



BOOK OF ABSTRACT

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I. SESSION DESCRIPTION

ID: B1b

Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Hosts:

	Title	Name	Organisation
Host:	Mr.	Ibon Galparsoro	AZTI-Tecnalia
Host:	Mr.	Daniel Depellegrin	National Research Council – Institute of Marine Sciences (CNR-ISMAR)
Others involved :	Mr.	Kemal Pınarbaşı	AZTI-Tecnalia

Abstract:

Marine Ecosystem services (MES) assessments have increasingly arisen as valuable framework to better understand human–environment interactions. In fact, valuation, quantification and mapping of MES should be of great help to understand the benefits flowing to society from the use of ecosystems but also to understand the impacts of human activities can produce on ecosystem functioning. These relationships are essential for designing a sustainable use of marine services, and thus, ES valuation, quantification and mapping of MES have a direct application for policy making, sea use planning and management. In the recent times, it is also seen as a valuable information for ecosystem-based marine spatial planning. The integration of the ES in marine spatial planning as a tool for enhancing sustainable use, to promote the development of new maritime activities according to the Blue Growth, to optimise sea space and resource exploitation, or for the adoption of conservation measures such as Marine Protected Areas, is promising. The use of ES framework, requires specifying the spatial and temporal configuration between ES production, demand and supply, as well



as human activities distribution, the pressures they produce and the potential impacts on ecosystem functioning. Marine ecosystems are especially complex and dynamic and thus, such kind of assessment and approaches are still its infancy.

This session aims to discuss the use of the MES concept and framework in ecosystem-based spatial planning. The session will be focused on latest developments of this topic and particularly, showing: (i) examples of implementation and use of operational tools and methods for assessment, valuation and mapping of MES, and presenting (ii) examples of transferability of such outcomes in real implementation of MSP.

Moreover, the session will give attention on stimulating knowledge exchange and analysis of the future trends in this topic. It will also promote research collaborations and networking.

Goals and objectives of the session:

The goal of the session is to open the debate around different methodological approaches focusing on multiple ES assessment to estimate the current and expected trends in MES valuation, assessment and mapping to support ecosystem-based marine spatial planning. The specific objectives of the session are: (i) to share knowledge of the latest developments of operational tools and methods for assessment, valuation and mapping of MES, and practical examples of the transferability of such information in the implementation of EB-MSP.

The first objective refers to conceptual part and developments of models and tools to interlink the marine ecosystems and human dimensions; meanwhile the second objective will be focused on giving practical examples on how that knowledge could be or has been implemented in real management.

Planned output / Deliverables:

We will promote a special issue in a scientific journal and/or a position paper on the topic in a journal to be determined.

Related to ESP Working Group/National Network:

[Biome Working Groups: B1 b – Coral reefs](#)



II. SESSION PROGRAM

Date of session: Tuesday, 16 October 2018

Time of session: 8:45 - 16:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
8:45–9:00	Ibon	Galparsoro		Operationalizing ecosystem services in support of ecosystem-based marine spatial planning
	Daniel	Depellegrin	AZTI-Tecnalia	
	Kemal	Pınarbaşı		
9:00–9:15	Kemal	Pınarbaşı	AZTI-Tecnalia	Potential tool developments for ecosystem services valuation with respect to requirements in marine spatial planning
9:15–9:30	Susanna	Jernberg	Finnish Environment Institute	Optimizing the management of multiple ecosystem services – case study from the Finnish Archipelago Sea
9:30–9:45	Nora	Fagerholm	University of Turku	Stakeholders' place-based knowledge supporting ecosystem-based maritime spatial planning in Kokemäenjoki riverine landscape
9:45–10:00	Robert	Aps	University of Tartu	Mapping cumulative risk to Marine Ecosystem Services provided by benthic habitats in the Gulf of Finland (Baltic Sea)
10:00–10:15	Miguel	Inácio	IOW	Assessing and mapping changes in ecosystem services provision: examples from Baltic transitional waters bodies
11:30–11:45	Jonne	Kotta	University of Tartu	Knowledge to decision in dynamic seas: Novel species are jeopardizing the integrity of



Time	First name	Surname	Organization	Title of presentation
				vital ecosystems and their functioning
11:45–12:00	Giacomo	Cozzolino	Ecolinfa	Operationalizing ecosystem services in support of Conservation Measures of Marine–coastal protected areas in Sardegna Region (Italy)
12:00–12:15	Fiona	Culhane	University of Liverpool	Linking marine ecosystems with the services they supply: what are the relevant service providing units?
12:15–12:30	Kate	Irvine	University of Aberdeen	A post normal science approach to operationalizing marine ecosystem services: lessons from the North Sea, Scotland
12:30–12:45	Marco	Custódio	University of Aveiro	Valuation of ecosystem services for sustainable aquaculture development
12:45–13:00	Keshav Prasad	Paudel	UiT The Arctic University of Norway	Mapping ecosystem services for coastal zone planning
14:30–14:45	Arantza	Murillas	AZTI–Tecnalia	Analysing the dependencies of marine activities and Natural Capital: a spatially–explicit Bayesian Belief Network approach under the Marine Spatial Planning framework
14:45–15:00	Daniel	Depellegrin	CNR–ISMAR	The Socio–Ecological Dimension of Multi–Use Sea Spaces
15:00–15:15	Sonja	Wanke	Deltares	A Bayesian Network Analysis of Trade–Offs Between Ecosystem Services in the Dutch Wadden Sea



Time	First name	Surname	Organization	Title of presentation
15:15–15:30	Elena	Gissi	IUAV	Marine ecosystem services trade-off assessment: a methodological approach to inform maritime spatial planning
15:30–15:45	David	Cabana	University College Dublin	Valuing Coastal Cultural Ecosystem Services to Inform Marine Spatial Planning
15:45–16:00	Daniel	Depellegrin	AZTI– Tecnalia/CNR– ISMAR	Discussion & Conclusions
	Ibon	Galparsoro		
	Kemal	Pınarbaşı		

III. ABSTRACTS

The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.

1. Type of submission: **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Mapping cumulative risk to Marine Ecosystem Services provided by benthic habitats in the Gulf of Finland (Baltic Sea)

First author: Robert Aps

Other author(s): Kristjan Herkül, Jonne Kotta, Roland Cormier, Kirsi Kostamo, Leena Laamanen, Juho Lappalainen, Liisi Lees, Anneliis Peterson, Riku Varjopuro

Affiliation: University of Tartu, Estonian Marine Institute, Ecuador

The objective of this study is to map the cumulative risk to Marine Ecosystem Services (MES) provided by benthic habitats in order to support the ecosystem-based adaptive maritime spatial planning processes. The methodology is built on the spatially-explicit marine environmental vulnerability profile (EVP) that is an aggregated product of the distribution of significant benthic nature values (habitat-forming benthic macro-algal and invertebrate species, benthic species richness) and their sensitivities to disturbances in terms of their



recovery potential. As an advancement of the methodology above, benthic nature values are translated into known provisioning, regulating and cultural MES and the spatially-explicit MES vulnerability profile is calculated to visualize the spatial patterns of MES and their sensitivities to different human pressures. The MES cumulative risk profile combines the MES vulnerability profile and the HELCOM Baltic Sea Pressure Index (BSPI), the latter representing the spatial distribution of intensities of cumulative anthropogenic pressures. The spatially-explicit MES cumulative risk profile can be easily communicated to politicians, maritime spatial planners and other interested stakeholders to jointly analyse and compare the potential environmental and MES related risk levels resulting from different potential planning solutions and thereby to overcome the major environmental challenges faced by any highly impacted marine ecosystem.

Keywords: Marine Ecosystem Services, environmental vulnerability, cumulative risk, Gulf of Finland, Baltic Sea

2. *Type of submission:* **Abstract**

B. Biome Working Group sessions: [B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning](#)

Valuing Coastal Cultural Ecosystem Services to Inform Marine Spatial Planning

First author: David Cabana

Other author(s): Frances Rylands, John Brannigan, Tasman Crowe

Affiliation: 1. Earth Institute and School of Biology and Environmental Science. 2. School of English, Drama and Film, University College Dublin, Ireland

The coastline is a socioecological system where a high demand upon ecosystem services converges in a narrow fringe resulting in an entanglement of activities and interests amongst groups of users. Thus, in coastal ecosystems management plans and marine spatial planning are essential to coordinate uses, maintain ecosystems health, and sustain human wellbeing. The incorporation of ecosystem services and benefits within marine spatial planning helps to evaluate trade-offs and take more balanced management decisions. Ecosystem services range from more tangible assets such as provisioning (e.g. fish stock) and regulating (e.g. water quality) to more intangible assets as cultural (e.g. wellbeing). In marine and coastal areas more tangible ecosystem services are more easily measured and so incorporated in management plans, conversely little consideration has yet been given to cultural ecosystem



services. Difficulties arise when accounting for less tangible and monetizable ecosystem services which are underpinned by different social values including personal perceptions. Accordingly, there is a need to develop methodologies for evaluating and further integration of cultural ecosystem services within management plans. In this work we present a case study focused in Dublin Bay which explores a set of multidisciplinary methodologies (i.e. humanities, social sciences and environmental sciences) for the assessment and valuation of cultural ecosystem services. We integrate qualitative and quantitative information obtained from advisory meetings, online and field surveys, and analysis of cultural texts to provide a set of methods for assessing and further integrating less tangible cultural ecosystem services within marine spatial planning. This work provides a multidisciplinary perspective demonstrating the importance of including cultural ecosystem services as an additional layer in marine spatial planning enabling managers to make more informed decisions and tradeoffs.

Keywords: cultural ecosystem services, coastal habitats, marine spatial planning, assessment methods

3. *Type of submission: Abstract*

B. Biome Working Group sessions: [B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning](#)

Operationalizing ecosystem services in support of Conservation Measures of Marine-coastal protected areas in Sardegna Region (Italy)

First author: Giacomo Cozzolino, Daniel Bazzucchi

Other author(s): Alessandro Piazzì

Affiliation: Ecolinfa, SETIN srl Italy

The financial resources available do not cover the current financial needs for the management and conservation of marine protected areas (MPAs) in the Mediterranean and the Natura 2000 network in Europe. This fact involves objective difficulties in the conservation of habitats and species and, more generally, of landscapes and ecosystems. In addition, the vast majority of available sources comes from public funding.

Keywords: Nature 2000, Marine Protected Areas, Sustainable Financing Mechanisms, Payments for Ecosystems Services



4. *Type of submission: Abstract*

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Linking marine ecosystems with the services they supply: what are the relevant service providing units?

First author: Fiona Culhane

Other author(s): Chris Frid, Eva Royo Gelabert, Lydia White

Presenting author: Leonie Robinson, University of Liverpool

Affiliation: University of Liverpool, United Kingdom

Marine ecosystems support supply of ecosystem services (ESs) through processes and functions carried out by diverse biological elements. Managing sustainability of ES use requires linking services to the parts of ecosystems supplying them. We specified marine service providing units (SPUs) as plausible combinations of a biotic group (e.g. bacteria, seabirds) with an associated major habitat (e.g. sublittoral sediment). We developed a network model for large marine ecosystems, documenting 2916 links between 153 SPUs with 31 services. Coastal habitats and their taxa accounted for 48% of links, but all habitats with their taxa contribute to at least 20 ESs. Through network analysis, we showed some services link to certain key habitats, while others are less clearly defined in space, being supported by a variety of habitats and their taxa. Analysis highlighted largescale flows across marine habitats that are essential in underpinning continued supply of certain ESs e.g. seed dispersal. If we only protect habitats where services are used, we will not fully protect the supply of services reliant on mobile taxa moving between habitats. This emerged because we considered habitats and their taxa together. We recommend using combinations of habitats and taxa as SPUs when informing marine ecosystem management and conservation. We demonstrate how this approach can be linked to current marine spatial planning approaches.

Keywords: biodiversity, conservation, ecological connectivity, mobile species, network analysis



5. *Type of submission: Abstract*

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Valuation of ecosystem services for a sustainable aquaculture development

First author: Marco Custódio

Other author(s): Sebastián Villasante, Ricardo Calado, Ana Lillebø

Affiliation: University of Aveiro & CESAM, Portugal

The ecosystem services (ES) framework has become a promising tool for ecosystem-based management (EBM), supporting better decision-making. In the particular case of the marine environment, its operationalization will foster a healthier use of the maritime space, integrating the various economic activities on a sustainable way. Aquaculture development in marine and coastal areas has turned into an important driver of change as it is now the fastest growing food-production industry, securing nearly 50% of the seafood supply worldwide. Such rapid expansion and intensification can have serious impacts on marine and coastal ES. Evaluating ES trade-offs under different aquaculture development scenarios can thus provide a comprehensive analytical matrix of interactions of the activity with the environment and society and stimulate science-based EBM. A review of the results from scientific publications on the valuation of ES delivered by marine and coastal areas under aquaculture development was carried out to assess the potential of the framework to support more sustainable development scenarios. Most of these studies were in Southeastern Asian countries, where shrimp-farming has led to the devastation of mangroves, seriously affecting ES with high economic costs to society. Results constantly revealed substantially higher ES value for intact mangroves and already encouraged effective measures towards better EBM. Studies suggest that aquaculture typically increases provisioning services at the cost of other services. However, certain modes of production, like Integrated Multi-Trophic Aquaculture, and cultured species (e.g. seaweeds and shellfish) can actually improve overall ES delivery by increasing not only provisioning services but also regulation & maintenance services. The assessment and mapping of ES in marine and coastal areas used or planned for aquaculture development will facilitate the sorting through different scenarios and support projects that sustain and improve ES capacity and flow to communities, safeguarding a sustainable economic growth.



Keywords: Aquaculture, ecosystem services, ecosystem-based management, valuation, Blue Growth

6. *Type of submission: Abstract*

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

The Socio-Ecological Dimension of Multi-Use Sea Spaces

First author: Daniel Depellegrin, Marta Vrigilio

Other author(s): Marta Vergilio, Martina Bocci, Emiliano Ramieri, Stefano Menegon, Alessandro Sarretta, Giulio Farella, Chiara Venier, Sebastian Villasante, Andrea Barbanti

Affiliation: CNR – National Research Council of Italy, ISMAR – Institute of Marine Sciences Arsenal, Venice, Italy, CIBIO – Research Center in Biodiversity and Genetic Resources/InBIO – Associate Laboratory, University of the Azores, the Azores, Portugal

European seas are subjected to a magnitude of concurrent commercial and non-commercial activities seeking sea space as fundamental driver for their existence. An emerging concept to better address sustainable resource exploitation and sea space allocation is Multi-Use (MU). Multi-Use sea spaces are geographic domains where joint use of resources occurs, shifting the single user paradigm towards a MU relationship. Marine ecosystem services (MES) as inherent component of the biotic and abiotic marine natural capital can contribute to a wider understanding of the actual socio-ecological benefits coming from MU supporting Blue Growth Strategies and ecosystem-based Maritime Spatial Planning (MSP). Nevertheless MES based assessment serving the analysis of MU concepts was never explicitly tested. This research presents an exploratory approach for identifying, collecting and analyzing MES generated by MU concepts combined with geo-spatial and -statistical modelling. The method is derived from an operational framework providing spatial and non-spatial analytical techniques to assess services, disservices and service associations generated by single versus multi-use solutions of the sea space. The method is tested through existing and potential future MU pilot sites identified in European regional seas. Opportunities and challenges of the application of the framework are discussed for their support in MSP, Blue Growth and Macro-Regional Strategies.



Keywords: Multi-Use, Marine Ecosystem Services, Disservices, Maritime Spatial Planning, Blue Growth

7. *Type of submission: Abstract*

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Stakeholders' place-based knowledge supporting ecosystem-based maritime spatial planning in Kokemäenjoki riverine landscape

First author: Nora Fagerholm, Paulina Nordström

Other author(s): Reija Hietala, University of Turku, Department of Geography and Geology; Asko Ijäs, Regional Council of Satakunta

Affiliation: University of Turku, Department of Geography and Geology, University of Turku, Department of Geography and Geology, Finland

Maritime spatial planning practices are currently under development in the European Union member states, also in Finland. In this strategic level spatial planning the blue growth priorities covering the interests on the sea-land interaction with top-down approaches are common. Maritime spatial planning is, however, essentially related to different stakeholders' interests and priorities at operating at the local and regional scale in the planning areas. Their place-based knowledge would be essential contribution to drafting spatial plans for future. There are, however, several questions to consider in relation to participation in maritime spatial planning context including: Who are the stakeholders who should participate? Who has interest to participate? What information could be valuable to collect through participation? We present a case study from Kokemäenjoki river watershed in Finland where we have developed an online survey to map residents' and recreational users' place-based perceptions of ecosystem services in connection with the ecosystem-based maritime spatial plan currently drafted for the area. The online map-based survey approach is developed in the phase of evaluating the draft plan to receive further input for finalizing the plan. Through such approach we create spatially explicit understanding of the contribution of the nature, ecosystems and landscapes to human values and activities in the area. In addition, we operationalize this participatory assessment to planning to advance transdisciplinary communication. The presented work is related to EU Interreg Central Baltic funded project SustainBaltic (2016-18).



Keywords: participation, place-based ecosystem services, perceived ecosystem services, riverine landscape, Central Baltic Programme

8. *Type of submission:* **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Analysing the dependencies of marine activities and Natural Capital: a spatially-explicit Bayesian Belief Network approach under the Marine Spatial Planning framework

First author: Jordan Gacutan

Other author(s): Ibon Galparsoro, Arantza Murillas

Affiliation: AZTI-tecnalia, Australia

Presenting author: Arantza Murillas

The expansion of traditional sectors and ‘Blue Growth’ initiatives poses a considerable challenge to the management of the marine space, due to their requirement for various marine resources. The Marine Spatial Planning (MSP) framework is increasingly employed to manage multiple activities at the ecosystem-level, combining both ecological and socio-economic data to maximise resource use and minimise conflicts across temporal and spatial scales. Through MSP, new management initiatives require a clear understanding of the dependencies each activity has with the environment and the human benefits that can be derived. This may be conceptualised as ‘Ecosystem Services’ (ES), generated by an underlying stock of ‘Natural Capital’ (NC). Over the last few years, several efforts have been made to define, take stock and value NC, although less attention has been given towards dynamics between NC, ES and the requirements of marine activities. Therefore, in recognising NC as the foundation for the suitability of present and emerging economic activities, we present a spatially-explicit Bayesian Belief Network (BBN) to identify the dependencies of marine activities with NC and ES. Using the Basque coast (SE Bay of Biscay) as a case study, the model links economic performance of most relevant marine activities (including aquaculture, renewable energy production and fishing) with the ES provided by benthic habitats, using both expert judgement and empirical indicators. The study identifies the dependencies of specific activities and further compares the cumulative dependencies of several activities. The model provides a ‘first-pass’ overview of the dependency of the maritime economy, especially Blue Growth sectors, on Natural Capital. The results obtained with this approach are highly relevant in achieving ecosystem-based Marine Spatial Planning.



Keywords: Integrated management, Decision support tool, Activity dependencies, Ecosystem Based Management (EBM)

9. *Type of submission:* **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

First author: Ibon Galparsoro

Other author(s): Daniel Depellegrin, Kemal Pınarbaşı

Affiliation: AZTI, Spain

Marine spatial planning (MSP) works across borders and sectors to ensure human activities at sea take place in an efficient, safe and sustainable way. Although, MSP focuses on the management of socio-economic activities, these should be considered under a broader ecosystem framework. Planning process should consider the dependencies between socio-economic activities performance and human wellbeing, with the environmental status and the ecosystem functioning. Therefore, mapping and assessment of ecosystem services (MAES), can be a potential framework that links different sectorial and environmental policies. The integration of ESs into MSP is promising, as it is a potential tool for enhancing sustainable use, to promote the development of new maritime activities according to the Blue Growth, to optimise sea-space and resource exploitation, or for the adoption of conservation measures such as Marine Protected Areas. However, due to complexity of the marine realm, ESs assessment is still in its infancy and there is still the need to develop and agree appropriate frameworks for marine natural capital (NC) and ESs to support ecosystem-based MSP. If NC and ESs information is going to be integrated into MSP framework, this requires the collation, management and integration of spatially and, if possible, temporally explicit information. This requires the integration of information on relevant ecosystem components and their environmental status and detailed information of the distribution of human activities to derive a better understanding of ESs flow, analysis of pressures and impacts that human activities exert to NC, and the potential effects on the delivery of ESs. This contribution will review existing NC, ESs and MSP frameworks and assessment methods, and their potential links, commonalities and integration. Strengths and weaknesses of the present status will be presented, and future needs will be discussed.



Keywords: Human activities, ecosystem functioning, valuation, assessment, framework

10. Type of submission: **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Marine ecosystem services trade-off assessment: a methodological approach to inform maritime spatial planning

First author: Elena Gissi

Other author(s): Elisabetta Manea, Davide Di Carlo, Stefano Menegon, Denis Maragno, Francesco Musco

Affiliation: University luav of Venice, Italy

Strategic natural resource management is of central interest for long-lasting and sustainable socio-economic development, especially in the marine realm, where ecosystem services (ES) and trade-offs assessment is backward compared to land-based studies. Maritime/Marine Spatial Planning (MSP) represents an opportunity to spatially allocate human uses at sea to favour socio-economic development, supporting the sustainable use of its resources. In the Adriatic Sea, which is a severely used and highly ecologically valued marine area, the need for informed and balanced measures of resource exploitation is urgent and claims for MSP to meet both conservation and socio-economic regional objectives. This study proposes a method to understand and assess potential trade-offs between multiple ES. The study takes as example the relationship between the supply of multiple supporting ES and the provisioning ES related to fishery activity, recognized as pivotal among the diverse uses in the area. The method supports the identification of pair-wise trade-off relationships between ES. The spatial analysis depicts areas revealing high ES delivery potential and heavy fishing activity that could lead to the impoverishment of the capacity to provide the delivery of ES due to environmental damage. The results are discussed in order to support the elaboration of spatial management measures in order to cope the fishing industry needs and conservation. Our study highlights the necessity in including ES trade-off assessment in MSP to explore potential conflicts between economic activities and the delivery of multiple ES because of marine environment integrity.



Keywords: trade-off analysis, cultural marine ecosystem services, fishery, supporting ecosystem services, maritime spatial planning

11. Type of submission: Abstract

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Assessing and mapping changes in ecosystem services provision: examples from Baltic transitional waters bodies

First author: Miguel Inácio

Other author(s): Gerald Schernewski, Yaroslava Nazemtseva, Philipp Paysen, Alkisti Pliatsika, Svenja Hoef, Rene Friedland, Egle Baltranaite

Affiliation: Leibniz Institute for Baltic Sea Research Warnemuende, Germany / Marine Research Institute, Klaipeda University, Lithuania, Germany

The European Commission's future view of the marine environment includes firstly the achievement of a good ecological and environmental status of coastal and marine waters and secondly the sustainable development sea-based socio-economic development. However, the success of both is being hampered by anthropogenic impacts and pressures. One way of counteracting this is by raising public awareness on the contribution of coastal and marine waters as supporters of our human wellbeing, which is also the underlying principle of the ecosystem services (ES) concept. It is therefore important to develop knowledge, by assessing and mapping ES, to support its integration into management strategies. In this study we aim to understand how changes of ES provision have occurred over time. For this we applied the Marine Ecosystem Services Assessment Tool (MESAT). MESAT is a user-friendly Excel-based tool, specifically design to assess changes in marine services provision over time. The tool is comprised by 31 services and 54 indicators. Two points in time, representing different ecological conditions, are assessed and the difference of the indicator values is classified as an increase, decrease or no change in in services provision. The tool was applied to 4 transitional waters of the Southern Baltic Sea: the Szczecin Lagoon (Germany/Poland), the Schlei (Germany), the Greifswald Bay (Germany) and the Curonian Lagoon (Lithuania/Russia). The results suggest that common to all lagoons is the increase in cultural services, which can be related to the increasing demand of cultural outputs and therefore an anthropogenic driven change. For provisioning and regulating & maintenance services results differ across lagoons. Here changes are not only connected anthropogenic uses and dynamics but also environmental characteristics of the water bodies. To



understand how services provision have changed over time may be a key factor to predict future changes.

Keywords: marine ecosystem services, indicators, MESAT, coastal lagoons

12. Type of submission: **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Optimizing the management of multiple ecosystem services – case study from the Finnish Archipelago Sea

First author: Susanna Jernberg

Other author(s): Riikka Puntila, Laura Uusitalo

Affiliation: Finnish Environment Institute, Finland

Marine ecosystems provide services that promote human well-being. Multiple users of the marine resources create trade-off situations between the users and services, and the challenge is to simultaneously keep the human induced pressures at a level where the usage of the seas is sustainable. Ecosystem-based management (EBM) helps to deal with these problems by including the ecosystem aspect in the decision-making process. Understanding the trade-offs between ecosystem services and the different users of the sea offers valuable input for the EBM and the marine spatial planning. In this study we investigated how management decisions affect different ecosystem components (e.g. fish biomasses, seal abundance, water clarity etc.) and the ecosystem services they contribute to. The study was conducted in the Finnish Archipelago Sea using Bayesian Network based decision support system (DSS). The management possibilities included different policies on nutrient inputs, fishing, and seal and cormorant harvest, and the effects of different management policies on the ecosystem variables were simulated using an Ecopath with Ecosim model. In addition, we wanted to study how the management decisions affect stakeholder groups using the sea and their experienced benefits. To achieve this, we conducted a questionnaire asking about the values of the stakeholders. The results of the questionnaire were included in the final DSS model. The modeling results demonstrate how different management decisions for the Archipelago Sea can maintain and maximize ecosystem service production and what are the trade-offs between the ecosystem services. The results also show the effect of the management decisions on the stakeholder groups.



Keywords: Baltic Sea, trade-offs, uncertainties, Bayesian network modeling, Decision Support System

13. Type of submission: Abstract

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Knowledge to decision in dynamic seas: Novel species are jeopardizing the integrity of vital ecosystems and their functioning

First author: Kiran Liversage, Jonne Kotta

Other author(s): Merli Rätsep, Kristiina Nurkse, Henn Ojaveer, Helen Orav-Kotta, Maiju Lehtiniemi, Riikka Puntila-Dodd, Tiia Forsström, Monika Normant-Saremba, Robert Aps

Affiliation: University of Tartu, Estonian Marine Institute, University of Tartu, Estonian Marine Institute Estonia

Incorporating ecosystem changes from invasive species is an important task of maritime spatial planning, and the importance will grow as incidences of “novel ecosystems” become more common. Estuaries and harbours are areas of focus due to extensive transport vectors, unsaturated niches, and because species surviving ballast conditions are liable to flourish upon release. In this context, invasive species must be viewed primarily as functional elements (as opposed to structural) which is underpinned by the often small number of niches occupied by native brackish-water species and the simple trophic structures, allowing invasive species to acquire strong ecological functions. In situations of novel ecosystems, maritime spatial planning will need a framework that strongly emphasises ecological functioning in a state of dynamic change, including interactions with climate and other changes. We discuss the importance of intensive monitoring, allowing knowledge of current invasive species occurrences, but more importantly, modelling of future scenarios that may be greatly influenced by novel functions introduced by even a single new strongly-interacting species. The most recent Baltic Sea examples are the North American mud crab *Rhithropanopeus harrissii* and the Ponto-Caspian round goby *Neogobius melanostomus*, which were experimentally found to cause regime-shifts arising from the collapse of important underwater habitats, loss of related ecosystem services and changes to benthic-pelagic nutrient coupling. Such information could not likely be derived without experiments, highlighting the need for maritime spatial planning methods to incorporate experimental data. Environmental niche modelling predicts that these species will spread across virtually the whole Baltic Sea area jeopardizing the integrity of vital ecosystems and their functioning.



These considerations highlight the value of using dynamic scenario-based modelling techniques informed from varied ecological and methodological perspectives to advise maritime spatial planners about rapid changes in the underwater realm and to implement mitigation actions to reduce the risks of these invasive species.

Keywords: novel species, ecosystem functioning, ecosystem services, Baltic Sea, framework

14. Type of submission: **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Mapping ecosystem services for coastal zone planning

First author: Keshav P. Paudel

Other author(s): Bente Sundsvold, Clarie W. Armstrong, Alma E. Thuestad

Affiliation: The Norwegian College of Fishery Science, UiT The Arctic University of Norway, Norway

Over the last decade, ecosystem services (ES) as a concept and framework have increasingly used to recognize both human impacts and dependencies on ecosystem and widely advocated to incorporate into spatial planning as a tool for enhancing sustainable management. However, ES are not commonly considered in local level planning of diverse and complex coastal areas because of availability of appropriate data and method for decision makers. In this paper, we provide a simple method to map the ES provided by a coastal area at local scale integrating existing biophysical and human activities datasets and inputs from stakeholders from participatory mapping meetings and public consultation meetings carried out in the planning processes. Using the case of inter municipal level planning of coastal zones in northern Norway, this paper deconstructs the existing practice of knowledge production and spatial decision making in coastal zone planning and discusses how it can be improved by using the ES framework.

Keywords: coastal zone planning, marine spatial planning, mapping ecosystem services, GIS



15. Type of submission: **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

Potential tool developments for ecosystem services valuation with respect to requirements in marine spatial planning

First author: Kemal Pınarbaşı, Ibon Galparsoro

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Healthy marine ecosystem services are significantly important for coastal communities due to reflecting physical and cognitive interactions between humans and nature. Marine spatial planning processes should consider goods and services provided by marine ecosystem for basic human needs and wellbeing. Besides, these services have a crucial role in ecosystem-based management of marine areas. As a part of ecosystem-based management process, marine ecosystems should be maintained healthy and productive. This requires a detailed and integrated valuation and assessment to investigate the socio-ecological benefits and the societal demand for the ecosystem services. Model-driven decision support tools can support planners in addressing the ecological and socio-economic complexity. Although there are several approaches and tools developed and applied to help planners for this purpose, consideration of novel concepts such as cumulative pressures and impacts, and natural capital can improve existing tools' structure and create opportunities for new developments. This work reviews the trending topics and concepts in marine spatial planning and analyses potential tool developments for ecosystem services valuation. In addition, it provides future outlook for tool developers working on this field.

Keywords: Marine spatial planning, decision support tools, natural capital, cumulative impact, marine ecosystem services



16. Type of submission: **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

A post normal science approach to operationalizing marine ecosystem services: lessons from the North Sea, Scotland

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Although governments worldwide are increasingly anticipating the use of an ecosystem services (ES) approach to address intersecting social, economic and environmental challenges on land and sea, practical processes and supports for policy development utilising ES are in practice limited. There are, however, a range of theoretical frameworks for implementing the ecosystem services approach. The Cooperative Participatory Evaluation of Renewable Technologies on Ecosystem Services (CORPORATES) is an interdisciplinary project funded by the U.K. Natural Environment Research Council (NERC) aimed at facilitating exchange of knowledge between researchers and a range of public and private sector stakeholders around the understanding of marine ES in the context of marine spatial planning (MSP) decisions for marine renewable energy. This presentation explains syntheses of theory and practice by discussing the CORPORATES research project in Scotland which adopted a post normal science (PNS) approach to implementing ES in an applied policy context using conceptual systems mapping. The knowledge exchange research developed an innovative, yet practical process of linking ecological processes, ES and benefits. It did this in the context of an emerging marine spatial planning system in the UK, specifically, the North Sea off the East coast of Scotland, using as a real case study of existing renewable energy developments undergoing the licensing process. The presentation will explain why a PNS approach was required to effectively implement the ES approach; what the CORPORATES method entailed; the process itself is described and how it was implemented. It goes on to evaluate the learning, strengths and weaknesses of the project in relation to the implementation of MSP and the development of policy, drawing conclusions which can be applied in the 'real world'.

Keywords: marine spatial planning, ecosystem services (ES), post normal science (PNS) conceptual systems modelling (CSM), knowledge exchange.



17. Type of submission: **Abstract**

B. Biome Working Group sessions: B1b Operationalizing ecosystem services in support of ecosystem-based marine spatial planning

A Bayesian Network Analysis of Trade-Offs Between Ecosystem Services in the Dutch Wadden Sea

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Ecosystems provide numerous benefits to humans, from clean water and air, food and flood protection to cultural heritage. Many of these benefits, which are also known as ecosystem services, are threatened by man-made pressures. In order for decision and policy makers to take the right management choices, they need clear information on how biodiversity supports these services, the demand for them, the capacity of ecosystems to provide these services, and the pressure they are facing to make relevant decisions. One concept that seems to bridge the gap between the many qualitative and quantitative evaluation methods are Bayesian Networks. They are statistical models functioning on the basis of causal dependencies between system elements of interest. The aim of this study is to extend the understanding of ecosystem services through causal relationships and trade-offs by developing a Bayesian Network. The Bayesian Network developed combines a blend of remote sensing and in-situ data with expert knowledge to value the causal relationships between prioritized ecosystem services of the Dutch Wadden Sea. It was shown that combining different data sources with expert knowledge aids in developing a well-functioning model. The developed network was able to also account for both, tangible and intangible ecosystem services. All in all, Bayesian Networks seem to be a useful tool in ecosystem service valuation as they are able to bridge the gap between qualitative and quantitative approaches. Furthermore, they are suitable for complex systems and are scalable. Results were very much dependent on the availability of complete datasets and/or expert opinions. Those limitations can be tackled by finding more valid data sources and therefore improving the reliability of the whole network.

Keywords: Bayesian Network analysis, ecosystem services, Dutch Wadden Sea, trade-offs