Editorial

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

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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

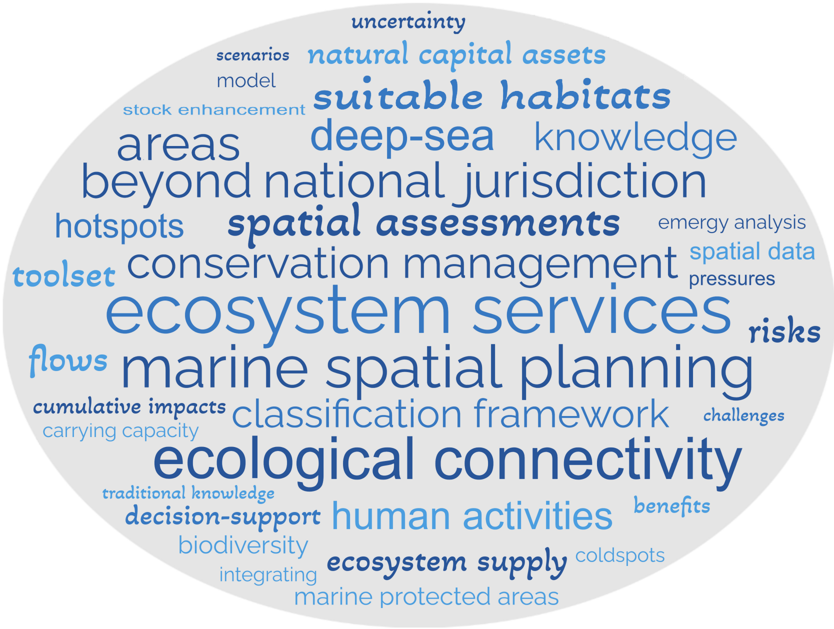

FIGURE 1
Word cloud of the abstracts of the contributions to this Research Topic (software: WordClouds.com).

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 decision-making. 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 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

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