

BOOK OF ABSTRACTS

This Book of Abstracts provides a comprehensive overview of the session content and is structured into three main sections:

- I. **Session Description** – an introduction to each session, including its objectives and expected outputs
- II. **Session Program** – a detailed schedule for each session, including speakers and timing
- III. **List of Abstracts** – a complete compilation of all accepted abstracts

I. SESSION DESCRIPTION

ID: X10

Linking land, freshwater, and sea: Nature-based Solutions for healthy and resilient aquatic ecosystems

Hosts:


	Name	Organisation	E-mail
Host (s):	Miguel Villoslada	University of Eastern Finland	miguel.villoslada@uef.fi
Co-host(s):	Anda Ruskule	Baltic Environmental Forum – Latvia	Anda.Ruskule@bef.lv
	Anita Zarina	University of Latvia	anita.zarina@lu.lv
	Francisco Rafael Barboza	University of Tartu	francisco.barboza@ut.ee
	Kristiina Nurkse	University of Tartu	kristiina.nurkse@ut.ee
	Miguel Inacio	Mikolas Romeris University	miguel.inacio@mruni.eu
	Priya Sharma	University of Eastern Finland	priya.sharma@uef.fi

Abstract:

Marine, coastal, and freshwater ecosystems are strongly connected by the spatial flows of energy and matter, as well as the movement of organisms. These cross-realm connections shape how impacts imposed by drivers of change (e.g., land-use dynamics, climate change) are propagated, with anthropogenic pressures producing direct and indirect consequences across terrestrial, freshwater, and marine systems. Although the terrestrial-freshwater-marine ecosystems continuum is well recognised, environmental research and management have often treated realms in isolation, hindering holistic actions to mitigate human impacts. Nature-based Solutions (NbS) offer a promising approach by tackling pressures on freshwater, coastal, and marine waters while simultaneously contributing to human well-being through the delivery of a broader range of ecosystem services (ES).

However, NbS planning and testing has mainly been conducted at restricted spatial scales targeting specific ecosystems, limiting scalability and cross-realm application. Moreover, current policies may not fully recognise the value of NbS for mitigating pressures on aquatic ecosystems. How can we best integrate ES with NbS to ensure scalability? How can we better equip planning processes with operational approaches and tools that support the seamless transition from vision to action? How can water-management frameworks fully benefit from an integrated ES–NbS approach? How do perceptions, institutional settings and stakeholder involvement affect the upscaling and implementation of integrated ES–NBS approaches?

We invite contributions on methods for mapping and modelling water-related ecosystem services, approaches for NBS planning and prioritization in aquatic environments, and practical applications of these



insights in participatory decision-making and land and water governance involving diverse stakeholders. We welcome examples across aquatic realms, from freshwater to coastal and marine environments.

Goals and objectives of the session:

1. Synthesise recent methodological advances in aquatic ES mapping/modelling integrating realms, from land to sea.
2. Showcase examples that prioritise and implement NbS effectively, highlighting barriers and enablers.
3. Facilitate exchange on best practices for integrating ES and NbS approaches into decision-making and water management.

Planned output / Deliverables:

Strategic perspective paper on operational and forward-looking approaches for integrating ES into the design of NbS. Special attention will be given to the mapping and modelling of ES and their role in guiding the design, prioritization, and optimization of NbS to address major environmental challenges while maximizing their multifunctionality. Drawing on case studies, the paper will showcase tools and methods that enable the effective design and implementation of NbS across terrestrial, freshwater, and marine ecosystems, with the potential to strengthen their consideration in policy and decision-making.

Session format:

Two slots of 1.5 h each. The session will begin with a 10-minute introduction, followed by presentations following a 10+5 format (10 minutes for the talk and 5 minutes for questions). Each slot will be followed by a roundtable discussion or breakout groups., providing space for all participants to exchange perspectives. The exact balance between presentations and discussion may be adjusted depending on the number of speakers and the desired level of interaction.

Related to ESP Working Group:

[Other](#)

II. SESSION PROGRAM

Room: Lounge

Date of session: Tuesday, 19 May 2026

Time of session: 11:00 – 12:30

Timetable speakers:

Time	First name	Surname	Organization	Title of presentation
11:00 – 11:12	Priya	Sharma	University of Eastern Finland	Spatially Explicit Prioritization of Nature-Based Solutions to Mitigate Eutrophication in Connected Aquatic Systems
11:12 – 11:24	Francisco R.	Barboza	University of Tartu	Integrating digital decision support tools to strengthen the science-based planning of nature-based solutions in marine environments
11:24 – 11:36	Anda	Ruskule	Baltic Environmental Forum - Latvia	The role of stakeholders in exploring nature-based solutions for tackling eutrophication in the Lielupe River basin, Latvia
11:36 – 11:48	Miriam	von Thenen	Leibniz Institute for Baltic Sea Research Warnemünde	Assessing coastal ecosystem services with ecosystem models, socio-economic statistics and social-ecological system's understanding

11:48 – 12:00	Johanna	Schumacher	Leibniz University Hannover	Assessment of Saltmarsh and Seagrass Ecosystem Services in the German Wadden Sea
12:00 – 12:12	Claudia	Betancourt	Universidad Austral de Chile	Structural and functional consequences of foundation species loss in coastal marine ecosystems: implications for restoration in Chile
12:12 – 12:24	Pearlin Sam Jinoj	Thangappan	Basque Centre for Climate Change	Climate-Driven Impacts on Carbon Sequestration in Mangrove Ecosystems Using a Semantically Interoperable ARIES Model
12:24 – 12:30	Wrap-up			

III. LIST OF ABSTRACTS

The first author is the presenting author unless indicated otherwise

1. Spatially Explicit Prioritization of Nature-Based Solutions to Mitigate Eutrophication in Connected Aquatic Systems

First author: Priya Sharma

Other author(s): Miguel Villoslada

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Aquatic realms form an interconnected continuum through which the impacts of land use changes and climate variability can cascade across ecosystem boundaries. The Baltic Sea's ongoing eutrophication illustrates the limitations of fragmented, single-realm management: despite significant reductions in nutrient inputs, recovery is slow due to siloed policies, limited data sharing, and weak cross-border coordination.

In this context, nature-based solutions (NBS) offer a promising approach, as they utilise the functions of ecosystems to retain, transform, and reduce nutrient loads, while providing multiple additional benefits. Building on this concept, our project, CREATE (Cross-REalm modelling and assessment of Aquatic ecosystem services - Towards a Science-Based Design of Nature-Based Solutions to Tackle Eutrophication), aims to address key knowledge gaps by developing a science-based toolkit that connects eutrophication dynamics with ecosystem services (ES), enabling spatially coherent decision-making. The framework developed in this project integrates: (i) harmonized multi-scale datasets; (ii) process-based models coupling nutrient flows with ES supply; (iii) ES-driven spatial prioritization using optimization algorithms to minimize trade-offs; and (iv) governance instruments to foster policy uptake across river basins, rural development, and maritime planning.

We demonstrate this approach in Finland through basin-scale hydrological modelling in the Kiiminkijoki river basin and site-level NBS testing at Kyyrösuo peatland. SWAT+ simulations quantify nutrient loads, while paludiculture trials assess NBS performance in peatland landscapes shaped by forestry and peat extraction. Bidirectional scaling, upscaling local effects, and downscaling basin insights guide implementation. Spatial allocation of NBS is optimized using CoMOLA (Constrained Multi-objective Optimization of Land Use Allocation), balancing demand, suitability, and ecosystem functions. Expected outputs of our study include harmonized datasets, eutrophication-ES models, an NBS prioritization toolkit, and co-created governance measures. Together, these deliverables aim to improve coordination, accelerate ecological recovery, and enhance human well-being through ES delivery.

Keywords: Baltic Sea, Eutrophication, Nature-Based Solutions (NbS), Ecosystem Services, Spatial Optimization

2. Integrating digital decision support tools to strengthen the science-based planning of nature-based solutions in marine environments

First author: Francisco R. Barboza

Other author(s): Jonne Kotta, Mihhail Fetissoov, Kadri Maarja Arismaa, Miguel Villoslada, Kristiina Nurkse

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The growing demand for robust scientific evidence to support decision-making and to meet international and European environmental and sustainable development commitments has led to a rapid proliferation of digital decision support tools. Although many of these tools are developed for specific purposes, their core assumptions and algorithms are often generalizable and can be adapted to address related questions across different contexts. Integrating such tools can strengthen how complex management challenges are tackled by bringing together complementary methods, functions, and data. This approach also shifts efforts away from developing new tools that are often underused, inaccessible to end users, or maintained only for the lifetime of the projects that created them, toward repurposing, integrating, and scaling existing fit-for-purpose solutions. Guided by the principle of “not reinventing the wheel” and leveraging the best available digital solutions, we present an operational workflow to support the planning and implementation of nature-based solutions to mitigate eutrophication symptoms and address underlying drivers in marine environments. Building on advanced digital tools developed for cumulative effects assessment, the prioritization and optimization of area-based conservation measures, and the estimation of production and nutrient-removal capacity by macroalgal and shellfish farming across environmental settings, we provide an integrated approach to optimize the design and deployment of low trophic aquaculture as an in situ solution for nutrient removal. The workflow integrates information on the environmental suitability and expected performance of cultured species with implementation costs and trade-off analysis among co-occurring human uses, enabling the identification and prioritization of feasible, high-impact solutions.

Keywords: Nature-based solutions, low trophic aquaculture, decision support tools, eutrophication

3. The role of stakeholders in exploring nature-based solutions for tackling eutrophication in the Lielupe River basin, Latvia

First author: Anda Ruskule

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Eutrophication is one of the major environmental concerns in the Lielupe River basin, which is dominated by a typical lowland agro-industrial landscape and a dense river network. Intensive agriculture in this region has led to severe fragmentation of semi-natural habitats, homogenization of the landscape, and pollution of water bodies, which continues to contribute loads of nutrients into the fragile, partially enclosed, and highly eutrophic marine ecosystem of the Gulf of Riga. The mitigation of eutrophication in the Gulf of Riga and associated aquatic ecosystems requires integrative approaches that tackle causes and effects across realms. Nature-based solutions (NBS) that utilize the ecosystem's ability to filter, store, and sequester nutrients can be a significant help in this regard. Close cooperation between scientists, practitioners, and decision-makers is key to designing site-appropriate and effective NBS. Proactive stakeholder engagement and a collaborative approach have been undertaken in the Lielupe River basin and the Gulf of Riga – a case study area of the Water4All project CREATE, which aims to develop a toolkit for targeting and prioritizing eutrophication mitigating NBS and ensuring their policy uptake. The collaboration process includes various engagement methods, starting with a nationwide public survey on the perception of eutrophication and NBS, followed by more targeted surveys of stakeholders and experts focused on solutions in the specific case study area, as well as participatory scenario-building workshops on integrating NBS and the ecosystem service approach in land and water management. Active involvement of stakeholders from the very beginning allows researchers to draw on their experience, understand their views, and identify potential barriers and opportunities for NBS implementation.

Keywords: eutrophication, aquatic ecosystems, nature-based solutions, surveys, co-creation

4. Assessing coastal ecosystem services with ecosystem models, socio-economic statistics and social-ecological system's understanding

First author: Miriam von Thenen

Other author(s): Nicole Swer, Giulia Bellon, Ida Marie Bonnevie, Gerald Schernewski, Tin-Yu Lai

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Coastal seas consist of distinct yet closely connected ecosystems, including estuaries, shallow-water habitats, and tidal wetlands. These environments are among the most threatened in the world due to terrestrial nutrient and pollution inputs, human infrastructure developments, and rising temperatures and increased sea levels. At the same time, these areas provide a wide range of ecosystem services on which coastal communities and wider society depend, including coastal fisheries, coastal recreation, and the filtering of nutrients and remediation of pollutants. Assessing the variety of ecosystem services provided by coastal areas requires a mixed-methods approach. Here, we present an example from a large Baltic Sea lagoon, where ecosystem services are assessed using simulations from an ecosystem model and socio-economic statistics. These are complemented by conceptual mapping workshops, which helped us to better understand the area's social-ecological system and the perceived relevance of its ecosystem services. With a focus on coastal water quality and recreational values, we highlight and discuss how to address existing knowledge gaps (e.g. how the coastal filter functions), how to overcome difficulties in obtaining socio-economic data at the appropriate scale and how to account for diverging views on ecosystem services.

Keywords: coastal seas, water quality, ecosystem modelling, conceptual mapping, cultural ecosystem services

5. Assessment of Saltmarsh and Seagrass Ecosystem Services in the German Wadden Sea

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The conservation and restoration of coastal vegetated ecosystems (CVE), such as saltmarshes, mangrove forests, and seagrass meadows, has gained increased attention as a nature-based solution to climate change, due to their ability to capture and store carbon, protect coastlines, and provide additional ecosystem services, such as food and recreation. In order for CVE to serve as effective nature-based solutions, it is necessary to have a good understanding of their ecosystem services' supply, in relation to their biophysical characteristics, and the associated synergies and trade-offs. The provision of these services varies greatly between different CVE and regions. Fewer studies have focused on the ecosystem services provided by seagrass meadows and saltmarshes compared to mangrove forests globally, and knowledge on their ecosystem service provision in Europe remains limited. Furthermore, assessments of the ecosystem services provided by seagrass meadows and saltmarshes in European seas have only been conducted in isolation and usually on a small spatial scale.

The Wadden Sea is a large, temperate, and relatively flat coastal wetland which comprises 395 km² of saltmarshes and the largest intertidal seagrass area in Europe with 90-100 km². As a UNESCO World Heritage Site there is a strong emphasis on nature conservation while preserving the area's cultural heritage. However, a quantitative spatial assessment of saltmarsh and seagrass ecosystem services is currently lacking, but needed as a basis for improving their management and restoration.

To fill this gap, we present an assessment approach that uses biophysical indicators for quantifying saltmarsh and seagrass ecosystem services jointly and demonstrate its large-scale application in the German Wadden Sea. The study focusses on exploring the connections between the CVE's biophysical characteristics (e.g., location, area, structure, biomass, age, etc.) and the supply of ES. Key services that are explored are coastal protection, climate regulation, habitat provision, food provision, and recreation and tourism. Potential synergies and trade-offs are analysed and implications for coastal management and the transferability of the approach are discussed.



Keywords: Coastal vegetated ecosystems, quantification, biophysical assessment, trade-offs, synergies

6. Structural and functional consequences of foundation species loss in coastal marine ecosystems: implications for restoration in Chile

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Bivalves, corals, macroalgae, and seagrasses are key habitat-forming species in coastal marine ecosystems, creating structural complexity and stabilizing local environmental conditions that support diverse communities. By underpinning processes such as primary production, carbon and nutrient storage and sequestration, sediment stabilization, they deliver key ecosystem services including water-quality regulation, fisheries support, coastal protection, and climate regulation. As human pressures intensify across coastal seas, foundation species are increasingly degraded by both sudden disturbances and chronic environmental change, with effects that can cascade through entire ecosystems and reshape functioning and services delivery. In this context, understanding how ecosystems respond structurally and functionally to the loss of foundation species, and the compensatory dynamics that occur among species, is essential for generating the evidence needed to design effective, science-based conservation and restoration policies and measures. In Chile, most restoration efforts have largely focused on macroalgal-dominated habitats, and following a single-species approach and, therefore, primarily targeting the recovery of the dominant species. As a result, comparatively less attention has been given to community-level and functional outcomes of restoration. This creates a need to conduct fundamental ecological studies that provide information on the long-term structural and functional effects of losing dominant species that could be used in ecological restoration. As explicitly considering community-wide dynamics and ecosystem functioning is the only meaningful approach that can improve the protection and recovery of critical ecosystem processes under environmental change, in this work we present discuss the integration of fundamental ecological knowledge and the structural-functional recovery of biogenic habitats and their associated communities, with the aim of enabling the development of more adaptive and robust restoration strategies across Chile and the continent.

Keywords: Foundation species, ecosystem services, coastal marine ecosystems, ecological restoration, functional dynamics

7. Climate-Driven Impacts on Carbon Sequestration in Mangrove Ecosystems Using a Semantically Interoperable ARIES Model

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Mangrove ecosystems are implemented as nature-based solutions (NbS) for coastal protection, climate change mitigation (carbon sequestration) and other services. They play a core role in providing benefits for biodiversity, livelihoods and human well-being. They are among the most efficient natural carbon sinks, yet their carbon sequestration capacity is increasingly threatened by climate change-driven stressors such as sea-level rise, temperature increases, and altered precipitation regimes. This study assesses the impacts of future climate scenarios on mangrove carbon sequestration by integrating region-specific primary and secondary mangrove datasets from Caribbean (Barbados, Bonaire, Martinique), Africa (Madagascar), Asia (India – Coringa) and the Pacific (Low Isles of the Great Barrier Reef, Australia) within a semantically interoperable ARIES (ARTificial Intelligence for Environment & Sustainability) modelling framework.

The ARIES model leverages semantic metadata and probabilistic reasoning to harmonize heterogeneous



ecological, climatic, and socio-environmental datasets, enabling consistent cross-regional ecosystem service assessment. Using downscaled Shared Socioeconomic Pathway (SSP1, SSP3 & SPP5) climate change projections, we estimate present and future carbon sequestration potential under multiple climate trajectories. The model incorporates biophysical drivers including biomass productivity, inundation dynamics, soil carbon storage, and disturbance exposure, allowing for spatially explicit and uncertainty-aware projections.

Results highlight pronounced regional variability in climate sensitivity, with small-island mangroves exhibiting higher vulnerability to sea-level rise and extreme events, while larger deltaic systems show comparatively greater adaptive capacity. Across all regions, high-emission scenarios (SSP3-7.0 & SSP5-8.5) indicate a decline in long-term carbon sequestration potential, driven primarily by increased inundation stress and reduced biomass accumulation.

This study demonstrates the value of semantic interoperability and AI-driven ecosystem service modelling for comparative, scalable, and policy-relevant assessments of blue carbon under climate change. Through a better understanding of mangrove's ecology we shall provide critical insights for mangrove conservation, climate mitigation planning, and nature-based solutions under future socioeconomic pathways.

Keywords: Carbon sink, sea-level rise, SSP Scenario, integrated modelling, nature-based solution