insect vectors

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Presenting Author: Nathan Jay Baker

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 11:30-11:45, Monday 21 July

Abstract

The EU Water Framework Directive aims to achieve good ecological status of freshwater ecosystems, yet more than 60% of EU freshwaters fail to meet this target as the 2027 deadline approaches. While numerous initiatives address freshwater degradation and its consequences on biodiversity, existing and novel stressors continue to create dynamic multi-stressor environments with unknown and complex ecological consequences. For instance, in degraded systems, invertebrate communities often shift to uneven distributions where certain taxa thrive, potentially altering ecosystem functions. Under such conditions, Dipteran species frequently dominate, though their true diversity and ecological sensitivities remain poorly understood. Some Diptera, namely the Simuliidae (blackflies), Ceratopogonidae (biting midges), and Culicidae (mosquitos) are generally tolerant and can occur in high densities in waterbodies with lower ecological quality. These groups are also known vectors of malarial and other haemosporidian parasites amongst wildlife and humans. Recent parasitological surveys in Lithuania revealed increasing diversity and prevalence of avian malarial and haemosporidian parasites between 2003/2004 and 2018/2019, raising concerns about potential links between water quality (63% of Lithuanian rivers fail to read good ecological status) and vector-borne diseases amid expanding distributions of human disease vectors (e.g., Aedes aegypti, Aedes albopictus) in Europe. This study investigated long-term trends of Diptera communities in Lithuanian freshwaters, with a particular focus on vectors like Simuliidae, Ceratopogonidae, and Culicidae. We analysed an extensive freshwater biomonitoring dataset comprising 603 riverine and 331 lake sites sampled from 2013-2022. Using spatial-temporal Bayesian generalised linear mixed models, we examined relationships between vector abundance and environmental drivers, including ecological quality ratios and climate predictors such as precipitation, temperature, and landcover. Contrary to our initial hypothesis that increases in vector abundance would be linked to degraded environmental conditions, higher ecological quality was associated with greater vector abundance. Elevation, precipitation, and temperature also demonstrated strong statistical importance, while land use showed surprisingly minimal influence. Distinct spatial patterns emerged between eastern and western Lithuania, indicating latent geographical

influences on vector distribution that could not be accounted for in our model. These findings suggest that good ecological quality supports higher vector abundances as part of overall increased dipteran diversity and ecosystem health. The highland regions of eastern Lithuania, characterized by forested, interconnected lake-river water systems, demonstrated both better ecological quality and stronger aquatic-terrestrial linkages. Our results thus identify priority areas for future parasitological and biodiversity research, particularly regarding understudied Dipteran diversity. The implementation of DNA-based biomonitoring methods, such as eDNA and metabarcoding, will be crucial for uncovering the “dark” diversity of Diptera and tracking their distribution patterns, especially under global change scenarios. The study also offers a robust model for predicting vector abundance that bridges freshwater ecology and epidemiology, highlighting the broader implications of continued anthropogenic perturbation and water quality management. This project has received funding from the Research Council of Lithuania (LMT), agreement No Nr. S-MIP-24-61.

Ecological Responses to Simulated Flood and Drought Events in Freshwater Reservoir Outflows

Xavier Richard Badham[1]

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Presenting Author: Xavier Richard Badham

Status: Oral presentation

Session Number & Date: Linking hydromorphology and ecology, 11:15-11:30, Friday 25 July

Abstract

Predicted climate change scenarios for the UK and Ireland indicate an increase in winter precipitation and a decrease in summer rainfall, resulting in a higher frequency of flash floods and prolonged droughts. These hydrological extremes are projected to alter freshwater ecosystems, influencing habitat availability, nutrient fluxes, species interactions, and overall ecosystem functioning. While theory predicts that extreme pulse disturbances should affect ecological stability, empirical evidence remains limited, particularly regarding natural system manipulations. Existing research typically relies on post-hoc observational studies or mesocosm studies which, though highly valuable, contain limitations of control and realism respectively. We present a novel whole-stream manipulation approach to simulate extreme hydrological events using controlled releases from existing reservoir infrastructure. Twelve reservoir outflow streams across Northern Ireland were assigned four treatments: flash flood, drought, mixed and control. Hydrological manipulation parameters were designed with a year-long study of the stream outflow prior to the event and co-ordination with the local water authorities' regular discharge schedule, allowing for controlled, yet ecologically relevant disturbance simulation. Ecological responses were assessed across multiple dimensions. Algal biomass was quantified before and after events using chlorophyll-a concentrations, providing a proxy for primary productivity. Benthic decomposition rates, indicative of ecosystem functioning, were quantified via standardised local leaf litter packs, capturing the contribution of bacterial and detritivore-driven processes. Benthic macroinvertebrate communities were sampled to evaluate changes in abundance, taxonomic diversity and functional trait composition. By integrating structural and functional metrics, this study allows for the calculation of ecological stability metrics, including resistance, recovery and temporal variability. Our work highlights both the promise and challenge of using existing reservoir infrastructure to simulate pulse disturbances in situ, while reducing set-up costs of mesocosm experiments and improving translatability of study conclusions. Results will enhance our understanding of freshwater resilience under extreme flow events and

provide evidence to inform conservation planning and adaptive water management under future climatic uncertainty.

Ecological Restoration of Exploited Peatlands: Impacts on Greenhouse Gas Fluxes and Biodiversity

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Presenting Author: Juliet Everson

Status: Oral presentation

Session Number & Date: Wetland ecology and management, 16:15-16:30, Tuesday 22 July

Abstract

Globally peatlands store twice as much carbon as forests, despite only covering a 3% of the Earth's landmass. However, peatlands in the UK and Ireland are in poor condition, with more than 90% of lowland raised bogs classed as "degraded". In response, rewetting as an approach to restoration has become more common, despite being largely understudied. This project looks at two commercially exploited peatlands in Northern Ireland, which have been restored in different plots in different years between 2013 and 2023 to create a decade-long chronosequence. These have been used to investigate the progression of restoration, and its impacts on biodiversity and greenhouse gas fluxes. Protected sites across Northern Ireland were categorised as favourable or unfavourable, and used as references for the direction and ultimate goal for the restoration. A plot which had been exploited in the same manner but not rewetted was used to demonstrate the effect of the restoration compared to natural recovery. Sphagnum species richness and percentage cover was sampled using quadrats in 2023, and while richness is better predicted by location, percentage cover was found to increase with age. Carbon dioxide and methane fluxes were investigated using dynamic closed chamber sampling once a quarter between July 2024 and April 2025, and used to investigate photosynthesis, respiration, and net productivity (NPP), as well as methane emission. Initial results show an increase in photosynthesis with age, but no strong effect on respiration, NPP, or methane production, however at the time of writing ,the last month's data has not been collected. Net greenhouse effect will also be calculated and modelled using age of plot as well as environmental variables. Results of this study will lend weight to arguments for peatland restoration as a nature-based solution for climate change, and help inform our understanding of the recovery of these delicate systems. We will also link the recovery of biodiversity to ecosystem services such as carbon capture, emphasising the importance of a diverse community.

Ecological uniqueness, habitat suitability and species diversity of non-marine Ostracoda (Crustacea)

Okan Külköylüoğlu[1], Mehmet Yavuzatmaca[1]

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Presenting Author: Okan Külköylüoğlu

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 15:15-15:30, Monday 21 July

Abstract

Elucidating the factors that determine suitable or ecologically unique habitats preferred by species is a challenging concept. Understanding why certain habitats are better suited for specific species, as well as why some habitats exhibit ecological uniqueness, is crucial. This understanding can help explain the relationship between habitat characteristics and species diversity. This study, the first of its kind in the literature, investigates the diversity, ecological uniqueness, and habitat suitability of non-marine ostracods in the Denizli province of Türkiye. A total of 49 ostracod taxa were identified, including 35 extant species and 14 subfossils, with 28 new records for the region. This brings the total number of known ostracod species in the province to 44, indicating a high species diversity. Canonical Correspondence Analysis revealed that the first two axes explained 66.7% of the cumulative variance in species-environmental relationships, with relatively low variance (4.0%). Ecological uniqueness scores (the sum of dissimilarities for each site) ranged from 63.43 to 74.00, with sites (e.g., Sites 1 and 75) showing the highest uniqueness, suggesting these areas may harbor unique species assemblages and/or suitable physicochemical environmental conditions for those species. Conversely, sites (e.g., Sites 30 and 46) displayed lower uniqueness, indicating more generalized ecological conditions. Habitat suitability analysis, based on seven environmental variables (pH, dissolved oxygen (DO), electrical conductivity (EC), water temperature (Tw), elevation, longitude, and latitude), revealed that sites (e.g., Sites 1, 3, and 2) had the highest suitability scores (0.7468, 0.4524, and 0.2909, respectively), with Site 1 identified as the most suitable habitat. Species with cosmopolitan characteristics exhibited broad ecological tolerance, thriving across a range of habitats, while species with narrow ecological preferences were more likely to be found in ecologically unique habitats. Two-way Indicator Species Analysis (TWINSPAN) revealed that certain species, depending on their morphological traits, were associated with specific habitat types, such as stagnant or flowing waters. The integration of habitat suitability analysis, ecological uniqueness, and species-specific ecological tolerances provides a comprehensive approach for identifying

critical habitats for conservation. Further studies are needed to refine this method for more effective environmental management and conservation strategies.

Ecosystem status of agricultural ponds across Eastern Germany and the influence of pesticides upon their macroinvertebrate communities

Holly Blevins[1], Kathrin Fisch[1], Stefan Lorenz[1]

[1]Julius Kühn-Institut

Presenting Author: Holly Blevins

Status: Oral presentation

Session Number & Date: Small water bodies: from assessment to impact mitigation, 11:30-11:45, Tuesday 22 July

Abstract

Small standing water bodies less than one hectare in size (i.e. ponds) are of great importance for life forms both aquatic and terrestrial, and yet their contributions to regional biodiversity are largely ignored by protective legislature as well as by the landowners themselves. Ponds provide habitat for invertebrates, which cycle nutrients within the water body and in turn provide food sources for other organisms; these intricate relationships are vulnerable to the impacts of pesticide runoff from adjacent fields. Thus, understanding the status and drivers of biodiversity in ponds found in cultivated landscapes is critical for making land management choices that protect these systems. We therefore performed a status assessment in 35 ponds found in agricultural areas of eastern Germany and investigated the riparian vegetation for potential shielding effects from harmful chemical exposures. To determine the ecological health of the water bodies, we collected water samples during each season in 2024 and analyzed them for presence of pesticide compounds. To correlate the detected pesticide levels with the pond's biodiversity, we collected benthic macroinvertebrate samples from each habitat type in each water body, and compared species diversity metrics and presence of indicator taxa (Ephemeroptera, Plecoptera, and Trichoptera, i.e. EPT taxa) against the detected pesticide levels. To determine the shielding effects of the riparian vegetation, we deployed an unmanned aerial vehicle (UAV) fitted with a LiDAR sensor and recorded in a 500m space around the pond. We calculated the density and height of the point cloud in the riparian zones of each pond, used the elevation models to calculate the flow paths from the agricultural fields into the water bodies, and correlated the amount of shielding vegetation with the detected pesticide levels in the ponds. Our results allowed us to make recommendations for effective management practices for each water body in our study.

eDNA Analysis of Avian Biodiversity in Salda Lake: A Comparative Study of Sterivex and Dual Filter Methods

Atakan Pipilos[4], Işılay Çelik[1,2,3], Ayşegül Er Gökçe[1,2,3], Berkay Gülen[1,3,5], Açelya Dalgıç[1,3,6], Emre Keskin[1,3,7]

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Presenting Author: Atakan Pipilos

Status: Poster presentation

Session Number & Date:

Abstract

Environmental DNA (eDNA) has been gaining a lot of attention lately as a powerful tool for monitoring biodiversity in aquatic ecosystems. In this study, we took a unique approach—using eDNA—to assess the avian biodiversity of Salda Lake, Türkiye. To the best of our knowledge, this is the first study of its kind in this region. We used high-throughput sequencing techniques and tested two different eDNA filtration methods—Sterivex filters and eDNA Dual Filter Capsules (Sylphium)—to see how well they capture bird diversity and taxonomic composition. At the same time, we compared how effective these filtration methods are when used with whole genome shotgun sequencing (WGS). For sample collection, we gathered water from three different locations around Salda Lake. In total, we ended up with six samples—three per filtration method. We then extracted DNA using the Qiagen DNeasy PowerSoil Pro Kit, following a filter-cutting technique to make sure both filtration methods were processed in the exact same way. After that, we performed shotgun sequencing to determine the presence of avian species at different taxonomic levels—order, family, genus, and species. We identified several dominant avian families in Salda Lake, including Accipitridae, Anatidae, Phasianidae, Apterygidae, and Turdidae. These bird groups are quite important in terms of ecological roles. For instance, Accipitridae (hawks and eagles) and Falconidae (falcons) are top predators in their ecosystems, whereas Anatidae (ducks and geese) are closely associated with wetlands. Meanwhile, Phasianidae (pheasants and partridges) and Turdidae (thrushes) contribute significantly to the lake's surrounding terrestrial bird communities. When we compared the two filtration methods, we noticed a difference in

the number of bird species detected. Specifically, samples processed with Sterivex filters seemed to retain more Aves DNA than those processed with dual filters. This suggests that there might be differences in DNA retention or extraction efficiency between these two filtration methods. To our knowledge, this is the first large-scale study that directly compares Sterivex and dual filters using whole genome shotgun sequencing. Our findings provide useful insights into the advantages and limitations of each method, especially for biodiversity studies that rely on eDNA. Overall, this study is a step forward in using eDNA for avian biodiversity monitoring in freshwater ecosystems. By exploring the dominant bird species in Salda Lake and evaluating different filtration approaches, we contribute not only to the growing field of eDNA research but also to broader conservation efforts aimed at protecting biodiversity.

Effect of the Use of Different Biological Indexes Based on Invertebrates on The Assessment of the Ecological Status of Water Bodies. Case Study of the Rivers Shared by Spain and Portugal

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Presenting Author: Neftali Roblas

Status: Poster presentation

Session Number & Date:

Abstract

During 2019 and 2020, the rivers shared by Spain and Portugal were studied in order to determine the origin of the discrepancies detected in the results of the ecological status assessment submitted by each country to the European Commission. Benthic invertebrates were sampled from 32 river water bodies (RWB) following the official protocols approved by each country, and national quality indices were calculated. The obtained results showed a strong discrepancy. According to Spanish methodology, 24 RWB reached the very good ecological status, 4 good ecological status and 4 did not reach good status, while according to the Portuguese methodology, 11 RWB were in very good ecological status, 10 in good ecological status, and 11 did not reach good status. After the analysis of the potential causes of discrepancy, such as types of rivers defined, reference conditions, location of the sampling point, sampling protocol, type of data obtained, calculated index, etc., it was concluded that these were mainly due to the type of data used for the calculation of the quality index: qualitative (presence/absence of families) in Spain and quantitative (number of individuals in each family) in Portugal. As a result of this study, a common strategy has been proposed to harmonize the procedures for assessing the ecological status of shared rivers based on benthic invertebrates using intercalibrated quantitative indices.

Effective infiltration estimation in the alteration material and the soils of the Toledo platform (Spain)

Miguel Martín-Loeches[1], Antonio Sastre-Merlín[1], Eugenio Molina-Navarro[1], Silvia Martínez-Pérez[1]

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Presenting Author: Miguel Martín-Loeches

Status: Poster presentation

Session Number & Date:

Abstract

The Toledo platform, located south of the city of Toledo in Spain and extending to the Appalachian mountains of Montes de Toledo, is a flat and elevated region of 1530 km^2 with an average height of 700 m above sea level and a slope of 7%. Its substrate is composed of igneous-metamorphic rocks. From the Oligocene to the end of the Pliocene, a notable alteration of these rocks occurred, reaching a maximum thickness of 50 m. Although these alteration processes have decreased, they still persist. Currently, the platform is partially covered by more recent sediments and edaphic soils, while other parts have been eroded. To estimate the annual recharge of the alteration material and the edaphic formations that occasionally cover it, the chloride balance method is used. This method is suitable for arid areas with little surface runoff and has been applied in regions with similar climatic and physiographic conditions. The formula used is: Inf = P (Cp/Cr), where Inf is the effective infiltration in mm, Cp is the concentration of chloride in precipitation water, and Cr is the concentration of chloride in the groundwater. In the Toledo platform, precipitation is higher in mountainous than flat areas. The water from the surface currents coming from the mountains contributes to aquifer recharge in the flat areas. This "Mountain front recharge" (MFR) is relevant in the southernmost strip of the aquifer, near the San Pablo, El Castañar, and Los Yébenes mountain ranges. However, "Mountain block recharge" of aquifers adjacent to the mountains with groundwater flowing through the interior of the rocks is unlikely due to the reduced thickness and irregular distribution of the permeable material on the platform. The average annual precipitation in the Toledo platform varies in three bands: <400 mm, 400–500 mm, and 500–600 mm. Some streams of the Guajaraz headwaters, the main water course in the study area, begin in the 500–600 mm band before entering the alteration material, favoring the MFR phenomenon. In these areas, the chloride balance formula is applied with P equal to 550 mm, Cp of 4 ppm, and Cr of 100 ppm. The results show that the annual recharge volume in the permeable material of the Toledo platform is approximately 9 hm^3, comparable to the 2.8 hm^3 of baseflow in the Guajaraz stream basin (obtained using the SWAT+ model), which occupies ~33% of the total studied area. The convergence of both results

demonstrates that the chloride balance method is suitable for the climatic conditions of the Toledo platform.

Effects of exposure to nanoplastics on the structure and physiology of Planktothrix agardhii

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Presenting Author: Pluskota Mateusz

Status: Oral presentation

Session Number & Date: Freshwater quality: Tackling the challenge of pollution, 14:45-15:00, Monday 21 July

Abstract

Plastic production has reached high levels globally, with nearly 370 million tonnes produced in 2019, including 58 million in Europe according to the Plastics Europe Foundation. Water ecosystems are critical in transporting and storing plastic pollution, with freshwaters potentially absorbing more pollutants than marine ecosystems. Plastics rapidly enter aquatic environments and are broken down into smaller fragments by UV radiation, wave action, abrasion, oxidation, and microbial activity. Diverse plastic fragments permeate the environment in various dimensions, from larger macroplastics to microplastics, although nanoplastics seem to raise even greater concerns related to their impact on biological processes at the cellular level. Most of the nanoplastic research focuses on effects on fish, mollusks, crustaceans, and mammals, with limited studies on bacteria and cyanobacteria. Research suggests bacterial communities in aquatic ecosystems may be more vulnerable to nanoplastics and potentially serve as a protective barrier for algae. Current research indicates nanoplastics promote microcystin synthesis and release from Microcystis aeruginosa, inhibit photosystem II, and induce oxidative stress. However, comprehensive research is lacking on nanoplastic effects on Planktothrix agardhii, a dominant cyanobacterial species in many shallow eutrophic lakes in Europe that produces hepatotoxic microcystins threatening aquatic organisms and human health. This study investigated the effects of nanoplastics on P. agardhii by exposing cultures to 25 mg/L of nanoplastic particles for a three-week period. Analysis was performed using image flow cytometry to measure several key parameters: trichome concentration, percentage of trichomes among all objects, trichome area, chlorophyll autofluorescence intensity, and Sytox Blue fluorescence intensity (an indicator of membrane permeability). The nanoplastic-treated samples were compared to control cultures without nanoplastic exposure, while Sytox Blue fluorescence was additionally compared between nanoplastic-

exposed dead cells and heat-treated control dead cells. Our results showed differences between nanoplastic-treated and control samples. Trichome abundance was substantially reduced in nanoplastic-exposed cultures (4,913.95 trichomes/ml) compared to controls (8,425.55 trichomes/ml). Similarly, the percentage of trichomes among all objects decreased from 38.53% in controls to 22.93% in nanoplastic-treated samples, potentially due to trichome disintegration resulting in single cells too small to be captured by the gating parameters. The structural changes were also evident, with median trichome area decreasing from 403 μm2 in controls to 316 μm2 in nanoplastic-exposed samples. Chlorophyll content, measured through autofluorescence intensity, showed a slight decrease in the nanoplastic-exposed samples (19.61 AU median intensity) compared to controls (20.83 AU), suggesting a minor impact on photosynthetic capacity. Membrane integrity was severely compromised in nanoplastic-treated cultures, as indicated by an increase in Sytox Blue fluorescence intensity of dead cells (1,110.63 AU median intensity) compared to dead cells in the control samples (428.52 AU median intensity). This difference in fluorescence intensity suggests that nanoplastic exposure causes more severe membrane damage than what occurs in cells inactivated by heat treatment in control. Nanoplastic exposure substantially reduced cyanobacterial trichome concentration, prevalence, and size compared to controls. While chlorophyll content showed minimal change, membrane integrity was severely compromised in nanoplastic-treated samples, with significantly higher fluorescence intensity indicating more extensive membrane damage than in heat-treated controls.

Energy-related biomarkers reveal stress responses in macroinvertebrates from intermittent Mediterranean karst rivers

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Presenting Author: Zuzana Redžović

Status: Oral presentation

Session Number & Date: Science and management of non-perennial rivers and streams, 11:15-11:30, Thursday 24 July

Abstract

Intermittent rivers and ephemeral streams (IRES) are characterized by frequent disturbances and extreme environmental conditions, such as high water temperatures, increasing nutrient and declining oxygen concentrations in isolated pools after flow ceases. Aquatic invertebrates inhabiting IRES are often exposed to multiple interacting stressors, such as drying coupled with excess pollutants and nutrients from wastewater, which degrade water quality, reduce oxygen levels and trigger physiological stress. Biomarkers of aerobic/anaerobic energy metabolism, such as enzymes pyruvate kinase (PK), phosphoenolpyruvate carboxykinase (PEPCK), and lactate dehydrogenase (LDH) are used to assess oxidative stress. The impact of flow intermittence and resulting oxidative stress on aquatic invertebrate physiology is poorly studied. The aim of this study was to measure PK, PEPCK and LDH activity in the larvae of the shredding caddisfly Micropterna nycterobia (Trichoptera, Limnephilidae) and the freshwater crustacean Asellus aquaticus (Isopoda, Asellidae) from two karst Mediterranean intermittent rivers in Croatia: the pristine Krčić River and the anthropogenically impacted Čikola River. In each river, caddisflies and isopods were collected at three sites with increasing distance from the source. In the Čikola River, two sites were upstream and one downstream of the Drniš wastewater treatment plant (WWTP) discharge. Sampling occurred in spring, during the lotic phase, and in summer 2024, during the lentic phase, at sites where temporary pools had formed. Enzyme activities in macroinvertebrates were compared between hydrological phases and rivers. In both rivers, the same pattern was observed for both taxa: LDH activity was significantly higher in summer than in spring, suggesting higher stress levels in summer, possibly due to drying and the formation of pools with more extreme environmental conditions. The PK/PEPCK ratio was comparable for both taxa in

both seasons at the pristine sites and sites upstream of the WWTP, indicating that energy stress was not sufficient to induce the transition to partial anaerobiosis. Significant differences were found in LDH activity between the rivers, with caddisfly values at site downstream of the WWTP in the Čikola River being three times higher than at those from the sites in the Krčić River. The PK/PEPCK ratio was significantly lower in caddisflies in the Čikola River compared to the Krčić River, indicating a decline in aerobic capacity and activation of anaerobic metabolic pathways. Although M. nycterobia is an IRES specialist possibly adapted to higher drying-induced stress levels, the results suggest additional stress exposure due to the pollution. In conclusion, the LDH, PK and PEPCK activities of A. aquaticus and M. nycterobia were reported for the first time. The biomarkers of anaerobic capacity in caddisflies suggested the organisms rapid need for additional energy to cope with the increasing environmental stress at the Čikola River due to pollution. LDH in caddisflies and isopods also reflected the possible physiological adaptations to the lower oxygen concentrations in the temporary pools, as drying was the main stressor. As IRES are particularly vulnerable to pollution but often overlooked in biomonitoring, these biomarkers can be used as tools to assess physiological stress in benthic macroinvertebrates, contributing to effective IRES management and protection.

Environmental and spatial drivers of planktic and benthic algal metacommunities in floodplains

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Presenting Author: Olena P. Bilous

Status: Oral presentation

Session Number & Date: Reconnecting fragmented river networks, 11:15-11:30, Monday 21 July

Abstract

Freshwater ecosystems play a critical role in maintaining global biodiversity, supporting nearly 6% of all described species. The most biodiverse ecosystems, which are also essential for freshwater storage, transport and filtration, and climate change mitigation and adaptation, are floodplains. Network connectivity – the importance of water body position, including flow pathways (directional downstream, bidirectional, subsurface transport) – is a key for the distribution of organisms. Additionally, the high variability of hydrological and morphological water bodies within floodplains (e.g., oxbows, lakes, backwaters) is essential for maintaining biodiversity. However, the role of flow pathways in the organisms' dispersal varies between different groups. Especially, the role of network connectivity in the distribution of algae, together with local environmental factors, is relatively understudied in the context of floodplains. Considering that network connectivity and local environmental factors play different roles in structuring the species composition of two major algal communities (phytoplankton, phytobenthos), we aim to understand the dominant forces driving the distribution of these communities. The primary objective of this study is to determine the role of spatial (network connectivity indices) and environmental parameters in the species composition of algal communities in a Danube River floodplain system. Thus, we hypothesized that the distribution and diversity of phytoplankton species are influenced primarily by spatial parameters (H1). In contrast, benthic organisms are expected to depend less on network connectivity and more on local environmental factors (H2). Specifically, diatom algae from the phytobenthos are predicted to be closely associated with the substrate (H3). Eighteen sites from different water bodies along the

Danube, including floodplain and main channel sites, were sampled in June 2022 and 2023. A total of 138 samples of phytoplankton, 120 samples of phytobenthos, and 192 permanent slides of diatoms were analysed. Local environmental parameters were measured as the type of aquatic habitat, flow type, pH, oxygen content, conductivity, water temperature, POM, PIM, TSS, the percentage of coverage by aquatic plants, the percentage of different groups of plants in the water and type of substrate. The connectivity indices were used to estimate the flow pathways and the water body position within the river network. Main dissolved nutrients (PO4 and NO3) were calculated with the network model. This data allowed us to perform RDA and to evaluate the influence of ecological parameters on the composition of algal communities. Preliminary results indicate that spatial factors predominate over environmental factors as drivers of phytoplankton community composition. A strong effect of network connectivity was also admitted for phytobenthos and benthic diatom algae.

European Freshwater Restoration Needs

Paulo Branco[1], Gonçalo Duarte[1], Angeliki Peponi[1], Diogo Moreno[1], Tamara Leite[1], António Faro[1], Florian Borgwardt[2], Sebastian Birk[3], Annette Baattrup-Pedersen[4], Pedro Segurado[1], Maria Teresa Ferreira[1]

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Presenting Author: Paulo Branco

Status: Oral presentation: Accepted

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:15-11:30, Thursday 24 July

Abstract

Freshwater habitats support 9.5% of all animal species globally, making them disproportionately significant relative to the earth's surface area they occupy. These ecosystems have been essential to human societal development since prehistoric times, yet they have faced continuous anthropogenic pressures and impacts over time. This study aims to map areas within freshwater ecosystems where legally binding European Union targets, as defined by the Habitats Directive (HD) and the Water Framework Directive (WFD), have not been met. Regions failing to comply with these directives are considered in need of restoration. Overall, the conservation status (CS) of freshwater-related protected habitats under the HD is predominantly unfavorable across most of Europe, with greater severity in coastal Central Europe and the British Isles. The CS of freshwater-related species reveals a clear West-East European divide: western regions generally fall into the unfavorable category (except the British Isles), whereas eastern regions maintain a favorable status. Regarding the WFD's Good Ecological Status target, only mountainous and/or remote areas are predicted to meet the required standards. By integrating these three assessments, the results highlight that only a few, specific regions—such as Scandinavia and western Greece—successfully achieve both HD and WFD legal objectives. This study not only identifies priority areas for river restoration but also determines which targets are unmet and which species and habitat groups are most affected in each freshwater unit. These findings are highly relevant for shaping governance and public policies (e.g., nature restoration law) to enhance biodiversity conservation and promote the functional resilience of freshwater ecosystems. This study was conducted under the EU funded MERLIN project.

Evaluating alkalinity as a key variable for phytoplankton-based lake typology: A case study of 70 lentic systems in Türkiye

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Presenting Author: Tuğba ONGUN SEVİNDİK

Status: Oral presentation

Session Number & Date: Plankton ecology, 16:15-16:30, Thursday 24 July

Abstract

In the study of 70 lentic systems across Türkiye, the influence of alkalinity on phytoplankton assemblages were evaluated in five alkalinity groups (I: < 140, II: 140-200, III: 200-300, IV: 300-600, V: > 600 mg L-1 CaCO3) as a proxy for geological variation. The analysis revealed that species composition varied with increasing alkalinity, with certain species favoring higher alkalinity levels and exhibiting higher alkalinity optima. Species richness (alpha diversity) was highest in Group I, while total species richness (gamma diversity) exhibited a consistent decline as alkalinity increased, from Group I to Group V. In contrast, the highest phytoplankton biovolume was observed in Group V. In addition to alkalinity, other environmental factors including water temperature, electrical conductivity, total nitrogen, total phosphorus, and pH were found to significantly influence the distribution of dominant species, variations in species composition, alpha diversity, and phytoplankton biovolume across different alkalinity groups. The PHYTO-TR index demonstrated that groups I, II, and III exhibited a higher proportion of high and good ecological quality systems compared to those in higher alkalinity ranges, making the index more effective in assessing the ecological status of these systems. While total phosphorus concentrations play a critical role in determining trophic status, variations in the assimilation of different carbon sources by species in response to alkalinity changes significantly affect the distribution, composition, biovolume, alpha and gamma diversity of phytoplankton and, consequently, the trophic status of lentic systems. Therefore, alkalinity directly impacts phytoplankton, underscoring its importance as a key parameter in determining phytoplankton-based lake types.

Evaluating habitat-based management practices for European eels in Mediterranean GFCM countries

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Presenting Author: Şükran Yalçın Özdilek

Status: Oral presentation: Accepted with small edits

Session Number & Date: Freshwater fish ecology, conservation and management, 16:00-16:15, Thursday 24 July

Abstract

The European eel (Anguilla anguilla) is a critically endangered species, mainly due to a substantial population drop in the 1980s. Overfishing, habitat degradation, migratory barriers, and pollution amplified by climate change pose significant challenges to eel populations. This species, highly affordable, has a complex life cycle and inhabits many environments ranging from marine to continental freshwater ecosystems. They inhabit almost two-thirds of their lives in at least one type of habitat, including estuaries, lagoons, rivers, lakes, or any catchment region. The eels encounter diverse habitat-specific challenges for survival, needing that eel populations adapt to varying environmental circumstances. Each environment's distinct features need targeted strategies that address

the critical aspects influencing the specific eel life stage within that habitat. In 2020, a research program involving nine nations, conducted by GFCM (General Fisheries Commission for the Mediterranean), addressed this topic in a research program throughout the Mediterranean. Habitat-specific data were gathered and the metrics alongside the yearly catch statistics were assessed. We categorised all catch values and management methods into four habitat types: lagoons, lakes, river mouths, and coastal marine waters. We used the quantity of each habitat category and the count of fisheries sites per nation. We observed no habitat-specific actions for eels, except for the establishment of several protected areas, such as lagoons, rivers, and lakes. The lagoons were the primary habitat for almost all examined nations. We agreed that habitat-based management plans should be coordinated, clear, and useful, and that actions related to fisheries should be matched up whenever possible.

Evaluation of Wintering Waterbirds in Uluabat Lake and Kocaçay Delta Wetlands

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Presenting Author: Burçak Gönül

Status: Oral presentation

Session Number & Date: Wetland ecology and management, 15:30-15:45, Tuesday 22 July

Abstract

Uluabat Lake Wetland (ULW), which is recognized as a Ramsar site, holds a significant ecological importance due to its rich biodiversity, its position along a major avian migration corridor, and its function as a crucial wintering site for large populations of waterbirds. Kocaçay Delta Wetland (KDW), located 25 km north of ULW, also represents a unique ecosystem characterized by high species and habitat diversity. This study aims to assess the similarities and differences in waterbird assemblages wintering in ULW and KDW. Data were obtained from 18 sites in ULW and 10 in KDW through annual mid-winter waterbird censuses conducted during 2015-2025. Over the 11-year period, a total of 558,736 individuals belonging to 63 species, 15 families, and 10 orders were recorded in ULW, whereas 85,136 individuals from 61 species within the same taxonomic groups were documented in KDW. The highest recorded abundance in ULW occurred in 2020, with 113,150 individuals, while the peak count in KDW was 27,810 individuals in 2019. The highest species richness was observed in both sites in 2024, with 38 species in ULW and 42 species in KDW. Given its larger spatial extent, ULW supported approximately seven times the total number of wintering waterbirds compared to KDW. However, despite its smaller size, KDW exhibited species richness comparable to ULW, likely due to its greater habitat heterogeneity. ANOSIM analysis revealed significant spatial differentiation in wintering waterbird populations between ULW and KDW ($p<0.05$, $R=0.90$). Although 50 of the 74 recorded species were observed in both wetlands, SIMPER between analysis indicated an 88% average dissimilarity. PCA analysis demonstrated that the first two principal components accounted for 49.5% of the total variance, effectively illustrating the distributional divergence of avian assemblages between the two wetlands and corroborating the SIMPER findings. The SIMPER within analysis, based on 11-year mean abundance values, showed that the three dominant species in ULW were Fulica atra,

Aythya ferina, and Phalacrocorax carbo, collectively constituting 75.84% of the total contribution, whereas in KDW, the most abundant species were A. ferina, Tadorna ferruginea, and F. atra, comprising 47.59% of the total contribution. According to the Indicator Species Analysis, species with an indicator value exceeding 90% ($0.0001<p<0.0003$) in ULW included Gallinula chloropus (97.65%), Microcarbo pygmaeus (96.95%), F. atra (96.92%), Podiceps cristatus (95.6%), A. ferina (95.7%), A. fuligula (92.63%), and Pelecanus crispus (90.83%). In KDW, the most indicative species were Tadorna ferruginea (81.81%, $p=0.0004$) and Cygnus olor (69.46%, $p=0.0021$). Additionally, populations of Oxyura leucocephala were observed in ULW in the years 2019, 2020, 2022, 2024, and 2025, with recorded abundances of 4,415, 1,450, 3,585, and 1,346 individuals, respectively. According to the IUCN Red List, this species exhibits a declining population trend and is classified as Endangered (EN) on a global scale and Vulnerable (VU) at the European level. The estimated wintering population in Europe ranges between 7,500 and 15,900 individuals. Given these figures, ULW constitutes a critical wintering site for O. leucocephala and plays a pivotal role in the conservation of this globally threatened species.

Exploring Molecular and Morphological Diversity of Ostracoda: A Combined Approach Based on COI Sequences and Morphological Characters

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Presenting Author: Serdar Dinç

Status: Oral presentation

Session Number & Date: Advances in genetics and molecular ecology, 11:30-11:45, Tuesday 22 July

Abstract

Species of the class Ostracoda are diminutive aquatic invertebrates, typically measuring approximately 1 mm in size, with a broad geographical distribution across a diverse range of aquatic habitats, including both lentic and lotic freshwater environments as well as marine waters. Today, approximately 65,000 species encompassing both fossil and extant forms are known, with more than 2,400 species reported from nonmarine aquatic ecosystems. Due to their sensitivity to environmental changes, ostracods are valuable tools in biodiversity monitoring, providing a link to past, present, and future ecological conditions. Despite the significance of taxonomic studies in species identification, molecular approaches remain underutilized in ostracod research, representing an area of potential growth for advancing our understanding of this diverse group. Thus, molecular studies in ostracods have the potential to greatly enhance our understanding on morphology, ecological variation and adaptation, and species diversity. While adaptation through morphological characters such as carapace variation serving as a protective structure, its form such as size, shape, and mineral composition varying in response to environmental factors like salinity, temperature, and water quality, molecular tools such as DNA sequence analyses of ostracods can be useful for exploring how ostracods thrive in different aquatic habitats and how they speciated over time. In addition, it may allow us to disclose cryptic species, helping refine taxonomic classifications that rely on morphological and ecological traits alone. In this study, we isolated total DNA, amplified a 658 base pairs of cytochrome c oxidase I (COI) gene from non-marine ostracod species collected from the Denizli province, Türkiye, and 4284 downloaded sequences from NCBI. The aims of this study are to (1) complete and compare the first molecular data amid these species, (2) provide possible relationship between molecular and morphological data for them, and (3) show how these data can cope with the species morphology and ecological preferences. Our results based on sequence analyses offered a more comprehensive framework for studying the evolutionary and ecological significance of ostracod

morphology and habitat types which requires further and more detailed research in this area.

Exploring the potential for Natural Flood Management in the River Thames Catchment

Paul Leonard[1], Rob Rees[1]

[1]Thames Regional Flood and Coastal Committee

Presenting Author: Paul Leonard

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 10:45-11:00, Tuesday 22 July

Abstract

Engineered solutions, while providing immediate and specific flood protection, often come with significant installation & maintenance costs and may have a damaging environmental impact. These are predominately fixed structures with limited adaptability, prioritised and funded via national programmes. Typically, these assets have an exclusive function and benefit, chiefly the exclusion or reduction of water in places where it would be damaging - namely flooding. Though it can require time to fully implement and show results, Natural Flood Management (NFM) may provide a more holistic, environmentally friendly approach to delivering flood protection benefits. These typical participative measures can lead to securing benefits for mental and physical well-being as well as improving biodiversity, water stewardship, community ownership and inclusion. Government funding has been utilised to explore the potential for the use of a range of nature-based solutions that may reduce the impact of fluvial flooding. In the River Thames catchment and with additional regional / local funding, a wide range of research and delivery has been undertaken and the aim of this work is summarised. This includes deciding on suitable sites, their potential benefits and promoting effective communication. We demonstrate that working in partnership, with risk management authorities, non-governmental organisations and communities is a successful formula. The Thames Regional Flood & Coastal Committee has worked collaboratively with the Wildfowl & Wetlands Trust to extend the NFM programme to 2027 with the creation of a priority and opportunity map. This includes the evidence for small and sub-catchment projects.

Eye size variation of European perch (Perca fluviatilis) and sunfish (Lepomis gibbosus) along the turbidity gradient of Lake Balaton (Hungary)

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Presenting Author: Réka Pallos

Status: Poster presentation

Session Number & Date:

Abstract

Lake Balaton, the largest lake in Central Europe, plays a vital role in its surrounding environment and possesses numerous remarkable features that make the entire ecosystem worth of study. The lake receives several inflows into its western basin, supplying water and nutrients, and is drained by a single canal that flows out of the eastern basin. Additionally, the differences in the lake's four basins, which vary in depth and area, have several environmental implications. These characteristics result in a west-to-east gradient along the longitudinal axis, leading to differences in color, transparency, turbidity, chemical composition, and trophic status. These environmental features may influence the life history, distribution, growth, production, and morphology of many aquatic organisms. By examining the morphometric characteristics of two visual predator fish species, the native European perch (Perca fluviatilis) and the non-native sunfish (Lepomis gibbosus), which inhabit areas with varying light conditions and water transparency, we aim to reveal the potential effects of light conditions on their relative eye size. Fish were collected from 16 sampling sites along the gradient, including the western and eastern ends, as well as the northern and southern shores of the lake. Analyses were conducted using traditional distance-based morphometric methods on photographs of 1,322 specimens. Standard body length and eye diameter were recorded as variables. To characterize the general turbidity conditions, the mean diffuse attenuation coefficient (Kd), derived from six years of remote sensing data (Sentinel-2 satellite images) was used. The results show a positive correlation between the mean Kd values and eye size in both species. Therefore, it can be concluded that in more turbid waters, where light attenuation is higher, fish tend to have larger eyes. Based on these preliminary findings, we suggest that the turbidity gradient may induce plasticity in fish, leading to eye size adaptation to environmental conditions. This phenomenon was observed in both the native perch and the sunfish, where the latter was introduced to the area about 110 years ago. Further studies (e.g., breeding experiments) are needed to determine whether this morphological difference is simply a phenotypic adaptation to environmental conditions or if it involves genetically fixed changes.

Fantastic beetles and where to find them? Do spring floods govern the occurrence of Graphoderus bilineatus in Hungary?

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Presenting Author: Martin Drenovácz

Status: Poster presentation

Session Number & Date:

Abstract

The Graphoderus bilineatus (De Geer, 1774), a highly protected species listed as Vulnerable (VU) by the IUCN Red List of Threatened Species and designated under the Natura 2000 network in Hungary, holds significant conservation importance at both national and European levels. Although research on its ecology is expanding, there remain substantial gaps in understanding, particularly regarding its life cycle, development and ecological preferences, which vary significantly by region and over time. Understanding these differences is crucial for developing both effective and long-term conservation strategies targeting both the species and its habitats. Extensive fieldwork in Hungary over the decades has revealed a consistent pattern: the abundance and presence of G. bilineatus are strongly associated with the occurrence of spring floods, especially within floodplain habitats, a phenomenon which is less observed in other northern European countries. We quantified the time intervals between the occurrence of spring floods and the presence or absence of the species in known habitats along the Bodrog, Danube, Drava and Tisza rivers. Our findings demonstrate a significant correlation between the occurrence and appearance of the species and spring floods. Furthermore, our data suggest that these floods might serve as a catalyst, encouraging the G. bilineatus to initiate flight and potentially colonize new water bodies within its range. Understanding the connection between the dynamics of spring floods and the ecology of G. bilineatus is crucial for guiding focused conservation strategies aimed at protecting this species and its associated habitats.

Feeding of a dominant copepod species in a temperate impacted lake

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Presenting Author: Gleice Santos

Status: Oral presentation

Session Number & Date: Plankton ecology, 16:30-16:45, Thursday 24 July

Abstract

Macrocyclops albidus is a cyclopoid copepod that dominates crustacean communities in urban-impacted lakes in temperate climate regions during the winter, when the lake is completely covered by ice. However, the food preferences of this species are poorly understood. Feeding experiments were performed with M. albidus and different types of prey: the cyanobacteria Cyanobium, the green alga Stichococcus and the ciliate Paramecium, which were collected from Lake 3 (Cluj Napoca, Romania) and maintained in the laboratory. Prior to the experiment, M. albidus were cultivated in filtered freshwater supplemented with a mix of four autotrophic organisms: Chlamydomonas, Clorella, Chlorococcum and Euglena gracilis. The cultures of both algae and Paramecium were maintained in Bold's basal medium and in filtered freshwater with red rice, respectively. Copepodites of M. albidus were isolated from the culture and starved for 2 hours. For each prey type, a set of six 5-ml well plates was used to test, separately, differences in M. albidus feeding rates between prey. The concentration of algae pigments was analysed using a PHYTO-PAM-II before and after the experiment. Cultures were diluted to produce final algal concentrations of ~10–20 µg.L-1, which corresponds to approximately 5 mg.C. L-1, which is considered the optimum food concentration for zooplankton species. For the Cyanobium experiment, a concentration of 16.5 µg.L-1 of blue pigment was placed in each of six well plates. Comparable experiments were done with Stichococcus and Paramecium for the other two sets of six well plates, with a concentration of 17.7 µg.L-1 (chlorophyll) and 10 individuals, respectively. Subsequently, two copepodites were added to three well plates for each prey type. The other three well plates were used as a control treatment. The feeding experiments were performed for 3 hours. The treatments with both algae and copepods did not show a significant decrease after the 3 hours. However, in the treatment with Paramecium and copepods, no ciliates were found in well plates containing copepods, while all ciliates remained present in the control well plates. These results

suggested that M. albidus may prefer Paramecium as a more nutritious food resource in comparison with Cyanobium and Stichococcus.

First Data on the Reproductive Migration of A. Anguilla In the North Adriatic Area, A Changing Scenario

Pagani Samuele[1], Gavioli Anna[1], Gaglio Mattias[1], Castaldelli Giuseppe[1], Lanzoni Mattia[1]

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Presenting Author: Lanzoni Mattia

Status: Poster presentation

Session Number & Date:

Abstract

The European eel (Anguilla anguilla, Linnaeus 1758) is a critically endangered species that completes its life cycle between the freshwaters of Europe (and North Africa) and spawning grounds in the Sargasso Sea. European eel is a threatened species throughout its range, recorded as "critically endangered" by the IUCN. The main global threats to the species are recognized as illegal fishing of juveniles, habitat loss and the general lack of information, awareness and attention for conservation. With the LIFEEL project "Urgent measures in the Eastern Mediterranean for the long-term conservation of the European eel" it was possible to monitor the start of the reproductive migration of A. anguilla in the Northern Adriatic area, contributing to the updating of the first data on the behavior and possible modification in the migration timing of the species. The Italian activities were carried out in one of the most important coastal wetlands in Europe for biodiversity conservation, located within part of the Regional Park of the Po River Delta. Migratory activities were investigated between 2021-2024 with an indirect monitoring system (tagging-recapture) with T-BAR TAGS markers, and a direct telemetric monitoring system (sonic tracking). Of the total of 1878 animals released with tags, the recaptures of 27 were reported, of which 3 specimens at over 140 km after 15 days from the release site. Of the 225 specimens released equipped with transmitters, 21 were detected by the receiver system at an average distance of 45 km and on average 15 days after release. The results obtained highlighted the common migratory behavior of the specimens in all monitoring campaigns. The revealing always occurred in the same period of the year, on the same day at a maximum temporal distance of 25 minutes from the first to the last one, at a distance from the coast between 0.7 and 1.5 miles, in a period delayed by 2 months matched to the natural reproductive migration period for the northern Adriatic. These data provides new insights into European eel management and conservation practices.

Freshwater body size distributions in the Anthropocene

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Presenting Author: Ignasi Arranz

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 15:15-15:30, Tuesday 22 July

Abstract

Body size is a fundamental trait in ecology and evolution, explaining biological processes across multiple scales – from organismal metabolism and growth to ecological networks governing trophic interactions and energy fluxes. Empirical research has observed that body size distribution shifts are closely linked to biotic and abiotic changes, making them widely used as indicators of ecological status. In this talk, I synthesize past, current and future research on body size distributions in freshwater taxa, mainly fish, across multiple freshwater ecosystems including ponds, lakes and streams over large spatial and temporal scales. Building on past research, I first present the strong variability of body size distributions over large spatial and temporal gradients in distinct bioregions and local contexts. My findings reveal that in both Nearctic and Palearctic bioregions, climate temperature drives steeper body size distributions in fish communities, with a greater abundance of small-bodied fish in warmer sites. However, the climatic effects are more complex than expected due to the interplay of other human-induced impacts and nonlinear ecological responses, posing challenges for effective freshwater management. In the second part of the talk, I focus on current and future research examining how body size distributions can infer metabolic scaling, i.e., the relationship between metabolic rate and body size, through the Maximum Entropy Theory of Ecology to predict macroecological patterns. Preliminary results from trout populations in French streams suggest that metabolic scaling exponent inferred from entropy models averages 0.83, exceeding theoretical expectations (e.g., 0.67 or 0.75) yet aligning with some previous metabolic scaling studies on the species. Moreover, the true causal impact of temperature on metabolic scaling might be overestimated when season and human footprint are unaccounted for. Finally, I also explore the causal effects of temperature on the metabolic scaling exponent using biological experiments in microcosms. These main findings offer a nuanced perspective on how body size distributions shape freshwater biodiversity and ecosystem function, improving our ability to make better predictions in the Anthropocene. Future research should prioritize three key directions: (1) characterizing broad-scale patterns of body size distributions in nature to bridge observational variation with underlying ecological processes and mechanisms (a macroecological theme); (2)

developing a robust theoretical framework linking body size distributions to energy fluxes and ecosystem function (a trophic theme); and (3) assessing the causal insights of environmental factors on body size distributions (a global change theme).

Freshwater fish diversity in heavily invaded river ecosystems (Northeastern Italy)

Anna Gavioli[1]

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Presenting Author: Anna Gavioli

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 15:30-15:45, Thursday 24 July

Abstract

The introduction of non-native species is a global phenomenon and a major driver of biodiversity loss and community homogenization, particularly in freshwater ecosystems. How the functional and taxonomic diversity of freshwater communities responds to the presence of non-native species is still a matter of debate and requires further investigation. In this context, fish communities in impacted rivers, which are highly vulnerable to the introduction of non-native species, provide an excellent model to study these dynamics. In this study, a comprehensive dataset from 335 Mediterranean rivers and streams was analyzed to investigate the relationships between functional and taxonomic diversity and the presence of alien species. Results showed that lower functional diversity in total fish communities was associated with higher levels of invasion, and that the non-native component of fish communities exhibited less diverse functional traits compared to native ones, even when stream order was considered. Hotspots of non-native species with low functional diversity were predominantly located in human-disturbed areas, suggesting a significant role of human disturbance in invasion patterns. Further analysis of functional uniqueness showed a decreasing trend in overall fish community uniqueness with increasing stream order. Interestingly, native species exhibited high functional uniqueness in disturbed canals, whereas non-native species exhibited the highest uniqueness in the lowest stream order ecosystems. These results highlight the importance of assessing native and non-native components of biotic communities separately to better understand the links between invasion dynamics and biodiversity loss.

From Metabolism to Population Dynamics: Amphipod Responses to Pollution and Temperature Stress

Marina Veseli[1], James Evans[2], Buntu Fanteso[2], Iva Kokotović[3], Sam Macaulay[2,4], Nina Marn[1], Ana Previšić[3], Marko Rožman[1], Phillip Sanders[2], Michelle Jackson[2]

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Presenting Author: Marina Veseli

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 14:45-15:00, Monday 21 July

Abstract

Pollution and climate change are crucial research problems in freshwater ecology worldwide. To successfully predict and mitigate ecological consequences of pollution and climate change, it is essential to study and understand how organisms respond to these environmental stressors. Despite an increasing interest in this research issue, the combined effects of these stressors on freshwater communities and individual species remain poorly understood. Benthic invertebrates like amphipods are a fundamental part of stream ecosystems, and that makes them an important indicator of environmental changes in their habitat. We conducted an extensive in situ study, using 64 flow-through mesocosms across four study sites in England with the aim to examine the individual and combined effects of wastewater contamination and elevated temperature on Gammarus pulex body size and population abundance. Furthermore, we conducted non-target analyses of the metabolome and lipidome of amphipod individuals with the aim to provide important insights into the sublethal effects of the stressors at the metabolic level. This multi-level approach offers observation of the responses from molecular and individual scales to broader population-level dynamics. To analyse our data, we used Generalized Linear Models (GLMs) to assess the significance of treatment effects on amphipod community and metabolic responses, compared between sites and treatments. Furthermore, to examine how metabolome and lipidome profiles of amphipods varied across treatments, we performed Principal Component Analysis (PCA), which then provided further insights into the metabolic shifts induced by environmental stressors. Our results generally show that multi-stressor effects differ from individual stressor treatments and the control. We observed differences in effects between the sites, which highlights the influence of local wastewater composition and environmental conditions on amphipod

responses. This emphasizes the need for multi-site approaches when assessing pollution effects. These findings provide important information on complex ways in which wastewater pollutants and temperature stress interact and affect freshwater organisms.

From Wet to Dry: Climate-Driven Water Level Oscillations Amplify Nutrient Accumulation and Chlorophyll-a Response in Shallow Lakes

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Presenting Author: Dilvin Yıldız

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:00-11:15, Tuesday 22 July

Abstract

The functioning of shallow lakes, which are extremely susceptible to variations in precipitation, evaporation, and water inflows and outflows due to their shallow form, depends heavily on hydrology. Water level changes in shallow lakes have large impacts on the physical and biological features of these ecosystems, and water chemistry; nutrient processing and nutrient retention. The Mediterranean region, characterized by warmer and dry conditions, is experiencing increased evaporation and fewer wet days due to the effects of climate change. Here, we investigated the relationships between lake nutrient and chlorophyll-a (Chl-a) concentrations in Eastern Mediterranean Lakes Mogan and Eymir in the semi-arid climate overall and in dry, mid and wet periods of long-term monitoring. We hypothesised that; (i) high alteration in water levels between dry and wet periods will be observed due to semi-arid climate in the region, (ii) external loadings will play an important role on the in-lake nutrient concentrations, (iii) hydraulic retention time (HRT) will be affected on in-lake concentrations because longer the HRT higher the water column-sediment interactions and increase the internal phosphorus loading, and (iv) increasing temperatures will increase the Chl-a concentrations especially in dry periods due to more profound effects of stratification which triggers internal phosphorus loading. We further included PCA plots to determine the relationships between Chl-a and nutrient concentrations, temperature, external loading, HRT, depth, macrophytes and fish. 28-year mass balance analysis of two shallow, semi-arid lakes yielded the following primary outcomes: (1) variability between the dry and wet periods was high showing the risk of drying out of the lakes under the less precipitation and higher evaporation future of semi-arid Mediterranean lakes, (2) even with modest external loading, the nutrient concentrations during dry periods increased with nutrient accumulation from evaporative water loss especially in Lake Mogan, (3) Chl-a concentrations were affected mainly by temperatures in Lake Eymir where cyanobacteria blooms occur during summers most likely causing by more frequent thermal stratification and increased internal loading. These

results enhance the understanding of how variations in hydraulic loading, water level, and hydraulic residence time influence nutrient and chlorophyll-a concentrations in shallow, semiarid lakes under both dry and wet conditions.

FunAqua: a global DNA-based database of aquatic fungal biodiversity in water and sediments

Victoria Prins[1], Leho Tedersoo[1,2], Vladimir Mikryukov[2], Margot Sepp[3], Veljo Kisand[1,3], FunAqua Consortium[3], Kristel Panksep[1,3,4]

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Presenting Author: Victoria Prins

Status: Oral presentation

Session Number & Date: Aquatic fungi and microorganisms in a changing world, 10:45-11:00, Friday 25 July

Abstract

Aquatic fungi play a crucial role in the functioning of aquatic habitats, including diverse ecological roles as parasites, decomposers, pathogens and mutualists, but are under-researched compared to terrestrial fungi and other aquatic microorganisms. Consequently, there is limited knowledge about the global distribution of aquatic fungi. To address this knowledge gap, the University of Tartu and the Estonian University of Life Sciences launched a the collaborative FunAqua project in 2018. The aims of FunAqua are to: (1) build a comprehensive aquatic fungal database based on metabarcoding data collected from sediment and water filter samples on a global scale; and (2) to describe and elucidate the factors that affect aquatic fungal diversity and community composition. We present an overview of the FunAqua project, introducing the metabarcoding dataset derived from 1080 sediment samples, 1299 filtered water samples and a chemical dataset from 668 samples. This dataset also encompasses comprehensive sample metadata. The samples were collected from 86 countries across all contients from 2018 to 2024 by voluntary contributors. We assigned sampling points to 10 biome types based on generalized categorization. From these, freshwater lakes had the most samples (n = 1039), followed by rivers (n = 758), saltwater marine (n = 330) and brackish marine (n = 155) habitats. DNA samples were PCR amplified, targeting the internal transcribed spacers (ITS) region of the rRNA operon along with the flanking 18S V9 region for barcoding purposes. Libraries were sequenced at Oslo University on the PaciBio Sequel instrument. Overall, 137,887 high-quality OTUs were produced, from which 50,175 (36% of OTUs) were fungal. From sediment (n = 1060) and water filter (n = 1212) samples, 34,170 and 26,296 unique fungal OTUs were produced, respectively. We identified 37 fungal phyla, 133 classes, 331 orders, 761 families, 2 550 genera and 3 985 species. The

most abundant phylum was Ascomycota (35.6 % of fungal OTUs), followed by Rozellomycota (21.6%), Chytridiomycota (14.7%) and Basidiomycota (13.6%).

Functional traits of macroinvertebrates as potential metrics for the bioassessment of intermittent streams

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Presenting Author: Pál Boda

Status: Oral presentation

Session Number & Date: Science and management of non-perennial rivers and streams, 15:45-16:00, Thursday 24 July

Abstract

The Water Framework Directive aims to protect and manage surface waters through best practices, with the River Basin Management Plan as its operational tool. Ecological assessment relies on community metrics that respond to environmental pressures, which, when integrated into indices, enable water type-specific evaluations of biological status. Currently, no typology, biological validation, or assessment method exists for intermittent water bodies. In line with European Union requirements for scientifically validated method development, bioassessment, and planning, it is crucial to understand how macroinvertebrates – being the most relevant organisms –respond to flow intermittency at both structural and functional levels for effective water management and the development of indices. Here, we present our scientific findings that may later contribute to bioassessment efforts. We classified intermittent water bodies within the Hungarian water typology, revealed the differences in Ecological Quality Ration (EQR) between near natural intermittent and perennial streams and identified key metrics that indicate community changes in response to flow intermittency. These metrics will later be tested for their suitability in ecological assessments across pressure gradients. To achieve this, we analyzed a comprehensive dataset of seasonal, quantitative macroinvertebrate samples from Hungarian lowland and hilly streams, incorporating species-level biotic data, genus-level functional data, and hydrological data from streambed loggers. Data selection was tailored to address specific research questions. Our findings show that EQR and functional diversity in intermittent streams is generally lower or equivalent to that in perennial streams. The latter suggesting disparities in functional functional (trait) composition. We examined whether changes in community trait

composition are also reflected at the trait group and trait state levels. While significant differences were observed between intermittent and perennial streams at the community level, these differences were not consistent across all trait groups, indicating specific trait group responses to intermittency. We identified the key trait states – including current velocity preference, reproduction strategy, respiration mode, female wing length, locomotion type, substrate relation, aquatic life stages, and resistance forms – that contributed to these differences. However, our findings indicate that differences at the trait state level do not always translate to broader trait group or community-level differences. Additionally, we investigated whether species with more resilience and resistance trait states are more abundant in intermittent streams. It appears that more resistant trait states do not necessarily provide a greater advantage, but a core set of these traits is essential for survival under flow intermittency. Our results suggest that trait-based metrics can serve as early indicators of community shifts in response to intermittency. Incorporating these traits into bioassessment frameworks could enhance early detection of functional changes and strengthen ecological assessments of intermittent water bodies under increasing hydrological variability.

Global scale quantification of stressor responses in five riverine organism groups

Willem Kaijser[1], Michelle Musiol[1,2,7], Andrea R. Schneider[1], Sebastian Prati[1,2], Verena S. Braue[3], Rike Bayer[1], Sebastian Birk[1,2], Mario Brauns[5], Louisa Dunne[1], Julian Enss[1,2], Luan Farias[1,2], Christian K. Feld[1,2], Lena Feldhaus[1], Svenja M. Gillmann[1,2], Kamil Hupało ,[1,2,4], Stephen E. Osakpolor[6], Sarah L. M. Olberg[1], Iris Madge Pimentel[4], Ralf B. Schäfer[7,8], Christian Schlautmann[1,2], Jessica Schwelm[1,2,9], Bernd Sures[1,2,7,9], Cornelia S. Wagner[1], Nicole E. Wells[1], Franziska Wenskus[1], Christian Schürings[1], Daniel Hering[1]

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Presenting Author: Willem Kaijser

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 10:45-11:00, Monday 21 July

Abstract

Freshwater ecosystems, particularly rivers, are experiencing the most rapid biodiversity declines of any biome, driven by multiple interacting stressors operating across local to global scales. Despite growing research on these interactions, the lack of systematic quantification of individual stressor gradients limits our ability to disentangle their cumulative responses. Here is the first global synthesis of stressor-response relationships across five key riverine organism groups - bacteria/archaea, algae, macrophytes, invertebrates, and fish. Drawing from 1,334 stressor-response relationships extracted from 22,120 studies spanning 87 countries, multiple Generalized Linear Mixed Models and Bayesian meta-analyses were used to quantify the response to the seven most prevalent stressors. Consistently, elevated salinity, oxygen depletion, and fine sediment accumulation were negatively related to biodiversity across taxa, while the relation of nutrient enrichment and warming varied among groups. Predictive tools, including hypothetical outcome plots and partial dependence plots, revealed multivariable stressor-

response patterns, underscoring the need for tailored management strategies. These findings establish the first quantitative baseline for a continuous global synthesis, refining predictions of anthropogenic stressor impacts, identifying key research gaps, and informing conservation strategies to enhance freshwater ecosystem resilience.

Gwflow as a tool to improve groundwater representation in SWAT+: the Tagus River headwaters (Spain)

José Manuel Rodríguez-Castellanos[1], Silvia Martínez-Pérez[1], Miguel Martín-Loeches[1], Ryan Bailey[2], Eugenio Molina-Navarro[1]

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2Department of Civil and Environmental Engineering, Colorado State University

Presenting Author: José Manuel Rodríguez-Castellanos

Status: Oral presentation

Session Number & Date: Beneath the surface: The science and management of groundwater systems, 15:00-15:15, Monday 21 July

Abstract

Mediterranean regions, characterized by climates that transition between humid and semi-arid conditions, are facing growing challenges in water resource management due to climate change. This phenomenon particularly affects Spanish river basins, where decreasing precipitation and rising temperatures directly affect both surface and groundwater resources. The headwaters of the Tagus River are a clear example of this scenario, where aquifer recharge and groundwater–surface water interactions are essential to maintaining ecological flows and to ensure water supply during prolonged drought periods. Hydrological modelling, therefore, requires tools capable of realistically representing these processes. SWAT+ is one of the most widely used models for simulating hydrological dynamics at the watershed scale, but it has limitations in representing geological heterogeneity, which directly affects the simulation of groundwater recharge and discharge. In this study, conducted in a geologically complex area of the Tagus headwaters, efforts have been made to improve groundwater representation by coupling SWAT+ with the gwflow module. This integration aims to enhance the simulation of hydrogeological processes, especially in a context where the contribution of groundwater to streamflow is highly significant. To achieve this, a distributed parameterization was carried out based on three distinct geological zones classified by lithology and permeability for SWAT+: (i) carbonate rocks with high and medium permeability, (ii) detrital materials with high and medium permeability, and (iii) detrital materials with low permeability. In addition, two distinct aquifer zones with different hydrogeological characteristics were defined for the groundwater module. This regionalization allowed a more accurate adjustment of groundwater recharge and discharge dynamics, reflecting the diversity of processes from areas with rapid infiltration to zones with higher retention and dominant surface runoff. Improvements in streamflow simulation at gauging stations and reservoir inflows in the headwaters demonstrate the

need to adapt model resolution to the heterogeneity of the hydrogeological system. The effective integration of groundwater–surface water interactions provides consistent results for recharge and discharge processes, which are fundamental for designing sustainable water management strategies. Besides, compared to using only SWAT+, coupling gwflow enables the representation and analysis of additional outputs such as water table elevations, recharge, water exchange between river cells or groundwater evapotranspiration. Approaches like this significantly contribute to the development of simulation tools tailored to the challenges of Mediterranean basins and demonstrates the value of combining models such as SWAT+ and gwflow to monitor, protect, and responsibly manage groundwater resources. These hidden resources are key elements in sustaining ecosystem services and ensuring the resilience of water systems in the face of climate change.

Habitat specific whole lake survey of fish assemblages using eDNA metabarcoding and traditional methods

Anna Szolnoki[1,2], István Czeglédi[1,2], Attila Mozsár[1,2], Didier Pont[3], Bálint Preiszner[1,2], Péter Takács[1,2], Alice Valentini[4], András Specziár[1,2], Tibor Erős[1,2]

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Presenting Author: Anna Szolnoki

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 16:15-16:30, Tuesday 22 July

Abstract

In ecological studies, representative sampling is fundamental to reliably monitor community structure. Accurate determination of attributes like species composition and relative abundance of community constituting species is needed to properly evaluate ecosystem health and develop management plans. Nevertheless, collecting representative samples remains a challenge, especially with increasing size and complexity of the habitat. When monitoring freshwater fish communities, results can depend significantly on the sampling methods used, as traditional gears generally have specific selectivity (for species and/or size classes) and limited applicability. Assessments based on environmental DNA (eDNA) sampling may be a promising complement, in the future even an alternative to traditional methods. However, there is still a lack of knowledge on its applicability, for example, its effectiveness across habitat types. In our work, we compared the results of traditional surveys and eDNA metabarcoding to characterize the fish community structure in different habitat types of Lake Balaton, the largest shallow lake in Central and Eastern Europe. Traditional surveys of littoral habitats (reed, rip-rap, harbours) and the pelagic zone were carried out with electric fishing gear and multi-mesh gillnets, respectively. Water samples for eDNA metabarcoding were taken uniformly from all habitat types. The eDNA sampling survey slightly outperformed both traditional methods in all habitat types. Although differences in species detection at the lake-wide level can be considered minor, eDNA metabarcoding proved to be highly effective in detecting very rare species, or species that are generally underrepresented in traditional surveys (particularly, benthic and large-bodied species). Multivariate analyses revealed that eDNA metabarcoding captured a greater number of species per sample and yielded

a more even distribution across habitats. Habitat-area-weighted analyses showed consistently strong correlations in species rank abundance between eDNA metabarcoding and traditional methods, albeit remarkable differences also emerged in the relative dominance of certain species. Overall, our findings support the integration of eDNA metabarcoding into long-term monitoring programs. The method can provide comprehensive, habitat-independent assessments of fish community structure and therefore enhance conservation and management in lake ecosystems.

Host preference of epizoic bdelloid rotifers

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Presenting Author: Diego Fontaneto

Status: Oral presentation

Session Number & Date: Freshwater biodiversity - status, advances & future priorities, 15:00-15:15, Monday 21 July

Abstract

Several species of rotifers live as epibionts on other aquatic invertebrates. However, this type of association has never been thoroughly studied. This work aimed to observe these associations and understand the reasons behind host selection by rotifers. By analyzing various potential hosts in different freshwater ecosystems, the study explores whether bdelloid rotifers exhibit specific preferences for certain hosts or if these associations are more opportunistic. Phylogenetic relationships among various potential host organisms were reconstructed, using a genetic approach, to understand how much phylogenetic signal influences these relationships. Differences between sampled habitats (lentic and lotic environments) were also considered to evaluate the impact of the environment on host selection. A combination of ecological and phylogenetic analyses was employed to test for host specificity, revealing a significant influence of evolutionary relationships and habitat type on rotifer-host interactions. The findings suggest that while some invertebrate species are frequently selected by bdelloid rotifers (e.g., Trichoptera and Asellidae), others appear to be avoided (e.g., Platyhelminthes and Annelida), indicating selective attachment behaviour. This study helps to fill a gap in knowledge regarding symbiotic relationships between bdelloid rotifers and their hosts and provides insights into the ecological and evolutionary dynamics underlying these interactions.

How do road crossings affect the functional diversity of aquatic macroinvertebrates?

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Presenting Author: Blanka Gál

Status: Oral presentation

Session Number & Date: Freshwater ecosystems in urbanized catchments, 14:15-14:30, Monday 21 July

Abstract

The expansion of roads is a major driver of land use change and also poses a significant, direct threat to biodiversity. Humans are rapidly approaching the point at which remaining biologically rich and environmentally important ecosystems are disintegrating due to fragmentation by roads. Functional diversity is regarded as a key link between ecosystem function and biodiversity, and is therefore widely investigated in relation to human-induced impacts. However, how the intersection of roads and streams (hereafter, road crossings), influences the functional diversity of stream-dwelling macroinvertebrates remains poorly known. Our aim was to characterize the impacts of road crossing structures on multiple facets of the functional diversity of macroinvertebrates. Our research showed that road crossing structures had negative impacts on functional richness and dispersion; i.e, functional diversification. This was reflected in decreased trait diversity and greater dominance of fewer and similar traits. However, we found no significant impact on functional divergence and evenness. We found an increase in functional uniqueness and a decrease in functional redundancy at road crossing structures, which could reduce the ability of a community to recover from disturbances. Finally, we found that road crossings drive changes in stream habitat and hydrology in parallel with modification of the trait composition of macroinvertebrate assemblages. These results suggest that road crossings cause notable changes in the functional diversity of macroinvertebrate assemblages. Considering the ongoing human pressure on aquatic communities and explosive road sprawl in many countries, the problem could be more significant at the landscape scale due to the cumulative impacts of road crossings over entire catchments. In this context, further research is essential to monitor the functional characteristics of

freshwater ecosystems, as well as to develop future management plans that aim to mitigate these ongoing impacts.

How does naturalization impact greenhouse gas concentrations and fluxes in artificial urban ponds?

Daniel von Schiller[1], Jorge J Montes-Perez[1], Lidia Cañas[1], Josep M Carmona[1], Paula Irusta[1], Fernanda Mejia[2], Alberto Millan[1], Berta Montane[1], Biel Obrador[1], Nael Pinaud-Brageot[3], Diana Puigserver[1]

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Presenting Author: Daniel von Schiller

Status: Oral presentation

Session Number & Date: Last-ditch efforts? The science and management of artificial waterbodies, 14:30-14:45, Monday 21 July

Abstract

International policies and agreements, such as the European Green Deal and the 2030 Agenda, encourage cities to adopt strategies that enhance sustainability and climate resilience. In this context, the naturalization of artificial urban ponds (AUP) represents a promising Nature-based Solution (NbS) that can provide essential supporting, regulating, and cultural ecosystem services. However, the naturalization process intensifies biogeochemical cycles, which may lead to an unintended consequence: increased greenhouse gas (GHG) emissions. Despite the growing interest in urban NbS, the effects of AUP naturalization on GHG dynamics remain poorly understood. In this study, we assessed the impact of AUP naturalization on GHG emissions by measuring the partial pressures of carbon dioxide (pCO_2), methane (pCH_4), and nitrous oxide (pN_2O) in the water of 41 AUP (28 naturalized and 13 non-naturalized) across the city of Barcelona, Spain. We conducted seasonal measurements during winter and summer to account for temporal variability. Additionally, we analyzed biological, chemical, and physical parameters in each pond to identify the main drivers influencing GHG variability. To evaluate the overall climate impact, we estimated diffusive fluxes in CO_2 equivalents (CO_2eq) and compared the global warming potential of naturalized versus non-naturalized AUP. Our results indicate that both naturalized and non-naturalized AUP were supersaturated with CO_2, CH_4, and N_2O. Naturalized AUP exhibited higher pCH_4, whereas pN_2O levels were greater in non-naturalized AUP. We found no significant differences in pCO_2 between the two pond types. Key factors influencing GHG partial pressures included seasonal temperature variations, naturalization status (particularly primary production-related variables), and groundwater legacy effects. Importantly, our analysis revealed no significant differences in total GHG emissions expressed in CO_2eq between naturalized and non-naturalized AUP. These findings suggest that while

naturalization alters GHG dynamics, it does not substantially increase emissions from artificial urban water bodies. Therefore, AUP naturalization remains a viable strategy for enhancing urban resilience without exacerbating climate change.

How does Warming Impact the Stability and Recovery of Shallow Saline Lakes?

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Presenting Author: Cihelio Amorim

Status: Oral presentation

Session Number & Date: Impacts of freshwater salinisation on aquatic ecosystem structure, function and biodiversity, 16:00-16:15, Tuesday 22 July

Abstract

Climate change, as projected by the IPCC, will exacerbate lake vulnerability through rising temperatures, altered precipitation and evaporation rates, and extreme weather events. These challenges pose serious threats to biodiversity, including rising salinities, and disrupting nutrient cycling, thereby threatening ecosystem stability and resilience. Understanding how aquatic ecosystems respond to pulse (heatwaves) and press (continuous warming) disturbances under varying salinity conditions is critical for predicting climate change impacts. This study examined ecosystem stability and resilience in shallow saline lakes (4 and 40 g/L salinity) using mesocosm experiments conducted synchronously in two Turkish climates: a cold semi-arid (BSk, Ankara) and a hot Mediterranean (Csa, Mersin) region. They included four treatments (ambient and warm temperatures at each salinity), each replicated four times. The first experiment (2022) examined the pulse effects of a two-week heatwave (+6°C), while the second (2023) explored the press effects of continuous warming (+4.5°C) over three months. Ecosystem variables such as turbidity, metabolism, and nutrients were evaluated. The two-week heatwave experiment (+6°C in 2022) revealed significant ecosystem shifts, especially in high-salinity systems. At both salinities and climates, resistance to dissolved oxygen decline was low, with partial recovery observed. High salinity reduced alkalinity recovery in both climates, while suspended solids showed incomplete recovery only in the cold semi-arid region. Chlorophyll-a at low salinity showed contrasting resilience across climates, recovering fully in the Mediterranean but not in the semi-arid region. Continuous warming (+4.5°C in 2023) caused more pronounced ecosystem changes, particularly at high salinity in the hot Mediterranean, leading to increased water transparency and nitrate/nitrite levels, and decreased chlorophyll-a, suspended solids, and phosphorus

concentrations. High salinity systems were more vulnerable to warming, with increased variability. Submerged macrophytes at low salinity buffered warming effects, achieving 100% coverage and enhancing ecosystem stability. Overall, the findings highlight the critical role of salinity in shaping ecosystem responses to pulse and press disturbances. Saline systems are particularly vulnerable to warming impacts, underscoring the need for mitigation strategies to enhance aquatic ecosystem resilience under climate change.

How effective is wetland restoration in enhancing carbon storage and reducing greenhouse gas emissions? Insights from a global meta-analysis

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Presenting Author: Benjamin Misteli

Status: Oral presentation

Session Number & Date: Greenhouse gas (GHG) exchanges and biogeochemical processes, 10:45-11:00, Friday 25 July

Abstract

Wetlands are vital ecosystems that provide numerous ecosystem services, including their remarkable capacity for carbon storage and greenhouse gas (GHG) regulation. Due to their common anaerobic conditions, the decomposition of organic matter is significantly reduced, leading to the accumulation of substantial carbon stocks. Despite covering only 5–8% of the Earth's land surface, wetlands are estimated to store 20–30% of global soil carbon. Healthy wetlands act as effective carbon sinks while influencing emissions of the most important GHGs, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide

(N_2O). As such, they play a crucial role in mitigating climate change and supporting the European Union's goal of achieving climate neutrality by 2050. Recent research underscores their indispensable role in both climate action and biodiversity conservation. While the benefits of wetland restoration are widely acknowledged, the extent to which wetland restoration enhances carbon sequestration and reduces greenhouse gas emissions remains poorly quantified across different wetland types and restoration approaches. To address this knowledge gap, we conducted a global-scale meta-analysis synthesizing existing scientific knowledge on the effects of wetland restoration on the carbon cycle. Our study evaluates the impact of restoration on key GHG (CO_2, CH_4, N_2O) fluxes and carbon stored in biomass, sediment, and water column, based on more than 150 studies. Covering a wide range of wetland types, from peatlands to salt marshes and mangroves, we also examine how restoration outcomes vary based on different types of environmental alterations (e.g., land-use change, invasive species, hydrological disruptions), restoration approaches (e.g., dam removal, sediment removal, vegetation planting), and climatic gradients. Preliminary results reveal a geographic imbalance in wetland restoration research, with most studies conducted in North America, Asia, Australia, and Europe, while data from South America and Africa remain scarce. Regional research priorities also differ: Studies in European wetlands focus predominantly on GHG emissions, whereas Asian research emphasizes carbon stored in vegetation. While wetland restoration consistently increases carbon storage in soil and biomass, its effects on GHG fluxes remain variable, with considerable regional and methodological differences. Through a meta-analytical approach, our study synthesizes existing knowledge and identifies critical research gaps. These insights will inform future research directions, optimize restoration strategies, and better understand the role of wetlands as a nature-based solution for climate change mitigation.

Human land-use and non-native fish species erode ecosystem services by changing community size structure

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Presenting Author: Dieison A. Moi

Status: Poster presentation

Session Number & Date:

Abstract

Organism body size influences ecosystem services, and human pressures alter the size structure of ecological communities. However, our understanding of how different human-induced pressures (such as land-use and biotic invasion) interact to drive community size structure and ecosystem services remains limited. We compiled a 21-year fish database comprising 110,001 individuals of 143 species in a hyperdiverse Neotropical wetland, the Upper Paraná River Floodplain. We used this dataset to test how human land-use and non-native species alter the size structure of fish communities and in turn their

consequences for fishery potential (fishery monetary value), which provides income and protein for millions of people worldwide. To test the influence of non-native fish on the community size structure, we estimated the size spectra exponents for the whole community (native + non-native species), native species only, and non-native species only. We then investigated how both size spectrum exponents changed over time. We also determined how the size spectrum exponent of native species relates to the size spectrum exponents of non-native species and the whole community over time. By accounting for climate drivers, we disentangle the pathways by which human land-use and non-native fish species affect the fishery potential. We demonstrate that the size spectrum exponent of native species became more negative over time, indicating a relative decrease in the biomass of large versus small native individuals. Conversely, the size spectrum exponent of non-native species became less negative over time due to the increased abundance of large non-native individuals. In general, fishery potential declined by >50% over time. We also found a positive relationship between the size spectrum of the whole community and native species, but this relationship weakened over time. Similarly, the relationship between the size spectrum of native species and non-native species became negative over time. This indicates that large-bodied non-native species became progressively more influential on community size structure. Human land-use replaced the coverage of natural environments, indirectly reducing native richness. This scenario decreased the exponent of the native size spectrum, indirectly reducing fishery potential across floodplain environments. The size spectrum exponent of native species directly increased the fishery potential, whereas the size spectrum exponent of the non-native species decreased it. Our study illustrates how human land-use intensification alters the size structure of communities, favoring non-native individuals.

Hydro-morphological and ecological impact of a controlled sediment flushing operation from an Alpine reservoir

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Presenting Author: Quadroni Silvia

Status: Oral presentation

Session Number & Date: Linking hydromorphology and ecology, 11:00-11:15, Friday 25 July

Abstract

Controlled sediment flushing operations (CSFOs) allow recovering reservoirs to store loss, partly rebalancing the downstream sediment flux interrupted by dams. The term “controlled” refers to the operational actions implemented to mitigate the downstream ecological impact of the sediment release, including limits over acceptable suspended sediment concentration. Within a national research project (FluEMMA), we monitored riverbed sedimentation and its consequence on benthic organisms in an alpine stream impounded by a hydropower dam (Isolato Dam, Central Italian Alps). Specifically, the hydropower reservoir (Isolato Reservoir, 1.76 Mm3 capacity) was desilted by a CSFO in 2023. The CSFO took place from January 9 to March 31 and allowed evacuating ca. 20,000 m3 of fine sediment. The season (winter) and duration (ca. three months) of the operation differed from typical time windows of comparable CSFOs carried out in the same geographic area, basically due to specific technical constraints. Our field investigation extended over two years. We monitored one reference reach upstream from the reservoir, and two impacted reaches located 0.5-1 and 2-4 km below the reservoir. These two study reaches are separated by the confluence of a main tributary, and characterized by different slopes (0.084 vs. 0.014) and hydro-morphology (step-pool vs. riffle). The field campaigns included repeated measurements of riverbed substrate, fine sediment deposits, and

sampling of benthic communities (periphyton and macroinvertebrates). We analysed the experimental dataset acquired before, during, and after the CSFO to assess the ecological impact and subsequent recovery time. Moreover, we could evaluate the hydro-morphological effects of clear water releases, carried out during the CSFO (from another reservoir of the same hydropower complex), and five months after the CSFO (from the Isolato Reservoir). These further mitigation measures induced a faster recovery of the riverbed substrate, with a substantial reduction of fine sediment deposits, thus enhancing the chance of recolonization by benthic communities, which was significantly impaired in the first months after the CSFO. To minimize the downstream environmental effects while concurrently achieving acceptable flushing efficiency, the analysed scenarios need to be carefully evaluated from a multidisciplinary perspective.

Impact of Freshwater Salinization on Lakes in Central Anatolia using Remote Sensing and Synchronised Mesocosm Experimental Approaches

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Presenting Author: Meryem Beklioğlu

Status: Oral presentation

Session Number & Date: Impacts of freshwater salinisation on aquatic ecosystem structure, function and biodiversity, 16:15-16:30, Tuesday 22 July

Abstract

Freshwater salinization is a one of the major grand challenging problem that poses a major threat to lakes ‘ecosystem structure, function and services that they provide. Arid climatic conditions coupled with excessive water use for irrigation of water- thirsty crops led to a substantial rate of reduction of the surface and ground water levels, surface area of lakes decreased, followed by an increase in salinisation, and even complete loss of several lakes in the Central Anatolia. To understand changes in size and salinity taking places in Central Anatolian Lakes, Sentinal Satellite images were used to create salinity index as well as to estimate the surface are of the lakes from 1985 to 2020. Furthermore, to understand the effects of salinization on shallow lakes, we performed synchronized gradient and factorial design mesocosm experiments in 2021, 2022 and 2023 in two mesocosms systems built in following exactly the same design located in cold dry-semi-arid Ankara and Mediterranean Mersin. While the gradient design experiment included 16 salinities from 0.5 -60 g salt/L. The other two synchronized mesocosm experiments had factorial design with two different salt concentrations (4 and 40 g/L) crossed with 2 weeks of heatwave (+ 6.5oC) in 2022 experiment and continuous heating (+ 4oC) applied in 2023 experiment. Major changes in ecosystem structure that took placed will be discussed thoroughly.

Impacts of glacier melt on an Alpine riverine ecosystem and benthic macroinvertebrates under climate change

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Presenting Author: Francesca Vallefuoco

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 11:30-11:45, Tuesday 22 July

Abstract

Climate change is significantly reshaping Alpine riverine ecosystems worldwide, with dramatic consequences for flow regimes, sediment transport, ecological functioning and aquatic biodiversity. Glaciers play a crucial role in Alpine catchments, regulating water storage and flow regimes, while acting as sensitive indicators of climate variability. Glacial ice loss alters seasonal and annual water and sediment contributions, affecting habitat stability, aquatic community dynamics, species distributions, and altering overall biodiversity. Given these rapid changes, understanding the ecological implications of climate change on Alpine freshwater ecosystems has become increasingly critical. Glacier-fed streams, such as the Saldur/Saldura stream in the Italian Central-Eastern Alps, are particularly vulnerable due to their dependence on snow and glacier melt. The Saldur/Saldura catchment (~100 km²), represents a unique study area due to its relatively dry climate, low anthropogenic stressors, and the presence of the Matsch glacier that is essential for sustaining the hydrology of this inner-Alpine valley. However, over the past century, the Matsch glacier has retreated by more than 60%, with an accelerated rate of loss in the last 30 years. Since 2010, benthic macroinvertebrates have been collected monthly during the snow-free period (April-September/October) at three altitudinal sites as part of a long-term monitoring program within the LT(S)ER Italian network. This high-resolution temporal dataset has allowed us to analyse the spatial and temporal dynamics of macroinvertebrate assemblages in response to both environmental and climatic drivers. Additionally, changes in the proportion of cold-adapted taxa were analysed to assess their response to climate change. Our findings highlight the predominant influence of seasonal melting processes on macroinvertebrate community structure and taxonomic composition. Hydrological models showed that, particularly in recent decades, glacial meltwater has been the dominant contributor to Saldur/Saldura river runoff during summer months (July-

September), while snowmelt dominates ealry summer runoff Increased runoff during peak melt periods corresponds to a decrease in faunal density and taxa richness, while longitudinal gradients in taxa distribution reflect variations in temperature, discharge, and suspended sediment load along the stream. Notably, seasonal glacial melt dynamics appear to overshadow the hydrological and ecological effects of the small run of a river hydropower plant, suggesting that the Saldur/Saldura stream's hydrology and benthic communities remain primarily shaped by climatic drivers rather than local anthropogenic impacts. However, climate change can result in upward shifts in species distribution, as evidenced by our report of Baetis rhodani (Pictet, 1843) being recorded for the first time in 2024 at the downstream sampling site (1650m a.s.l.). By integrating high-resolution temporal benthic observation with an accurate hydrological modelling of the ice and meltwater contribution, this study highlights the vulnerability of macroinvertebrates to climate-induced shifts in glacier and snowmelt dynamics. In the perspective of a warming climate, our preliminary results highlight the importance of long-term monitoring programs that include both glaciers melt and the associated biological responses. This is essential to better understand ongoing and projected climate-induced changes, and to improve conservation strategies and water resource management.

Interacting agricultural pressures and climate change enhance phosphorous export from watersheds

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Presenting Author: Monia Magri

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 15:00-15:15, Monday 21 July

Abstract

Point pollution source management has effectively reduced phosphorus (P) inputs to surface waters, while reducing diffuse runoff from agricultural lands remains challenging due to excessive fertilization, soil P accumulation, irrigation- and precipitation-mediated erosion. Although riverine P export generally represents a minor fraction of total P inputs due to adsorption and precipitation processes, irrigation and extreme precipitation events can greatly enhance particulate and dissolved P mobilization. The present study analyzes the annual P budget and riverine P load in the Chiese River (northern Italy), located within the Po River watershed -a globally recognized hotspot of nutrient pollution-, and quantifies the role of extreme rainfall events in increasing baseline annual export. A soil system budget was developed to assess the P surplus in agricultural soils, accounting for inputs from fertilizers and manure and outputs from crop harvest. This approach identified P-enriched soils, prone to contaminate water, and quantified potential P export to aquatic ecosystems. Monthly measurements of particulate phosphorus (PP), and soluble reactive phosphorus (SRP) concentrations and loads were conducted along the river course, with intensified sampling during extreme rainfall events to capture high P mobility periods in 2022, 2023, and 2024. The three years showed marked differences in precipitation patterns and hydrometric level variations, with 2022 and 2024 characterized by extremely dry and wet conditions, respectively. The average discharge was 6, 16, and 37 m3s-1 for 2022, 2023, and 2024, compared to a 10-year average of 17 m3s-1. From the analysis of budget results, manure spreading accounted for more than 90% of P inputs to soils, with crop uptake removing approximately 30% of inputs, resulting in an annual surplus of 1,700 tons P y-1 (52 kg P ha-1 UAA y-1). Under baseflow conditions, riverine concentrations ranged between 20 and 60 µg P L-1 for SRP and between 15 and 40 µg P L-1 for PP. During extreme rainfall, SRP concentrations remained stable, while PP concentrations

increased by an average of 350%, constituting more than 75% of the total P load. The annual exported load was estimated in 6, 40, and 95 tons P y-1 for 2022, 2023, and 2024, respectively, corresponding to less than 1%, 2.5%, and 6% of the soil P annual surplus. The loads attributable to the 5 days with the highest precipitation for each year accounted for 13%, 70%, and 22% of the exported loads in 2022, 2023, and 2024, respectively. In 2023, a single precipitation event contributed 60% of the total annual load. This study demonstrates the critical interaction between agricultural and livestock-related P surplus and the increasing frequency and intensity of extreme rainfall events due to climate change. The combination of these factors significantly increases the risk of P mobilization from soil and export to water bodies, especially in areas with long-term soil P accumulation. Extreme events can mobilize large amounts of legacy P, posing challenges to nutrient pollution mitigation. Addressing this issue requires integrated strategies that combine sustainable agricultural practices with climate adaptation measures.

Interactions between invasive P. stratiotes and Hydrocharis morsus-ranae under various environmental factors

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Presenting Author: Gergő Koleszár

Status: Oral presentation

Session Number & Date: Invasive species in freshwater ecosystems, 11:00-11:15, Friday 25 July

Abstract

Climate change-induced variations in nutrient levels, temperature, and light availability can significantly impact the species composition of aquatic ecosystems, as global warming may accelerate eutrophication processes. Eutrophication, in turn, can facilitate the invasion and spread of non-native aquatic plant species. In this study, we examined the competitive interactions between the invasive Pistia stratiotes and the native Hydrocharis morsus-ranae, focusing on how different light intensities, temperatures, and nutrient concentrations influence their functional traits. In a short-term (8-day) monoculture experiment, we tested two nutrient conditions - low (0.5 mg L^{-1} N; 0.05 mg L^{-1} P) and high (2 mg L^{-1} N; 0.2 mg L^{-1} P) - along with four light intensities (25–295 μmol m^2 s^{-1}) and two temperature treatments (cold: 21.5°C; warm: 27.5 ± 0.5°C) in a full factorial design. Additionally, a 28-day mixed-culture experiment was conducted with varying initial biomass ratios under both shaded and well-illuminated conditions, using a high nutrient concentration (4 mg L^{-1} N; 1 mg L^{-1} P). Our findings indicate that in monocultures, P. stratiotes exhibited a significantly higher relative growth rate than H. morsus-ranae in warm water, whereas in cooler conditions, this difference was not statistically significant. At the high temperature with the lowest and the highest light intensity, RGR of P. stratiotes was significantly higher than that of H. morsus-ranae. In mixed cultures, P. stratiotes consistently outgrew H. morsus-ranae regardless of the initial biomass ratio. The RGR of P. stratiotes was significantly higher regardless of light intensity compared to H. morsus-

ranae and at high light intensity the relative growth rate of P. stratiotes was twice as much as H. morsus-ranae. Under shaded conditions (65 ± 5 μmol m^2 s^{-1}), P. stratiotes dominated the water surface, leading to the decline of H. morsus-ranae. Our experimental results with monocultures pointed out that the three abiotic factors strongly modified the investigated plant traits of either or both species. These results suggest that rising temperatures may promote the expansion of P. stratiotes, while reduced light availability could further enhance its competitive advantage over native species. It leads to a decrease in the composition of animal communities and the biodiversity of native aquatic macrophytes, furthermore, largely contributing to the development of several ecological and economic problems.

Investigation of ER Stress Changes In Liver and Gill Tissues Of Zebrafish (Danio rerio) Reared In Waters Containing Zinc Oxide Nanoparticles And High Carbon Dioxide

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Presenting Author: Ayşe İğci

Status: Oral presentation

Session Number & Date: Ecotoxicology: Ecological responses to chemical stress in freshwaters, 10:45-11:00, Thursday 24 July

Abstract

Carbon dioxide (CO2), a gas that absorbs and radiates heat, is an important greenhouse gas. Almost 29% of atmospheric CO2 could be absorbed by surface water. When CO2 dissolves in water, it forms carbonic acid (H2CO3), which dissociates to release hydrogen ions (H+), lowering the pH and making the solution more acidic. Calculations predict that the increase in CO2 emissions will lower surface water pH from 8.1 to 7.7 by 2100. Enabled by technological advances, the industrial use of metal nanoparticles such as nano-zinc oxide (nZnO) is increasing. The uncontrolled release of the resulting nanoparticle pollutants into the environment poses a significant threat to both the physicochemical structure of water and the life of aquatic organisms. Nanoparticle pollution is associated with various diseases, including those caused by the accumulation of misfolded proteins. Endoplasmic reticulum (ER) stress associated with such protein accumulation can cause of aquatic animal diseases and may be important for understanding the environmental stress response in animals. Here, the correlation between the ER stress mechanism in zebrafish and exposure to elevated CO2 and increasing nZnO concentrations was analyzed. Experimental groups were exposed for 96 h to increasing concentrations of 2.5, 5 and 10 mg/L nZnO in water reduced to pH 7.7 with high CO2 and only increasing concentrations of 2.5, 5 and 10 mg/L nZnO without CO2; control groups were exposed to water only (pH 8.4) and water without nZnO but with high CO2 levels (pH 7.7). For ER stress investigations, the expressions of BIP, IRE1, XBPs, PERK, Elf2α, and CHOP genes in the liver and gill tissues were analyzed by real-time (RTqPCR) PCR using β-actin as a control gene, and the expression amounts were calculated by the Pfaffl method. We found that high CO2 increased the mRNA expression of ER stress markers IRE1, XBPs, PERK, Elf2α, BIP and CHOP in liver tissue. Conversely, CO2 decreased the mRNA expression of IRE1, XBPs, PERK, Elf2α, BIP and CHOP in gill

tissue. Application of nZnO to water at a concentration of 10 mg/L together with CO2 decreased the mRNA expression of IRE1, XBPs, PERK and CHOP in liver compared to groups exposed to nZnO concentrations of 2.5 and 5 mg/L together with CO2. However, in gill tissues, IRE1, XBPs, PERK, Elf2α, BIP and CHOP mRNA expression showed non-linear dose-response relationships in both high CO2 water and water with increasing nZnO concentrations. In conclusion, high CO2 and nZnO together induce ER stress in zebrafish, but stress levels differ in liver and gill tissue.

Lake Shobaidak as an example of eutrophication of high-altitude lakes

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Presenting Author: Anna Kallistova

Status: Poster presentation

Session Number & Date:

Abstract

Climate change is causing noticeable melting of glaciers, altering the hydrological regime of high-altitude lakes, activity of microbial communities, and trophic state. However, the impact of climate change on microbial processes, abundance and diversity of microbial communities in high-altitude lakes remains mostly unknown. We evaluated the causes of eutrophication of the high-altitude (2936 m a.s.l.) Caucasus lake by measuring hydrochemical parameters, the intensity of microbial processes, and the structure and metabolic capacity of microbial communities in the sediments and water column. Analytical and radiotracer methods were used together with 16S rRNA profiling, and metagenome analyses. High dissolved organic carbon (DOC) concentrations were measured in the lake water column (12.2-19.4 mg/L) and pore water of sediments (6.3-15.8 mg/L).The enrichment of the lake with DOC occurred due to blooms of phototrophic organisms on the benthic sediments caused by sufficient warming of the overlying water and negative effects of UV radiation preventing phototrophs from inhabiting the upper water layers. Most cyanobacteria were located in the upper layer of sediments (0-2 cm), where their sequence reads exceeded those of other microorganisms, constituting 30% of the total 16S rRNA sequences. Copepods of the genus Diaptomus also enrich the water column with organic matter. The elevated DOC concentrations facilitated the activity of diverse heterotrophic microorganisms in the water column, resulting in oxygen depletion and activation of anaerobic microbial processes. We identified genes involved in pathways for the aerobic and anaerobic transformation of carbon, nitrogen, and sulfur compounds in the microbial communities of upper sediments of profundal and littoral zones of the lake by metagenome analysis. Given ongoing human pressures, it is possible that the lake will become a eutrophic reservoir with an anoxic bottom water layer and a microbial community that resembles meromictic reservoirs - that is, one in which sulfate reduction and methanogenesis play a major role. The work was supported by the Russian Science Foundation (grant no. 22-14-00038).

Large-scale assessment of ecological outcomes from river restoration: disentangling the intertwined effects of measure type, time lapse and spatial context on fish and macroinvertebrate communities

Floury, M.[1,2], Charrat, B.[1], Jeliazkov, A.[2], Palt, M.[3], Tales, E.[2], Stoll, S.[3], Verdonschot, R.[4], Weber, C.[5], Le Pichon, C.[2], Piffady, J.[1]

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Presenting Author: Jeremy Piffady

Status: Oral presentation

Session Number & Date: Novel approaches to assess the success of freshwater ecosystem restoration, 15:15-15:30, Thursday 24 July

Abstract

Many restoration projects have been implemented in the past two decades to improve the ecological status of rivers worldwide. Over this period, restoration practices have gradually evolved from local, habitat-based strategies to cross-project, process-based approaches. Yet, restoration outcomes are still strongly contrasted and often unsuccessful. To address this issue, it is now widely acknowledge that the landscape context has to be more carefully considered in restoration planning. However, the potential effects on ecological responses to restoration of multiple drivers at various spatial scales, such as land-use, river fragmentation and species pools, remain understudied and, thus, poorly understood. As part of the COSAR project, we gathered information from more than two-hundred sites across six European countries about restoration context and ecological outcomes based on fish and macroinvertebrate communities. Using hierarchical generalized additive models, we found a significant effect of the restoration type on the diversity responses: in average, the more complete the bunch of restoration measures, the greater the increase in taxonomic richness and functional diversity of both biological groups. In addition, we highlighted an increasing pattern of biological responses along the reach-scale urbanization gradient in most of the cases, as well as interacting effects of cropland proportion and river fragmentation at the basin scale on this response pattern. We showed also that small and large rivers could significantly differ in their responses to restoration along time. Moreover, if generalist and tolerant taxa seemed to drive the main diversity responses in some cases, sensitive taxa were also promoted by restoration under certain circumstances. Finally, using complementary clustering and correlative approaches, we were able to distinguish different groups of restored sites exhibiting specific patterns for

bundles of ecological responses. These clusters were quite stable over time regardless of the biological group and were significantly related to restoration context for fish communities. Overall, these results provide an original assessment of the context-dependence of the ecological outcomes from river restoration based on the compilation of a rare large-scale dataset. This work would further benefit from additional developments such as including more evenly replicated cases of restoration (i.e. among the possible combinations of restoration measures, river types, spatial context, monitoring design, etc), or addressing the influence of legacy effects which have been poorly considered so far. Ultimately, these different pieces of work should help managers to define more holistic strategies in river restoration planning.

Lateral dispersal of the mayfly Ephemera danica is driven by morphological traits and sex

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Presenting Author: Leon A.H. van Kouwen

Status: Oral presentation

Session Number & Date: Linking hydromorphology and ecology, 10:45-11:00, Friday 25 July

Abstract

Although longitudinally connected, the upper, middle, and lower reaches of streams differ in hydrological and morphological conditions, consequently harbouring unique habitats and macroinvertebrate assemblages. However, anthropogenic activities have severely degraded many of these specific habitats. This has led to a marked decline in lotic biodiversity, primarily at the expense of specialist species, many of which have suffered from (local) extinctions. Growing concerns about the degraded lotic ecosystems have driven the adoption of various legislations related to water quality, and the initiation of many hydromorphological restoration projects. Initially, overall stream biodiversity increased owing to the recolonization of suitable habitats by generalists, either through longitudinal dispersion of larvae and adults, or adult lateral dispersion from nearby source populations. However, specialist species are often confined to isolated stream reaches, which limits their dispersal, retarding recolonization of potentially suitable restored streams. Consequently, this hinders further ecological recovery. Understanding and facilitating the ecological recovery of streams and the timeline for recovery requires reliable predictions of the recolonization potential of macroinvertebrates. While incidental observations give some insight into the distances covered by adult invertebrates during dispersal, quantitative estimates of dispersal capacity are currently lacking. Our study aimed to determine the lateral dispersal capacity of adult macroinvertebrates, and to assess how sex and morphological traits influence the lateral dispersal capacity. We selected the mayfly Ephemera danica as our model organism. It is a characteristic species of the middle reaches of lowland streams with a good ecological quality. During the spring of 2023 and 2024, adult mayflies were caught using a series of light traps placed in a lateral gradient at 0, 25, 50, 100, and 150 m from a lowland stream. Trapped individuals were counted at each distance point, sexed, and morphological traits including wing

length, wing area, body size, and dry weight were measured. The total number of Ephemera danica individuals caught in the traps strongly decreased with distance from the stream. Male individuals remained within 50 m of the stream, being both heavier and larger-bodied at increasing distances. This pattern might have been the result of large individuals having higher fat reserves, leading to a prolonged life span, and an increased potential to cover larger distances. Females were found at up to the maximum distance of 150 m from the stream, increasing only in weight with increasing distance from the stream. For the females, higher fat reserves, and behavioural differences due to the presence of larger egg clutches may have influenced dispersal distance. Our findings showed that colonization of new habitats through lateral dispersion depends on the presence of large-bodied individuals within the population, and primarily on females. This is an important finding, as increasing stream water temperatures due to climate change are expected to negatively impact adult body size. This might decrease adult dispersal capacity of macroinvertebrates, hindering recolonization of restored streams.

Life goes on in a stinky world: exploring the tolerance of copepod crustaceans to hydrogen sulfide in the Movile Cave, Romania

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Presenting Author: Pop Maria Mirabela

Status: Oral presentation

Session Number & Date: Ecotoxicology: Ecological responses to chemical stress in freshwaters, 11:45-12:00, Thursday 24 July

Abstract

Sulfidic aquifers are unique and rare groundwater reservoirs which are critical habitats for specialized subterranean life and also provide ecosystem services, such as water purification and degradation of pollutants. Found worldwide, these extreme environments are characterized by high levels of hydrogen sulfide (H2S), which create challenging conditions that drive adaptive strategies in their resident organisms. In south-eastern Romania, sulfide-rich mesothermal aquifers along the Black Sea coast support unique biological communities, including several species adapted to cope with a wide array of toxic compounds such as H2S, CH4 and NH4, and relatively high temperature (cca. 21°C). Movile Cave serves as a window into this aquifer, an ecosystem sustained by chemosynthesis. Here, organisms, including 37 endemic species, exhibit diverse traits—physiological, morphological, and behavioral adaptations—which promote their survival. Apart from nutrient and energy limitations, darkness, oxygen scarcity, and geochemically constant conditions apply additional pressure to these organisms, particularly when H2S is present. H2S is naturally present in living cells at low concentrations, acting as a signaling molecule and regulator of physiological processes. However, when its concentration increases it can reach toxic levels, and organisms thus have specific strategies to maintain optimal H2S levels without affecting their physiological and

metabolic activities. Movile Cave, with its sulfidic environment, offers an opportunity to study the physiology and metabolic adaptations of cave dwellers to extreme environments. We investigated the tolerance of the stygobite Eucyclops subterraneus scythicus (Crustacea: Copepoda) to H_2S, using a 96-hour ecotoxicological test exposing individuals to four sulfide concentrations (80, 40, 20 and 10 mg S^{2-}/L). Eucyclops subterraneus scythicus exhibited a notable tolerance to elevated H_2S levels, with survival patterns suggesting potential physiological or behavioral adaptations to sulfide exposure. Mortality reached 100% only at the highest concentration of 80 mg S^{2-}/L, while at lower concentrations, some individuals survived the test duration. Our findings provide insights into species adaptations that confer tolerance of toxic chemical stressors, contributing to a deeper understanding of species survival strategies under stress.

Life on plastic garbage in a eutrophic pre-dam

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Presenting Author: Simon Zonkpoedjre

Status: Oral presentation

Session Number & Date: Freshwater quality: Tackling the challenge of pollution, 14:15-14:30, Monday 21 July

Abstract

Plastic garbage in freshwaters is still much less studied compared to oceans. Despite representing a problematic pollution, it may also serve as habitat for freshwater organisms. The research aims to understand how the physical properties of plastics (material type and surface texture) and seasonal variations influence the colonization patterns by aquatic organisms. Additionally, the study compares colonization on plastic items with wood as natural substrate to fill gaps in understanding the ecological role of plastics in freshwater systems. The Oehna pre-dam, a small impoundment connected to Bautzen Reservoir, was selected as a study site due to its high concentration of plastic waste originating from Bautzen city and the River Spree. Over a year, from November 2023 to November 2024, five sampling campaigns were conducted. 143 visible plastic items and 12 wood pieces as references were collected from the shoreline zone. The collected items were documented, and their physical properties (color, material type and size) were recorded. Plastics were categorized by type (hard, Styrofoam, soft, and film) and surface texture (porous vs. smooth). Organisms attached to the plastics were identified using light microscopy, and their abundance was quantified (2 cm^2 per item). Statistical analyses, including PERMANOVA and Generalized Linear Models (GLMs), were used to assess the influence of material type, surface texture, and season on organism colonization. The highest number of plastic items was found in summer (52 items) and the lowest in winter (18 items). The plastics included hard items (35%), Styrofoam (30.1%), soft items (23.1%), and film items (11.9%). Of these, 59 items (41%) were visibly colonized by organisms. Styrofoam items showed the highest colonization rate (69.8%), followed by hard (32%), soft (27.3%), and film items (23.5%). Organisms were assessed on phylum level, either quantitatively or only qualitatively (Ciliomorpha, Gyrista, Chlorophyta, and Amastigomycota). Out of the quantitative phyla, Rotifera and Nematoda were the dominant phyla, accounting for over 90% of the observed organisms. Seasonal variations significantly influenced organism abundance, with the highest colonization observed in summer (46.1%) and the lowest in winter (3.4%). Surface texture also played a crucial role, with porous surfaces (Styrofoam) supporting higher organism abundance than smooth surfaces. However, the community composition did not significantly differ between

wood and plastic items, indicating that both substrates provide similar habitats. The study concludes that both the physical properties of plastics and seasonal changes significantly affect the colonization patterns of aquatic organisms, showing the complex interactions between plastic pollution and aquatic ecosystems. This study provides more details on the role of plastics as habitats in freshwater systems and the need for further study to address the management of plastics in freshwater environments.

Life on the edge: ecological and behavioral insights on stygobiont shrimp activity in ecotonal habitats

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Presenting Author: Valeria Messina

Status: Oral presentation

Session Number & Date: Beneath the surface: The science and management of groundwater systems, 15:15-15:30, Monday 21 July

Abstract

Animals that have adapted specifically to life underground are often seen as an evolutionary dead end. Nevertheless, some such stygobionts occur in springs, transitional zones that expose them to different selective pressures. Understanding their presence in these habitats provides insight into their ecological flexibility and potential for adaptation. This study aims to (i) assess the environmental factors that influence spring use by the highly mobile stygobiont caridean shrimp Troglocaris planinensis in northeastern Italy and (ii) compare the behavioral responses of cave and spring populations to surface-related cues. From June 2020 to January 2025, we surveyed 64 springs of the classic karst region, recording shrimp activity during both day and night and characterizing each site based on abiotic and biotic factors. In the laboratory, we tested whether individuals from cave and spring populations responded differently to light stimuli and chemical predator cues, as potential indicators of habitat-driven behavioral variation. We used generalized linear mixed model (GLMM) and/or LMM to assess relationships between the relative abundance of T. planinensis and environmental features, and to analyse responses to light and predatory cues. Field observations showed that shrimp activity in springs was significantly higher at night and lower in sites with a higher abundance of predatory fish, suggesting that environmental conditions strongly influence their surface presence. In constrast, laboratory experiments revealed no significant differences in behavioral responses to light or predation cues between cave and spring individuals, indicating that

habitat type alone may not drive immediate behavioral adaptations. These findings suggest that highly mobile stygobiont crustaceans can exploit ecotonal habitats dynamically, with their presence in springs being influenced by environmental factors. However, the lack of behavioral differences in controlled conditions raises questions about their perception of surface-associated pressures and the extent to which prolonged exposure to ecotonal environments might lead to evolutionary shifts. Further research is needed to explore whether these stygobionts exhibit long-term adaptive changes in response to surface habitats and what mechanisms may favor their exploitation of springs.

Long–term studies on the effects of river flow on changes in selected abiotic and biotic factors in a mountain dam reservoir (southern Poland)

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Presenting Author: Ewa Szarek-Gwiazda

Status: Poster presentation

Session Number & Date:

Abstract

Dam reservoirs created on rivers are more susceptible to climatic and hydrological factors than natural lakes. This applies particularly to dam reservoirs on mountain rivers, which are characterized by strong fluctuations in discharge. As a result of climate change, many places are experiencing an increase in both prolonged rainfall, which causes flooding, and periods of drought. The aim of the study was to determine the changes in the concentrations of dissolved oxygen, nutrients (NO3-, Ptot), chlorophyll a and zooplankton density in a mountain dam reservoir in relation to river flows. The study was conducted in the Carpathian Dobczyce Reservoir on the Raba River in southern Poland from April to October during 1994-2017. The results showed that the magnitude and timing of high flows were crucial for the distribution of dissolved oxygen concentrations and influenced the length and extent of strong oxygen stratification. Higher nutrient concentrations, greater activity of primary producers (chlorophyll a) and higher zooplankton density were observed in years with high summer flows that strongly disturbed oxygen stratification. The intensive development of primary producers could be related to the inflow of nutrients from the catchment during heavy rainfall and/or to the disturbance of stratification, which facilitated the movement of nutrients released from the bottom sediments to the upper layers of the reservoir, consequently leading to more intensive development of zooplankton. The results demonstrate the importance of the magnitude and timing of river flow in shaping the ecosystem of the dam reservoir and may have great implications for the management of water resources in the context of the observed climate changes.

Macroinvertebrate response to water level regulation in the littoral zone of Lake Maggiore

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Presenting Author: Lyudmila Kamburska

Status: Poster presentation

Session Number & Date:

Abstract

Macroinvertebrates are essential components of freshwater ecosystems, recognized as reliable bioindicators due to their sensitivity to changes in environmental conditions, including water quality, habitat structure, and hydrological regimes. While there is growing research into how climate change and hydro-morphological alterations impact freshwater ecosystems, studies specifically addressing the effects of human-induced water level fluctuations (WLFs) on macroinvertebrates in temperate lake littoral zones are limited. Here, we present a study aimed at investigate the impact of water level management from mid-March to mid-September on the littoral macroinvertebrates of Lake Maggiore, a large and deep subalpine lake spanning /crossing the border between Italy and Switzerland. The research was part of the INTERREG project “Parchi Verbano Ticino” (2019-2021), which seeks to understand the consequences of water level management on both lake littoral zones and downstream river areas. Macroinvertebrate sampling was carried out in three sites , two of which were located in Italy and one in Switzerland, all three within protected areas to assess the response of biota to varying water level conditions. The study focused on the diversity of chironomids and oligochaetes, their abundance, and their functional traits, including body length, dry weight and functional feeding habits. Our results revealed significant alterations in the diversity and size structure of the dominant oligochaetes and chironomids. Spatial distribution patterns of functional feeding groups (FFG) also varied in response to different water levels and depths within the lake, emphasizing how WLFs may affect the food-web structure in the littoral zone. The analysis of body length and dry weight indicated that both low and high-water levels exerted stress on chironomid growth , though the effects were more pronounced at low water levels. Interestingly, chironomids exhibited faster growth rates under low water conditions compared to medium water levels, but this growth came with trade-offs in body size and weight. The growth and development of chironomids were exacerbated by higher temperatures recorded along the littoral zone and extreme precipitation events during the

study period. These environmental factors combined with the fluctuating water levels added complexity to the biological responses of macroinvertebrates, requiring to account for both hydrological and climatic stressors. Although the results are not exhaustive, our findings suggest that both extremely low and high water levels may cause significant disruptions in the growth and diversity of key macroinvertebrate taxa. This study underscores the importance of considering the effects of water level management on macroinvertebrates, particularly in temperate lakes where human-induced fluctuations are increasingly common. The focus on both the diversity and functional traits of dominant taxonomic groups, particularly chironomids and oligochaetes, is an effective approach to assess the ecological consequences of human-induced WLFs. Although more comprehensive studies are needed to fully grasp the long-term consequences, the results provide an important basis for the development of decision support tools aimed at optimizing water level management strategies for biodiversity and ecosystem services conservation in the face of hydrological and climatic changes.

Macroinvertebrate responses to single and interactive effects of climate warming and wastewater pollution: a stream mesocosm experiment

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Presenting Author: Buntu Fanteso

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 14:15-14:30, Monday 21 July

Abstract

Freshwater ecosystems are among the most important biologically diverse habitats on Earth, yet they face increasing threats from stressors associated with climate change and pollution. Despite the growing body of research examining multiple stressors, the interactive effects of climate warming and wastewater pollution on freshwater macroinvertebrate communities remain poorly understood. Macroinvertebrate communities are important ecological indicators and have been used for decades to understand the ecological responses of freshwater systems to global environmental changes. To effectively manage these ecosystems in a rapidly changing world, it is crucial to advance our understanding of the individual and interactive effects of simultaneously occurring stressors under ecologically realistic conditions. In this study, we used an ExStream System comprising 64 mesocosms distributed across four wastewater treatment sites in England to investigate single and interactive effects of climate warming, simulated by raising water temperatures to 3.5 °C above ambient levels, and sewage pollution within a full-factorial experimental design. The mesocosms were allowed to colonise for 21 days, followed by a 30-day heating phase, during which we conducted weekly sampling of macroinvertebrate drift and emergence, complemented by final elutriation sampling. We used Principal Component Analysis (PCA) in the prcomp() function to explore variations in benthic community structure across different treatments and sites. Linear Mixed Effects models were used to analyse both the individual and combined effects of warming and wastewater pollution, with seven community-level biodiversity metrics, including taxa abundance, richness of Ephemeroptera, Plecoptera, and Trichoptera (EPT), and body size as our response variables. Our findings reveal important interactions between climate warming and sewage pollution, highlighting their

combined impact on ecological communities. Our findings have important implications for the regulation and management of wastewater treatment sites in England, highlighting the need for improvements in wastewater treatment processes to manage freshwater ecosystems in the face of evolving environmental challenges.

Managing aquatic vegetation to reduce greenhouse gas emissions in urban ponds

Jorge J. Montes-Perez[1], Berta Montané[1], Lidia Cañas[1], Biel Obrador[1], Oscar Ramírez-Lizón[1], Daniel von Schiller[1]

[1]Universitat de Barcelona

Presenting Author: Jorge J. Montes-Perez

Status: Oral presentation

Session Number & Date: Last-ditch efforts? The science and management of artificial waterbodies, 14:15-14:30, Monday 21 July

Abstract

Nature-based solutions (NbS) are a promising strategy increasingly implemented by municipalities to adopt international development policies (e.g. the European Green Deal), and transition towards more sustainable cities. The naturalization of urban ponds is an NbS that has been implemented in several cities, with management strategies usually focused on increasing biodiversity and/or providing aesthetic value. Introducing different vegetation types (i.e. floating, submerged or emergent) increases ecological complexity favouring greater biodiversity and more appealing urban ponds. However, vegetation plays an active role in biogeochemical cycles, and it could impact greenhouse gas fluxes (GHG) from naturalized urban ponds. This role is often not taken into consideration in management plans. In this study, we aim to unravel the effect of different vegetation types on GHG fluxes in order to improve management strategies to minimise emissions from naturalized urban ponds. To achieve this, we measured GHG fluxes (CO_2, CH_4 and N_2O) from four different areas in two naturalized urban ponds in Barcelona, Spain: three areas covered by vegetation (emergent, floating and submerged), and one open water surface control area. Fluxes were measured during both the growing season (late May) and the decaying season (late December) to integrate subannual variability. Net daily fluxes were calculated from four measurements taken over a 24-hour cycle. In general, CO_2, CH_4 and N_2O fluxes were much lower in the decaying season than in the growing season. CO_2 fluxes were lower in vegetated areas than in open water surface, with emergent vegetation showing the lowest fluxes. All areas acted as sources of CH_4. In the case of N_2O, less clear patterns were observed with more pond-dependent fluxes. The annual average fluxes, expressed as CO_2 equivalents, showed that although all areas were net emitters, emissions were lower from areas covered by vegetation. These results suggest that introducing vegetation, especially emergent vegetation, can reduce GHG emissions from naturalized urban ponds.

Mapping Nature-Based Solutions for Enhancing Water Quality and Ecological Restoration in Freshwater Lakes

Sarti Chiara[1], Rizzo Anacleto[1], Conte Giulio[1], Principi Ilaria[1], Masi Fabio[1]

[1]IRIDRA Srl

Presenting Author: Masi Fabio

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:45-12:00, Thursday 24 July

Abstract

Freshwater lakes across Europe are increasingly threatened by nutrient pollution, sediment accumulation, hydrological alterations, and biodiversity loss, leading to severe ecosystem degradation and reduced water quality. Agricultural runoff, wastewater discharges, and climate-driven hydrological stress exacerbate these pressures, resulting in eutrophication, harmful algal blooms, and declining aquatic habitats. Effective lake restoration requires integrated strategies that reduce external pollutant loads, enhance hydrological balance, and improve ecosystem resilience. Within the FutureLakes project, a comprehensive literature review on innovative restoration technologies has highlighted Nature-Based Solutions (NBS) as one of the most promising, sustainable, and adaptable approaches for addressing these challenges. By leveraging natural processes, NBS can effectively mitigate pollution, regulate water flow, and enhance biodiversity while providing long-term ecological and socio-economic benefits. This study presents a decision-support framework that employs favorability mapping to guide spatial planning, feasibility assessment, and cost-effectiveness analysis of NBS for environmental protection, including lake restoration. The methodology integrates hydrological, ecological, and land-use data to identify the most suitable locations for NBS implementation. By combining biophysical constraints such as topography, flood risk, soil permeability, and groundwater depth with key indicators of ecosystem stress, including nutrient emissions, soil erosion, and hydrological deficits, the study evaluates where targeted interventions can have the highest impact on aquatic restoration. The analysis focuses on the role of NBS in reducing external nutrient loads through constructed wetlands, vegetated buffer strips, and drainage ditches, while also considering their contribution to improving water availability and hydrological stability through retention ponds and managed aquifer recharge (MAR) systems. A key aspect of this framework is the cost-effectiveness analysis, which estimates the investment and operational costs of different NBS types and compares them with expected ecological benefits. This approach allows decision-makers to prioritize interventions in areas where NBS provide the highest return in terms of water quality improvement, ecosystem restoration, and climate adaptation. Additionally, the spatial

prioritization model identifies sub-basins where NBS interventions can significantly contribute to meeting restoration targets at both the local and regional scale. Beyond this mapping approach, the FutureLakes project is continuing to explore emerging and innovative restoration technologies that could complement NBS and further enhance the sustainability of lake rehabilitation efforts. The proposed methodology aligns with EU environmental policies, including the Water Framework Directive, the Common Agricultural Policy, and the EU Biodiversity Strategy, supporting a science-based and policy-driven approach to freshwater ecosystem restoration. By integrating hydrological, ecological, and economic criteria, this research supports a sustainable transition toward holistic lake restoration, demonstrating how strategic NBS planning can effectively safeguard the long-term ecological integrity of surface waters. Acknowledgments: This research was conducted in the framework of FutureLakes project. FutureLakes is funded by the European Union under Grant agreement 101157743. Views and opinions expressed are those of the author(s) and do not necessarily reflect those of the European Union, the European Climate, Infrastructure and Environment Executive Agency (CINEA) or UK Research and Innovation (UKRI). Neither the EU, CINEA or UKRI can be held responsible for them.

Metabarcoding of diet DNA in wolf spiders evaluates the support of emerging aquatic insects to terrestrial food webs

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DECOD (Ecosystem Dynamics and Sustainability)

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Presenting Author: Nadège Belouard

Status: Oral presentation

Session Number & Date: Emerging aquatic insects in terrestrial landscape, 15:30-15:45, Thursday 24 July

Abstract

The integration of emerging aquatic insects into terrestrial food webs tightens the links between aquatic and terrestrial ecosystems, but the importance of this contribution remains largely undetermined. In agricultural landscapes, aquatic insects may support populations of natural providers of pest control services such as spiders, especially because aquatic insects emerge earlier in the season than their terrestrial counterparts. We explored the magnitude of this effect by evaluating the contribution of emerging aquatic insects to the diet of wolf spiders, a family of widespread, opportunistic predators in agricultural ecosystems. We collected 982 wolf spiders of the Pardosa genus in spring and early summer across five agricultural watersheds in western France. Molecular analyses of gut contents showed that 30% of these spiders had eaten recently enough to sequence their diet DNA. The frequency of detection of prey DNA in the gut contents was lower in cocoon-bearing female spiders. DNA metabarcoding was used to characterize the spiders' diet. The taxonomic diversity and the aquatic or terrestrial origin of prey identified in the spiders' diet DNA were analyzed at the individual level. We compared the diet between individuals from spring and early summer to evaluate the contribution of emerging aquatic insects to the diet of terrestrial predators. We also considered the distance from watercourses and gradient of intensity in agricultural practices. Measures of species diversity, nestedness, and interaction evenness within ecological networks were used to characterize the structure of food webs at aquatic-terrestrial interfaces across the studied ecosystems. The variations observed shed light on complex interactions that extend beyond the transfer of energy at aquatic-terrestrial interfaces, and open avenues for practical recommendations for ecosystem management at the landscape level.

Metacommunity structure and assembly rules of zooplankton in hypereutrophic fishponds: sharp declines in functional diversity

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Presenting Author: Cihelio Amorim

Status: Oral presentation

Session Number & Date: Freshwater biodiversity - status, advances & future priorities, 14:45-15:00, Monday 21 July

Abstract

Freshwater ecosystems are undergoing a dramatic loss in biodiversity during the Anthropocene, largely driven by eutrophication. The ecological implications go beyond species loss, as this is accompanied by a decrease in ecosystem functions. This study examined zooplankton metacommunities in highly eutrophic fishponds to explore coexistence patterns and the underlying assembly rules: niche filtering, limiting similarity, and guild proportionality. We hypothesized that: (1) species sorting governs metacommunity dynamics, while dispersion is not a limiting factor; (2) environmental, spatial, and temporal variables influence zooplankton depending on functional traits; and (3) eutrophication leads to functional homogenization by reducing functional diversity and promoting trait convergence, with niche filtering becoming dominant. To test these hypotheses, we analysed elements of metacommunity structures, joint species distribution models, functional diversity indices, and 15 key functional trait community-weighted means. We compared observed data to null models, evaluating deviations via standardized effect sizes. Eutrophication effects (total phosphorus) were assessed with generalized additive mixed models. The zooplankton metacommunity was composed of 59 species, with local richness stable across ponds (30–40 species) but increasing over time. Communities displayed a Clementsian structure, characterized by species replacement along environmental gradients. The interaction between temporal and environmental factors was more relevant to explain the composition and coexistence patterns, mediated by species sizes. The β-diversity was turnover-driven, with spatial β-diversity peaking in June. Eutrophication significantly reduced taxonomic and functional diversity, affecting metrics like Simpson's diversity, functional richness, divergence, and dispersion. Community assembly shifted: functional richness transitioned from limiting similarity to random patterns, while divergence and dispersion moved from random to niche filtering. Functional traits converged under eutrophication, favouring medium-sized

organisms while reducing large-bodied species. Herbivores and stationary feeders (calanoid copepods) declined due to trait convergence, while omnivores and raptorial feeders (cyclopoid copepods) increased, showing trait divergence. The findings underscore eutrophication's threat to aquatic ecosystems. The functional diversity loss aligns with patterns seen in other freshwater communities. Conservation efforts and fishpond management must expand beyond species monitoring to include responses across multiple biodiversity dimensions in the face of anthropogenic pressures.

Metagenomic Shotgun Sequencing of Van Lake: Unveiling Aquatic Biodiversity and Optimizing eDNA Filtration Methods

Işılay Çelik[1,2,3], Ayşegül Er Gökçe[1,2,3], Atakan Pipilos[6], Berkay Gülen[1,3], Açelya Dalgıç[5], Esra Mine Ünal[1,3], Emre Keskin[1,3,4]

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Presenting Author: Işılay Çelik

Status: Oral presentation

Session Number & Date: Advances in genetics and molecular ecology, 10:45-11:00, Tuesday 22 July

Abstract

Van Lake, Turkey's largest alkaline soda lake, is a distinctive ecosystem with a rich diversity of microbial and macroinvertebrate communities which remain poorly characterized. This research used shotgun metagenomic sequencing to comprehensively evaluate the aquatic biodiversity of Van Lake. Triplicate water samples were collected from selected representative locations and processed using two environmental DNA filtration methods—Sterivex filters and a double-filter system—to assess their efficiency in recovering eDNA. The eDNA analysis will offer a more comprehensive understanding of the ecosystem dynamics within Van Lake by providing insights into the composition and abundance of species. Comparative analyses revealed that taxonomic recovery is greatly impacted by the filtration protocol. Sterivex filters performed better in separating insect orders such as Coleoptera and Lepidoptera, whereas the two-filter system enhanced Diptera recovery. The Coleoptera, Diptera, and Lepidoptera orders dominated the insect fauna, with Carabidae, Noctuidae, and Syrphidae families being well represented. Notable species include Leptidea sinapis, Chrysolina oricalcia, and Culicoides sonorensis. Rotifers included the families Brachionidae and Synchaetidae, and species such as Brachionus plicatilis and Synchaeta tremula dominated. These findings stress the significance of methodological choices in eDNA-based biodiversity monitoring. The contrasts between taxonomic recovery detected by the two filtration approaches underscore the necessity of optimizing sample protocols as well as presenting a methodological standard for future conservation and environmental monitoring in alkaline lake environments. By building

upon a sound foundation for aquatic biodiversity assessment, the research offers important baseline information upon which future work can build and ultimately inform improved ecosystem management planning within difficult and unique aquatic environments.

Microbial responses to stream intermittency: biofilm adaptations and nitrogen cycling response to hydrological discontinuity

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Presenting Author: Cavallini Edoardo

Status: Oral presentation

Session Number & Date: Science and management of non-perennial rivers and streams, 11:45-12:00, Thursday 24 July

Abstract

Climate change and increasing water demand from human activities are intensifying river flow intermittency, even in temperate climates. Intermittent and ephemeral streams undergo cycles of drying and rewetting, which vary from a few days to months, depending on groundwater inputs, flood events, and upstream discharge. Shifts between wet and dry phases lead to the formation of a mosaic of mesohabitats and alter biodiversity and ecosystem functioning. Biofilms, which play a key role in nutrient cycling, respond differently to the duration, frequency, and intensity of drying and rewetting. These factors affect biofilm structure, modifying metabolism and community diversity. Ecosystem respiration (ER) restarts more quickly than gross primary production (GPP) after rewetting, due to the high recovery capacity of microbes compared to algae. Therefore, microbial components of biofilms play a key role in nutrient cycling during desiccation and rewetting phases. However, which ecosystem functions remain active is still an open question. This probably depends on the intrinsic resilience of microbes and community composition, as shaped by the legacy of past drying events. This study characterizes biofilm metabolism and nutrient cycling, focusing on nitrogen, in temperate rivers (northern Italy) affected by summer dry phases. Additionally, it seeks to understand how microbial communities, which drive nitrogen- related processes, respond to flow intermittency and shape biogeochemical cycles. We hypothesize that seasonal factors (including light availability, temperature, nutrient supply, biofilm growth, and aging) have a stronger influence on microbial communities than historical intermittency (i.e., whether a site has perennial or intermittent flow). We also hypothesized that intermittency-driven habitat characteristics

(such as isolated pools vs. running water or the persistence of dry versus wet conditions) selectively influence microbial community composition and either promote or inhibit specific metabolic pathways, leading to distinct nitrogen flux patterns. To investigate these dynamics, we monitored biofilm development across three seasons (winter, spring, and summer) in three streams. We selected two sites within each stream: one with perennial flow (upstream) and one with intermittent flow (downstream). At both sites, we collected biofilm-covered cobbles from pool and riffle mesohabitats under both dry and wet conditions. Cobbles were incubated to measure primary production, respiration, and nutrient fluxes. Additionally, environmental DNA metabarcoding was used to analyze microbial community composition and its functional potential in nitrogen cycling. During summer, the wet biofilm was autotrophic (GPP/ER >1), whereas the dry biofilm was heterotrophic. In winter, it reached a state of equilibrium, while in spring, it was distinctly autotrophic. Net nitrogen fluxes were

Mitigating microplastic pollution in Alpine streams: Insights from WWTP filtration systems

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Presenting Author: Magdalena Vanek

Status: Poster presentation

Session Number & Date:

Abstract

Alpine aquatic ecosystems are often portrayed and perceived as pristine, near-natural habitats. However, Alpine stream biodiversity, particularly benthic macroinvertebrate communities, is increasingly shaped by anthropogenic pressures. Climate change, land-use alterations, and emerging pollutants pose significant threats to these ecosystems. The spread of microplastics (plastic particles <5mm) represents a particularly concerning challenge. Microplastics originate from various man-made polymers, each possessing unique properties, and possible toxicological effects. In freshwater ecosystems these microscopic particles originate from sources such as wastewater effluents, urban runoff, and agricultural activities. They accumulate in river sediments and aquatic organisms, potentially disrupting ecological processes. Wastewater Treatment Plants (WWTPs) serve as both sources and sinks for pollutants in aquatic systems offering the opportunity to mitigate their input into rivers and the environment. Our study aims to address critical gaps in understanding the transport, accumulation, and possible ecological impacts of microplastics emerging from WWTPs, as well as their effectiveness of filtration methods. In an ongoing study we are applying a Before-After-Control-Impact (BACI) approach, to evaluate a novel filter system installed in three different WWTPs of varying scales – one large facility with a population equivalent of 450 000 and two smaller facilities with population equivalents of 75 000 and 8750, respectively, in the region of South Tyrol, northern Italy. By adopting a comprehensive approach, we analyze microplastics across three interconnected components: sediment layers, macroinvertebrate communities (through Surber samples), and water samples (through a rapid habitat sampling method). At each WWTP, nine sediment, nine macroinvertebrate, and nine water samples (before, during and after the installation of an additional filter) are collected up- and downstream of the WWTP to determine the efficacy of the filtration system. Sediment samples are dried and assessed through density separation with a solution of $ZnCl_2$ at a density of 1.5 g.cm-3. Macroinvertebrate and water samples are chemically treated with a 10% KOH solution

to remove organic matter. The solutions are then vacuum filtered through a 25 μm filter paper to separate the microplastics out which are identified through stereomicroscopy. Types of plastic polymers are further identified by Raman spectroscopy to determine whether polymers decrease in the downstream site during the use of the filtration system. Microplastics can be found in every river and sampled compartment. However, microplastic abundance, composition, and associated ecological impacts differ across sediment, macroinvertebrate, and water compartments near WWTPs. This novel filter system and comprehensive sampling approach provide initial insights into the filter system's effectiveness. Such efforts are needed to develop effective stakeholder and conservation strategies to safeguard aquatic ecosystems, which are not only biodiversity hotspots but also crucial providers of ecosystem services, including water purification.

Modelling water quantity and quality in international river systems: Updates and improvements of the nutrient emission model MONERIS

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Presenting Author: Anna Oprei

Status: Oral presentation

Session Number & Date: Freshwater quality: Tackling the challenge of pollution, 15:00-15:15, Monday 21 July

Abstract

Aquatic ecosystems worldwide are challenged by a variety of anthropogenic stressors. Among others, water abstraction, soil sealing and compaction, tile drainages and flow regulation alter quantity and dynamics of water fluxes. Changing hydrological regimes that encompass extended dry periods and floods (IPCC 2022) alter the fate of nutrients such as nitrogen and phosphorus in freshwater and terrestrial ecosystems. For example, extended low flow periods may lead to transient nutrient storage, potentially enhancing eutrophication or impacting aquatic habitats. Since the implementation of the EU Water Framework Directive (WFD), the availability of high-quality data and the knowledge on aquatic ecosystems and processes has steadily grown. In order to effectively manage water quality at the supra-national level, it is essential to apply water quality modelling and monitoring at large spatial scales across international borders to account for hydrologically connected river basins in neighboring countries. The long-established nutrient emission model MONERIS (Venohr et al., 2011, Lemm et al., 2021) calculates landuse-specific nutrient fluxes for entire river basins and has recently received extensive improvements: The model was transferred to the open-source programming language R for transparency of all calculation steps and to implement flexibility to consider new approaches or the variation of input data. MONERIS enables the combination of alternative international input data or different national data sets. The temporal resolution was increased to monthly scale to account for seasonal effects, while the spatial resolution was standardized to 1 km2. Here, we applied the updated nutrient emission model MONERIS to the main river basins of Germany, including their hydrologically connected catchment areas in neighboring countries (total catchment area of 660,000 km2), on a monthly basis from 2003 to 2020. We calculated the long-term change in nitrogen surpluses, and quantified the denitrification rates as well as the soil and groundwater residence times to assess potential time lags of management measures. The runoff and residence times were modeled using an integrated precipitation-runoff model and the retention processes in soil and groundwater were calculated via a coupled three-layer denitrification module, based on soil characteristics such as pH, soil texture, soil temperature, leakage water

concentration. Our results show that denitrification rates exhibit a high local variability (range 1 – 92 kg ha-1 a-1, mean 44.1 kg ha-1 a-1), leading to different spatial patterns of nitrogen emissions despite similar nitrogen surpluses. We show that total residence times depend strongly on the partition of runoff components and local site characteristics. Whereas areas with a high proportion of direct runoff and sealed urban areas react within months or even days, the lag time in surface waters results as a runoff-weighted average of local residence time in its upstream reaches. Our results highlight that the efficiency of measures for the reduction of nutrient loads in surface waters should not be solely based on quantitative reduction potential, but also evaluated against potential lag effects due to regional patterns of differing soil and groundwater residence times.

Monitoring and Management of the Endangered Beluga (Huso huso, Linnaeus, 1758) and Adriatic (Acipenser naccarii, Bonaparte, 1836) Sturgeon through a novel eDNA based approach

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Presenting Author: Caterina Maria Antognazza

Status: Oral presentation

Session Number & Date: Advances in genetics and molecular ecology, 11:00-11:15, Tuesday 22 July

Abstract

The Po River (Italy) is a complex freshwater ecosystem flowing into one of the most populated European regions (Po plain). The whole ecosystem is altered and impacted by human activities and climatic stressors, including long and frequent drought periods, threatening freshwater habitats and their communities. In recent years, more attention has been spent on conservation management of local fauna, both to protect target species and to recover habitat connectivity through projects reversing river defragmentation. The reintroduction of sturgeon species (Huso huso and Acipenser naccarii), extinct since the 1970s, represents one important goal of ecosystem restoration. Currently, the LIFE NATURA project (Life Ticino BIOSOURCE) has the aim of reintroducing both species through captive breeding programs. Sturgeons are bred in seminatural tanks at Ticino Park on the Ticino River, a main tributary of the Po River, and specimens are released into both rivers. To manage effective conservation efforts, knowledge of a species' distribution and abundance is critical, especially for adult sturgeon that can move 100s of km from release sites. To address this need, we developed two new quantitative PCR assays, targeting the mitochondrial cytochrome b region to detect beluga sturgeon and Adriatic sturgeon environmental DNA (eDNA) in water samples. These Taqman-based assays demonstrated high specificity, with no cross-amplification of co-occurring fish species. The LOQ for H. huso assay corresponded to Ct = 41 (7.33 × 107 DNA counts/μL of reaction) and for A. naccarrii to Ct = 37 (2.23 × 1016 DNA counts/μL of reaction). Both assays successfully detect sturgeon eDNA up to 2 km from release sites. Overall, the eDNA-based approaches developed represent a promising new monitoring tool for both beluga and Adriatic sturgeons. Therefore, these two assays have been applied to the

Ticino River up to the confluence with the Po River, during spawning season and winter. This sampling could effectively provide a more accurate representation of spawning abundances, an essential factor for optimizing conservation and management actions.

Multi-metallic atmospheric contamination in forest dendrotelmata: consequences for communities and ecosystem multifunctionality

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Presenting Author: Nicolas Cros

Status: Oral presentation

Session Number & Date: Ecotoxicology: Ecological responses to chemical stress in freshwaters, 11:15-11:30, Thursday 24 July

Abstract

Dendrotelmata (or water-filled tree cavities) have important roles in forest ecosystems., including supporting the secondary production of aquatic organisms, hosting specialized biodiversity, and supplying freshwater for terrestrial animals. We measured important concentrations of air prone and potentially toxic metal(-oid) elements (PTEs) such as lead, cadmium, zinc and arsenic in dendrotelmata. We investigated their toxic effects on ecosystem multifunctionality and aquatic communities (hyphomycetes, protozoans, and invertebrates) through a semi-controlled experimental design. Larger trees showed higher PTE concentrations in the sediments of their dendrotelmata compared to smaller ones, creating a natural gradient of multi-contamination within a forest plot. Density and community structure of aquatic invertebrates were both impacted by this multi-contamination gradient. To further explore these effects, we established semi-controlled artificial dendrotelmata microcosms in La Massane Forest, an old-growth beech forest in France and a UNESCO World Heritage site. These microcosms were installed for six months in the field and subsequently exposed to environmentally realistic PTE concentrations in the laboratory for one month. We are currently assessing the direction and magnitude of PTE effects on communities and ecosystem functions including primary production, bacterial and fungal secondary production, litter decomposition and CO2 emissions. Our research could inform the use of dendrotelmata as an ecological indicator of the effects of atmospheric pollution on forest ecosystems.

Natural microcosms as model systems to investigate human-induced global changes

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Presenting Author: Gustavo Q. Romero

Status: Poster presentation

Session Number & Date:

Abstract

The impacts of global change on biodiversity and ecosystems have become a pressing concern for researchers, necessitating the selection of suitable model systems for empirical investigation. For decades, natural microcosms, particularly tank bromeliads, have proven invaluable in addressing fundamental questions in ecology and evolution. Their natural environmental conditions, high multitrophic diversity, and small size facilitate both realistic and highly replicable controlled experiments across the Neotropics. Tank bromeliads have thus emerged as effective model systems for studying various anthropogenic impacts. This review synthesizes studies employing bromeliads in space-for-time substitution approaches and experiments simulating human-induced changes in temperature, precipitation, habitat and biodiversity loss, detritus quality, ecological interactions, and ecosystem processes. These studies consistently reveal the profound effects of human drivers on organismal vulnerability, ecological dynamics, food webs, and ecosystem functioning. By enabling generalizations across scales and levels of biological organization, these "big answers from small worlds" provide critical insights into the impacts of global changes on complex systems. These findings from bromeliad microecosystems can be used as guiding strategies to preserve and manage natural freshwater ecosystems amidst ongoing global change. Funding: FAPESP (2019/08474-8)

Nature-Based Solutions for Ecological Stream Restoration: Enhancing Biodiversity and Water Quality in the Zwalm river basin (Belgium)

Pieter Boets[1], Marie-Anne Eurie Forio[1], Mechtild Zoeter Vanpoucke[1], Peter Goethals[1]

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Provincial Centre for Environmental Research

Presenting Author: Mechtild Zoeter Vanpoucke

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:45-12:00, Tuesday 22 July

Abstract

The northern part of Belgium (Flanders) is characterized by a high population density, intensive agriculture, scattered housing and large scale industries. From the 1970ies to the 1990ies the water quality was very low due to hydromorhoplogical changes and discharge of untreated wastewater. Thanks to the water framework directive and investments in wastewater treatment plants (WWTPs) the chemical water quality gradually started to improve since the beginning of 2000. However, a stagnation in this improvement, mainly in the ecological quality, has been observed during the last decade. It is clear that besides technical solutions such as WWTPs ecological restoration is needed to promote the functioning and biodiversity within these ecosystems. In the MERLIN project we restored a small stream (Dorenbosbeek) situated in the upper reaches of the Scheldt River basin by providing free fish migration, remeandering a straightened river part, restoring spawning habitats, reducing erosion, providing a water buffer and installing buffer strips along watercourses. The main aim was to restore the entire ecosystem and its related ecosystem services thereby promoting the endangered bullhead (Cottus perifretum) but also promoting recreation and working together in a sustainable way with farmers. The first preliminary results seem very promising and indicate a biodiversity increase of riparian insects thanks to buffer strips. Meanly flying insects such as wasps and bees seem to have benefited in addition to ground dwelling beetles. The direct and immediate effects on water quality are more difficult to measure and are not present yet since full recovery after ecological restoration generally requires several years. In addition there are still smaller problems present such as storm overflows. Meanwhile we continue to monitor the diversity, the chemical water quality and the importance for water buffering. Finally, we started upscaling our restoration efforts in order to implement them at the river basin scale. We are positive that the nature restoration law will support our future efforts in restoring aquatic ecosystems.

Nature-Based Solutions: Looking Back & Looking Forward

Paul Leonard[1]

[1]Thames Regional Flood & Coastal Committee

Presenting Author: Paul Leonard

Status: Oral presentation

Session Number & Date: Integrating international policies to support achievement of environmental quality objectives, 10:45-11:00, Thursday 24 July

Abstract

Long-term contributors to the Symposium on European Freshwater Science have promoted a wide range of nature-based solutions in response to climate change and community concerns. Since 2005, when the Crane Valley Partnership (CVP) was formed, various collaborations have been reported. The River Crane is part of the River Thames, with about 650,000 residents and a length of 65 km across five council boroughs, which includes Heathrow Airport. On 13th February 2025, a celebration event for local communities was held. This included recognition of five key themes: (1) public awareness, (2) access and recreation, (3) biodiversity & ecological connectivity, (4) flood resilience and (5) water quality and geomorphology. This work has been supported by a local utility company, Thames Water, with the overall aim of helping to establish the first United Kingdom Urban Smarter Water Catchment. How such work relates to government policies & environmental directives is explored from a historical and predictive perspective. On 26th March 2025, the London Borough of Richmond upon Thames held a public meeting to promote its Climate and Nature Strategy for 2025 to 2030. The London Borough had been divided into 18 areas, and climate change reporters were identified for each area, with a remit to collate interests and concerns that included flooding and ways to minimise environmental impact. At a domestic level, this includes better water retention and enhancing gardens and green spaces. At a river scale, Community Bluescapes is a project that seeks to enhance wetlands, the use of reed beds and better connections to flood plains. The relevance of surface urban drainage systems, hydro rocks and better environmental monitoring through the use of community organisations is also relevant to show the effectiveness of nature-based solutions. Changes to embed concepts such as NetZero by 2030 & definitions of sustainability in terms of future planning regulations at a national and international scale are suggested.

Non-marine Ostracoda (Crustacea) Diversity of the Isparta Province and Ecological Insights

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Presenting Author: Alaettin Tuncer

Status: Poster presentation

Session Number & Date:

Abstract

Isparta Province (IP) is located in a geographically and climatically significant area in the "Lakes District of Türkiye" (southwestern Anatolia). The area encompasses several intermontane basins and depressions (~1000 m a.s.l) mainly surrounded by mountainous terrains. This region hosts diverse aquatic ecosystems, mainly including tectonic, karstic, and volcanogenic lakes with notable examples such as Lakes Beyşehir and Eğirdir—Türkiye's largest freshwater reservoirs. Climatically, the area represents a transitional ecotone between Mediterranean and continental regimes, characterized by pronounced seasonal variability in precipitation and temperature. This interplay of geological and climatic factors generates heterogeneous habitats, fostering unique hydrological conditions critical for ostracod colonization. The primary objective of this study is to discover the recent ostracod assemblages of IP. Additionally, we investigated the ecological and biogeographical characteristics of ostracods. We also made an initial investigation to comprehend how the species assemblages, diversity, and habitat preferences of ostracods relate to the type of sediment and the complexity of the habitat. Within the scope of the study, 66 different aquatic habitats including creeks, dams, ponds, troughs, springs, lakes, and canals were randomly sampled from 240 to 1801 m of elevational range. According to the measurements made in situ, variables such as dissolved oxygen (2.94-15.47 mg/L), electrical conductivity (177-1407 μS/cm), water temperature (2.87-20.13°C), air temperature (1.8-29.4°C) were found in wide ranges. In which, 46 non-marine ostracod taxa belonging to 18 genera (e.g., Cypridopsis, Eucypris, Heterocypris, Herpetocypris, Ilyocypris, Neglecandona, Pseudocandona, Physocypria, Potamocypris, Prionocypris, Psychrodromus, and Trajancypris) were determined. Comparing the diversity measures with other provinces in similar surface area, this number was found relatively high. Contribution of the species with cosmopolitan characteristics (e.g., H. incongruens, H. salina, Her. brevicaudata, Her. intermedia, Her. reptans, I. bradyi, I. decipiens, I. gibba, Pot. arcuata, Pot. fallax, Pot. similis, Pot. unicaudata, Pot. variegata, Pot. villosa, P. fontinalis, and P. olivaceus) was particularly

significant in terms of taxonomic diversity. The highest diversity values were recorded at two locations, each hosting 8 ostracod taxa. Along with the ecological measurements, the sediment composition at these stations consisted predominantly of gravel size (>2000 µm: 81.94-87.68%), while relatively small amounts of sand (2000-75 µm: 10.87-15.28%) and mud (<75 µm: 1.45-2.78%) sizes were also determined. Among the species, coexistence of two cosmopolitan (H. incongruens, Cypridopsis vidua) species was found consistent with their broad distribution when Palearctic species (e.g., Neglecandona neglecta, Prionocypris zenkeri, P. olivaceus, T. clavata) were frequently found in some certain habitats. This study was supported by the Scientific and Technological Research Council of Türkiye (Project no: 121Y430).

Non-native species affect the long-term stability of native stream fish assemblages

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Presenting Author: István Czeglédi

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 15:15-15:30, Thursday 24 July

Abstract

Characterizing temporal changes in biotic communities and disentangling their driving mechanisms are central themes in ecology and environmental management. Non-native species have multiple adverse impacts on native communities and species. However, understanding of how non-natives influence the long-term dynamics of native communities remains limited. We compared the role of non-native species alongside various local and regional factors in the long-term dynamics of stream fish assemblages in the catchment area of Lake Balaton, Hungary, the largest lake in Central -Europe. Although we found no consistent trend in species re-ordering between native and non-native species, the temporal stability of native fish assemblages became significantly lower with increasing relative abundance of co-occurring non-natives. Structural equation modelling revealed that assemblage dynamics were also determined by a habitat degradation gradient. Moreover, habitat degradation and the presence of fishponds increased the relative abundance of non-native species, further affecting native assemblages through indirect interactions. Fish assemblage dynamics also showed some degree of finer-scale spatial structure. Non-metric multidimensional scaling further illustrated the destabilizing effect of non-native species but highlighted that native fish assemblages could generally be described by non-directional gradual or abrupt changes over time, regardless of the relative abundance of non-natives. Our results thus revealed that native fish assemblages may possess some resilience to biological invasions. However, increasing temporal variability induced by non-natives makes native assemblages more vulnerable to environmental stochasticity, threatening their long-term persistence. This is especially worrying given that future increases in the frequency and intensity of environmental disturbances are expected due to climate change, increasing anthropogenic pressure on aquatic ecosystems.

Occurrence and distribution of microplastics in freshwater benthic invertebrates

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Presenting Author: Barbora Loskotová

Status: Poster presentation

Session Number & Date:

Abstract

The ubiquity and circulation of microplastics in all environmental components is a highly discussed phenomenon globally. Thus, the research on microplastic pollution in surface waters has been one of the fastest-growing science topics in the last decade. In freshwater ecosystems, microplastics can easily enter the food webs and possibly accumulate in biota. In lotic freshwaters, the distribution of microplastics may vary in river longitudinal gradient according to anthropogenic pollution sources, such as inputs from agriculture, industry or insufficiently treated municipal wastewater. Although many experimental studies have been conducted yet to observe the potential of aquatic biota to consume and digest microplastics, our knowledge of microplastic distribution and dynamics in trophic chains in natural habitats is still limited. We conducted several pilot field studies to access preliminary insight into the presence and distribution of various types, forms and sizes of microplastics in different freshwater macroinvertebrate taxa depending on their feeding habit, along ten streams with a focus on artificial pollution sources. All specimens were collected in the field with minimal use of plastic equipment and stored in pre-filtered plastic-free media. Samples were laboratory purified using oxidative and digesting protocols (i.e., 30% H2O2, proteinase) followed by density separation (ZnCl2) if needed. Obtained microplastic samples were filtered to Anodisc filters (Whatman), analysed using µFT-IR transmission spectroscopy (LUMOS II, Bruker), and evaluated in Microplastic Finder software (Purency GmBH). For all studied invertebrate taxa (Baetis sp., Calopteryx sp., Gammarus sp., Hydropsyche sp., Simulium sp.), we found the most microplastics particles in active filtrators and collectors/scrapers, predominantly smaller-sized taxa. Although in lower numbers – 558 specimens with 234 microplastic particles in total –, we observed microplastics in all the taxa, even predators, presuming microplastics transfer in trophic chains. We have not observed a significant increase in microplastic particles amount along the longitudinal gradient or below pollution influx in corresponding invertebrates. Contrarily, we observed the highest numbers of microplastics in upper river parts and even

in protected areas, suggesting atmospheric deposition as a highly significant source of microplastic pollution. This research was supported by TA CR project SS07010295.

On the role of dispersal limitation and patch connectivity on meta-community stability: An experiment using water-filled tree holes

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Presenting Author: Malo Joly

Status: Oral presentation

Session Number & Date: Small water bodies: from assessment to impact mitigation, 11:45-12:00, Tuesday 22 July

Abstract

Water-filled tree holes (WTHs) are ubiquist forest aquatic ecosystems whom fluxes of matter are connected by the dispersal of organisms across patches and allochthonous organic matter inputs, with their main ecosystem functioning being decomposition. Patch dynamics, implying connectivity among patches and dispersal abilities of organisms, are a priori pivotal for stabilizing meta-communities submitted to frequent disturbances such as seasonal droughts. However, empirical endeavours on water-filled tank bromeliads suggest in-situ resistance of organisms as a major driver of stability. Due to the patchy nature of these discretized ecosystems, WTHs and other water-holding systems are particularly appropriate to test meta-community theory at small scales. In our ongoing experiment at the Mediterranean old-growth beech forest of the Massane Reserve (UNESCO World Heritage Site), fine mesh nets were placed on twenty over fourty WTHs, departed among areas with either low or high WTH density, and hence varying connectivity among patches. This full-factorial approach will allow to observe community responses along a dispersal gradient. With six sampling campaigns, this experiment makes it possible to test the effect of dispersal limitation of flying insects and patch connectivity on population and meta-community stability. Leaf-litter is let to decompose in-between each sampling session, which enables quantifying WTHs' ecosystem functioning in response to the dispersal gradient. In addition to strong variations in WTH abiotic conditions that should ultimately shape communities, dispersal limitation (covering by the

net) and low connectivity should reduce temporal stability and alpha diversity, while our expectation would be relaxed if local community diversity can be maintained through in-situ resistance. The lack of dispersal and connectivity should increase spatial beta diversity over time, destabilizing the meta-community. Alpha diversity should be maximal at moderate dispersal rates, resulting in community and ecosystem functioning stability through portfolio effect and functional redundancy. In recent years, decreasing rainfall in our study area has substantially impacted ecosystems, influencing many WTHs' perenniality. In drought-prone environments, a better understanding of meta-community principles shall guide conservation practices in ever-more water-stressed ecosystems.

Pesticides indirectly affect benthic macroinvertebrate communities in small water bodies of the agricultural landscape

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Presenting Author: Lena C. Ruf

Status: Oral presentation

Session Number & Date: Small water bodies: from assessment to impact mitigation, 11:00-11:15, Tuesday 22 July

Abstract

Small standing water bodies (SWBs) harbor the highest species diversity and the highest proportion of endangered species at landscape level compared to other water ecosystems. They are extremely abundant in the northeast German lowlands, where they are mostly found in agricultural landscapes. Beyond their role as biodiversity hotspots, SWBs can also function as stepping stones for species dispersal. However, agricultural land use adjacent to SWBs can lead to pesticide and nutrient pollution as well as habitat degradation, which can profoundly affect their biodiversity. Benthic macroinvertebrates (BM) within SWBs are highly sensitive for habitat quality and inhabit both terrestrial and aquatic habitats, making them particularly suitable as bioindicators for anthropogenic and other ecological influences. This study assesses the condition of 84 SWBs in agricultural areas of northeastern Germany in terms of pesticide contamination and its connection to BM diversity. To achieve this, we 1) assessed direct effects from their pesticide contamination based on invertebrate toxicities and 2) developed and applied a complementary indicator evaluating indirect pesticide impacts on BM communities through toxic effects for non-target plant species. The indicator development process included structural as well as functional biodiversity indices, as metrics based on functional traits are considered to facilitate the comparison of structure and impairment of communities with high divergence as reported in SWBs. Presented results indicate relatively low direct pesticide toxicity risks for BM in most of the investigated water bodies. However, the newly developed indicator for indirect pesticide effects reveals a higher potential risk through pesticide-induced changes in non-target plants, which cannot be captured by assessments of direct insecticide toxicity measures alone. Consequently, we recommend the combined use of both indicators to achieve a more holistic view on the risk of pesticide input for BM in SWBs. Moreover, the new indicator, incorporating both structural and functional trait diversity indices, was proven suitable as monitoring tool for SWB. We therefore advocate for its application and for the general inclusion of indirect effects and functional trait diversity indices in ecological monitoring of SWBs and BM communities.

Plastic entrapment by riparian vegetation across ecological gradients in European rivers: first insights from the Biodiversa+ RIPARIANET Project

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Presenting Author: Luca Gallitelli

Status: Oral presentation

Session Number & Date: Advancing research on plastic pollution: Impacts, transport, and management, 10:45-11:00, Monday 21 July

Abstract

Plastic litter accumulating in riverine riparian habitats is a threat of global concern. Macrolitter items, being highly visible (items > 0.5 cm) and impactful pollutants, pose significant threats to biodiversity and ecosystem functioning. Although research recently started to address plastic entrapment, large-scale studies and predictive models aiming at reducing biases and uncertainties in understanding plastic accumulation are still scarce. Given those gaps, this study investigates plastic entrapment by riparian vegetation at different ecological scales and gradients across European rivers. We focused on six river basins across Europe, covering the boreal (Sweden), continental (Germany), alpine (Trento, Italy), Mediterranean (Rome, Italy), and Atlantic (Northern Spain, Northern Portugal) climatic regions as part of the European project Biodiversa+ RIPARIANET. By surveying six European basins, we aim to unveil riverine macrolitter accumulation in riparian areas across biogeographic regions. We found that riparian vegetation acts as a sink for macrolitter, with the highest trapping value recorded in the Tiber River catchment (Italy) and the lowest in the Sävar River basin (Sweden). Among river basins, we highlighted a latitudinal gradient for plastic entrapment by vegetation, which increased from North to South. Among macrolitter items, we found that plastics was the most abundant litter type, followed by textile items. Additionally, we observed most macroplastics near the downstream zone of rivers rather than the upperstream zone.

Urbanization, land use, river discharge, river sinuosity, and vegetation structure are crucial predictors of macroplastic accumulation. Our findings shed light on how macroplastics accumulate in European riparian zones, emphasizing their ecological and societal implications and potentially supporting environmental managers in addressing macrolitter removal from the environment. Monitoring macroplastic accumulation is essential to understand the interactions between pollutants and ecosystems, enabling the development of effective conservation strategies. Given the potential impacts on biodiversity and ecosystem resilience, specific monitoring and clean-up activities should be prioritized to protect riparian ecosystems under future conditions.

Macroinvertebrates as Bioindicators of Microplastic Pollution in European Freshwater Ecosystems: Insights from the RIPARIANET Project

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Presenting Author: Giulia Cesarini

Status: Oral presentation

Session Number & Date: Advancing research on plastic pollution: Impacts, transport, and management, 11:15-11:30, Monday 21 July

Abstract

Freshwater riverine systems are vital ecosystems that provide essential services, including biodiversity support, water purification, and recreational opportunities. In this context, the European Biodiversa+ RIPARIANET project aims to enhance the spatial biodiversity conservation of natural stream-riparian networks. The project provides practitioners with evidence-based guidance and conservation strategies, leveraging the increasing resolution of remote sensing data. Special emphasis is placed on riparian biodiversity, environmental stressors, and ecosystem functions. One emerging concern within these ecosystems is the widespread presence of plastic pollutants, particularly microplastics (< 5 mm). These smaller particles are more readily ingested by freshwater biota, posing a potential risk to ecosystem health. Macroinvertebrates are recognized as key bioindicators of water quality and have recently gained attention for assessing pollution, including microplastic contamination. This research aims to evaluate microplastic pollution by investigating macroinvertebrate communities that represent different feeding strategies: Baetidae (grazers), Simuliidae (filter feeders), and Chironomidae (detritivores). To achieve this objective, both macroinvertebrates and water samples were collected from six European rivers, representing diverse geographical and

climatic gradients. Sampling sites included the Sävar River (Sweden), Queich River (Germany), Noce Stream and Tiber River (Northern and Southern Italy), Saja River (Spain), and Cávado River (Portugal). The sampling strategy extended from upstream to downstream, ensuring coverage of different environmental conditions and anthropogenic pressures. It is hypothesized that microplastic contamination will show an increasing trend from river source to valley, with higher concentrations near areas characterized by greater human activity. Among the selected macroinvertebrate groups, Chironomidae are expected to exhibit the highest microplastic concentrations. This prediction is based on their ecological traits; as detritivores, they inhabit sediment-rich environments where microplastics tend to accumulate. Additionally, their tolerance to polluted conditions makes them more prone to prolonged exposure and ingestion of microplastic particles. This research is crucial in assessing the transfer of microplastics within freshwater food webs and aims to inform future remediation efforts. By providing a comprehensive biological risk assessment framework for European freshwater ecosystems, these findings will contribute to evidence-based conservation strategies and improved environmental management practices.

Post-flood recovery of benthic macroinvertebrate communities in an Alpine River

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Presenting Author: Doretto Alberto

Status: Oral presentation

Session Number & Date: Linking hydromorphology and ecology, 11:30-11:45, Friday 25 July

Abstract

Floods are natural disturbances for river ecosystems and riverine biota are usually adapted to cope with the hydro-morphological changes (i.e. increased discharge and sediment transport) associated with floods. However, the frequency and magnitude of floods are increasing worldwide as a possible consequence of the current climate change. From 29th to 30th June 2024, the Anza River (Northwestern Italian Alps) was affected by an exceptionally severe flood caused by rainfall anomalies higher than the seasonal standards. This study examines the post-flood recovery of macroinvertebrate communities from three sampling sites on the Anza River. One site was located upstream of the Ceppo Morelli Dam, while the other two sites were located 0.5 km and 2.5 km downstream, respectively. In each site, benthic macroinvertebrates were collected before (i.e. May 2024) and on 6 sampling campaigns after the flood (period: July 2024 – March 2025). Moreover, quantitative data on the substrate grain size were collected in all sampling sites, along with the main physical and chemical parameters of water. The average percentage of deposited fine sediment (<2mm) increased from less than 10% before the flood to more than 50% in each sampling site after the event. Both taxon richness and total density of macroinvertebrates significantly dropped in the post-flood sampling campaigns. Also,

significant changes in the community composition were observed in all sampling sites. Overall, the results showed a slow temporal recovery of the macroinvertebrate communities, but relevant differences in the post-flood trajectories were also found depending on the sampling site. This latter aspect highlights the role of biotic interactions and local habitat conditions on the recovery dynamics of macroinvertebrate communities. Since this study was carried out within a national research project focused on the effects of sediment flushing operations (FluEMMA), these findings were compared with the previously available data on sediment flushing operations from the Ceppo Morelli Dam. Thus, this study offers an excellent chance to compare the response of macroinvertebrate communities to floods and sediment flushing operations in order to highlight parallels and contrasts.

Predation pressure of diurnal fish on multiple macroinvertebrate prey under artificial light at night (ALAN)

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Presenting Author: Magdalena Czarnecka

Status: Poster presentation

Session Number & Date:

Abstract

Artificial light at night (ALAN) can favour diurnal visually-oriented fish, increasing their pressure on macroinvertebrates during nights in urban waters. However, this effect may vary depending on the macroinvertebrate prey type and its activity, which is often reduced by nocturnal illumination. We examined feeding efficiency of young perch Perca fluviatilis (mean weight 1.15 g) exposed to dim white LED light at night (2 lx) and darkness (<0.01 lx). Two prey types: sedentary chironomid larvae (Chironomus sp.) and actively swimming gammarids (Gammarus jazdzewskii) were offered to each fish in single (either gammarids or chironomids) and mixed-species treatment (gammarids and chironomids, equal proportions) in two sequences: (I) gammarids – chironomids – mixed, (II) chironomids – gammarids – mixed. Our results indicate that ALAN affected foraging efficiency of perch and this effect was mediated by the prey activity. Gammarid consumption was lower under ALAN compared to darkness (both in single and mixed-species treatment), likely as a result of the reduced gammarid activity decreasing predator-prey encounter rate. In single-prey treatment, chironomid consumption was higher compared to gammarids and unaffected by light, as in darkness fish needed more time to find passive prey, while in ALAN perch significantly delayed the activity onset, which reduced their overall hunting time. We also observed that the presence of actively swimming gammarids increased the predation pressure on sedentary chironomids. Specifically, we found higher consumption of chironomids in mixed than single-species treatment, as well as in single-species treatment when chironomids were offered to perch as a second food option after gammarids. This indicates that initial contact with more mobile gammarids stimulated perch to increase their foraging activity. When chironomids were offered as the first prey, perch, not motivated by prey movements, delayed foraging and consumed less, and this effect was particularly strong in single-species treatment in darkness. In this situation, only the presence of ALAN increased chironomid consumption, probably due to better prey

visibility. Our study showed that ALAN can disrupt trophic relationships in aquatic communities. Specifically, nocturnal illumination may deprive sedentary species of a period when they are less visible to predators, thus increasing their vulnerability to predation, while at the same time predation pressure on active prey may be reduced.

Presence and distribution of microplastics in Alpine freshwater ecosystems: Preliminary results of the PlasticFree project

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Presenting Author: Francesca Vallefuoco

Status: Poster presentation

Session Number & Date:

Abstract

Microplastics (MPs) are ubiquitous and persistent pollutants, raising significant environmental and public health concerns due to their role as vectors for toxicants and their accumulation in various ecosystems. Once released into lotic freshwater environments and before reaching the marine ecosystem, MPs can be stored in soils and river sediments, acting as temporary or permanent sinks. At the same time, their accumulation in these compartments can compromise ecological quality potentially increasing their availability and entering aquatic food webs. This allows MPs to impact a wide variety of organisms from benthic macroinvertebrates to birds and even humans. Despite growing awareness of their impact, standardized European protocols and legislation for quantifying MPs in freshwater environments are still under development. The PlasticFree project aims to bridge this gap by: (i) conducting first investigations of MP distribution in the mountainous Province of Bolzano/Bozen (Italy) through the analysis of various biotic and abiotic matrices; and (ii) developing optimized sampling and analytical methods tailored for alpine waterbodies. A total of 10 sites across South Tyrol, representing varying levels of anthropogenic impact and hydrology, were sampled during spring and autumn 2024 to assess potential seasonal variations of MPs in sediment and macroinvertebrate communities. At each site, macroinvertebrates (collected through Surber samples), riverbank sediments (sampled with corers at -20 cm depth), and interstitial sediments (collected at depths of 5 cm and 20 cm) were analysed to identify and quantify different MP forms in relation to retention processes and potential ingestion by benthic communities. It was hypothesised that (i) MPs would be detected in remote areas such as in alpine sites, (ii) MP abundances would increase downstream within areas of increased population density, and (iii) a correlation between sediment and aquatic macroinvertebrate MP loads would be detected. Preliminary results from sediment samples taken at -20 cm depth from both instream and bank areas indicate that microplastics (MPs) are present in remote glacial rivers at lower abundances (14.78 ± 3.23

items/kg in instream sediment; 18.5 ± 8.5 items/kg in bank sediment). In contrast, significantly higher MP abundances have been observed in urbanized areas at the confluence of major streams (94.36 ± 23.43 items/kg in instream sediment; 66.7 ± 23.67 items/kg in bank sediment). These MPs can then become bioavailable and have been detected even in the most remote alpine sites. For example, in one of our glacial sites, we observed MP abundances of 55.51 ± 38.92 items/g in Plecoptera individuals. This study is part of a broader interdisciplinary initiative fostering collaboration between public administrations, research institutes, and private companies, highlighting the crucial role of research and innovation in addressing and managing this emerging contaminant.

Public and garden ponds as amphibian habitats in a European city (Budapest, Hungary)

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Presenting Author: Márton, Uhrin

Status: Oral presentation

Session Number & Date: Freshwater ecosystems in urbanized catchments, 14:45-15:00, Monday 21 July

Abstract

Amphibians are among the most threatened vertebrates, with over 41% of species at risk of extinction due to urbanization, habitat loss, fragmentation, and the spread of invasive species. These anthropogenic forces operate across multiple spatial scales, impacting both individual species and amphibian communities as a whole. Urban freshwater habitats, such as public and garden ponds, can serve as important refuges for amphibian populations. Public ponds support freshwater biodiversity and garden ponds may enhance habitat connectivity and stabilize urban metapopulations, yet their ecological roles remain poorly studied. We assess differences in amphibian community composition between public and garden ponds and identify key environmental, spatial, and landscape-scale drivers influencing habitat use. We applied a combination of permutational multivariate analysis of variance (PERMANOVA), stepwise model selection and variance partitioning to examine amphibian community structure, followed by species-level analyses to determine how specific taxa respond to environmental gradients in each pond type. Our results show significant differences in environmental conditions and ionic composition between public and garden ponds, which in turn shape patterns of amphibian community structure. While overall variation in amphibian communities is complex, analyzing public and garden ponds separately reveals clearer patterns: species composition in garden ponds is primarily driven by local environmental factors, whereas in public ponds, spatial autocorrelations and connectivity indices play a greater role in shaping community structure. Species-level analyses support this pattern, with garden ponds being strongly influenced by local management practices, whereas public ponds reflect broader spatial and connectivity dynamics. Additionally, a binomial variance partitioning approach using logistic regression models revealed contrasting patterns between the two pond types: in garden ponds, spatial structuring (outskirts vs. city centre) was the dominant factor,

whereas in public ponds, fringing vegetation and canopy cover were the strongest predictors of amphibian presence. Both pond types support urban amphibian conservation, but their communities are shaped by different ecological mechanisms—garden ponds by local management and public ponds by urban connectivity. Recognizing these differences can help refine conservation strategies to strengthen urban biodiversity and counteract habitat fragmentation.

Quantifying the effectiveness of restoration actions on Greenhouse Gas fluxes in heterogeneous European coastal wetlands using in-situ measurements

Miguel Cabrera-Brufau[1], Mihai Adamescu[2], Katrin Attermeyer[3], Nina Bègue[4], Martynas Bučas[5], Antonio Camacho[6], Alba Camacho-Santamans[1], Lidia Cañas[1], Rafael Carballeira[6], Marco Carloni[7], Lamara Cavalcante[8], Constantin Cazacu[2], Giovanni Checcucci[7], João P. Coelho[8], Valentin Dinu[2], Anis Guelmami[4], Mirco Guerrazzi[7], Marija Kataržytė[5], Ana I. Lillebø[8], Camille Minaudo[1], Benjamin Misteli[3], Jorge J. Montes-Pérez[1], Daniel Morant[6], Biel Obrador[1], Bruna R. F. Oliveira[8], Jolita Petkuvienė[5], Antonio Picazo[6], Tudor Racioviceanu[2], Carlos Rochera[6], Michael Ronse[4], Chiara Santinelli[7], Ana I. Sousa[8], Wouter Suykerbuyk[9], Claudia Tropea[7], Diana Vaičiūtė[5], Silvia Valsecchi[7], Marinka van Puijenbroek[9], Daniel von Schiller[1]

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Presenting Author: Miguel Cabrera-Brufau

Status: Oral presentation

Session Number & Date: Greenhouse gas (GHG) exchanges and biogeochemical processes, 11:00-11:15, Friday 25 July

Abstract

Coastal wetlands are globally recognized as critical hotspots for carbon sequestration and Greenhouse Gas (GHG) regulation, exerting a disproportionate influence on the carbon cycle despite their relatively small areal extent. In Europe however, historical and current pressures related to land use and land use change, water pollution and climate change have degraded coastal wetlands compromising their biogeochemical functioning. As the European Union strives to meet its net-zero emissions targets, wetland restoration is increasingly promoted as an effective nature-based solution for climate regulation. Nevertheless, the effectiveness of specific restoration actions on GHG abatement in coastal wetlands remains difficult to predict. This uncertainty largely arises from a lack of widespread in-situ measurements and the large variety of alterations, restoration

strategies and wetland types, which jointly limit our understanding of the underlying biogeochemical processes governing GHG dynamics in coastal wetlands. The main objective of this study is to quantitatively assess the effect of restoring impacted European coastal wetlands on their GHG exchange dynamics and climate-regulation capacity. To achieve this, we conducted an extensive sampling campaign across six major and diverse European coastal wetlands, which were selected as pilot sites by the RESTORE4Cs project. Within each wetland pilot site, GHG exchange rates were measured seasonally over one year in six distinct subsites representing three different management conditions: two well-preserved, two altered, and two restored subsites. GHG fluxes (CO_2, CH_4, N_2O) were measured in-situ using static chambers deployed in representative open-water, vegetated and bare areas. In total, 3041 individual incubations were performed. The instantaneous fluxes derived from chamber incubations were temporally and spatially scaled to daily subsite GHG emission profiles, enabling to assess the effect of preservation status and restoration actions on GHG fluxes across seasons and ecosystem types. Preliminary results suggest that, across the six pilot sites studied within the RESTORE4Cs project, wetland restoration had an inconsistent effect on the net balance of GHG exchanges, with some of the pilot cases showing clear reductions in GHG emissions while in others restoration seemed to have limited impact. Additionally, contrasting exchange patterns were observed for the three studied GHGs between restored, well-preserved and altered subsites. These results highlight that, for wetland restoration projects to be effective in mitigating GHG emissions, they must be designed considering both the alteration history of the wetland as well as the different biogeochemical processes in which CO_2, CH_4 and N_2O are involved. Overall, our findings offer valuable guidance for researchers, restoration practitioners, managers, and policymakers to prioritize restoration efforts of European coastal wetlands with the objective of climate change mitigation.

Quantifying the role of wet and dry areas in CO2 emissions from an intermittent stream network: a modelling approach

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Presenting Author: Alba Camacho-Santamans

Status: Oral presentation

Session Number & Date: Science and management of non-perennial rivers and streams, 11:00-11:15, Thursday 24 July

Abstract

River networks are increasingly shrinking and drying due to climate change and human interventions, altering their hydrological regimes and biogeochemical processes. Given that more than half of the global stream network is classified as intermittent, understanding their role in carbon cycling is crucial. Rivers and streams act as dynamic biogeochemical reactors, metabolizing organic carbon and releasing carbon dioxide (CO_2) into the atmosphere. They are recognized as hotspots for CO_2 emissions. While extensive research has focused on carbon biogeochemistry in flowing conditions, the role of dry riverbeds in carbon emissions remains overlooked.We use a modeling approach to quantify the relevance of CO_2 fluxes from the dry area of the river network in the overall annual CO_2 balance, integrating both dry and wet areas under different hydrological and biogeochemical scenarios. Our model is based on a synthetic catchment representative of a Mediterranean climate. We simulate the river network longitudinal and lateral contraction and expansion, and partition the whole streambed into wet areas, which correspond to sections of the streambed that are inundated, and areas of exposed, dry sediments. We assumed constant areal CO_2 fluxes from wet areas, and made fluxes from dry areas vary dynamically, peaking shortly after stream drying due to enhanced metabolic activity before gradually declining over time. We explore CO_2 fluxes magnitudes based on literature values and investigate multiple hydrological and biogeochemical scenarios, including variation in streamflow flashiness, longitudinal drying patterns (headwaters to downstream reaches), water persistence (low, medium, high), emission decay rates from dry areas (slow, medium, fast), and effective rainfall frequency (low, medium, high). Our results reveal that these factors significantly influence overall CO_2 fluxes at the river network scale. In reference conditions, dry areas contributed approximately 20% of the

total emissions of the river, including wet and dry areas. This share is higher in smaller headwater streams and decreases with increasing drainage area, particularly at the river mouth. These findings emphasize the need to account for drying riverbeds when assessing large-scale carbon budgets, especially as intermittence becomes more frequent in a changing climate.

Re-evaluation of Saprobic and Trophic indices using updated diatom indicator values in Slovenian rivers

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Presenting Author: Barbara Debeljak

Status: Poster presentation

Session Number & Date:

Abstract

Phytobenthos is a vital component of river ecosystems, playing a crucial role in primary production, nutrient cycling, and overall ecosystem functioning. Given its ecological importance, understanding the response of phytobenthos to pressures is essential for effective river management. Consequently, phytobenthos is recognized as one of the biological quality elements required for the assessment of ecological status of surface waters under the Water Framework Directive (WFD). In Slovenia, the ecological status of rivers based on phytobenthos is currently assessed using two diatom indices, namely, Saprobic Index and Trophic Index , which reflect organic pollution and eutrophication, respectively. In our study, we recalculated Saprobic and Trophic Indices using updated indicator values of diatom taxa.. The analysis included diatom datasets collected in rivers, covering a wide gradient of anthropogenic pressures, between 2006 and 2022 in the Slovene national WFD monitoring of surface water quality. We examined the differences between the original and recalculated index values of both indices and evaluated their sensitivity to stressor gradients, particularly nutrient concentrations, biochemical oxygen demand (BOD_5), and land use. Our results revealed a strong correlation between the original and updated index values (R^2 = 0.77 for TI and R^2 = 0.78 for SI), suggesting general consistency in ecological interpretation. Both indices, showed good correlations with the tested parameters, indicating enhanced sensitivity to stressor gradients. This improvement is likely attributable to the updated taxonomic classification and refined ecological preferences of individual diatom taxa. The findings support using updated indicator values to strengthen the ecological sensitivity of phytobenthos-based indices. Additionally, the results suggest revising current class boundaries or pressure-response relationships to better reflect ecological conditions in Slovenian rivers. Overall, the study demonstrates that regular updates of biological assessment tools are essential to ensure their relevance and effectiveness in water quality monitoring under the WFD.

Reconciling waterscape and landscape: the role of emerging aquatic insects

Benjamin Bergerot[1], Christophe Piscart[1]

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Presenting Author: Benjamin Bergerot

Status: Oral presentation

Session Number & Date: Emerging aquatic insects in terrestrial landscape, 15:15-15:30, Thursday 24 July

Abstract

Streams are traditionally viewed as receptacles rather than sources of energy with regard to nutrient and energy cycles. For a long time, terrestrial-aquatic interactions have focused on studying the impact of terrestrial ecosystems on aquatic ecosystems, but more and more studies are highlighting the role of aquatic ecosystems on terrestrial ecosystems. However, these studies usually address this role in terms of physical (e.g., water resources) and chemical (e.g., fertilization during floods) inputs and often neglect the role of biological factors, such as aquatic insects that enable many ecosystem services (regulation of crop pests, depollution of watercourses, fertilization of adjacent terrestrial soils, etc). The strong interactions between species can affect the whole ecosystem and underline the importance of landscape-scale processes in driving local interaction, specifically in the context of aquatic-terrestrial interactions. With the increasing consideration of the waterscape concept, landscape perspectives in riverine ecology and their biota nested within the socio-ecological landscape now provide guiding principles and approaches in watershed management. Numerous studies have shown that lakes and rivers are an important source of energy for the terrestrial environment, mainly through the emergence of winged aquatic insects, recognized as providing nutritional subsidies to terrestrial consumers. They represent a substantial source of fertilization for soils and an important resource for terrestrial organisms. Plants near wetlands where food webs contain fewer insect predators or flying insects receive more pollinator visits and are less pollen limited. Thus, dense hydrographic networks could suggest a strong impact in terms of ecosystem services in adjacent terrestrial ecosystems. Recent studies carried out in temperate agricultural landscapes on these emerging aquatic insects suggest that the proportion of individuals and their fluxes (i.e., their aquatic signatures) have been underestimated. Using an original conceptual approach based on the spatio-temporal dynamics of floods, associated with the emergence and aerial fluxes of adult aquatic insects, we show that landscapes and waterscapes are intertwined rather than superimposed. Moreover, we show that the waterscape may represent proportions largely underestimated until now. We thus call for urgent research effort to include the temporal

dimension of waterscapes into landscape models to estimate the fluxes of insects emerging from all kinds of aquatic ecosystems and quantify their role in the functioning of terrestrial ecosystems in agricultural landscapes.

Resilience and vulnerability of the stonefly Nemoura cinerea to increased temperature and drought

Elmar Becker[1], J. Arie Vonk[1], Ralf C. M. Verdonschot[2], Jelmer Klaassena, Charlotte J. Chambers Moreira[1], Piet F. M. Verdonschot[1,2], Michiel H. S. Kraak[1]

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Presenting Author: Elmar Becker

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 16:00-16:15, Tuesday 22 July

Abstract

Aquatic ecosystems worldwide are under severe pressure from climate change. However, studies on climate change effects on stream biota mainly focus on indicator or vulnerable species, leaving unanswered how more resilient species cope with elevated temperatures and drought, and the long-term consequences for these populations. This study therefore aims to determine the long-term population responses of a common, apparently less sensitive aquatic insect, to climate change-induced heat and drought, and to unravel the mechanisms underlying its persistence under such harsh conditions. The long-term population responses of the stonefly Nemoura cinerea (Plecoptera: Nemouridae) to heat and drought are assessed by linking antecedent seasonal meteorological data to 42 years of abundance data from streams in the Netherlands. The mechanisms of resilience that enable N. cinerea to withstand these stressors during its transition from juvenile to adult stages are studied in a microcosm experiment on late-stage nymphs. Results from modelling long-term population responses to antecedent climate variables and observed responses in experimental microcosms show that temperature, and to a lesser extent drought, have negative impacts on N. cinerea fitness and abundance. Nonetheless, the species' abundance still modestly increases over the last four decades. This discrepancy may result from general water quality improvements, an increase in intermittent sites, or altered biotic interactions due to increased intermittency, reducing competition and predation by less resilient species. It is concluded that that even species seemingly less sensitive to climate change experience harmful effects, though these appear offset by altered biotic and abiotic conditions.

Response of billabong dissolved oxygen and ecosystem metabolism to multiple Birrarung (Yarra River) connection events

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Presenting Author: Ryan M. Burrows

Status: Oral presentation

Session Number & Date: Wetland ecology and management, 16:30-16:45, Tuesday 22 July

Abstract

Billabongs or oxbow lakes are important wetland ecosystems with immense ecological and cultural value. River connectivity drives their ecological structure and function, but the connectivity of many billabongs has been reduced by channel modification and flow regulation. Here, we investigate how billabong connection, from natural and managed (via environmental watering by Melbourne Water Corporation) high flow events in the lower Birrarung (Yarra River, Victoria, Australia), impacts dissolved oxygen concentrations and ecosystem metabolism. We collected near-continuous data for dissolved oxygen and water temperature in the epilimnion of three urban billabongs from October 2023 until April 2025, each with different connection regimes. We also collected continuous weather data (e.g. irradiance, wind, humidity, rainfall) from floating weather stations, which enabled us to model ecosystem metabolism before and after connection events. The impact of billabong connection on dissolved oxygen concentrations was variable and likely influenced by flood peaks, the degree of stratification prior to connection, and ecosystem metabolism dynamics. All three billabongs were largely heterotrophic throughout the study period. The impact of connection events on billabong ecosystem metabolism was variable, but gross primary production was often suppressed relative to the pre-connection period. This project has provided important insights into the immediate biogeochemical and ecological impacts of billabong flooding. Future work should focus on the longer-term and broader ecological impact of billabong flooding, including consequences for aquatic food -webs, which will inform future environmental water management.

Restoration challenges in Karla lake: Resilience, management and Future Lake directions

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Presenting Author: Ifigenia Kagalou

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 11:15-11:30, Tuesday 22 July

Abstract

The restoration and management of Lake Karla, a historically significant wetland in Greece, have been extensively studied due to their its ecological, hydrological, and socio-economic importance. Once a vital ecosystem, its drainage in 1962 caused biodiversity loss, groundwater depletion, and soil salinization . The lake's re-establishment as a multipurpose reservoir aimed to restore ecosystem services (ES) and support local communities, yet challenges persist, particularly regarding eutrophication, water quality, and ineffective management. Our research findings since 2015 highlight that catchment pressures affecting hydromorphological parameters, nutrient inflows, lake depth, surface to groundwater connection and residence time significantly influence Karla's trophic state, exacerbating cyanobacterial blooms and biodiversity threats with negative projections due to climatic variability and especially drought incidents. Hydrological modeling highlights a deficient water balance despite different water management scenarios and field studies show that phytoplankton communities are primarily driven by temperature and nutrient availability, reinforcing the lake's degraded status. Despite restoration efforts, operational inefficiencies persist, including infrastructure failures, weak environmental policies, and inadequate hydraulic management. While some ecosystem functions have fully or partially recovered, critical services such as water quality improvement and sustainable food production remain unresolved. Extreme weather events have further exposed vulnerabilities in the lake's infrastructure, emphasizing the need for integrated, adaptive management with participatory approaches and "green" novel environmentally friendly solutions. The lacking resilience has recently caused long-lasting extra economic burden in the entire area, affecting natural processes and impeding agricultural practices. This overview underscores the complexity of Lake Karla's restoration, advocating for a science-based strategy incorporating natural and hybrid solutions, addressing water balance and biodiversity conservation measures to enhance ecological resilience and ensure the lake's long-term sustainability while providing important ES for the economic growth of the area. The Future Lakes' (Horizon project) aim for Lake Karla is to support the improvement and stabilization of the ecological potential of Lake Karla, encouraging NBS and circular

innovations on agri-business sector, supporting active cross-sectoral cooperation by learning from unsustainable practices of the past and engaging local stakeholders and experts in monitoring through citizen science campaigns and decision-making processes.

Restoring Freshwater Ecosystems for Landscape Resilience: Setting the Stage

Sebastian Birk[1], Laurence Carvalho[2]

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Presenting Author: Sebastian Birk

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 10:45-11:00, Tuesday 22 July

Abstract

Welcome to our special session on "Restoring Freshwater Ecosystems for Landscape Resilience". Landscapes represent vast, interconnected systems where ecological and societal dynamics intersect. Restoring these systems carries profound implications, challenging conventional practices while fostering scientific and policy innovation. However, the complexity of landscape-scale restoration extends beyond ecological concerns—it also encompasses administrative, economic, and societal challenges. Administrative barriers arise from navigating complex regulatory frameworks and policy landscapes. Community engagement requires addressing diverse income and livelihood interests while overcoming entrenched "business-as-usual" mindsets. Economic considerations involve balancing competing profit interests and long-term sustainability. Meanwhile, scientific progress in this field depends on interdisciplinary collaboration and the ability to transcend traditional knowledge boundaries. In this session, we will examine insights from two major EU innovation projects on freshwater restoration (MERLIN and FutureLakes), each targeting different freshwater ecosystem types. While each project focuses on specific environments, their combined findings reveal key principles that apply broadly to landscape-scale freshwater restoration. One central takeaway is the need to understand landscape functionality beyond administrative borders. This approach aligns with river basin management strategies already embedded in the EU Water Framework Directive and reinforces the need for an integrated, cross-sectoral vision. Furthermore, we emphasize the importance of coupled biophysical-economic modeling in quantifying the benefits and trade-offs of restoration efforts. Viewing restoration through an ecosystem services perspective allows for transparent scenario-building, helping to identify both beneficiaries and those facing trade-offs in land-use transitions. We also stress the role of stakeholder engagement in driving effective restoration. A multidisciplinary approach – integrating scientists, landscape architects, economists, entrepreneurs, and administrators – has proven essential in overcoming conventional thinking and unlocking innovative pathways for sustainable restoration. This session will set the stage for a series

of talks that explore the challenges and opportunities in scaling up freshwater ecosystem restoration. By advancing practical strategies and integrating ecological, economic, and societal dimensions, we aim to provide a framework for achieving resilient, biodiversity-rich landscapes that support both nature and people in the face of future environmental challenges.

Restoring river ecosystems by removing physical, social and psychological barriers

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Presenting Author: Miriam Colls

Status: Oral presentation

Session Number & Date: Restoring freshwater ecosystems for landscape resilience, 10:45-11:00, Thursday 24 July

Abstract

River ecosystems are among the most degraded on the planet due to decades of overexploitation and human-induced modifications. For a long time, rivers were seen merely as pipelines through which water flowed, leading to modifications in their hydromorphology to meet human needs. As a result, rivers worldwide are impacted by a myriad of barriers, including culverts, weirs and dams. While some of these structures remain functional for purposes such as water supply or hydroelectric power generation, many others have become obsolete. Regardless of their status, they disrupt natural river dynamics by creating lentic conditions upstream, obstructing sediment transport, impairing the movement of many aquatic organisms, and degrading overall ecological integrity. Traditional solutions like fish ladders have often proven ineffective for many species and fail to address broader impacts, including disrupted sediment transport, habitat degradation, and altered ecosystem functioning. Consequently, barrier removal has gained momentum as a solution closer to nature (a nature-based solution) for river restoration. Initially focused on improving migratory fish populations in relatively pristine rivers, it is now widely recognized for its multiple benefits in highly altered landscapes. However, such actions often face opposition from certain sectors, forcing practitioners to confront other barriers, from the stakeholder's psychology to political disputes within local communities, placing them in the midst of science denial, misinformation, and resistance. Overcoming these challenges requires a clear understanding of the ecological impacts of barriers, the benefits of their removal, and the key uncertainties that must be addressed to ensure successful implementation. Here, we present empirical evidence showing how, beyond enhancing fish mobility, barrier removal restores sediment transport and natural habitats, reduces greenhouse gas emissions, and boosts self-purification capacity. Additionally, the removal of certain structures, particularly weirs, can help mitigate flood risks and reduce associated economic damages. Beyond environmental benefits, river

restoration through barrier removal involves complex social, economic, and cultural dimensions that must be considered to ensure long-term success. Public perception, political interests, and legal frameworks often pose significant obstacles, making it essential to adopt a multidisciplinary approach that integrates ecological science with community engagement and stakeholder participation. Restoring river ecosystems by removing barriers must be understood as a multifactorial process that not only focuses on physical aspects but also incorporates sociocultural factors to achieve sustainable outcomes.

River conservation and restoration in croplands: can we improve the Common Agriculture Policy as an instrument of practice?

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Presenting Author: Leonor Santos

Status: Oral presentation

Session Number & Date: Integrating international policies to support achievement of environmental quality objectives, 11:00-11:15, Thursday 24 July

Abstract

This study investigates the integration of river restoration within the Common Agricultural Policy (CAP) by comparing European Union (EU) and Portuguese policy documents. Using Thematic Content Analysis, the study finds that despite differences in document length, the proportion of references to river restoration and management is similar in both EU and Portuguese legislation, demonstrating its recognized importance. However, key differences emerge in policy approach—Portuguese legislation prioritizes water management and regulatory compliance over proactive restoration, reflecting a maintenance-oriented rather than an interventionist strategy. As the EU's primary agricultural policy, the CAP incorporates conditionalities, eco-schemes, and agri-environment-climate commitments (AECs) to integrate sustainability into agricultural landscapes. While EU CAP documents emphasize agriculture's environmental impact, aligning with the Water Framework Directive (WFD) and focusing on wetlands, buffer zones, and restrictions on agricultural activities near water bodies, references to active restoration remain underutilized. In Portuguese policy, restoration efforts primarily focus on passive measures, such as land conservation and buffer strip maintenance under GAEC 2 regulations. A key finding is that the Portuguese CAP Strategic Plan (CAPSP) restricts AEC funding to Natura 2000 areas, excluding 80% of agricultural land from financial support for restoration efforts. Additionally, eco-schemes and agri-environmental measures—which could promote restoration—are underfunded and limited in scope. While conditionalities enforce compliance with environmental standards, they do not actively promote ecological improvements, reinforcing a regulatory rather than incentive-based restoration model. To improve the CAP's effectiveness in supporting river restoration, this study highlights key policy adjustments. Extending the duration of eco-schemes would prevent restoration efforts from being constrained by short-term funding cycles, allowing for meaningful environmental improvements. Similarly, increasing

financial incentives for voluntary environmental measures would encourage wider farmer participation in sustainable land and water management. Given the AEC funding restriction to Natura 2000 areas, expanding eligibility to include a broader range of farmland would make restoration efforts more inclusive and impactful. Moreover, stronger integration between CAP mechanisms and River Basin Management Plans under the WFD is essential for improving policy coherence and ensuring alignment with broader water management strategies. Finally, tailoring restoration measures to Mediterranean ecosystems would address region-specific climate and hydrological challenges, ensuring that policies are adapted to local environmental conditions. By implementing these changes, the CAP could better align with the European Green Deal's objectives, fostering a more effective and sustainable approach to river restoration in agricultural landscapes. Future CAP reforms should prioritize incentive-based conservation strategies to encourage sustainable land and water management practices across Europe.

River Restoration Units (R2U) – The new European River Restoration layer

Gonçalo Duarte[1]

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Presenting Author: Gonçalo F Duarte

Status: Poster presentation

Session Number & Date:

Abstract

Freshwater ecosystems are one of the most threatened across the globe. In the European continent, relevant efforts are being conducted to prevent human negative impacts on nature. The Dammed fish project focuses on artificial fragmentation of river networks, one of the main threats for freshwater environments in Europe. Along with this project, the MERLIN project (H2020 program) aims to mainstream ecosystem restoration at landscape scale for freshwater-related ecosystems. Both projects target working at the pan-European scale aim to contribute to the Nature Restoration Law, particularly on large-extent ecological restoration planning. Thus, to support achievement of this goal we developed the River Restoration Units (R2Us). R2Us abide by river network functioning and enable the possibility of aggregating multiple input sources of data with varying resolutions to size-wise comparable units. To create these units, we established a methodological approach that uses the Catchment Characterization and Modelling—River and Catchment Database v2.1 (CCM2) and takes advantage of the computing capabilities of the River Network Toolkit (v2) software (RivTool). Using CCM2 and RivTool we were able to implement a seven-step methodological procedure. The method developed led to the creation of the 11,557 R2U units in sea outlet basins of European rivers, along with their attributes. Results were organised to create a relational database with normalized data implemented in SQL language. R2Us are particularly well-suited for large-scale restoration, freshwater conservation planning and river management in accordance with European nature legislation.

Run for cover: the response of riverside ground beetle communities to changes in riparian vegetation

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Presenting Author: Cristian Andrei Murgu

Status: Oral presentation

Session Number & Date: Wetland ecology and management, 16:00-16:15, Tuesday 22 July

Abstract

Riparian zones link lotic and terrestrial ecosystems across catchments. The widespread conversion of such areas in agricultural landscapes led to substantial loss of biodiversity and ecosystem services along many European rivers. Our research addresses how changes in riparian vegetation shape ground beetle (Carabidae) communities within an agriculturally modified catchment representative of the tributaries of the lower Danube region. We suggest that ground beetles can enable efficient assessment of human impacts along riparian corridors, because they represent important cross-ecosystem trophic links and are established bioindicators of environmental change. We highlight taxonomic and functional changes within the studied communities based on a multi-seasonal sampling carried out across a land use change gradient ranging from headwaters to the floodplains, with four site types established based on impact level. We identifed (1) key variables associated with human impacts and (2) the direction and magnitude of community responses to these variables. Differences between site types, in terms of metrics describing community composition, taxonomic diversity and functional diversity are explored, compared, and discussed. Results indicate that the structure of riparian and adjacent vegetation, as well as the integrity of the woody riparian buffers, are the strongest drivers of local-scale community composition. Despite higher densities and overall widespread distribution of generalist eurytopic species, sites with arboreal riparian vegetation supported some rare and endangered habitat specialists at low densities, as well as communities with higher taxonomic and functional diversity. Trait-based metrics highlighted differences between communities and support the idea that biodiversity assessment can be better achieved by employing multiple complementary methods. Our findings inform recommendations for future research and the conservation of riparian and wider wetland biodiversity.

Seasonal dynamics of microalgae colonization on plastic polymers across European lakes

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Status: Oral presentation: Accepted with small edits

Session Number & Date: Advancing research on plastic pollution: Impacts, transport, and management, 11:00-11:15, Monday 21 July

Abstract

Plastic pollution is a global environmental problem, and one of the major anthropogenic pressures affecting freshwater ecosystems. While numerous studies have focused on the occurrence and types of plastics, and their ecotoxicological impacts, less have examined the direct interactions between plastics and microorganisms, and even fewer assess the broader implications of these interactions on ecosystem functioning. Despite increasing research on the plastisphere, it remains unclear which environmental factors regulate the biofilm development on different plastic substrates. Here, we present the results of the 4th collaborative FreshProject "PhytoPlastic". We investigated the formation and biomass dynamics of benthic microalgae on two plastic polymers (low - density polyethylene (LDPE) and polyethylene terephthalate (PET) compared to glass (control condition) across fifteen lakes in eight European countries. The study was conducted over an annual cycle (autumn, winter, spring, summer) in order to better investigate the factors affecting the microbial colonisation processes of plastic polymers in lentic environments. Biofilm samples were collected four times per season at day 3, 7, 15, and 30 after deployment, to assess the temporal and seasonal evolution of the polymer substrates colonization. For each substrate (LDPE, PET and glass), we assessed the phytobenthic biomass estimating the chlorophyll-a, and ash-free dry mass. This study on freshwater biofilms revealed three key findings: (1) microalgal biomass (chlorophyll-a) increased over time, (2) PET and glass showed similar colonization patterns, and (3) peak colonization occurred in spring and summer. Our results indicate that substrate type, seasonality, and time of colonization are key factors influencing microalgae and total organic biomass accumulation. However, the role of plastics as a substrate for biofilm formation appears to be complex and context dependent and requires further research to elucidate the potential ecological implications.

Seasonal variation in zooplankton communities from a clear and glacially turbid alpine lake

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Presenting Author: Ambre Placide

Status: Oral presentation

Session Number & Date: Plankton ecology, 15:30-15:45, Thursday 24 July

Abstract

Zooplankton, such as copepods, are subjected to multiple environmental stressors in alpine lakes. In clear lakes, they are exposed to harmful solar UV radiation (UVR) that penetrates deep into the water column, forcing them to move through the depths of the lake, whereas in glacier-fed systems with high turbidity due to suspended mineral particles and during the ice covered season, they are protected from UVR. Here we report on seasonal changes in abundance, daytime vertical distribution and life cycle development of zooplankton, mainly Cyclops abyssorum tatricus, in two lakes (clear Faselfadsee 4 'FAS4' and turbid Faselfadsee 3 'FAS3'). Our results show a higher zooplankton abundance in the ice-free season than in the ice cover season (1.2 times higher in FAS4 and 1.9 times in FAS3) and on average 1.8 times more copepods in the turbid than in the clear lake. Copepods were evenly distributed in both lakes during the ice cover period (weighted mean depth (WMD) of 5.2 m in FAS3 and 5.8 m in FAS4 in April). During the ice-free period, they remained close to the lake bottom in clear FAS4 (WMD 12.5 m; maximum lake depth 14.5 m) and followed a similar distribution trend in FAS3, but with copepods present higher in the water column (WMD 11.6 m; maximum depth 16.5 m). Most copepods were found at the nauplius stage, with the highest mean abundance in August (9.2 Ind.L-1 in FAS4 and 13.7 Ind.L-1 in FAS3). While in the clear lake the nauplius was the most prominent life stage for most of the year, in the turbid lake the copepodid stage C4 was most abundant from late October to June (mean 1.04 Ind.L-1). Our data suggests a broad adaptability of copepods to different physicochemical and visual properties in these harsh ecosystems. Physiological adaptability can be investigated with transcriptomic data, but despite the time and cost efficiency of RNA sequencing, there is still a noticeable lack of research using transcriptomic approaches to address questions in freshwater zooplankton. A transcriptome assembly would provide a valuable tool in physiological research. The de novo transcriptome of C. abyssorum tatricus was assembled by merging Pacific Biosciences long reads from the FAS3 and FAS4 copepod populations collected at two different time points (December and July) into a de novo transcriptome of 70,496 contigs with a BUSCO score of 80.8%, GC% of 41.12, and N50 of 3,058. This new assembly will allow us to measure gene expression, allowing us to track transcriptomic changes over time and space.

Shell morphometrics, growth and spatio-temporal distribution of the terrestrial gastropod Pomatias elegans (O. F. Müller, 1774) from the karst intermittent Mediterranean river

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Presenting Author: Nera Vuić

Status: Oral presentation

Session Number & Date: Science and management of non-perennial rivers and streams, 11:30-11:45, Thursday 24 July

Abstract

Intermittent rivers are highly dynamic and complex freshwater ecosystems characterised by seasonal flow cessation. Riparian habitats increase the biodiversity of these rivers by creating areas of transition between stream and terrestrial ecosystems. The land winkle, Pomatias elegans, a species of saprophagous terrestrial snail associated with calcareous soils, often dominates gastropod assemblages along intermittent karst rivers in Croatia, yet research regarding this species is still scarce. This study aims to gain insight into the differences in this species' morphometric traits and growth, seasonal dynamics and habitat preferences laterally – between riparian and adjacent karst habitats, and longitudinally – along an intermittent Mediterranean river. Monthly sampling was conducted from May to November using pitfall traps at 72 sites, equally distributed between the karst and riparian habitats along the river, which was divided into three sections: spring area, upper reaches and lower reaches. Each month, environmental factors were measured at each site, including air and soil temperature, air humidity, pH and Ca concentration in the soil. Seven morphometric traits (including shell length, shell width and aperture length) were measured to detect differences in shell sizes and shell growth rates between the habitats. Karst habitats were characterized by significantly higher mean air and soil temperatures, while mean air humidity, organic matter and Ca concentration were higher in the riparian habitats. The snails showed spatio-temporal differences in abundance, with the tendency to aggregate in certain warmer microhabitats along the river course. Interestingly, snail morphometric traits differed significantly between the habitats. Specifically, adults in karst habitats showed higher mean values of morphometric traits (particularly shell length, shell width and body whorl length) compared to those in riparian habitats, suggesting that warmer environments might be more suitable for adult snails, as higher temperatures facilitate growth and reproduction by increasing metabolic rate. In contrast, juvenile snails showed higher mean values of morphometric traits in riparian compared to karst habitats, suggesting a higher suitability of riparian habitats during development, as juvenile snails

are more prone to desiccation. Differences in shell growth rates were also observed, with juveniles in both habitats showing allometric shell growth, indicative of a more dynamic growth compared to adults. This study brings novel information regarding the spatio-temporal dynamics, habitat preferences, morphometric trait differentiation and growth of P. elegans, highlighting the importance of maintaining habitat heterogeneity along Mediterranean intermittent rivers.

Shifts in lake biological communities over 30 years in response to reduced ice cover in an oligotrophic high-latitude lake

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Presenting Author: Francesca Pilotto

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 11:15-11:30, Tuesday 22 July

Abstract

With rising temperatures, high-latitude lakes are experiencing reduced ice cover, leading to earlier ice break-up and prolonged ice-free seasons. This trend is expected to continue, potentially triggering cascading effects across lake ecosystems. Understanding how lacustrine pelagic biota are affected by these shifts is crucial for predicting future ecological responses to climate change. In this study, we examined the long-term changes in ice phenology, temperature, water discharge, and aquatic pelagic communities in an oligotrophic subalpine lake in Norway from 1994 to 2022. The lake's catchment has minimal anthropogenic influence, making it an ideal system for assessing climate-driven ecological changes. We analysed the composition, abundance, diversity, and temporal stability in phytoplankton, zooplankton, and fish communities, as well as the synchrony across trophic groups, to better understand ecosystem dynamics in response to environmental change. Our results indicate a significant reduction in ice-cover duration, with the average ice-covered period decreasing from 192 days in the first five years of the study to 176 days in the most recent five-year period. Concurrently, all three biotic groups showed notable changes in community composition. Phytoplankton biovolume and species richness increased over time, suggesting shifts in primary production dynamics. Zooplankton communities showed increasing diversity and evenness and changes in temporal community stability, possibly reflecting altered resource availability or predator-prey interactions. The catch per unit effort of brown trout increased, while that of arctic char declined over time. Additionally, we observed shifts in the synchrony across trophic groups, suggesting changes not only in the community structure of lacustrine biota but also in the interspecific interactions and ecosystem functioning. The observational nature and lack in replication in this study limits our ability to establish direct causal relationships or fully disentangle the drivers of the observed changes. However, we found correlations

between shifts in the lacustrine biota and climate-related variables, suggesting that climate change is already influencing oligotrophic high-latitude lakes. Despite its remote location and minimal direct human impact, the studied lake has undergone substantial ecological changes over the study period. These results highlight the far-reaching effects of climate change on freshwater ecosystems and underscore the need for continued long-term monitoring to better understand and anticipate future ecological shifts.

Shotgun Metagenomic Analysis of Beyşehir Lake: Exploring Microbial and Viral Dynamics in a Critical Freshwater Resource

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Presenting Author: Işılay Çelik

Status: Oral presentation

Session Number & Date: Advances in genetics and molecular ecology, 11:15-11:30, Tuesday 22 July

Abstract

Lake Beyşehir, Turkey's largest freshwater lake, is important for biodiversity conservation. An in-depth examination of its viral and microbial community is necessary amid heightening pressures from anthropogenic activities, climatic change, and emerging microbial hazards. To infer the taxonomic and functional diversity of viral and microbial communities in the lake, we carried out shotgun metagenomic sequencing of shoreline water samples. We identifed taxa including bacteria, fungi, protists, and viruses. Uroviricota was particularly prevalent, indicating the diversity of viruses and possible host interactions. Some of the most prevalent genera in the bacterial phylum Bacillota were Bacillus, Brevibacillus, Enterococcus, Lactobacillus, Streptococcus, and Staphylococcus. The presence of opportunistic pathogen species across various taxa, particularly Streptococcus, Staphylococcus, and Enterococcus, highlights the potential for waterborne infections to have adverse effects on aquatic life and human populations. Such bacteria indicate possible sources of pollution, including sewage effluent and agricultural runoff. The families Ackermannviridae, Autographiviridae, Casjensviridae, Demerecviridae, Herelleviridae, and Straboviridae belong to Caudoviricetes, a principal class of bacteriophages, as defined by viral community studies. Bacteriophages significantly influence microbial community composition by impacting bacterial population dynamics, facilitating horizontal gene transfer, and potentially regulating pathogenicity. The existence of numerous phage families implies an active interaction between bacteria and viruses that may have consequences for the overall health of freshwater ecosystems such as

lakes. Several of these viral families have been associated with toxic bacterial hosts, implying possible consequences for water quality and microbial community pathogenicity. The findings emphasize the need for routine monitoring of microbiological and viral parameters to establish potential health risks and ensure water safety, particularly because Lake Beyşehir is a source of drinking water. Although some microbial organisms facilitate ecosystem processes such as biodegradation and nutrient cycling, others may indicate anthropogenic pressures and environmental stressors. This study provides a baseline understanding of the microbial and viral ecology of Lake Beyşehir which will inform future conservation, pollution mitigation strategies, and the development of sustainable water governance policy.

Shredding efficiency of invasive amphipod Dikerogammarus villosus and native species, Gammarus fossarum and G. roeselii, in a laboratory experiment

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Presenting Author: Kralj, T.

Status: Poster presentation

Session Number & Date:

Abstract

Allochthonous organic matter serves as a vital resource, the primary energy source in aquatic food webs. Amphipods, often the most abundant shredders, significantly contribute to leaf litter breakdown. However, the invasive amphipod Dikerogammarus villosus exhibits inconsistent shredding efficiency, raising concerns about its ability to perform the same ecosystem functions as native amphipod species following their displacement. This laboratory experiment investigated the differences in alder leaf breakdown rate between the invasive D. villosus and two native species, Gammarus fossarum and G. roeselii. All three species were collected from the left artificial drainage channel of the Dubrava Reservoir on the Drava River (Croatia) in October 2021. Sixteen aquaria were used, four for each species and four controls. Each aquarium contained 40 adult individuals of similar size and ten alder leaves. Prior to the experiment, amphipods were acclimated in the aquaria for 15 days, and alder leaves were conditioned in stream water. The experiment lasted 48 hours, with water temperatures ranging from 11.9 °C to 12.6 °C throughout both acclimatization and the experiment. Throughout the experiment, the native species G. fossarum had the highest mortality rate of 13.1% (five specimens), while G. roeselii had the lowest mortality rate of 2.5% (one specimen). The invasive species D. villosus recorded a mortality rate of 9.9% (four specimens). Aquaria with G. fossarum, with the smallest dry mass of living individuals (194 mg dry mass-DM), had the fastest breakdown rates (leaf mass loss of 91.43 mg day-1, rate 0.46 mg day-1 DMmg-1). Breakdown in G. roeselii aquaria (376 mg DM) were intermediate (98.4 mg day-1, 0.27 mg day-1 DMmg-1), while invasive D. villosus (340 mg DM) had the lowest breakdown rates (47.5 mg day-1, 0.14 mg day-1 DMmg-1). In control aquariums, leaf litter breakdown was 18.3 mg day-1. These results suggest native species contribute more to the leaf litter breakdown and that population of D. villosus in the Drava River may not effectively replace native species in this important ecosystem process.

Simulating hydrological response to climate change in two Mediterranean reservoir catchments in central Spain

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Presenting Author: Brian Omondi Oduor

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 11:00-11:15, Tuesday 22 July

Abstract

The Mediterranean region is facing escalating water scarcity challenges due to rising anthropogenic demands and climate change-induced hydrological alterations. Projections from the latest Intergovernmental Panel on Climate Change (IPCC) reports indicate substantial warming alongside declining precipitation across the region, further intensifying aridity trends. This study utilized the Soil Water Assessment Tool (SWAT+) to simulate the hydrological behavior and assess the climate change impacts in two reservoir catchments, El Torcón (203 km²) and Picadas (2001 km²), within the Tagus River basin in central Spain. The two models were calibrated (2011-2015) and validated (2016-2020) using observed monthly reservoir inflow and storage data for the El Torcón catchment, and daily streamflow data from two gauging stations (Navaluenga and San Martín de Valdeiglesias) for the Picadas catchment. A novel integrated calibration protocol applying both soft and hard calibration methodology was adopted to ensure not only a statistically robust model but also realistic representation of hydrological processes. The SWAT+ model configuration for both catchments integrated key advancements, such as water transfers and reservoir releases, to accurately reflect the reservoirs dynamics. Climate change impacts on the hydrological processes were assessed for two Shared Socioeconomic Pathways (SSP2-4.5 and SSP5-8.5), utilizing 11 regionally downscaled global climate models from the IPCC's Sixth Assessment Report (AR6). The ensembles of the outputs from the 11 models were used to analyze the impacts for medium-term (2041-2070) and long-term (2071-2100) scenarios relative to the historical baseline period (1981-2010). Additionally, the model outputs would be analyzed to quantify scenario impacts on the catchments' hydrological dynamics using hydrological alteration indices. The model performance was very good during calibration and validation periods, replicating accurately the observed hydrological patterns. The monthly reservoir inflows and storage dynamics were effectively captured for the El Torcón Reservoir, as well as the spatial variability in the daily streamflow responses at Navaluenga and San Martín de Valdeiglesias stations for the Picadas catchment. The climate change simulation results

showed declining precipitation (-5% to -24%) along with increasing potential evapotranspiration (+9% to +25%) in both catchments, which could exacerbate the hydrological deficits, particularly in the high-emissions scenario (SSP5-8.5). Both catchments experienced substantial reductions in key hydrological components such as streamflow, direct flow, groundwater flow, reservoir inflow and storage. The projected reservoir inflow decline was more pronounced in the long-term scenarios, with decreases of -42% under SSP2-4.5 and -85% under SSP5-8.5 in the El Torcón catchment, and -23% and -47%, respectively, in the Picadas catchment. These trends point to a growing imbalance between water supply and demand, with direct implications on water security and ecosystem sustainability in the catchments. Based on these findings, there is an urgent need for adaptation and mitigation measures, such as prioritization of integrated water resource management approaches and climate-resilient policies to enhance adaptive capacity against future climate uncertainties within these catchments and the Mediterranean region at large. This study highlights the need for proactive planning and intervention to protect freshwater resources amidst a rapidly changing climate.

Sources, distribution and transfer of potentially toxic elements (PTEs) in forest ecosystems, the role of water-filled tree holes and their associated aquatic communities

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Presenting Author: Nabil Majdi

Status: Poster presentation

Session Number & Date:

Abstract

Water-filled tree-holes, i.e. dendrotelms, represent a mosaic of tiny (<100 mL) to relatively larger (>100 L) water bodies distributed throughout a forest ecosystem. Dendrotelms harbor communities of aquatic insects adapted to tolerate harsh conditions, such as hypoxia. Low oxygen availabilty can reflect the substantial amounts of dissolved and particulate organic matter (atmospheric particles, mosses, lichens, leaves, twigs, wood chunks, faeces and dead terrestrial invertebrates) that enter the dendrotelms via stemflow, wind or gravity. Insect larvae colonizing dendrotelms show adaptations such as breathing tubes, allowing them to thrive and exploit a variety of food items in those intriguing small water bodies (e.g. Syrphidae larvae are deposit-feeders, Culicidae are filter-feeders, Scirtidae graze on epiphytic biofilms and shred plant material falling in the dendrotelms). Terrestrial invertebrates (e.g. ants, isopods, spiders) and vertebrates (birds, mammals) also frequently visit dendrotelms to drink, feed on larvae, take a refreshing bath or pursue a more complex territorial strategy. Recently, however, relatively high concentrations of potentially toxic elements (PTEs) have been detected in dendrotelms, even in protected areas, raising questions about the ubiquity of atmospheric PTEs and their sources and

pathways through ecosystems. Bio-magnification through the food web is also expected, which raises concerns about possible contamination of other compartments of the forest ecosystem. In this study we measured PTE concentrations in the dissolved and particulate fractions of free-fall, through fall, and stemflow water; in 12 widespread aquatic and terrestrial invertebrate groups; and in feathers. We also analysed rocks, humus, lichens, fresh leaves and litter to evaluate the contribution of the near environment to PTE levels. All samples were collected in a 20-ha area of the Massane reserve, a UNESCO World Heritage old-growth beech forest situated at the eastern fringe of the Pyrénées near the Mediterranean Ssea. Coarse and fine benthic and suspended particulate organic matter in dendrotelms and stemflow had the highest concentrations of PTEs such as lead or copper. Aquatic invertebrates also showed worrying concentrations of lead, copper cadmium or arsenic. PTEs were detected in all biological compartments screened, including terrestrial invertebrates and feathers. Our results suggest that dendrotelms store considerable amounts of atmospheric PTEs that would otherwise reach the forest floor. However, dendrotelms may contribute to the spread of PTEs in forest food webs through bio-magnification processes.

Spatio-temporal variations of phosphorus in the sediments of the Hammam Boughrara Reservoir(western algeria): Biogeochemical processes and anthropogenic influences

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Presenting Author: Amina Taleb

Status: Oral presentation

Session Number & Date: Sediment and benthic ecology, 10:45-11:00, Tuesday 22 July

Abstract

This study investigates the spatio-temporal dynamics of phosphorus in the Hammam Boughrara Reservoir, focusing on its distribution, bioavailability, and controlling factors. Phosphorus concentrations were highest in fine sediments (clay and silt) and varied seasonally, with retention during low-water periods and release during high-water conditions. The left bank exhibited higher phosphorus levels due to urban and industrial inputs from Oued Moillah. Geochemical interactions with iron and aluminum regulate phosphorus mobility, with sediments acting as both a sink and a potential source. The presence of bioavailable phosphorus suggests a risk of internal loading, exacerbating eutrophication. The Trophic State Index (TSI) reached 57.46 (Eutrophic) during low-water periods, highlighting the significant role of sediments in phosphorus recycling. These findings emphasize the impact of sediment composition and hydrodynamics on phosphorus cycling, with implications for reservoir management and water quality preservation.

Spectral optical properties of microalgae: The case of Chlorella sp.

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Presenting Author: Pınar Gürbüzer

Status: Poster presentation

Session Number & Date: Advances in data analysis and technologies to support freshwater science, 11:15-11:30, Monday 21 July

Abstract

Microalgae are positioned at the base of the food chain and can thus affect all higher trophic levels. They form complex assemblages of microorganisms in aquatic environments, playing a crucial role in reducing atmospheric carbon levels. Characterizing microalgae in water has multiple applications. The determination of algal spectral properties has the potential to contribute to the field of remote sensing. Furthermore, this information can inform development of in situ measurement equipment that, for example, facilitates the optimization of culturing studies for higher productivity in biofuel production. This study aims to determine the spectral optical properties of colonial green algae of the genus Chlorella, so that this group can be used for such applications. Algal cells interact with light through absorption by pigments and scattering by cell structures. For the determination of optical properties, scattering at various angles, absorbance and transmittance of Chlorella sp. at different wavelengths covering the visible band (400–700 nm) were measured. The scattering characteristics depend on the size parameter (ratio of the particle radius to the wavelength of the light), density and shape of the Chlorella cells, clustering of the cells, scattering angle of the light and the cells refractive index. Chlorella sp. cell diameter vary between 2.4–7.3 µm and their shapes are almost spherical. The results align with existing literature, suggesting the reliability of these optical measurement. The results will be used to determine the density of phytoplankton and other organic and inorganic content in the water via optical methods. These findings contribute to the refinement of remote sensing algorithms, water quality monitoring techniques and bio-optical modelling of aquatic habitats.

Stakeholder engagement as a key element in defining basin-scale Safe Operating Spaces (SOS) for freshwater resilience

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Presenting Author: Katarina A. Cetinic

Status: Oral presentation

Session Number & Date: Defining ecological boundaries and tipping points: Establishing 'safe operating spaces', 16:15-16:30, Thursday 24 July

Abstract

Freshwater ecosystems worldwide are under growing pressure from climate shifts, land use changes, and competing demands for water resources. Transboundary river basins face additional complexities due to diverse cultural, economic, and political contexts. As resource availability fluctuates and extreme events become more frequent, it becomes essential to identify strategies that safeguard both ecological integrity and human well-being. A Safe Operating Space (SOS) framework offers a way to define ecological and socio-economic boundaries that help preserve long term resilience in freshwater systems. Approaches for establishing an SOS often rely on multiple lines of scientific and modelling-based evidence to determine thresholds for, e.g., flow regimes, water quality, and ecosystem health. Yet stakeholders at the local level bring critical insights into trade-offs, priorities, and governance challenges that extend beyond technical assessments. In transboundary river basins, the perspectives of communities, policymakers, water users, and other stakeholders are especially valuable. They contribute grounded knowledge about issues such as balancing flood protection, agricultural productivity, and biodiversity conservation. When these viewpoints are included in defining an SOS, basin level targets become more responsive to real world conditions and more likely to gain broad acceptance. Stakeholder engagement also supports inclusive decision making and productive knowledge exchange. Structured processes, including multi-criteria evaluations and facilitated discussions, help participants identify priorities, and then find consensus on boundaries that integrate scientific evidence with regional needs. This integrated approach enables effective monitoring and adaptation when basins experience changes in climate, land use, or political contexts. Within the Horizon Europe SOS-Water

project, stakeholder workshops in the Mekong and Danube basins revealed the necessity of capturing distinct socio-economic realities and local knowledge. Participants highlighted varied concerns, ranging from supporting flood-dependent livelihoods and food security to safeguarding ecological connectivity and effective water allocations, reinforcing the value of stakeholder-driven processes. By involving those most affected by environmental decisions, the SOS framework becomes a cooperative tool for sustainable water governance. Individuals and institutions who help define boundaries and thresholds are more inclined to uphold them, support necessary interventions, and adjust strategies over time. Through this feedback loop, ecological and socio-economic systems both benefit, strengthening the capacity of basins to navigate future uncertainty.

Sturgeons of the Po River (northern Italy), from a silent disappearance towards a bio-cultural restoration of these species: management challenges and perspectives

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Presenting Author: Samuele Pagani

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 15:45-16:00, Tuesday 22 July

Abstract

Sturgeons are iconic and often migratory fishes, facing global population declines due to multiple anthropogenic stressors such as overfishing, habitat alterations and poaching. Here we present a study focused on the Po, which is the longest river in Italy (652km) and the only one where three out of eight sturgeon species present in Europe -adriatic (Acipenser naccarii), common (Acipenser sturio), and beluga (Huso huso) - coexisted. In this region, sturgeons were appreciated as highly prized resources since Roman times and where specific culinary traditions developed, dating back to the 16th century onwards, shaping local economies and cultural traditions until the mid-20th century. Despite this cultural significance, their populations steeply declined until the mid-1980s, when the beluga and the common sturgeon disappeared from professional fishermen's catches and scientific monitoring programs. Both species were recently assessed as extinct in the Po River (IUCN, 2022) whereas the adriatic sturgeon remains the only survivor, benefiting from continuous restocking programs conducted over the last 30 years through ex-situ conservation efforts. The Storione Ticino farm, located on a main tributary of the Po River, maintains the only pristine broodstock of Adriatic sturgeons that has been genetically assessed for restocking purposes. To date, conservation efforts (including sturgeon releases) have primarily occurred within the Po River main course funded by projects ranging from regional to international scales. Although crucial for the survival of the species, these initiatives yielded a lower contribution than expected. Among the reasons include poaching, by-catch from recreational and professional fishermen, both within the Po River and deltaic areas, and accelerated by the replacement of native communities

with invasive species such as the apex predator Silurus glanis. Paradoxically, human communities represent both the primary source of threat and the sole restoration opportunity for these species. Overall, future restoration efforts are envisaged towards selected Po River tributaries based on available information regarding sturgeon's habitat requirements, despite several ecological details remain to be clarified. Additionally, societal and stakeholder involvement must be strengthened to preserve the sturgeon's bio-cultural heritage—the interlinked ecological and cultural significance of these species—thus preventing the failure of conservation measures.

The contribution of Anguilla anguilla as an umbrella and flagship species to the restoration of an aquatic ecosystem: problem statement

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Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 16:00-16:15, Thursday 24 July

Abstract

Umbrella species exist in a wide range of settings and impacts other species and ecological processes through its behaviour. They live in a variety of habitats and natural resources, and their protection ensures the survival of other species in those ecosystems. The conservation of umbrella species is a method for conserving biodiversity. Anguilla anguilla is a typical umbrella species whose distribution extends from Northern Europe in the north to Northern Africa in the south, the Middle East in the east, and the Gulf of Mexico in the west. They exist in a broad range of environments, including marine, brackish, and freshwater ecosystems, such as oceans, seas, estuaries, lagoons, wetlands, lakes, and large and small rivers and tributaries. These species' migratory characteristics provide a particular purpose in linking habitats and stimulating inter habitat commerce. Furthermore, under certain conservation scenarios, the European eel serves as a flagship species due to its attractiveness, economic value, and high emotional appeal. The European eel is a severely endangered species that needs conservation efforts. We might employ this species to preserve biodiversity and repair a section of a river system. Bafa Lake and the Büyük Menderes Delta are major habitats for European eels in Türkiye. Nevertheless, agriculture, industry, and urbanisation have all had significant effects on the system. In the current ecosystem restoration work, we want to deploy the European eels as an umbrella and flagship species in Bafa Lake and the Buyük Menderes Delta. We developed a

systematic framework for the conservation of European eels under the governor's supervision to identify and address important problems. This conservation system had three primary components: academia, non-governmental organisations, and national governmental agencies. This contribution outlines the first stage of constructing a problem statement. Identifying the primary issue and specific sub-issues pertinent to the local context is essential for devising practical and implementable remedies. It was decided to concentrate on resistant topics, particularly those involving pollution reduction.

The Effects of Salinity and Heatwave on Zooplankton Community Structures, Diversity and Resource Use Efficiency: Synchronized Mesocosm Experiments, Türkiye

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Presenting Author: Gül Canan Yavuz

Status: Oral presentation

Session Number & Date: Impacts of freshwater salinisation on aquatic ecosystem structure, function and biodiversity, 15:15-15:30, Tuesday 22 July

Abstract

Zooplankton are integral components of aquatic food webs, playing key roles in energy transfer, nutrient cycling, and overall ecosystem stability. In the context of global climate change, freshwater salinization and increased frequency of heatwaves have emerged as pervasive stressors,and those are mainly driven by anthropogenic activities such as urban runoff, agricultural irrigation, and industrial discharges. These changes alter the ionic composition of water bodies and intensify thermal stress, potentially pushing aquatic organisms beyond their physiological limits. To investigate the individual and combined impacts of these stressors on zooplankton communities, we conducted synchronized mesocosm experiments in two climatically distinct regions of Türkiye: Ankara, characterized by cooler conditions, and Mersin, known for warmer ambient temperatures. In each site, 16 mesocosms were deployed and assigned to a factorial design comprising two salinity treatments—4 ppt representing low salinity conditions and 40 ppt representing high salinity conditions—and a simulated heatwave treatment that raised the temperature by 6 °C above the ambient temperature levels. This experimental approach allowed us to directly compare the effects of salinity and thermal stress under differing regional climates. Our results indicate that elevated salinity is the dominant driver of community shifts. In high-salinity mesocosms, zooplankton communities became increasingly dominated by small, salt-tolerant rotifers, whereas larger-bodied cladocerans and copepods prevailed under ambient salinity conditions. The application of a heatwave further exacerbated these patterns, leading to a significant reduction in species richness and average body size. Notably, these effects were particularly pronounced in the warmer Mersin site, where the combined ionic and thermal stresses more severely limited the range of species able to

persist. Overall, these findings suggest that as climate change continues to drive both freshwater salinization and the frequency of extreme thermal events, the combined pressures will likely induce further alterations in zooplankton community structure and size dynamics, with clear differences emerging across climatic regions.

The role of emotion, trust, and Indigenous Knowledge in sustainable freshwater stewardship

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Presenting Author: Katarina Ana Cetinic

Status: Poster presentation

Session Number & Date:

Abstract

Achieving sustainable freshwater resource management requires more than scientific data and policy interventions; it necessitates meaningful communication that builds trust, evokes emotion, and encourages relational understanding. Non-verbal communication, storytelling, and Indigenous Knowledge Systems (IKS) play a crucial role in shaping human engagement with environmental issues. This presentation explores the intersection of emotion, trust, and Indigenous epistemologies in promoting sustainable action, with a focus on freshwater systems. Narrative and emotional appeals in science communication strengthen public engagement, encouraging a sense of responsibility and long-term commitment to sustainability. Emotional storytelling has been shown to enhance knowledge retention, shape attitudes, and make environmental crises feel more immediate and personally relevant. Indigenous knowledge, deeply rooted in relational values such as reciprocity, respect, and stewardship, presents an alternative framework for water governance that prioritizes interconnectedness over extractive resource management. Indigenous-led conservation efforts have demonstrated resilience and adaptability in the face of environmental change, yet mainstream conservation policies often fail to fully integrate these approaches due to systemic inequities, a lack of trust, and the dominance of Western scientific paradigms. Despite the advantages of emotionally resonant and Indigenous-led approaches, challenges remain. Over-reliance on narrative framing risks oversimplifying complex ecological issues, while Western science often struggles to integrate Indigenous epistemologies in a way that is both ethical and equitable, avoiding tokenization or appropriation. A critical approach to communication – one that prioritizes inclusivity, equity, and intersectionality – can help bridge these gaps by fostering deeper collaboration and mutual respect. By recognizing the power of emotion and trust in shaping environmental behaviors, freshwater governance can move beyond technocratic decision-making towards approaches that encourage deeper cultural and ethical engagement. Future efforts should prioritize co-management models that empower Indigenous leadership, integrate emotional storytelling into science communication, and

cultivate trust among diverse stakeholders, ensuring that freshwater sustainability efforts are holistic, inclusive, and effective.

The role of freshwater mussels in shaping macroinvertebrate communities in oil palm plantation streams

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Presenting Author: Tabitha Richmond

Status: Oral presentation

Session Number & Date: Multiple stressors in freshwater ecosystems, 11:15-11:30, Monday 21 July

Abstract

Conversion of tropical forest to oil palm plantations causes significant changes to rivers by altering their beds, banks and riparian vegetation, thereby increasing sedimentation, temperature, and input of nutrients and pollutants. While existing research indicates that these alterations lead to declines in tropical freshwater biodiversity in general, the specific impacts of oil palm plantations on one of the most vulnerable taxonomic groups on the planet – the freshwater mussel (Bivalvia: Unionida) – have never been quantified. This is a significant research gap when considering that freshwater mussels provide a range of ecosystem functions that support biodiversity, including water clearance, nutrient cycling, and habitat structuring, and could therefore potentially act as important mitigators of the negative impacts of oil palm plantations on freshwater habitat and biodiversity. In this study of the Serting river catchment in Peninsular Malaysia, we aim to elucidate the functional roles of freshwater mussels in tropical oil palm streams and quantify to what extent they are affected by variation in plantation management strategies (including riparian buffer size and characteristics). To achieve these aims, across 13 study sites, we quantified the relationships among environmental conditions, mussel communities, and other biotic communities. At each site, we conducted habitat assessments to assess water quality, river morphology and flow hydraulics, riparian vegetation and condition, and surrounding land-use characteristics. Our understanding of the diversity and distribution of tropical freshwater biodiversity is hampered by a lack of taxonomic research and identification keys, combined with the challenges of sampling tropical freshwater habitats. We overcame these challenges by combining traditional survey techniques with

environmental DNA (eDNA) sampling and metabarcoding. We conducted traditional mussel surveys, kick-net sampling for macroinvertebrates, aquatic eDNA sampling and sediment eDNA sampling. eDNA samples were amplified using a range of CO1, 16S, and 12S markers to describe mussel, macroinvertebrate, fish, and bacterial community compositions. Initial results suggest significant variation in mussel densities and macroinvertebrate community compositions across the study region. Our analyses focus on identifying a) relationships between mussel communities (density, species composition etc.) and fish, macroinvertebrate and bacterial communities; b) patterns of community compositions across the survey region and c) the environmental drivers of the observed patterns in biotic communities. Understanding the key drivers of spatial patterns in freshwater mussel communities, and other biotic communities will be key to identifying conservation opportunities in the region. Mitigating the functional loss of species under land-use changes could lead to effective safeguarding of freshwater ecosystems and the services they provide.

The role of periphyton in alpine and subalpine streams: biomass, nutritional quality, and ecological significance

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Presenting Author: Maria Chiara Vulcano

Status: Oral presentation

Session Number & Date: Sediment and benthic ecology, 11:45-12:00, Tuesday 22 July

Abstract

In mountain stream food webs, periphyton is a key resource that supplies consumers with carbon and essential nutrients, including polyunsaturated fatty acids (PUFA), which are critical for consumer growth and reproduction. Its role is particularly important in high-elevation streams above the tree line, where terrestrial organic inputs are minimal. However, studies indicate that periphyton is a vital energy source for invertebrates and fish also in subalpine streams, largely due to its higher nutritional quality compared to terrestrial detritus. Here we present the results of a literature review on the biomass and nutritional quality (PUFA content) of periphyton in alpine and subalpine streams. Research shows that, especially in high-elevation glacier-fed and groundwater-fed streams, periphyton biomass follows seasonal patterns, with peaks occurring when environmental conditions favor periphyton accrual. Research also suggests that periphyton biomass levels may vary in streams with different nutrient and disturbance regimes. For example, studied glacier-fed streams were found to be less productive than groundwater-fed ones. Published studies also demonstrate that environmental factors, such as light, temperature, and nutrient concentrations in stream water affect the nutritional quality of periphyton. The content of the omega-3 PUFA, eicosapentaenoic acid, in periphyton is higher at lower temperatures and at moderately high nutrient levels, whereases levels of the omega-6 PUFA, arachidonic acid, are influenced by light intensity. Specifically, arachidonic acid content is higher in sites and seasons characterized by low light intensity (high canopy cover). Despite their nutritional relevance, periphyton abundance and nutritional quality remain understudied in alpine and subalpine streams. Understanding their trophic fate is crucial for assessing effects on herbivores and consumers at higher trophic levels, including fish, insectivorous birds, and humans. Finally, improved knowledge of periphyton dynamics is crucial for anticipating how mountain stream ecosystems will respond to climate change, particularly in terms of shifts in primary production and food web stability.

The Role of Sediment Phosphorus Release in Algal Blooms: Insights from Lake Balaton Under Varying Oxygen and Temperature Conditions

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Presenting Author: Zsolt Kerekes

Status: Oral presentation

Session Number & Date: Sediment and benthic ecology, 11:15-11:30, Tuesday 22 July

Abstract

Lake Balaton is the largest shallow lake in Central Europe. From the millennium up until 2019, there was no significant problem with the water quality of the lake. However, in 2019, an unexpected algal bloom was observed in the western part of the lake, followed by a second, less severe event in the eastern parts. This raised concerns about the deteriorating water quality, prompting us to study the significance of internal nutrient loading under different environmental conditions. To investigate this, intact sediment cores were collected and analyzed for phosphorus release under both oxic and anoxic conditions, along with a temperature gradient (21 °C, 24 °C, 27 °C). The cores were deprived of light to prevent benthic photosynthesis. Anoxic conditions were maintained by bubbling the cores with nitrogen until the dissolved oxygen levels dropped below 1 mg/dm³, after which they were sealed airtight. Oxic conditions were established similarly, but with air instead of nitrogen. Dissolved oxygen levels were monitored, and soluble reactive phosphorus (SRP) concentrations were measured three times a week. Our results showed that cores under oxic conditions exhibited no significant phosphorus release, while the highest release rate occurred at 27 °C under anoxic conditions. This suggests that sediment phosphorus release under anoxia could have played a major role in the observed algal blooms over the last decades. These findings highlight the potential consequences of climate change-induced warming and oxygen depletion in shallow lakes, emphasizing the importance of effective water quality management strategies. This research was supported by the RRF-2.3.1-21-2022-00008 project and the Hungarian Academy of Sciences (MTA) National Program for Sustainable Development and Technologies (FFT NP FTA).

The role of shredder identity and ontogenesis in leaf litter decomposition: insights from an experimental study

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Presenting Author: Mourine J. Yegon

Status: Oral presentation

Session Number & Date: Sediment and benthic ecology, 11:15-11:30, Tuesday 22 July

Abstract

Biodiversity is key to ecosystem functioning, with greater efficiency of ecosystem processes often associated to higher biodiversity. Yet, such relationships may not always be constant as intraspecific variation modulates how a species contributes to ecosystem functioning. Ontogenetic shifts can be particularly important in modulating a species' contribution to ecosystem functioning. In aquatic ecosystems, benthic invertebrate shredders have an important role in organic matter processing and nutrient cycling. Shredder diversity has been shown to increase leaf litter decomposition, but how much shredders vary in their leaf litter decomposition capacity is yet not well understood. Arguably, ontogenetic stages can be expected to differ in their capacity to decompose leaf litter. Here, we examined how shredder taxonomic identity and ontogenetic stage influence leaf litter decomposition and fine particulate organic matter (FPOM) production in streams. Using a fully randomized factorial design in a laboratory experiment (April–May 2024), we fed three caddisfly shredders (Allogamus, Potamophylax, and Sericostoma) and their combinations with highly decomposable alder leaves. We compared (1) species-specific differences in leaf consumption and FPOM production, and how these processes differ among (2) ontogenetic stages and (3) experimental shredder communities. We hypothesized that shredder identity would primarily drive decomposition, with diversity enhancing leaf breakdown, and younger larvae exhibiting higher processing rates due to increased metabolic demands. Our results revealed that species identity and ontogenetic stage had strong influence on decomposition and FPOM production. Potamophylax, particularly in its younger instar stages, exhibited the highest decomposition and FPOM production rates, while Allogamus showed the lowest. We

observed positive diversity effects in some combinations of taxa. Also, ontogenetic shifts were evident, with younger larvae exhibiting greater decomposition and FPOM production rates. These results underscore the importance of shredder identity and life stage in determining the timing and intensity of ecosystem functions.

The role of submerged macrophytes in modulating methane emissions and denitrification processes under a global change context

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Presenting Author: Nuria Carabal

Status: Poster presentation

Session Number & Date:

Abstract

The emissions of greenhouse gases (GHG), such as methane, from inland waters is an increasingly important issue. Global change factors like warming and eutrophication can substantially influence GHG emissions, establishing feedback loops and synergies that may worsen the situation. Macrophytes inhabiting such ecosystems are thought to modulate GHG emissions and to act as a link between the carbon and nitrogen cycles. Specifically, aquatic vegetation would be involved in the anaerobic oxidation of methane coupled with denitrification, although this process remains underexplored. To tackle these issues, we conducted two microcosm experiments. In the first experiment, we addressed the influence of two thermal regimes on the growth of two submerged macrophyte species with contrasting functional traits (the charophyte Chara hispida and the phanerogam Myriophyllum spicatum), and, in turn, on the production of GHG and the sediment microbial composition. In the second experiment, we analyzed the relationship between methane oxidation and denitrification, and how these processes are modulated by C. hispida and its associated microbial community under two trophic status scenarios. Our results show that the warming (3 °C increment) did not cause significant changes in the final biomass and growth rate of the macrophytes in the short-term, nor did it significantly affect CH_4 emissions or dissolved CH_4 concentrations. However, the presence of macrophytes, both the vascular plant and the charophyte, considerably reduced the diurnal diffusive CO_2 emissions due to their photosynthetic activity, compared to bare-sediment conditions. Moreover, the different functional traits of the macrophyte species (e.g. roots -with higher radial oxygen loss- versus rhizoids) caused microaerobic versus anaerobic conditions in the superficial sediment, shaping distinct sediment microbiomes in each case that also differed from those observed in the bare-sediment condition. Regarding the coupling between methane oxidation and denitrification, we found that C. hispida treatments held significantly higher methane production rates than bare-sediment treatments, independently of the trophic status. However, more than 70% of the methane

produced in C. hispida treatments was anaerobically oxidized, attributed to higher denitrification rates compared to bare-sediment treatments. These findings suggest that submerged plants, especially perennial species like those tested here, play a crucial role in regulating GHG emissions in the current global change context. Thus, to effectively mitigate GHG emissions and eutrophication effects, ecosystem management strategies should favor the dominance of this type of primary producers, as they can provide ecological services year-round. Overall, these results underscore the significant contribution of macrophytes in mitigating the effects of global change on aquatic ecosystems.

The significance of Mayflies (Insecta: Ephemeroptera) in mountainous and semi-mountainous rivers from watersheds within the West Aegean basin

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Presenting Author: Biljana Rimcheska

Status: Oral presentation

Session Number & Date: Freshwater biodiversity - status, advances & future priorities, 14:30-14:45, Monday 21 July

Abstract

The mayflies (Ephemeroptera) are among the most abundant benthic invertebrates associated with natural running freshwaters. They inhabit a variety of environments and show a high sensitivity to anthropogenic pressure. Therefore they are often used as bio-indicators of freshwater health. Mayfly assemblages vary depending on the environmental, geographic and hydrological conditions along latitudinal gradient and the negative impacts on river watersheds. Nevertheless, the diversity and abundance of these communities and their ecological preferences in the mountainous and semi-mountainous streams and rivers across Balkans are yet insufficiently studied. We analysed mayfly assemblages, their microhabitat preferences in R3- (mountainous) and R5- (semi-mountainous) river types, as well as correlations between the relative abundance and species diversity both per site and season and accounting for water quality in spatial and temporal scale. In total 69 samples from 38 sites (Struma, Mesta and Vardar River basins) were collected in autumn 2017 and spring 2018. We reveal the characteristic elements of the mayfly fauna from representative sites of studied river types. Variation in species diversity, total and relative abundance, and the similarity in assemblage composition between/within studied basins were analysed. A total of 59 morphologically distinct mayfly taxa (from total 280 macroinvertebrate taxa) belonging to 18 genera and eight families were identified. Thus, mayfly taxa dominated the macroinvertebrate communities. The dominant taxa were Baetis rhodani (37 sites), B. muticus (36 sites) and the genus Ecdyonurus (35 sites). Minor differences in number of taxa, total and relative abundance and species diversity were noted between seasons and river types, mainly as the sites' seasonality was not influenced by the low water level in autumn, but by reach-scale microhabitat diversity. We observed a positive correlations (0.45) between relative abundance and the number of taxa per site. Mayfly species diversity was influenced by substrate heterogeneity which in turn was determined by seasonality and anthropogenic activities. The species richness

per river basin was high, and was highly influenced by river morphology and anthropogenic degradation of microhabitats. Struma basin had the highest taxa richness with >20 mayfly taxa, observed at four sites. Following the longitudinal gradient, we observed increasing taxa diversity, except at human-impacted sites. Mayfly taxa abundance and richness were comparable at R3- and R5- sites, likely because diverse microhabitats, higher oxygenation and water velocity, and lower water temperatures are characteristic of mountainous and semi-mountainous streams and rivers across Balkans. Their diverse mayfly assemblages, including rare and endemic species, highlight the importance of protecting such rivers from future degradation and pollution across Western Aegean basins and the wider Balkan peninsula.

The Underrated Consequence of River Disconnection: How Sediment-Driven Oxygen Consumption Reduces Floodplain Ecosystem Resilience under Climate Change

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Presenting Author: Luisa Coder

Status: Poster presentation

Session Number & Date:

Abstract

Climate change and anthropogenic river modifications alter water quality and ecosystem stability. Conservation efforts focus on reducing eutrophication in larger lakes, yet smaller, disconnected water bodies serve as valuable habitats and play a crucial role in water retention. We hypothesize that oxygen depletion in disconnected water bodies is driven predominantly by sediment oxygen consumption rather than planktonic algal biomass, particularly under low water conditions. This study examines two contrasting sites in the floodplain of the river Elbe in Germany. Here, the distal part of an old riverbed was separated by a dike in the 18th century, creating a permanently connected and disconnected site. We analyzed key hydro-biogeochemical parameters, including chlorophyll fluorescence (as a proxy for algal biomass), dissolved oxygen, and temperature, at high temporal resolution from 2022 to 2024, capturing a wide range of hydrological conditions, including an extreme drought and a flood event. Our results show that during peak algae growth, dissolved oxygen, and chlorophyll fluorescence follow the expected positive linear relationship in the main river and the connected site ($r^2 = 0.46$, $p < 0.0001$ and $r^2 = 0.23$, $p < 0.0001$, respectively). In contrast, no such relationship was observed in the disconnected site ($r^2 = 0$, $p = 0.6$). Furthermore, critically low oxygen concentrations below 20% saturation were observed only at the disconnected site. We argue that these differences are driven by sediment-oxygen consumption. In the disconnected site, a likely higher proportion of organic sediment leads to increased oxygen consumption, particularly during low water levels, when the total amount of available oxygen in the water column decreases. In contrast, water exchange in the connected site, in particular during flood events, may remove fine-grained organic sediments, maintaining the expected relationship between algal pigment concentration and oxygen production. Our findings highlight that small, disconnected water bodies with high organic sediment loads and limited surface water exchange are particularly vulnerable to oxygen depletion.

As a consequence, this can lead to phosphorus remobilization, hydrogen sulphide formation, and an increased risk of fish kills. As climate change and river modifications lower water levels and disrupt hydrological connectivity, these systems become increasingly sensitive to sediment-driven oxygen depletion, reducing their role as stable habitats and water retention areas—challenging current management approaches focused primarily on nutrient control.

Threatened fish and turtle assessment and recovery from extreme events in Australia's Mary River

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Presenting Author: Luke Carpenter-Bundhoo

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 15:30-15:45, Tuesday 22 July

Abstract

The Mary River in eastern Australia is a hotspot of threatened aquatic species including Australian lungfish, Mary River cod and Oxleyan pygmy perch, as well as the cloacal-respiring white-throated snapping turtle and Mary River turtle. The last extensive surveys of this river system occurred over 30 years ago, which has resulted in a limited understanding of the species' current distributions and population trends. Since then, extreme weather events have caused sequential severe droughts, heat waves, wildfires and floods. Coupled with habitat degradation and invasive species, these interacting threats pose increasing risks to the resilience and long-term survival of threatened freshwater species. In this study, we aimed to establish a post-impact baseline for the present distribution and demographics of native threatened and invasive species within the Mary River. We employed a combination of traditional and modern sampling techniques, supplementing electrofishing and fyke-netting captures with targeted environmental DNA (eDNA) assays, and comparing between the two. We surveyed >50 sites and found some differences in species detection between traditional and modern sampling techniques. While Australian lungfish and white-throated snapping turtles were widespread, all other threatened species were limited and fragmented in their ranges and low in abundance. Compared to available historic records, invasive species have substantially increased in distribution and abundance. While several concerning trends were recorded by this study, it is difficult to disentangle the concurrent and likely compounding effects on threatened species of extreme events, riparian degradation and invasive species. In addition to this, the Mary River cod lost a large proportion of critical nesting habitat (large hollow logs) during the flood event. We successfully trialled artificial nesting habitat enhancement for this species using natural materials to compensate those lost. Using endoscopic camera monitoring, we recorded a number of species using the

artificial habitat structures, including spawning Mary River cod. Information gained from these studies is being used to guide future recovery actions for these species and their habitats.

Towards the assessment of E-flows: a fish-based approach for the Tiber River basin (central Italy)

Antonella Carosi[1], Francesca Lorenzoni[1], Fatemeh Zarei[1], Rachele Brustenga[1], Lucio Di Matteo[2], Daniela Valigi[2], Corrado Cencetti[2], Carlo Cardellini[2], Stefano Casadei[3], David Cappelletti[1], Massimo Lorenzoni[1]

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Presenting Author: Antonella Carosi

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 16:30-16:45, Thursday 24 July

Abstract

Estimating Ecological Flows (EF) in rivers is crucial for meeting the goals established by the Water Framework Directive (WFD) 2000/60/EC. The hydrological regime and EF are strongly linked, as preserving natural flow patterns supports the conservation of native species. In developing an EF model, it is essential to use biological indicators as reliable tools to record the impacts of hydrological and hydromorphological alterations on aquatic ecosystems. The fish fauna can respond to annual flow variability, due to their ability to move at different spatial and temporal scales as well as their use of diverse mesohabitats to perform essential life processes. This adaptability positions fish as a significant biological quality element (BQE). Consequently, employing fish as bioindicators represents a powerful tool for assessing the impact of changes in the hydrological regime on the natural communities within a river system. The New Index of the Ecological Status of Fish Communities (NISECI) is the methodology developed in Italy that uses fish communities as BQE to assess ecological status, as directed by the WFD.We applied the NISECI as a criterion to define the transition from the Minimum Vital Flow (MVF), currently in force, to the EF, as required by the WFD. With this aim, we refined the reference conditions for freshwater fish communities of the Tyrrhenian side of Italy and updated the lists of alien species to be used in the calculation of NISECI. We defined NISECI values for 25 river stretches located in the Tiber River basin hydrographic network, and characterized physicochemical conditions. For summer flow rates, which correspond to the low-flow season, we equated the EF to the MVF at locations in which WFD objectives had been met. In the other cases, we predicted an increase in flow rate, depending on the deviation from good ecological status, also taking into account the need to maintain the river's diluting capacity. In line with this approach, we based variation in the quantity,

quality, and timing of water discharge envisioned by the EF concept on the natural flow duration curves calculated for the Tiber River basin.

Toxin production in Microcystis aeruginosa under elevated temperature and CO_2: short- vs. long-term responses

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Presenting Author: Bogdan Drugă

Status: Oral presentation

Session Number & Date: Freshwaters in a changing climate, 15:30-15:45, Tuesday 22 July

Abstract

Global climate change is altering aquatic environments through increasing temperatures and rising atmospheric CO_2 concentrations, both of which can influence the physiology, composition, and toxicity of freshwater phytoplankton communities. Cyanobacteria of the genus Microcystis, particularly Microcystis aeruginosa, are known for their ability to form harmful blooms and produce microcystins. These blooms pose risks to ecosystem health, water quality, and public safety. While it is widely predicted that M. aeruginosa may increase in dominance under future climate scenarios, the impact of elevated temperature and CO_2 on its toxin production, especially over longer timescales, remains poorly understood. In this study, we aimed to assess how microcystin production in Microcystis aeruginosa responds to increased temperature and CO_2, considering both short-term physiological plasticity and long-term evolutionary adaptation. We worked with three toxin-producing strains of M. aeruginosa, exposing them to elevated temperature (26°C compared to the ambient 22°C) and elevated CO_2 (1000 ppm vs. 430 ppm), both individually and in combination. These treatments were applied over short-term periods (2, 4, and 8 weeks) as well as after long-term cultivation (5 years) under the same environmental conditions. Secondary metabolite profiles were analyzed, with a focus on microcystin production and possible changes in toxin composition. Preliminary analyses show that the responses were strain-specific, and that toxin production clearly varied with exposure duration. These findings suggest that both plastic and adaptive responses influence the toxic potential of M. aeruginosa under climate stressors. Our study highlights the importance of considering exposure time in assessing the ecological impact of climate change on freshwater cyanobacteria. By integrating both short- and long-term perspectives, this research contributes to a better understanding of how key bloom-forming species may respond to a changing world. It also underscores the

need for long-term experiments when predicting future bloom dynamics and the associated risks for aquatic ecosystems and human health.

Tracking Aquatic Plant Phenology Across Europe: First Insights from the FreshProject EUPHORIA

Benjamin Misteli[1], Aaron Kaszta[2], Áine Roche[3], Alfredo Llorente[4], Altin Ghojoghi[5], Amelie Wächter[6], Annemieke Drost[7], Aránzazu Estrada Fernández[8], Armando Espinosa Prieto[9], Aron Castelli[10], Bastian Polst[11], Bastian Robran[12], Bujor Marius[13], Carlos Cano-Barbacil[14], Charlotte Doebke[15], Corentin Gaudichet[16], Daniel Morant[17], Daniel Zelenka[18], Darmina Niță[19], Dinu Valentin[20], Elmira Akbari[21], Elsa Bisbal[22], Eric Baqué-Díaz[23], Erika Skříšovká[24], Florian Lüskow[25], Frederike Kroth[26], von Lampe Friedemann[27], Harriet Kanyongi[28], Imola Tenorio-Baigorria[29], Jacqueline Hoppenreijs[30], Janine P da Silva[31], Jeanne Ricardo[32], Judith Hary[33], Kitti Németh[34], Laura Coulson[35], Lena Fehlinger[36], Leonie Haferkemper[37], Leonie Schweiger[38], Liucija Kamaitytė-Bukelskienė[39], Maja Novković[40], Małgorzata Łaciak[41], Manuela Ramírez-Valle[42], Marcos Rodrigues Rocha Dias[43], Mariusz Mangold[44], Mariusz Wierzgoń[45], Marta Pedrón[46], Mahdjoub Amine M.[47], Mónica Lanzas[48], Morgane Jean[49], Mourine Yegon[50], Muireann Cotter[51], Nadia Romelia Zinner[52], Vu Duc Thinh Nguyen[53], Noah Benjamin Maurer[54], Patricia Díaz[55], Pauline Balk[56], Pratiksha Acharya[57], Radka Sedláčková[58], Rebecca Oester[59], Selina Löffler[60], Sílvia Martins[61], Simon Wentritt[62], Sirka Heinrich[63], Stefano Mari[64], Tünde Mészáros[65], Valentin Moser[66], Krisztina Verbényiné Neumann[67], Víctor Manzanares-Vázquez[68], Vivien Bernhard[69], Zsolt Ladnyik[70], Alice Dalla Vecchia[71], Chiara Vitillo[72], Dario Di Lernia[73], Federica Rotta[74], Flavia Dory[75], Gabriele Consoli[76], Giulio Zangari[77], Lorenzo Pinzani[78], Maria Chiara Vulcano[79], Marta Zoppi[80], Martina D'Agostino[81], Paolo Cingano[82], Silvia Cannucci[83], Tancredi Fogazza[84], Tiberio Fiaschi[85], Veronica Nava[86], Angela Oguesha[87], Anna Nyberg[88], Athina Papatheodoulou[89], Bernhard Kløw Askedalen[90], Bruno Cremella[91], David de la Haye[92], Emil Nordström[93], Eve Cavey[94], Hayley McMechan[95], Katharina Wilfert[96], Kerstin Bouma[97], Kevin Noort[98], Léo Rasse[99], Lukas Petrulaitis[100], Marta Baumane[101], Michael Huby[102], Olivera Stamenković[103], Sydney Enns[104], Maria Pia Gervasio[105], Emanuele Pelella[106], Damiano Spagnuolo[107], Giulia Albani Rocchetti[108], Anne Lewerentz[109]

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Presenting Author: Benjamin Misteli

Status: Oral presentation

Session Number & Date: Aquatic and riparian vegetation, 16:00-16:15, Thursday 24 July

Abstract

Phenology, the timing of seasonal life cycle events, is a crucial indicator of environmental change and plays a fundamental role in shaping ecosystem interactions. Shifts in phenological traits of plants, such as earlier flowering or extended growing seasons, are well documented in terrestrial ecosystems and have profound ecological consequences, including trophic mismatches and altered competitive dynamics. However, despite the ecological significance of phenology and freshwater habitats, research on the phenology of aquatic macrophytes remains scarce. Understanding how phenological traits vary across spatial and environmental gradients is essential for predicting freshwater ecosystem responses to climate change. Given the expected extent of shifts in seasonal dynamics, broad-scale assessments are needed to evaluate spatial variation in macrophyte phenology.The newly formed FreshProject EUPHORIA (European Plant

Phenology Research in Aquatic Systems), is a collaborative project awarded by the European Federation for Freshwater Sciences (EFFS and EFYR) to tackle this topic. We are a team of over 100 Early Career Researchers (ECRs) from across 21 European countries who together investigate the topic of macrophyte phenology over the coming two years. Within EUPHORIA, we aim to document and analyze the phenological traits of macrophytes across Europe and understand their environmental drivers. During the next growth period, we sample five common native and non-native macrophyte species of different growth forms across a wide range of European freshwater systems. Following a standardized protocol, we investigate key phenological events throughout time in combination with environmental variables such as water temperature and trophic state. We will present our project, our plans for the two years, and preliminary results from the ongoing fieldwork. Our findings will contribute to a better understanding of freshwater plant responses to environmental change and improve predictions of macrophyte dynamics under future climate scenarios. By providing a continental-scale assessment, EUPHORIA offers valuable insights for conservation and management strategies in European freshwater ecosystems.

Trichoptera endemisms in the Italian peninsula: integrating genetic and morphological analyses

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Presenting Author: Quadroni Silvia

Status: Poster presentation

Session Number & Date:

Abstract

The peculiar geographical configuration of the Italian peninsula is ideal to support and maximize biodiversity. Literature data showed that Italy has a very rich and peculiar trichopteran fauna. Currently 468 taxa belonging to 444 species and 56 subspecies, 93 genera and 21 families have been reported. The Italian trichopteran fauna is characterized by a high rate of endemisms: the taxa that have a restricted range are 195 (equal to 41% of the Italian fauna), among these 95 are exclusive "Italian endemics", confirming the exceptional biodiversity hotspot of the Italian peninsula. Due to their abundance and species richness, Trichoptera constitute a fundamental component of the biocenoses of inland waters. The larvae have long been used in river quality monitoring, as excellent bioindicators of environmental conditions. However, the study of larvae often involves identification only at the family level. The absence of species-level information does not allow application of all the ecological and biogeographic information that these insects can provide. Hence, the importance of the knowledge of the Trichoptera taxonomy. Pivotal is the parallelism between morphological identification and genetic characterization, as morphology alone carries a high potential for misidentification, and the morphological classification of immature aquatic invertebrates is extremely challenging and time-consuming. This study, within the Next Generation EU project, aims to define and integrate with literature data the phylogeny of Trichoptera on the Italian territory, by combining genetic and morphological approaches. Samples, collected from the areas where the greatest number of endemic species are found (western Alps, southern Apennines and Sardinia), will be, firstly, photographed and the constitutive aspects of the distal segments of the abdomen will be evaluated, with comparative methods. The morphology of these elements will be extrapolated to define the structures useful for recognition at the species level. Second, mitochondrial cytochrome oxidase 1 gene (COI) will be sequenced for performing phylogenetic inferences. Genetic data will be integrated with the morphological ones and deposited in Genbank and BOLD database. This will provide new tools for species recognition, useful for future applications, targeting conservation actions.

Understanding the Factors Affecting the Diversity of Zooplankton Communities in a Pond Metacommunity

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Presenting Author: Feride Avcı

Status: Oral presentation

Session Number & Date: Freshwater biodiversity - status, advances & future priorities, 15:15-15:30, Monday 21 July

Abstract

Ponds, although small in size, are important ecosystems that act as hotspots for biodiversity in freshwater habitats. Within these microhabitats, they support a variety of ecological niches that are occupied by diverse communities of aquatic plants, invertebrates, vertebrates, and microorganisms. These habitats are especially important for connectivity and act as nodes in environmental networks, promoting gene flow, species dispersal, and the persistence of endemic and specialized species. Despite their ecological importance, ponds remain understudied compared to larger water bodies. Yet, they are ideal ecosystems to study metacommunity dynamics due to their small size, high environmental heterogeneity, and spatial structure. Functional trait-based approaches provide deeper insights into how species interact with their environment beyond traditional taxonomic measures, by linking traits to ecosystem processes and community responses to stressors. This study investigates the functional trait diversity within zooplankton communities across 40 ponds sampled in the villages of Ankara, Türkiye. The main objective is to assess the similarities among these ponds based on their abiotic conditions, including physicochemical variables, morphological attributes, and spatial proximity. Through this examination, the study aims to understand the role of environmental filtering and its influence on zooplankton communities in these pond ecosystems. By applying multivariate statistical approaches and trait-based analyses, the study evaluates how abiotic filters shape community assembly and functional composition. The results are expected to reveal differences in the degree of similarity between ponds and potential

associations between specific environmental variables and zooplankton community structure and traits. Understanding which filters play a dominant role can help identify which ponds are more vulnerable to environmental change and biodiversity loss. Determining the environmental drivers that affect zooplankton communities in these ponds can ultimately improve our understanding of the mechanisms regulating community assembly and ecosystem functioning in freshwater systems. Given the growing pressure of climate change, such knowledge is critical for creating conservation and restoration strategies to protect small waterbodies. This research aims to offer essential insights into the complex interactions between zooplankton diversity and abiotic conditions, contributing to evidence-based management of these overlooked yet ecologically valuable ecosystems.

Understanding “freshwater rewilding”: exploring the social and ecological context and impacts of rewilding interventions in the UK

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Presenting Author: Xi He

Status: Oral presentation

Session Number & Date: Novel approaches to assess the success of freshwater ecosystem restoration, 16:15-16:30, Thursday 24 July

Abstract

Freshwater ecosystems have been extensively altered to support human needs, such as irrigation, hydropower, and waste disposal, leading to hydrological changes, ecosystem degradation, and biodiversity loss. While restoration efforts, such as dam removal, and channel reconfiguration, have attempted to reverse these impacts, many projects fail to restore self-sustaining ecological processes. This has led to increased interest in rewilding as a novel and nature-led approach to freshwater restoration. Despite its growing recognition, the term “rewilding” is currently used inconsistently in the freshwater context, whilst attitudes, values and impacts of different freshwater rewilding approaches are poorly understood. In this project, we combine social science and ecological approaches to improve our understanding of “freshwater rewilding” with the aim to inform planning and implementation of freshwater rewilding interventions in the future. Firstly, we conducted a systematic review of the academic literature referring to “rewilding” in a freshwater context, which revealed strong temporal and geographical patterns. For example, since around 2003, researchers have begun using the term in freshwater environments in literature and have increasingly adopted it over the years. Researchers based in Europe and North America use the term more frequently than in other regions, particularly with regard to interventions in wetlands and rivers. In contrast, in China, freshwater rewilding is often focused on urban rewilding, whilst in Japan, the term applies mainly to passive rewilding practices, such as farmland abandonment. Secondly, we conducedt semi-structured interviews with important stakeholders across a freshwater rewilding project in the UK, including managers, rangers and farmers, to identify prevalent attitudes, values and motivations they hold towards freshwater rewilding. Interviews revealed diverse perspectives on the purpose and process of rewilding Thirdly, we assessed the early-stage environmental and ecological effects of restoring and rewilding interventions at the Boothby Wildland Rewilding Project in the UK. Previously used for arable farming and including the River Glen and several ponds, the site has recently been designated as a rewilding site. Ongoing and planned interventions for 2025 and subsequent years include river restoration measures, replanting of vegetation, and introduction of herbivores and

beavers. To assess the early impacts of these interventions on freshwater habitats, biodiversity and functionality, and to fill the gap of comprehensive monitoring of previous rewilding projects, we regularly collect pre- and post-intervention data on physical habitat characteristics, water quality and biodiversity across Boothby's freshwater sites, including environmental DNA (eDNA) approaches.The recent legalisation of beaver releases in England reflects a growing recognition of rewilding as a viable conservation strategy. This study will provide empirical evidence on the ecological benefits of freshwater rewilding, offering valuable insights for future freshwater restoration and conservation efforts. This presentation will focus on the initial findings of this project and reflect on the use of the term rewilding in freshwater environments.

Unveiling Microplastic Associated Microbial Communities: eDNA Analysis of Diversity and Environmental Risks

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Presenting Author: Işılay Çelik

Status: Oral presentation

Session Number & Date: Advancing research on plastic pollution: Impacts, transport, and management, 11:30-11:45, Monday 21 July

Abstract

Microplastics (MPs) are pervasive pollutants in aquatic environments, significantly impacting ecological processes and public health by serving as vectors for microbial colonization and biofilm formation. Understanding the microbial diversity and ecosystem interactions within these biofilms is crucial for assessing environmental risks. This study explores the seasonal dynamics of biofilm-forming microorganisms in the Melen River catchment using an environmental (e-DNA) approach. The V3-V4 region of the 16S rRNA gene was amplified from extracted DNA and sequenced using the Illumina MiSeq platform (2x300 paired-end chemistry). Analysis identified approximately 80,000 microbial genera across MP samples, with polyethylene (PE) and polypropylene (PP) being the most dominant polymer types. These plastics facilitate the attachment of bacterial genera such as Acinetobacter, Pseudomonas, Flavobacterium, Paludibacter, and Undibacterium, posing potential risks to aquatic food webs and public health. Possible metabolic pathways of bacteria that form on plastic surfaces engage in fermentation, vitamin biosynthesis, nucleoside and nucleotide degradation, and secondary metabolite breakdown. The findings underscore the urgent need to mitigate MP pollution in freshwater ecosystems to

protect environmental and human health. A deeper understanding of these microplastic associated microbial community is essential for evaluating the broader implications of plastic pollution on natural habitats and public health.

Unveiling the key drivers shaping the planktonic community size structure across lakes

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Presenting Author: Ariadna García-Astillero

Status: Oral presentation

Session Number & Date: Plankton ecology, 15:45-16:00, Thursday 24 July

Abstract

Body size influences ecological processes across all levels of biological organization from individuals to ecosystems. Body size explains individual metabolic rates and plays a crucial role in structuring consumer-resource interactions within food webs. In the context of global warming, increasing temperatures are expected to shift community size structure toward smaller body sizes. This is particularly relevant in aquatic food webs, where most organisms are ectotherms and thus highly dependent on environmental temperature. Predicted from metabolic theory and temperature-size rules, increased temperature fosters metabolic rates enhancing growth rates of juveniles but ultimately resulting in smaller adult body sizes. Additionally, both bottom-up (e.g., resource availability) and top-down (e.g., predation) factors may influence community size structure either promoting larger or smaller average body sizes and likely leading to changes in food web structure. In this study, we aimed to unveil the environmental variables shaping the planktonic community size structure in lakes across multiple trophic levels, from phytoplankton to predatory zooplankton. We used the local-size density relationship (LSDR) to analyse the planktonic size structure of an extensive dataset composed of 765 lakes sampled across the United States in summer 2017. The dataset included physical-chemical variables like water temperature, surface radiation, euphotic zone depth and total phosphorous, as well as biological variables like phytoplankton and zooplankton population density, and species mean body sizes. We used hierarchical partitioning and regression models to identify variable importance and select the most parsimonious model with explanatory variables and their two-way interactions. Results showed that most of the LSDR slopes deviated from the theoretical value of - 0.75 and becoming progressively shallower with increasing trophic level. We identified water temperature as the most important variable, with increasing temperatures leading to decreasing LSDR slopes across all trophic levels. Increased resource availability showed opposite trends across trophic levels, flattening

LSDR slopes for phytoplankton while steepening LSDRs for both herbivorous and predatory zooplankton. Predation only had significant effects on the herbivorous zooplankton, steepening its LSDR slopes. Nevertheless, these trends slightly changed when considering two-way interactions, as elevated temperatures or intensified predation modified the effects of the interacting variables and the community size structure. Our study underscores the value of developing body-size based approaches to improve the understanding of ecosystem structure and functioning.

Urban aquatic systems: fast forward to the future of water management

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Presenting Author: Lisette de Senerpont Domis

Status: Oral presentation

Session Number & Date: Freshwater ecosystems in urbanized catchments, 15:00-15:15, Monday 21 July

Abstract

Historically, humans have settled near to aquatic ecosystems, due to their demand of water for drinking and agricultural purposes, resulting in complex human-water interactions. Anthropogenic pressures such as eutrophication, emerging pollutants and climate change result in dramatic loss of biodiversity and ecosystem functions in aquatic systems, especially in urban environments which are a pressure cooker for fast environmental changes. Standing urban waters archive information from the entire catchment and serve as a sink for pollutants, and are therefore- vulnerable to compound effects of multiple contaminants and other stressors. Multiple pressures interact in complex ways and induce strong, often non-linear responses of species, communities and even entire ecosystems. In a rapidly urbanizing world, with almost 70% of the human population projected to live in cities in 2050, maintaining and creating an ecologically healthy urban waterscape will be a challenge. Urban waters are understudied as they are often not part of existing monitoring directives such as the European Water Framework Directive or Habitats Directive. At the same time urban waters are part of a multi-owner landscape, and ambiguous governance structures may lead to competing stakeholder demands and claims. Using a combination of participatory science approaches, experiments, and modeling, I will show how aquatic systems in heavily urbanized deltas are rapidly changing in the light of extreme climatic events, increasing discharge of emerging pollutants and eutrophication. The desired improvement of urban waterscapes represents a wicked social-ecological-technical systems (SETS) problem. I will provide examples on how viewing urban waters through the lens of the SETS framework can teach us valuable lessons that help to maintain healthy waters as we move towards a more urbanized future.

Using niche based-approach to predict the recovery of aquatic communities in restored stream

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Presenting Author: Valentin Marin

Status: Oral presentation

Session Number & Date: Novel approaches to assess the success of freshwater ecosystem restoration, 15:45-16:00, Thursday 24 July

Abstract

Hydro-morphological restoration is a common practice to rehabilitate perturbed streams and promote recovery of sensitive biodiversity. However, improving habitat quality does not always result in the recovery of resilient and functional community assemblages. This has been highlighted by using the substantial panel of bio-indicators over the last two decades to assess restoration outcomes, which has shown highly variable results, including negative ones. These results are primarily attributed to the rapid colonization by the surrounding species pool, considered as the « depauperate community », during the early stages of community's establishment. These species, more tolerant, tend to compete for resources and prevent the establishment of a community more sensitive and in tune with the habitat generated by restoration. Although the concept of priority effect is widely recognized in terrestrial restoration, the role of competition during colonization in restored streams is poorly understood. Reasons of this lack of knowledge were primarily due to the fact that most post-restoration monitoring have a low temporal resolution, which prevents the study of community dynamics during community's establishment. For the first time, we attempted to identify the potential role of priority effects in the community observed after river restoration by applying the concept of ecological niche occupancy. We used a decade of biannual monitoring of the macroinvertebrate community in a 200 m reach within a newly created channel of 5 km long located in a degraded and heavily invaded river floodplain (upper Rhine, France). We specifically focused on possible negative resistance of the local depauperate community arising from the nearby un-restored section

on the establishment of a sensitive community. We observed an important colonization of opportunist sensitive taxa during the primary succession (0-3 years), which were rapidly outcompeted by a community of tolerant taxa, largely constituted by exotic-invasive ones. We observed that establishment success decreased over time for all taxa and was higher in invasive taxa compared to native ones. Niche approaches based on multivariate analyses of functional traits revealed that the competition for feeding resources and habitat use can be related to taxa establishment success. However, it accounted for a minor part of the establishment success, suggesting that other traits or factors played a key role in the priority effect we observed. Although the extent of functional niches appeared stabilized after a decade, population dynamic analysis indicated that secondary succession was not fully completed. This was due to a slow recruitment of native community with competitive abilities (e.g., specialists in feeding) that in turn exclude invasive taxa in more recent years. Overall, these results suggest that duration of ecological successions in restored sections may considerably exceed the average time used for assessing community response to restoration (5 years). This could explain the large variability of responses to restoration observed in aquatic communities, and should encourage longer monitoring to assess an equilibrium status of communities. We argue that integrating functional approaches based on niche models could help to predict restoration effectiveness depending on the local species pool, particularly in a local context of invasive taxa occurrences.

Vulnerability of the freshwater fish community across European riverscapes

Gonçalo Duarte[1]

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Presenting Author: Gonçalo Duarte

Status: Oral presentation

Session Number & Date: Freshwater fish ecology, conservation and management, 16:30-16:45, Tuesday 22 July

Abstract

Fish species are the second most threatened animal group and represent 25% of all vertebrates across the globe, of which 40% are freshwater species. The aim of this study was to evaluate the vulnerability of native freshwater-dependent fish communities in European rivers. River systems are hierarchic and dendritic networks where flow imposes a directionality towards the sea within a drainage area, i.e., a sea outlet basin. In this work, the river basin spatial layer from the CCM2 database was used to represent the sea outlet basins. River Restoration Units (R2U) were used to allow for further spatial discretisation. We used the presence of native freshwater fish from the International Union for Conservation of Nature (IUCN) Red List to determine species occurrence per sea outlet basin and per R2U. To account for an overestimation of species distribution, due to the standardized convex hull methodology adopted by the IUCN, the dataset created was further curated using RivFISH, the most recent database about freshwater fish occurrence in Europe. RivFISH compiled information on 14453 presence records of European freshwater fish, covering 667 species across 1554 sea outlet basins. Freshwater fish status from the Habitats Directive (HD) allowed calculating the composite indicator Conservation Status (ciCS) whereas the species status from the IUCN allowed calculating the vulnerability index. The HD evaluated 165 species while the IUCN 633 species. Both indexes highlight the overall condition of the freshwater fish community per sea outlet basin and R2U. Both analyses show similar spatial patterns across Europe. River basins in Central and Eastern Europe were found to be the most species-rich, with the Danube, Volga, and Dnieper basins exhibiting the highest species richness values. The southern regions of Europe showed the highest vulnerability index values, with basins in the Iberian Peninsula, Adriatic Peninsula, the Balkans, and Turkey standing out compared to the rest of the continent. The relevant factors contributing to their high community vulnerability should be related to the combination of low species richness, the presence of threats, and high levels of endemism. The findings of this work enhance current knowledge and serve as a valuable resource for improving the management and conservation of freshwater fish communities in Europe.

Aquatic Plant Diversity in the Lake Yeniçağa Basin, Bolu, Türkiye

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Presenting Author: Nursel İkinci

Status: Poster presentation

Session Number & Date:

Abstract

Lake Yeniçağa is in northwestern Türkiye, in Bolu Province. It was formed as a result of tectonic activity due to its position along the North Anatolian Fault Line. The lake lies at an elevation of 989 meters above sea level (a.s.l.), while the highest point in the lake basin reaches 1,715 meters a.s.l. The lake covers a surface area of 2.42 km², and the entire basin spans 145 km². Yeniçağa is a shallow lake, with an average depth of 1.6 meters and a maximum depth of 4.5 meters. Except for its southern side, the lake is surrounded by peatlands. A total of 400 vascular plant species were recorded in the Yeniçağa Lake basin through our field studies conducted between 2022 and 2024, as well as through evaluations of previous research. According to the findings, 114 aquatic vascular plant species from 37 families were identified in the area. Among these, two are attached-floating, four are free-floating, ten are submerged, and the remainder are emergent species. Yeniçağa Lake basin hosts the highest number of macrophytes in Bolu Province. Some rare Turkish macrophytes, such as Ranunculus lingua and Acorus calamus, grow in the study area. The basin is also one of Türkiye's most important bird habitats, supporting 246 bird species from 56 families. The conservation status of the Yeniçağa Lake basin is classified as an "Internationally Important Wetland." However, the lake is surrounded by settlements that discharge sewage directly into its waters and by villages engaged in intensive agricultural activities. As a result, eutrophication has been one of the most significant threats to the basin's biodiversity for decades. Additionally, peat mining has been ongoing in the area since the early 1980s. The peatland has been shrinking primarily due to conversion to agricultural land and peat extraction. Given the multiple threats to the region's wildlife, it is crucial to document its biodiversity and assess the future of its habitats and their components.

Water Quality Dynamics in Foothill Rivers in the Context of Dam Reservoir Construction

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Presenting Author: Maksymilian Połomski

Status: Poster presentation

Session Number & Date:

Abstract

Reservoirs are structures potentially vulnerable to eutrophication, whose occurrence ocan be caused by, among other factors, the inflow of pollutants from the catchment area of the dammed watercourse. Surface runoff from agricultural fields or municipal and industrial wastewater discharges can supply rivers with water rich in biogenic compounds and inorganic nutrients, which may ultimately accumulate in the reservoir, leading to excessive growth of algae and cyanobacteria. Therefore, actions taken during the planning stage of such a structure are crucial, aiming to precisely assess the physicochemical potential of the river, predict the eutrophication process in the reservoir, and adopt appropriate technological solutions to mitigate undesirable deterioration of the quality of retained water, such as the use of pre-reservoirs. As part of the conducted research, an analysis of physicochemical parameters of water in the foothill rivers Ścinawka and Włodzica in southwestern Poland was carried out, where the construction of dam reservoirs is being considered. From March 2023 to March 2025, water samples were collected monthly along the entire length of the watercourses—from the sources to the planned dam site. This included a total of 6 sampling points along the 44.50 km length of the Ścinawka River (catchment area of 396 km²) and 4 sampling points along the 20.00 km length of the Włodzica River (catchment area of 105 km²). Data were obtained on parameters such as pH, conductivity, BOD5 and COD, as well as concentrations of nitrogen, phosphorus, dissolved oxygen, sulfates, and heavy metals. The results were supplemented by sediment analyses, further including the calculation of toxicity indices. The results were used to illustrate the variability of the hydrochemical state of the rivers on an annual scale and depending on the sampling location, to conduct statistical analyses, and to model the relationship between biogenic substance loads and the trophic potential of the planned reservoirs using the Vollenweider and Kajak methods. As a result, guidelines were obtained for potential investors or designers of these and other structures, indicating: (1) recommended sampling locations and the scope of laboratory analyses to be conducted during the planning stage, (2) the minimum duration and frequency of sample collection for studies, (3) which physicochemical parameter values may correspond to difficulties in maintaining proper water quality in the reservoir, and (4) what planning and technological

measures should be considered to reduce the risk of deteriorating trophic status of the retained water.

Water Wars: competition between native and exotic isoetid species

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Presenting Author: Jamoneau Aurélien

Status: Oral presentation

Session Number & Date: Invasive species in freshwater ecosystems, 10:45-11:00, Friday 25 July

Abstract

Among several global changes, invasion by exotic species is often pointed out as responsible for the decline of native species. Indeed, in the competition for space and resources, fast-growing species are generally more efficient than native ones. The natural lakes along the Aquitaine coast are home to unique and protected populations of isoetid macrophytes, which are declining in the last decades. The present study aims at testing the potential competition between the native isoetid Lobelia dortmanna and the exotic isoetid Sagittaria graminea, both coexisting in Lake Cazaux-Sanguinet, France. To achieve this, we set up a multi-year monitoring program across 1x1m quadrats, with three conditions: native species only, exotic species only, and mixed condition when both species occurred. Each individual in the quadrat was spatially mapped and its photosynthetic activity was measured, as well as its leaf length and width. Sediment samples were also collected to analyze differences in organic matter content and granulometry between the quadrats. Preliminary results show that, while substrate analysis indicates similar biotopes for both species, their co-occurrence triggered significant physiological and morphological responses. Additionally, the native and exotic species appeared to follow different patterns of spatial distribution. However, these first results did not necessarily indicate a negative effect of the exotic species on the native one. Further field sampling in the coming years will help clarify the temporal spatial dynamics of the two species.

What do we know or not know about the occurrence of freshwater invertebrate species in Europe

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Presenting Author: Mary Kelly-Quinn

Status: Oral presentation

Session Number & Date: Freshwater biodiversity - status, advances & future priorities, 14:15-14:30, Monday 21 July

Abstract

Recent publications have highlighted that freshwaters are among the most threatened ecosystems losing species at a faster rate than on land or sea. But what do we really know about trends in freshwater biodiversity? This paper provides an overview of data from

across Europe, collated to address a number of questions relating to knowledge on change in freshwater biodiversity. Questions asked: (1) What checklists are available and have been updated in recent years? (2) What do we know about the conservation status of European freshwater taxa? (3) What monitoring programmes are collecting species level data and for what taxonomic groups? (4) Can we use the data available to monitor biodiversity trends? Regarding national checklists, we surveyed 23 countries in Europe for 31 taxonomic groups living in freshwater, checking whether their checklists were updated after the publication of FaunaEuropaea in 2004. The number of countries with updated entries for each taxonomic group ranged from 6 to 20, with no group updated in all countries. The taxonomic groups that are included in the WFD were updated in significantly more countries than the groups that are not included in the WFD. The number of groups that have been updated for each country ranged from 2 to 31, with five countries having all groups updated. The number of groups for each country was strongly and positively influenced by latitude, number of inhabitants, and area, but not by per capita GDP. Species level data are collected for a limited range of taxonomic groups (e.g. molluscs, annelids, insects) in some countries with, again, a strong influence of latitude. The metrics used for the WFD cannot be used to assess trends in biodiversity. Many of these metrics are typically based on family level data, related to pressures or are poor measures of biodiversity (e.g. richness, Shannon-Wiener diversity). However, species level data could be used to assess trends in biodiversity where available .

Zooplankton Change (Kovid-19 process 2020-2021) in Lake Eğirdir-Türkiye

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Presenting Author: Meral Apaydın Yağcı

Status: Oral presentation

Session Number & Date: Plankton ecology, 16:00-16:15, Thursday 24 July

Abstract

Zooplanktonic organisms are closely related to water quality parameters and are used as Zooplanktonic organisms, which are important for fisheries, constitute a large group of aquatic organisms, and various species are considered as pollution indicators due to their sensitivity to environmental changes. In this study, the seasonal zooplankton fauna change of Lake Eğirdir for the year 2020-2021 was revealed during the Covid-19 pandemic. The study was carried out seasonally at 5 stations (Hoyran, Kayaağzı, Barla, Köprü, Gelendost) in Lake Eğirdir. Water temperature, pH, dissolved oxygen, oxygen saturation, salinity, electrical conductivity, from the physicochemical properties of water, were measured in the field with the WTW brand multi 3430 Set F field measurement set. Secchi disc visibility was taken with a secchi disc meter and depth with a sounder. Plankton samples were collected with the Hydrobios model horizontal plankton net and vertical plankton net with 55 µm mesh size. Collected zooplankton and their samples were determined in 4% formaldehyde, horizontally collected samples were used for qualitative determinations and vertically collected samples were used for quantitative determinations. The incidence (F %) was calculated according to the dominance of the species. A total of 27 species were determined in the seasonal study in Lake Eğirdir during the 2020-2021 Kovid-19 process. Rotifera constituted 52%, Cladocera 37% and Copepoda 11% and of total zooplankton qualitatively. Water temperature in the lake in 2020 summer, 2021 winter and spring seasons is 6.0-25.8°C, pH 8.33-9.26, dissolved oxygen 8.48-12.61 mg/L, dissolved oxygen saturation 89.1-150.1%, conductivity 248-438 µS/cm, Secchi disk measurement 0.4-6.0 m, depth values varied between 3.50-6.0 m. In terms of mean chlorophyll-a (1.8 mg/m3) and secchi disk (2.75 m) values, the lake showed oligotrophic-mesotrophic characteristics. According to the dominance index, Polyarthra dolichoptera (93%), Bosmina longirostris (87%), Asplanchna priodonta (73%) and Synchaeta pectinata (67%) are the species with the highest incidence. P.dolichoptera and B. longirostris were

found to be the dominant species. Euclanis dilatata, Filinia longiseta, P.dolichoptera, Keratella cochlearis, Lecane luna, L.bulla, Lepadella patella, Chydorus sphaericus, Coronatella recrangula and B. longirostris species that are characteristic of mesotrophic-eutrophic lakes were recorded in the lake.

Zooplankton Community Composition and Diversity Along a Salinity Gradient: Impacts of Freshwater Salinization

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Presenting Author: Irem Gamze Arık

Status: Oral presentation

Session Number & Date: Impacts of freshwater salinisation on aquatic ecosystem structure, function and biodiversity, 15:30-15:45, Tuesday 22 July

Abstract

Climate change-induced alterations in precipitation patterns, combined with the increasing demand for irrigation in agricultural areas, are contributing to rising salinity levels in shallow lakes. The increase in lake salinity may lead to irreversible consequences, such as changes in ecosystem structure and functioning, as well as a decline in biodiversity. Understanding the effects on zooplankton community structure is crucial for anticipating and mitigating the ecological consequences of freshwater salinization. We conducted a salinization mesocosm experiment in Ankara, Türkiye, over a six-month period to study how freshwater ecosystems respond to a gradient of 16 different salinities, ranging from 0.5 to 50 g/L. The experiment was divided into three phases: one month of gradual increase in salinity to reach different target levels (salinization period), five months of stable salinities (stable period), and two months of desalinization (desalinization period). In this study, we focused on salinization and stable periods to examine the response of zooplankton community structure and biodiversity to varying salinity levels. Preliminary results indicate that increasing salinity leads to significant, nonlinear declines in zooplankton richness, biomass, size, and resource use efficiency (RUE). Functional

diversity is also expected to decline; analyses are ongoing and will be presented. Community composition showed threshold responses: rotifers replaced cladocerans and copepods above 10–12 g/L, and a major shift occurred at 17 g/L, likely due to fish absence, suggesting altered trophic dynamics. These findings underline the vulnerability of zooplankton communities to salinization and emphasize the ecological risks posed by ongoing climate change and water management practices. By identifying community-level tipping points, this research contributes to our understanding of resilience and vulnerability in freshwater ecosystems under future salinization scenarios.