## Aalborg Universitet



### Editorial

Spatial planning for sustainable use of marine ecosystem services and resources

Bonnevie, Ida Maria; von Thenen, Miriam; Hansen, Henning Sten

Published in: Frontiers in Marine Science

DOI (link to publication from Publisher): 10.3389/fmars.2024.1361827

Creative Commons License CC BY 4.0

Publication date: 2024

**Document Version** Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA): Bonnevie, I. M., von Thenen, M., & Hansen, H. S. (2024). Editorial: Spatial planning for sustainable use of marine ecosystem services and resources. Frontiers in Marine Science, 11, Article 1361827. https://doi.org/10.3389/fmars.2024.1361827

#### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain You may freely distribute the URL identifying the publication in the public portal -

#### Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

#### Check for updates

#### **OPEN ACCESS**

EDITED AND REVIEWED BY Carlos M. Duarte, King Abdullah University of Science and Technology, Saudi Arabia

\*CORRESPONDENCE Ida Maria Bonnevie idarei@plan.aau.dk

RECEIVED 27 December 2023 ACCEPTED 29 January 2024 PUBLISHED 08 February 2024

#### CITATION

Bonnevie IM, von Thenen M and Hansen HS (2024) Editorial: Spatial planning for sustainable use of marine ecosystem services and resources. *Front. Mar. Sci.* 11:1361827. doi: 10.3389/fmars.2024.1361827

#### COPYRIGHT

© 2024 Bonnevie, von Thenen and Hansen. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

## Editorial: Spatial planning for sustainable use of marine ecosystem services and resources

## Ida Maria Bonnevie<sup>1\*</sup>, Miriam von Thenen<sup>2</sup> and Henning Sten Hansen<sup>1</sup>

<sup>1</sup>Department of Sustainability and Planning, Aalborg University Copenhagen, Copenhagen, Denmark, <sup>2</sup>Coastal and Marine Management Group, Leibniz Institute for Baltic Sea Research Warnemünde, Rostock, Germany

#### KEYWORDS

ecosystem services (ES), marine spatial planning (MSP), cumulative impact assessment, ecological connectivity, deep sea, decision support, ecosystem classification, spatial analyses

#### Editorial on the Research Topic

Spatial planning for sustainable use of marine ecosystem services and resources

## **1** Introduction

Life depends on healthy oceans that provide ecosystem services (ES) to humans, including provisioning, regulating, supporting, and cultural ES (Kovalenko et al., 2023). However, biodiversity, habitats, and the delivery of marine ES and resources are increasingly threatened by growing human activities in the oceans (Worm et al., 2006). Blue-growth activities, such as shipping and energy, eutrophication, and climate change represent major pressures that affect marine ecosystems (Halpern et al., 2008; Ehlers, 2016). Over the past two decades, increasing scientific attention has focused on the need to preserve and restore healthy marine waters and their role in adapting to climate change (Santos et al., 2020). This challenge calls for holistic approaches that advance our knowledge. Within the contributions to this Research Topic (see Figure 1), three themes are central to driving further research to expand our understanding in this interdisciplinary field.

## 2 Extending the geographic scope to the deep sea

While terrestrial and coastal regions are highly used and valued for their ES (Barbier et al., 2011), less is known about marine offshore areas (Townsend et al., 2018), especially those vast regions beyond national jurisdiction (ABNJs) (Zaucha and Jay, 2022). These areas offer important ES but at the same time are also threatened by growing pressures, e.g. overexploitation and climate change (IUCN, 2022). To target the deep-sea knowledge gap



and to support conservation goals (e.g. the U.N. Treaty on Biodiversity beyond national jurisdiction), La Bianca et al. provide the first comprehensive evidence to propose a deep-sea ES framework. While there have been a few studies focusing on deep-sea ES (e.g. Le et al., 2017), there has not yet been a standardized framework that considers existing ES frameworks such as CICES and TEEB and draws attention to existing knowledge gaps such as the ES role of deep-sea functional groups and the lack of deep-sea cultural ES considerations in decisionmaking. In a similar way, Niner et al. present a risk register of information and uncertainties on the natural capital assets (NCAs) of ABNJs that underpin the delivery of ES in order to appraise the many NCA benefits that cannot be easily quantified. They also show how the many numerical uncertainties cause over-prioritization in the governance of extractive ecosystem services with financial benefits. Together, the two papers illustrate the importance of ES frameworks to explore the known and unknown aspects of the deep sea.

# 3 Advancing spatial approaches to ecosystem service assessments

Spatial assessments of ES and the pressures affecting them are needed to inform marine spatial planning (Halpern et al., 2008; Sousa et al., 2016). Lavialle et al. use spatial statistics to delineate ES indicators in their French marine study area in the form of ecosystem process hotspots, which are areas with significantly higher ecosystem process values than coldspots. The ES hotspots/ coldspots are then used to investigate the spatial correlation of ecosystem processes and their spatial overlap with human activities and marine protected areas. Armoskaite et al. also investigate spatial links between human activities and ES but connect the two concepts more systematically by providing a framework for assessing changes in the relative supply of ES to changes in the cumulative impacts of human activities. The framework is the first systematic mapping of the effects of cumulative impacts on ES in a change analysis, demonstrated by reducing fishing in the Gulf of Riga. Complementing these two papers, Kitolelei et al. highlight the importance of combining spatial mapping with ethnographic methods to map indigenous traditional knowledge to inform sustainable resource management. Their participatory spatial mapping in a rural village in Fiji provides insights into the ecological, economic, and cultural meanings and uses of local fishing grounds across different generations and genders. All three papers develop and improve scenario-based methods for mapping ES indicators, which are needed to inform and evaluate spatial management for current and future scenarios.

## 4 Investigating the carrying capacities of ecosystems

Ecosystems are complex and vulnerable to pressures (Elliot and O'Higgins, 2020). Thus, investigations are needed for systematic ways to assess the sustainable carrying capacities of ecosystem components or sub-systems (Ma et al., 2017). Wu et al. propose a quantitative evaluation method to assess the carrying capacity of different settlement scenarios on yet-uninhabited coral reef islands. They demonstrate their method on a Chinese reef for which they convert energy and resources into a unified solar energy value. This enables them to compare and measure ratios for renewable energy,

non-renewable resources, indigenous renewable resources, imports, and environmental load, in addition to levels of sustainability. With a similar focus on carrying capacity, Hu et al. study how to actively increase a resource - in this case, a fishery resource. They combine a habitat suitability model with a model on optimal growth conditions for Portunus trituberculatus larvae to calculate suitable areas in Liaodong Bay and release larvae into them to test their actual suitability. Carrying capacity is, however, not only related to the suitability of habitats but also to the ecological connectivity between them. Podda and Porporato provide a comprehensive review of how ecological corridors, promoted in Europe by the EU Biodiversity Strategy for 2030, have been approached in marine spatial planning. They show how few studies exist on marine ecological corridors but the methods used involve least-cost theories of expected species movements and circuit theories that identify species movement bottlenecks that have ecological importance for ES delivery, biodiversity, and climate change resilience. In this supplementary way, the three papers explore ways to understand and improve habitat and resource-carrying capacities in support of ES.

### **5** Perspectives

The geographic and methodological diversity of the papers shows how marine ecosystems play an essential role globally and require transdisciplinary approaches. All papers contribute to more holistic ES assessments. At different scales, in crowded and more unknown places, we need to have a better understanding of marine ES and resources and how to deal with the issues affecting them. Future research should aim to operationalise ecosystem

## References

Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., and Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecol. Monogr.* 81, 169–193. doi: 10.1890/10-1510.1

Ehlers, P. (2016). Blue growth and ocean governance-how to balance the use and the protection of the seas. WMU J. Maritime Affairs 15, 187-203. doi: 10.1007/s13437-016-0104-x

Elliot, M., and O'Higgins, T. G. (2020). "From DPSIR the DAPSI(W)R(M) Emerges ... a Butterfly – 'protecting the natural stuff and delivering the human stuff'," in *Ecosystembased management, ecosystem services and aquatic biodiversity* (Cham: Springer).

Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., et al. (2008). A global map of human impact on marine ecosystems. *Science* 319, 948– 952. doi: 10.1126/science.1149345

IUCN. (2022). Governing areas beyond national jurisdiction. IUCN issues briefs. (Gland: International Union for Conservation of Nature).

Kovalenko, K. E., Bini, L. M., Johnson, L. B., and Wick, M. J. (2023). Inequality in aquatic ecosystem services. Aquat. Ecosystem Serv. 850, 2963–2974. doi: 10.1007/s10750-023-05165-y

Le, J. T., Levin, L. A., and Carson, R. T. (2017). Incorporating ecosystem services into environmental management of deep-seabed mining. *Deep Sea Res. Part II: Topical Stud. Oceanogr.* 137, 486–503. doi: 10.1016/j.dsr2.2016.08.007 classification frameworks in deep waters while advancing methods for spatial assessment of ES, pressures, and their spatial interlinkages, and investigating sustainable ES carrying capacities, ecological connectivity, and uncertainties.

## Author contributions

IB: Conceptualization, Formal analysis, Investigation, Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing. MT: Conceptualization, Formal analysis, Investigation, Methodology, Resources, Writing – original draft, Writing – review & editing. HH: Conceptualization, Writing – review & editing.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Ma, P., Ye, G., Peng, X., Liu, J., Qi, J., and Jia, S. (2017). Development of an index system for evaluation of ecological carrying capacity of marine ecosystems. *Ocean Coast. Manage.* 144, 23–30. doi: 10.1016/j.ocecoaman.2017.04.012

Santos, C. F., Agardy, T., Andrade, F., Calado, H., Crowder, L. B., Ehler, C. N., et al. (2020). Integrating climate change in ocean planning. *Nat. Sustain.* 3, 505–516. doi: 10.1038/s41893-020-0513-x

Sousa, L. P., Sousa, A. I., Alves, F. L., and Lillebø, A. I. (2016). Ecosystem services provided by a complex coastal region: challenges of classification and mapping. *Sci. Rep.* 6, 22782. doi: 10.1038/srep22782

Townsend, M., Davies, K., Hanley, N., Hewitt, J. E., Lundquist, C. J., and Lohrer, A. M. (2018). The challenge of implementing the marine ecosystem service concept. *Front. Mar. Sci.* 5, 1–13. doi: 10.3389/fmars.2018.00359

Worm, B., Barbier, E. B., Beaumont, N., Duffey, J. E., Folk, C., Halpern, B. J., et al. (2006). Impacts of Biodiversity loss on ocean ecosystem services. *Science* 314, 787–790. doi: 10.1126/science.1132294

Zaucha, J., and Jay, S. (2022). The extension of marine spatial planning to the management of the world ocean, especially areas beyond national jurisdiction. *Mar. Policy* 144, 105218. doi: 10.1016/j.marpol.2022.105218