BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: B1

Coastal ecosystem management: the role of ecosystem services in decision-making and restoration actions

Hosts:

	Name	Organisation	E-mail
Host:	Evangelia (Valia) Drakou	Harokopio University of Athens, Greece	e.drakou@hua.gr
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Abstract:

Marine and coastal ecosystem services (MCES) research has been gaining ground within the academic community, enhancing our understanding of the benefits that marine and coastal systems provide to human wellbeing. Despite their importance, coastal and marine ecosystems are degraded at an unprecedented rate by the accelerated expansion and intensification of human activities and uses but also climate change, in these social-ecological systems. To mitigate the impacts of these changes, management, and restoration practices have been designed, developed and applied currently underpinned by the UN Decade on Ecosystems

Restoration (2021-2030) targets. Practices range from strictly managed seascapes, as it is the case for active habitat restoration strategies, to passive approaches that rely on the capacity of ecosystems to recover their natural state e.g., rewilding. The effectiveness of such approaches is usually evaluated at a local scale, on a case-by-case basis. A systematic framework that assesses the consequences on ES supply under different restoration approaches is currently missing. With the introduction of the new EU Restoration Law and along with it, the development of research programs to support its implementation, it is essential to develop a systematic way of evaluating the effectiveness of restoration practices in marine and coastal social-ecological systems, ensuring that their capacity to supply multiple ES can address the plural values society acquires from them. This is also extremely relevant at the national level, as more and more European countries design management and policy agendas within their coastal and marine areas to support Blue and Green Growth, without necessarily acknowledging and integrating the plural contributions and benefits that these areas provide to society acquires, or the way in which restoration practices and plans can enhance the supply of ES.

Within this session we encourage submissions of oral or poster contributions, regarding the assessment of the change in ecosystem service supply and flow/use, under different restoration practices. Inputs can range from practical and methodological applications to evidence from the field, as well as evaluation of different policies and approaches. On that regard, we welcomed contributions that focus on:

- The effectiveness of different management practices within coastal ecosystems, in delivering MCES
- Understanding the challenges of capturing the plural values within areas of restoration in coastal and marine systems,
- Assessment of trade-offs and bundles across ecosystem services within restoration practices,
- Methods on cost-benefit analysis of different restoration practices,
- Temporal change assessment of seascapes and the generated ecosystem services across restored areas,
- The pros and cons of active versus passive restoration approaches in marine and coastal social-ecological systems.

Goals and objectives of the session:

To exchange knowledge, experiences and methodologies focused on assessing the effectiveness of coastal management and restoration approaches within a variety of marine and

coastal social-ecological systems, and to form a community of exchange, communication and practice on this topic.

Planned output / Deliverables:

A publication on evidence-based impacts of restoration practices on ecosystem services within marine and coastal social-ecological systems.

II. SESSION PROGRAM

Room: Expert Street 2

Date of session: 19th of November 2024
Time of session: 16:00-18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
16:00-16:12	Annelies	Boerema	International Marine and Dredging Consultants (IMDC)	Monitoring coastal NbS success
16:12-16:24	Stefanie	Broszeit	Plymouth Marine Laboratory	Creating a toolbox for interdisciplinary working on ecosystem services - A confidence framework
16:24-16:36	Miguel	Inácio	Mykolas Romeris University	Application of the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA-EA) in coastal and marine ecosystems in Lithuania
16:36-16:48	Sebastian	Raimondo	Adapt@Ve, Fondazione Eni Enrico Mattei	Ecosystem Services of Venice Lagoon: Carbon Sequestration Dynamics in Salt Marshes and Seagrasses
16:48-17:00	Federico	Cornacchia	Department of Environmental Sciences, Informatic and Statistics, Ca' Foscari University of Venice	Integrated System Dynamics Modelling for the Economic Valuation of Manila clam Biomass Ecosystem Service in the Venice Lagoon

Time	First name	Surname	Organization	Title of presentation
			Fondazione Eni Enrico Mattei, Climate Change Adaptation Group (ADAPT@VE)	
17:00-17:12	Ana	Sousa	ECOMARE, CESAM - Centre for Environmental and Marine Studies, Department of Biology, University of Aveiro	Seagrass active restoration at a socio-ecological ecosystem
17:12-17:24	Sara	Pino Cobacho	Deltares	Climate adaptation in coastal regions: a digital dashboard tool for decision-support and MCES assessment
17:24-17:36	Annelies	Boerema	International Marine and Dredging Consultants (IMDC	Added value of ecological measures for sustainable marine infrastructure
17:36-17:48	Sylvie	Campagne	Sorbonne Université, CNRS, Station Biologique de Roscoff, UMR7144, Adaptation et Diversité en Milieu Marin Fondation pour la Recherche sur la Biodiversité, Centre de Synthèse et d'Analyse sur la Biodiversité (FRB-Cesab)	Meta-analysis and stakeholders' perceptions analysis of changes in marine and coastal ecosystems services delivery
17:48-18:00	Clara	Villegas-palacio	Universidad Nacional de Colombia	Understanding the Complexity of Socio-Ecological Systems in Mangrove Forests: A Systems Dynamics Approach in a Case Study of the Colombian Pacific Coast

III. ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Added value of ecological measures for sustainable marine infrastructure

First authors(s): Annelies Boerema
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The surge in marine infrastructure projects, including offshore wind farms, subsea cables, energy islands, and aquaculture facilities, underscores the urgent need to evaluate the ecosystem performance of these activities and the quest to enhance the sustainability of marine infrastructure. Critical to this evaluation is the incorporation of eco-friendly measures and nature-inclusive designs (NID) that mitigate environmental impacts. Different measures are possible in the different marine zones, depending on the occurrence of the infrastructure (seabed, subtidal, intertidal and supratidal). However, how effective are those measures?

This research aims to provide a comprehensive state-of-the-art review of best practices for marine infrastructure, focusing on the added value of eco-infrastructure measures. By drawing on the work of the Marine Ecosystem Performance (MEsP) initiative, which inventories such measures, describes their potential benefits, and proposes methods to quantify these benefits, the study seeks to establish a robust framework for quantifying the ecological contributions of marine business activities. We will be discussing a variety of examples of marine eco-measures, pros and cons of the measures, lack of monitoring data, upcoming evaluation studies, but also challenges and risk factors which complicate the assessment of its benefits, such as the temporal and spatial impact zone.

This evaluation will help to validate and enhance the sustainability of marine infrastructure projects, ensuring they contribute positively to marine ecosystems while meeting economic and operational objectives.

Keywords: Eco-design; marine infrastructure; positive impact; risk factors; sustainability

2. Literature review and stakeholders' perceptions of changes in marine and coastal ecosystems services delivery

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The urgent need to manage human use of nature in a sustainable manner requires improved knowledge of the interactions between biodiversity and ecosystem services, particularly in understudied and vulnerable marine coastal areas, which attract 40% of the world's population and support many cultural services. Two approaches, a meta-analysis and a perception analysis, were performed and compared to understand how global changes in the dynamics of marine and coastal ecosystems affect ecosystem services with a special attention on cultural ecosystem services (CES).

The meta-analysis of 223 effect sizes extracted from 59 articles assessing the impact of drivers of change on coastal and marine CES revealed that recreational CES is the most studied, in contrast to other important dimensions such as spiritual, cognitive or symbolic services. Our quantitative analysis also shows that while pollution has negative effects on recreation, it also has large but non-significant positive effects on religion, bequests and scientific opportunities. We confirm the strong negative impacts of climate change, land/sea use change and direct exploitation.

Through a perception analysis, we gathered the views of Marine Protected Area (MPA) managers on their knowledge of CES and its changes, from 78 interviews conducted with managers of 152 MPAs in metropolitan France. The managers mentioned a lack of knowledge about pollution regulation services, well-being and greenhouse gas sequestration, for which they need more resources to effectively carry out their missions. They perceived an increase in recreational CES, as well as a general increase in representational values of ecosystems.

Although the meta-analysis and perception analysis provide results at different scales, the results show that these approaches complement each other in providing information on all CES and on the different pressures affecting coastal and marine ecosystems.

Keywords: Meta-analysis; perception; recreation; marine protected area

3. Climate adaptation in coastal regions: a digital dashboard tool for decision-support and MCES assessment

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Presenting author: Sara Pino Cobacho

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Coastal regions, which host some of the highest densities of population, assets, and cultural heritage globally, are experiencing rapid urbanization compared to inland areas. Despite their productivity and biodiversity, which provide substantial marine and coastal ecosystem services (MCES), these areas face progressive degradation. REST-COAST, an EU Green Deal project, aims to demonstrate the benefits of large-scale systemic restoration to enhance biodiversity and MCES delivery for European coasts using nature-based solutions. To evaluate the potential of systemic restoration and nature-based solution packages, a Quick Scan Tool (digital dashboard environment) has been created. Tested specifically at the Ems-Dollard estuary, a pilot area in the Netherlands, this dashboard enables the rapid assessment of MCES at landscape scales for various future climate and management scenarios. It supports and informs decision-making regarding restoration upscaling and adaptation pathway development. The core of the dashboard is the supply of MCES, which forms the basis for decision-making. The dashboard displays semi-quantitative rank scores for MCES supply from ecosystems present in the Ems-Dollard estuary and compares trends in MCES delivery under different modelled climate scenarios and restoration measures. These MCES are combined with governance and financial indicators to present an integrated assessment and highlight trade-offs and benefits between the different restoration strategies considered. In practice, the dashboard transforms complex datasets into interactive visualizations. This facilitates the communication of scientific findings and showcases project results, thereby supporting decision-making processes relevant to the adaptation and upscaling of restoration measures in European coastal zones.

Keywords: coastal regions, climate adaptation, decision-support tool, nature-based solutions, systemic restoration

4. Seagrass active restoration at a socio-ecological ecosystem

First authors(s): Ana Sousa

Other author(s): Mariana Pinto, Nerea Piñeiro-Juncal, João Oliveira Silva, Vítor Oliveira, Ana I. Lillebø, J. Pedro Coelho

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Seagrass ecosystems are crucial for blue carbon sequestration, shoreline stabilization, and provide habitat for many species, contributing to the ecosystem sustainability and health. However, human activities, natural threats and climate change have threatened these blue carbon ecosystems and the services they provide, facing a global declining trend over decades. To reverse this trend and mitigate these impacts, underpinned by the UN Decade on Ecosystem Restoration (2021-2030) and the Nature Restoration Law targets, seagrass restoration is urgent. This study focuses on Zostera noltei seagrass restoration within a socio-ecological system, Ria de Aveiro coastal lagoon (Portugal) and its role in carbon storage and climate regulation. Using a citizen science approach, intertidal Z. noltei seagrass restoration was implemented at several sites at Ria de Aveiro using a pre-validated technique consisting on sod transplants. Seagrass contribution to blue carbon sequestration was assessed by comparing the blue carbon stock at the seagrass donor meadow, bare sediment and restored sites, at different locations at Ria de Aveiro. This collaborative approach (scientists and stakeholders) and community engagement is crucial to the upscaling and sustainability of the restoration plans, but also fosters the sense of ownership among coastal populations. By aligning restoration efforts with international conservation targets, this work supports the potential of seagrass restoration as a nature-based solution (NbS) for climate regulation and coastal resilience in socio-ecological ecosystems.

Keywords: Blue carbon, Climate regulation, Ecosystem restoration, Community engagement, Coastal resilience

5. Creating a toolbox for interdisciplinary working on ecosystem services - A confidence framework

First authors(s): Stefanie Broszeit

Other author(s): Nicola Beaumont, Steven Watson, Claire Szostek, Heidi Tillin, Gordon Watson, Joanne Preston, Ian Dickie, Rob Tinch, Daryl Burdon, Tavis Potts, Jeremy Anbleyth-Evans, Mark Collar, Keila Guillen Onate, Andrew van der Schotte-Olivier

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Climate regulation and bioremediation of nutrients are two key regulating services in temperate coastal habitats. Our understanding of these services is improving but important questions still remain, for example, how they interlink with biodiversity in the coastal seascapes. We also do not understand how we can aid their restoration through targeted blue financing mechanisms.

To address these questions, we have chosen two very distinct coastal areas in the UK: the Cromarty Firth, a small firth in Scotland and the relatively well-studied Solent in the South of England. The project was developed to allow the comparison between the two sites: one rich in natural sciences data, the other less so. And to compare the establishment of blue financing mechanisms (better developed for Climate regulation than for Bioremediation of nutrients). This approach allows us to learn from the more advanced and to contrast the different approaches used.

A key challenge encountered with the mixed approaches we have taken is the uncertainty in the data and how this can be transparently communicated within the team and ultimately with stakeholders. To address this challenge we created a confidence framework that can be communicated across different groups.

We will present how we created the framework and how it is applied.

Keywords: uncertainty, confidence levels, climate regulation, bioremediation of nutrients, interdisciplinary research,

6. Application of the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA-EA) in coastal and marine ecosystems in Lithuania

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Coastal and marine ecosystems are essential in supporting socio-ecologic systems worldwide, especially in semi-closed regional seas like the Baltic Sea. The ecosystem services (ES) provided by coastal and marine ecosystems support coastal communities' economic and social development. Therefore, it is essential to maintain a sustainable supply of ES. Nevertheless, despite their importance, the supply of ES has been jeopardised due to multiple direct (e.g., pollution) and indirect (e.g., climate change) anthropogenic impacts. Ensuring the continuing contribution of nature, in this case coastal and marine ecosystem, to socio-economic development is the objective of multiple environmental policies, both regional (e.g., Baltic Sea Action Plan), European (e.g., Marine Strategy Framework Directive) and international (e.g., United Nations Sustainable Development Goals). To achieve such an objective, several frameworks have been developed. The System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA-EA) has recently been adopted as a global standard to assess nature's contribution to social and economic wellbeing in physical and monetary terms. In Europe, Member States will adopt and report on the implementation of SEEA-EA. The objective of this study is to, within the System of Environmental-Economic Accounting – Ecosystem Accounting in Lithuania (SEEAL) project, develop a set of methodological frameworks to assess and map physical ecosystem accounts (extent, condition and ecosystem services) to support the implementation of the SEEA-EA in Lithuania. The methodological frameworks will explore existing datasets (e.g., Copernicus Marine Service) to map and assess multiple ES (e.g., nutrient regulation) in coastal and marine ecosystems. This information will then be conveyed to authorities to support the full implementation of the SEEA-EA in Lithuania. Moreover, the information generated in the SEEA-EA physical accounts (mapping and assessment of ecosystem condition and services accounts) can support the implementation of other European policies, like the newly adopted European Nature Restoration Law, by unveiling priority areas for nature restoration efforts.

The work was supported by the project System of Environmental-Economic Accounting – Ecosystem Accounting in Lithuania (SEEAL), funded by the Lithuanian Research Council (Contract: S-PD-24-18).

Keywords: SEEA; ecosystem services; accounting; Baltic Sea; restoration

7. Integrated System Dynamics Modelling for the Economic Valuation of Manila clam Biomass Ecosystem Service in the Venice Lagoon

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The Manila clam (Ruditapes philippinarum), initially an introduced alien species, has become a cornerstone economic resource in the Venice Lagoon, with remarkable social and environmental consequences. This work aims at contributing to the economic assessments of harvested clam biomass, to provide informed support to local decision-makers. Its novelty lays in the integration of dynamic economic valuation with three ecological modelling approaches within the same system dynamics framework: (1) a tolerance landscape model assessing population mortality under extreme temperature events (Bertolini & Pastres, 2021), (2) an individual bioenergetic model simulating growth dynamics driven by temperature and nutrient availability (Bertolini et al., 2021), and (3) a stochastic demographic model dependent on the initial clam seeding density (Melià et al., 2004).

Our model incorporates three main forcing variables (lagoon trophism scenarios, sea level rise, and water temperature variations), and simulates their influence on the state variables, which include somatic tissue, reproductive tissue, and shell growth. By simulating the interaction of these variables, the model provides a comprehensive view of the population dynamics of the Manila clam according to alternative future scenarios.

Starting from a specific seeding density of X individuals per square meter, we can observe the final marketable population in response to different levels of food availability and future thermal shocks, such as heatwaves.

This dynamic quantification allows for rigorous analysis of the economic evolution of this essential resource in the Venice Lagoon. The policy implications are significant, offering clear

guidance on managing this resource in line with the triple bottom line: economy, society, and environment.

Keywords: Ecosystem services, Dynamic economic valuation, System Dynamics, Ecological modelling, Sustainable resource management

8. Ecosystem Services of Venice Lagoon: Carbon Sequestration Dynamics in Salt Marshes and Seagrasses

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This research unveils the hidden potential of Venice Lagoon's salt marshes and seagrasses in combating climate change through carbon sequestration. By modelling and economically evaluating these vital ecosystem services, we pave the way for innovative conservation strategies and sustainable coastal management.

Key Dynamics and Ecosystem Challenges – Salt marshes, with their high efficiency in carbon sequestration, are crucial for climate regulation, shoreline protection, and biodiversity support. The dynamics of these ecosystems involve sediment deposition and the impacts of tidal and climatic variations on their elevation. Accurate modeling of these processes is essential for predicting their capacity to adapt to sea level rise and for designing effective management interventions.

Seagrasses are another critical component of the lagoon's carbon sink, contributing significantly through organic matter accumulation. Their health is closely linked to sea level and temperature changes, which are increasingly affected by climate change. Modeling the resilience and adaptability of seagrasses is crucial for understanding their future carbon storage role and developing strategies to mitigate climate change impacts on these ecosystems.

Both salt marshes and seagrasses play pivotal roles in the lagoon's carbon dynamics. Therefore, a comprehensive understanding of their responses to environmental changes, coupled with an economic evaluation of the carbon sequestered, is essential to estimate their future contributions to carbon sequestration and develop informed conservation strategies.

Methodological Approach – Our comprehensive approach integrates key biophysical processes into a System Dynamics model. The model is segmented into modules addressing the MoSE (Modulo Sperimentale Elettromeccanico) flood protection system, sediment dynamics in salt marshes, and the biomass dynamics of seagrasses. By assessing the cumulative impacts of MoSE operations and various climate scenarios, the model describes the evolution of the lagoon's carbon stocks and their future economic value.

Significance and Contributions – Our simulation model of the Venice Lagoon's carbon sequestration dynamics provides valuable insights into the ecosystem services of coastal environments. By integrating biophysical modeling with economic valuation, our study offers a multidimensional perspective that informs conservation and management decisions. Our findings underscore the importance of preserving salt marshes and seagrasses to support climate change mitigation and adaptation strategies, highlighting their essential roles in the ecosystem's overall health and resilience.

Keywords: Carbon sequestration, Economic evaluation, Salt marshes, Seagrasses, System dynamics

9. Monitoring coastal NbS success

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Nature-based solutions (NbS) for coastal management have become a prominent topic, demonstrated by numerous pilot projects aiming to enhance coastal resilience and coastal ecosystem services (ES). However, there is a critical need for comprehensive quantification of the multiple benefits provided by these solutions, both before project implementation to support for example leverage decision making and financing, but also after project implementation for validation and knowledge development purposes.

A broad range of effects of NbS on coastal ecosystem services can be quantified such as carbon sequestration, water retention, coastal protection against flooding, food production, denitrification, and recreational benefits. However, those assessments are rarely validated. Therefore we want to discuss the possibilities for validation and post-implementation impact monitoring. Still significant challenges remain in monitoring the long-term success of NbS implementations. A key aspect of this challenge is identifying which effects can be reliably

monitored post-implementation and which cannot, necessitating an open and ongoing discussion among stakeholders and researchers. The validation of NbS impacts will be important to ensuring that the NbS projects achieve their intended outcomes and adapt to any unforeseen challenges.

This presentation aims to discuss how we can bridge the gap between theoretical benefits and practical outcomes, providing validated data through field monitoring to support the optimization and broader adoption of NBS in coastal areas. A clear understanding of the outcome of NbS is essential information for policymakers, project developers and financers.

Keywords: Coastal nature-based solutions; coastal ecosystem services; quantification; validation; monitoring