BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: B2

Living waters: Ecosystem services of freshwater biodiversity

Hosts:

	Name	Organisation	E-mail
Host:	Helmut Habersack	University of Natural Resources and Life Sciences, Vienna (BOKU)	helmut.habersack@boku.ac.at
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Abstract:

Freshwater ecosystems – including rivers, lakes, wetlands, groundwater, and floodplains – are indispensable to human health and well-being, offering critical ecosystem services.

Freshwater biodiversity is integral to these services and underscores the substantial connections between human, environment, and biodiversity health. For example, provisioning services from small-scale inland fisheries are essential for food security, nutrition and poverty eradication for millions of people in developing nations. Regulating and supporting services, such as water

purification provided by aquatic plants, ensure clean water supplies, while culturally endemic species enhance human well-being through their spiritual and cultural value in many societies.

Despite their critical role, biodiversity in these ecosystems faces significant threats, with a third of freshwater species at risk and a concerning 83% decline in populations as reported in 2018. This decline surpasses that of terrestrial and marine species, attributed to inadequate protection and failure to recognize unique ecological values of freshwater biodiversity and their interconnected role in supporting human and environmental health.

There is a pressing need for a systemic, interdisciplinary approach to protect biodiversity and ecosystem services of inland waters as critical natural assets within the 'One Planet, One Health' framework.

Goals and objectives of the session:

The session's primary goal is to consolidate current understanding of the key ecosystem services provided by freshwater biodiversity across diverse taxa and geographic regions, with a particular focus on how these relate to the One Health framework. Additionally, this session aims to inspire greater interest and motivation for interdisciplinary research focused on understanding the factors contributing to the decline of ecosystem services, and enhancing the effectiveness of freshwater ecosystem restoration efforts. This includes synthesizing the challenges and opportunities in restoring biodiversity and its services.

Specific objectives include:

- Synthesize current knowledge on the range of ecosystem services provided by freshwater biodiversity and its linkage to human health and well-being, highlighting both well-documented and understudied ecosystem services and geographical regions.
- Identify and evaluate potential synergistic effects and trade-offs of ecosystem services provided by freshwater biodiversity, and their subsequent effects on local and global health outcomes.
- Review advanced methods for monitoring and quantifying ecosystem services provided by freshwater biodiversity. This incorporates the consideration if and how cultural services and their relationship to human and environmental health can be quantified and integrated in assessments.
- Evaluate the state of knowledge of the effects of climate change and other co-occurring anthropogenic drivers on the capacity of freshwater biodiversity to deliver essential services to human health and well-being, as well as challenges for the restoration of freshwater biodiversity and its vital services.

- Identify research priorities to improve understanding of how protecting and restoring freshwater biodiversity can support both human health and well-being and environmental health, including non-material dimensions.

Planned output / Deliverables:

Freshwater biodiversity's ecosystem services are often overlooked in favor of focusing on the habitat itself rather than the life within it. We hope to challenge this perspective by fostering an interdisciplinary environment for researchers to share ideas, methodologies, and pinpoint gaps in the current knowledges of understudied ecosystem services provided by freshwater biodiversity.

We aim to identify key areas where the concepts of ecosystem services and ecosystem and human health intersect, as research priorities for future transdisciplinary work. In particular, we aim to identify non-material services and consider how such services, particularly cultural ecosystem services, can be included and considered alongside material contributions that are more easily quantifiable.

We hope that by identifying key areas of overlap for research, we will stimulate the development of transdisciplinary methods to more effectively monitor and assess the complex effects of simultaneous drivers on freshwater biodiversity and ecosystem services they offer. Outcomes from this session will inform a synthesizing opinion paper that guides future research and management strategies within the 'One Planet' health framework, looking beyond freshwater as simply a resource that provisions clean water and sanitation, but as an ecosystem with diverse benefits that require integrated management amid multiple co-occurring and emerging drivers.

II. SESSION PROGRAM

Room: Expert Street 6

Date of session: 18th of November 2024

Time of session: 14:00-17:30

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
14:00-14:15	Bence	Decsi	Budapest University of Technology and Economics, Hungary	Why do the Green Arteries of Danube River Basin shine in yellow? Exploring a major ecosystem services trade-off for

Time	First name	Surname	Organization	Title of presentation
				the riparian zones of Danube River Basin
14:15–14:30	Margot	Sepp	Catalan Institute for Water Research, Spain	Is streamflow intermittency deteriorating the dilution capacity of European river networks?
14:30–14:45	Jan E.	Vermaat	Norwegian University of Life Sciences, Norway	Mass development of aquatic plants: how does mechanical plant removal affect ecosystem services?
14:45–15:00	Fábio André	Matos	University of Aveiro, Portugal	Understanding the monetary value of water quality through ecosystem service
15:00–15:15	Jiří	Jakubínský	Global Change Research Institute, Czech Republic	Towards a precise evaluation of floodplain ecosystem services as a means of supporting environmentally favourable spatial planning and preserving biodiversity
15:15–15:30	Ágnes	Vári	McGill University, Canada	Ecosystem services at Lake Balaton – perceptions, environmental awareness and trade-offs between conservation and development
15:30–16:00				SESSION BREAK
16:00–16:15	Angélica	Hernández Goez	Federal University of Goiás, Brazil	Extractivism expansion of palm oil and its relation with freshwater ecosystem services. A study case in Colombia
16:15–16:30	Anda	Ruskule	Baltic Environmental Forum, Latvia	Comprehensive framework for assessment of freshwater cultural ecosystem services in Latvia
16:30–16:45	Linda	Rogge	Dresden University of Technology, Germany	Assessing natural and cultural heritage in fishery-managed pond landscapes in Upper Lusatia, Germany
16:45–17:30				Q&A /Panel discussion

III.ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Why do the Green Arteries of Danube River Basin shine in yellow? Exploring a major ecosystem services trade-off for the riparian zones of Danube River Basin

First authors(s): Bence Decsi

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Riparian strips form a transition zone between terrestrial and freshwater ecosystems providing essential ecosystem services. Healthy strips are crucial for the stability and sustainability of ecological systems. Riparian zones have major environmental importance because these could be interpreted as collision zones of transporting pollutants (on both surface and subsurface) from the land to the freshwater. According to that riparian zones have irreplaceable effect on sediment- and nutrient mitigation and securing freshwater ecosystem biodiversity.

Despite their vital importance, the research community paid less attention on riparian strips. Policy-level regulation of land use and related pollutant emissions within strips is also lacks. As a result, degradation of riparian habitats is still increasing.

In this study, we determined of a critical delineation distance of riparian strip with a/the fixed buffer strip approach. This was based on the analyses of almost 5000 computed local groundwater – surface water gradients in four counties of the Danube River Basin. We evaluated the actual and past land use conditions within the derived riparian strips. To establish and understand the motivations and cause-effect relationship behind the land use arrangement, we examined the vegetation biomass production inside and outside the defined zone.

We highlighted in our results, that the proportion of agricultural areas exceeds national level ratios concerning natural land cover types within the riparian strips. For most countries of the Danube River Basin, the agricultural land use category shows 4 to 8% increase within the riparian strips compared to outer zones regarding a crop yield indicator. This means, that within the riparian strips, areas with significant potential for provisioning services are primarily

exploited, to the detriment of regulating services. This revealed conflict is also an opportunity that affects the feasibility of several European Union strategies (Water Framework Directive, Biodiversity Strategy until 2030), by pointing out potential restoration sites.

Keywords: freshwater ecosystems, riparian strips, vegetation productivity, land use conflict, ecosystem services trade-off

2. Extractivism expansion of palm oil and its relation with freshwater ecosystem services. A study case in Colombia.

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Colombia is the fourth country in the world, and the first in Latin America, in palm oil production (Elaeis guineensis); 37% of its exports are destined for the EU market. In this country, the Magdalena Middle River basin region is the second one in importance with 30%, approximately, of processing and occupied area.

This basin expands around 36.000 km2 where, approximately, one million of people live, of which, 35% live in rural areas. Furthermore, it is rich in wetlands and rivers that occupy 37% of its surface. There, the municipality of Puerto Wilches is the place of the first palm plantations and has the largest amount of processing plants in that region.

Thus, in this study, we ask for how the expansion of the extractivism of palm oil is affecting the freshwater ecosystem services in this municipality. We will use qualitative and quantitative tools such as documentary and bibliographic research through secondary sources, discourses analysis, processing and geoprocessing data. Furthermore, this study pretends to put in dialogue the extractivism descriptive concept and the conceptual framework of ecosystem services in order to find and introduce other kind of variables, like the property regimes, to the ecosystem services assessments.

As preliminary conclusions, it is suggested that this expansion has reducing the capacity of generating provisioning, regulating and cultural services such as food, access to drinking water, recreation, human and environmental health etc.

Keywords: oil palm, extractivism, ecosystem services, Puerto Wilches, Colombia.

3. Towards a precise evaluation of floodplain ecosystem services as a means of supporting environmentally favourable spatial planning and preserving biodiversity

First authors(s): Jiri Jakubinsky
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Floodplains can be considered one of the most valuable habitats in terms of ecosystem services provision, especially when maintained in their natural state. The main objective of this contribution is to present selected results of the ongoing project to develop a comprehensive methodological approach to determine the extent of floodplain disturbance under current conditions based on the identification and assessment of key floodplain ecosystem functions and services (EFS). Using the outputs of this work, it is possible to identify the approximate quality of the most important floodplain EFS in the Czech Republic, including the potential for improvement in the case of significantly degraded floodplains. Several widely used indicators are applied to evaluate the following EFS – flood control, soil water retention, carbon sequestration, local climate regulation, soil erosion regulation, habitat provision, connectivity with natural habitats, biomass production, recreation potential, and cultural (and aesthetic) values. An online map application has been developed to display the detected data for all defined floodplains (at a scale corresponding to 1:10,000), and to enable the EFS assessment and identification of at-risk sites.

Our research has shown that the ability of floodplains to provide ecosystem services is highly dependent on anthropogenic influences, such as the presence of levees and increases in channel capacity, which lead to floodplain degradation and changes in their functioning. Habitat provision and biodiversity are significantly negatively affected by land- use changes that result

in degradation or loss of floodplain and wetland habitats. In particular, the loss of alluvial forests significantly reduces the ability of floodplain habitats to store carbon and retain water.

The outputs of the project should preferably be used by local nature conservation authorities when deciding on construction permits and in the spatial planning process, which should consider the protection of environmental values.

Keywords: floodplain disturbance, human pressure, environmental change, nature protection, spatial planning.

4. Understanding the monetary value of water quality through ecosystem service valuation

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Ecosystems are increasingly threatened by anthropic action in the forms of human interventions and climate change. With such phenomena negatively affecting ecosystems on a global scale, it is crucial to assess the natural services that are being lost. Humans obtain a number of ecosystem services (ES) from natural systems, including provisioning, regulating & maintenance and cultural services, that contribute to human health and well-being. Estimating the monetary value of these ES is an efficient way to transmit the importance of natural systems to stakeholders and policy makers who may lack in-depth understanding of their function, services and values. Despite this, ecosystem service valuation is a field of research where methodologies can be very diverse, and where not all topics are given the same amount of consideration. Water is a fundamental component of all ecosystems, and its quality (chemical; ecological) can have deep effects on ecosystem service provision from multiple standpoints. However, as a result of the complexity of these systems, measuring the value of water quality is a difficult task, and most studies attempt to do so in approximate or partial ways. This occurs for diverse reasons, namely, lack of access to rigorous water quality measurement data, incomplete understanding of the relations between water quality and ecosystem functions, and a general difficulty in finding effective methods to quantify the value of water quality. The objective of this study is to compile and understand the different methodologies employed by

the academic community to economically value water quality in the context of ecosystem services. To this end a systematic literature review is performed, using the SCOPUS database, expert-based review tools, and content analysis and synthesis. Based on this analysis, insights are gathered and discussed, so as to inform researchers and practitioners looking to assess water quality in ecosystem service valuation studies.

Keywords: Water quality, Ecosystem services, Monetary valuation, Systematic literature review

5. Title: Assessing natural and cultural heritage in fishery-managed pond landscapes in Upper Lusatia, Germany

First authors(s): Linda Rogge

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The cultivation of carp has led to the creation of artificial pond landscapes that form cultural landscapes. These landscapes are characterized by their biological and structural diversity, overall ecological importance as well as their provision of ecosystem services such as fish for nutrition, water regulation or recreation. Moreover, they contribute to the natural and cultural heritage of people living in these areas. Natural and cultural heritage includes landscape elements that have a meaning for the present, which encompasses historical as well as non-historical objects, landscape features but also intangible aspects. Within the ecosystem services concept, natural and cultural heritage is understood as a cultural service. According to the Common International Classification of Ecosystem Services (CICES) natural and cultural heritage is described as natural elements that help people identify with the history or culture of where they live or where they come from.

The pond landscape in Upper Lusatia is one of the largest in Europe and characterizes the region's scenery. In order to assess how people perceive natural and cultural heritage, we combined different methodological approaches to explore which landscape elements people feel particular connected to and why, while making it spatially explicit. Our findings suggest that natural and cultural heritage is experienced through lived practices. It forms synergies with other cultural ecosystem services such as recreation or education and can contribute to the feeling of regional identity. Our methodological application aims to contribute to the assessment of cultural ecosystem services to acknowledge their value and contribute to a greater recognition in the context of decision-making. In the face of declining freshwater

biodiversity, it highlights the importance of safeguarding fishery-managed ponds to preserve cultural ecosystem services, while targeting conservation policy objectives. This way our findings can contribute to enhance the understanding of ecosystem health towards human well-being.

Keywords: Cultural landscape, cultural ecosystem services, assessment, human well-being

6. Comprehensive framework for assessment of freshwater cultural ecosystem services in Latvia

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Freshwater ecosystems are vital for human well-being, providing a wide range of tangible and intangible benefits. The assessment of cultural ecosystem services (CES) offers a holistic framework for exploring human-nature relations, uncovering multiple dimensions of interactions and fundamental aspects of why people value water and waterscapes. However, water management policies, such as river basin management plans and monitoring programmes, mostly fail to integrate cultural values into the assessment of freshwater ecosystems.

In Latvia, a comprehensive CES indicator framework has been developed as integral part for monitoring the status and impacts to freshwater ecosystems and services they provide. The framework relates six CES classes (characteristics enabling active and passive interactions with freshwaters, scientific investigations and education, cultural heritage and symbolic/sacred meaning) to all components of ecosystem service "production chain" of the cascade model (Hernández-Morcillo et al., 2013), including: (i) condition indicators – biophysical and cultural preconditions underpinning CES; (ii) function indicators representing the potential of CES supply; (iii) indicators on mediation of service supply – amenities/infrastructure that enable access to CES; (iv) benefit indicators – CES-related tangible goods, events or informative products; (v) impact indicators reflecting physical, mental, social and economic well-being associated with cultural practices and landscape.

The indicator framework was tested on 6 small rivers, using landscape areas as service providing unit. The landscape areas were determined considering dominant topographic

features, land cover, degree of waterbody modification level and flood area. Data for quantification of indicator values were obtained from expert fieldworks, survey of freshwater ecosystem users and various spatial data sets.

The CES assessment framework was developed for the "LIFE Goodwater IP" project, aiming at improving the status of water bodies at risk in Latvia. The proposed framework is further explored within the "Water Cultures" project addressing people-water relations in Latvia.

Keywords: water management policy, human-nature relations, indicator framework, small rivers, landscape areas

7. Ecosystem services at Lake Balaton – perceptions, environmental awareness and trade-offs between conservation and development

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Lake ecosystems, as all freshwater ecosystems, are highly vulnerable. Multiple pressures result among others from recreational uses, where people intending to engage with "nature", seeking recreation at a lake, unintentionally affect directly and indirectly the lake ecosystem (e.g. directly through effects on wildlife, or indirectly via an enhanced demand for infrastructure). People's awareness of environmental issues is essential in managing targets of conservation versus tourism and economic development. Their views are of paramount importance because they influence societal and political pressure on environmental management. We assessed preferences for ecosystem services (ES), recreational activities, shore types, and acceptance of increasing pressures in terms of shore modifications for Lake Balaton. Our survey involved 1500 respondents (tourists, vacation homeowners, and lake shore residents). Survey results show that the greatest importance was assigned to regulating & cultural ES, in line with the prevailing use as a place of recreation. Greatest differences were between locals and tourists, with environmental awareness as the strongest explanatory factor. Most frequent activities were simpler and close-to-nature (e.g. swimming, walking) and not high-profile activities like sailing, yachting or even angling. Preferred activities aligned well with preference for more natural shore types. Privatization of shores (as holiday resorts), further development of tourism infrastructure (including marinas, sailing and yachting opportunities) were not endorsed by the

broad public (58–61 % disliked these options). We identified trade-offs and related them to shore types. We discuss the results of this survey in relation to present trends in investments to tourism at the Lake and power relations in the space spanned by recognized ES and preferred activities in general.

Keywords: lake ecosystem services, recreation, tourism, conservation, trade-offs

8. Mass development of aquatic plants: how does mechanical plant removal affect ecosystem services?

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Dense beds of aquatic plants are often perceived as nuisance and costly mechanical removal is a common measure. Such removal, however, may affect different ecosystem functions and consequently also the ecosystem services that benefit society. Five cases were studied: River Otra (Norway), River Spree (Germany), Lake Kemnade (Germany), Lake Grand-Lieu (France), and Hartbeespoort Dam (South Africa). In all, nuisance aquatic plant cover is managed, but dominant species, geographic setting and societal uses are different. We quantified 12 final ecosystem services as fluxes per area and year in biophysical and monetary terms. These services were: food and fodder production, commercial fisheries, hunting and gathering wild products, hydropower production, drinking and irrigation water production, flood prevention, carbon sequestration, different forms of active and passive recreation, and biodiversity conservation (non-use). These services were related to aquatic plant cover via a causal network of ecosystem functions, and the effects of three plant removal regimes were estimated on the different services and the total sum of their monetary estimates (Total Economic Value, TEV). The three regimes were 'maximum removal', 'current practice', and 'do nothing'. TEV was dominated by recreation in all cases. In three out of five cases the different removal regimes had little effect on the estimated TEV. In Lake Kemnade, TEV dropped in the 'do nothing' regime due to a negative effect on esthetic appreciation above a threshold in cover. In Hartbeespoort Dam, boating and angling were negatively affected in 'do nothing'. We conclude that effects on recreation should be a core consideration in the management of nuisance aquatic plants, since recreation dominated the estimated societal benefits, also in cases where

provision of hydropower, drinking water or irrigation water were relevant. Furthermore, benefits can be gained from incorporating variation in perceived nuisance among different categories of recreative users before engaging in costly removal.

Keywords: integrated aquatic weed management, keystone species, introduced invasive plants, ecosystem functions, questionnaires surveys.

9. Mass development of aquatic plants: how does mechanical plant removal affect ecosystem services?

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Rivers provide numerous important ecosystem services, including fisheries, water purification, and recreation. Research on ecosystem services provisioning has focused almost solely on perennial rivers and knowledge about ecosystem services in non-perennial rivers remains limited. However, 51-60% of the world's rivers are non-perennial: they experience occasional, seasonal, or even permanent drying. Streamflow intermittency has increased and will continue to increase in many regions around the world due to climate change and intensive water abstraction. We studied the provisioning of one regulating ecosystem service, dilution capacity, in European river networks, including both perennial and non-perennial rivers. Dilution capacity is river's capacity to dilute effluents from wastewater treatment plants (WWTPs), contributing to water purification. We evaluated dilution capacity by Dilution Factor (DF), which is one of the main indicators of ecological risks originating from WWTP effluents. We calculated DF as the ratio between streamflow and sum of WWTP discharges in the river network upstream from the corresponding river. High-resolution time series of monthly streamflow were obtained by downscaling output of global hydrological model WaterGAP. WWTP discharge data were obtained from European Union database Waterbase-UWWTD. DF was calculated for 110,936 river reaches, 96,429 of them were perennial and 14,507 non-perennial. Overall, DF of non-perennial reaches was approximately 4 times lower than that of perennial reaches. During the driest summer months (July-August), DF of non-perennial reaches was even 6 times lower. DF was negatively related to the number of no-flow days of the river and to the higher proportion of non-perennial reaches in the upstream river network. This effect was strongest in South-Europe and during summer months. Increasing streamflow intermittency in the future will

deteriorate the dilution capacity of European rivers. Therefore, our results provide useful information on how to better manage WWTP discharges to support river ecosystem health and human health.

Keywords: regulating ecosystem services, water purification, wastewater discharge, European rivers, streamflow intermittency