Ecological Engineering xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Ecological Engineering

journal homepage: www.elsevier.com/locate/ecoleng

Incorporating principles of reconciliation ecology to achieve ecosystem-based marine spatial planning

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ARTICLE INFO

Keywords:
Marine spatial planning
Reconciliation ecology
Ecosystem-based management
Marine conservation

ABSTRACT

Intense human activity in the marine environment poses a threat to marine ecosystem. The ecosystem-based planning and management approach has developed over the past decades with the goal of reducing this threat by defining planning and management of uses in a way that mitigates negative effects on ecosystem structure and function. For oceans and coasts, marine spatial planning (MSP) can further aid the implementation of ecosystem-based management, a widely accepted tenet of planning for the marine environment. It can do so by allocating different uses of space in a way that reduces conflicts for the benefit of the environment. Here, we propose an approach to MSP that incorporates principles of reconciliation ecology for the planning of marine (nearshore) enclosures. The approach supports conservation within and around anthropogenic elements outside of marine protected areas. Since human activity typically involves some damage to natural ecosystem, this research contributes by proposing a way to incorporate ecosystem modeling for MSP that includes human activity. Examining areas of human activity under different management scenarios allows identification of possible trends in human-natural ecosystem interactions. Using such an approach increases marine conservation opportunities, and directs educated and cautious MSP in ways that allow implementation of an ecosystem-based approach.

1. Introduction

Increased human utilization of marine resources is a major threat to the conservation of marine environments (Douvere and Ehler, 2009; Portman, 2011). However, and somewhat counter-intuitively, marine areas dedicated to human activity can be beneficial for conservation (Bulleri and Chapman, 2010; Dyson and Yocom, 2015; García-Gómez et al., 2015) and in some situations, can be part of the solution rather than the problem.

Marine spatial planning (MSP) is a comprehensive framework which allows the integration of such conservation opportunities (Table 1). MSP facilitates integrated strategic and comprehensive planning of multiple uses in the marine environment in ways that can mitigate the impacts of development on the marine environment and can promote conservation while doing so. Some MSP initiatives focus on economically efficient use of an area (e.g., Plasman and Van Hessche, 2004). Here, we are consider MSP, as a tool for achieving ecosystem-based management (e.g., Douvere and Ehler, 2009). The latter is a holistic management strategy for systems (rather than individual components) that considers humans as an integral part of the ecosystem (COMPASS, 2005). As such, it aims to maintain the diversity, productivity, and resilience of the ecosystem. Mengerink et al. (2009) discuss five aspects of ecosystem-based management which are necessary for its implementation. The first two aspects are the development of an ecosystem-based vision and plan, and incorporation of science into management decisions. For the remainder of this paper the use of term ecosystem-based management (EBM) refers exclusively to these two aspects.

The coupling of MSP and EBM produces different outcomes based on the planning objectives. In a review of ecosystem-based marine spatial planning and management initiatives, Katsanevakis et al. (2011) and Collie et al. (2013) found that various plans that differ in their scope, implementation methods, and legislative support, do share a general common notion of aiming for sustainable development and conservation of marine biodiversity. Despite the different outcomes and emphases in each of these plans, they all share the intention of marine ecosystem protection.

Marine protected areas are a well-known conservation tool and their designation is often part of MSP (Arkema et al., 2006; Douvere, 2008; Leathwick et al., 2008). There are currently several initiatives that promote the establishment of marine protected areas and suggest MSP as a tool for improving management of the marine environment, mainly

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http://dx.doi.org/10.1016/j.ecoleng.2017.08.026
Received 24 October 2016; Received in revised form 2 July 2017; Accepted 23 August 2017

Table 1
Applying reconciliation ecology to MSP to enhance EBM and overall conservation in the marine environment.

	Reconciliation ecology	MSP	Reconciliation approach for MSP
What is it	A conservation approach which aspires to establishing or maintaining habitats in areas of residence, industry and recreation to conserve species within them.	A process of allocating spatial and temporal distribution of all human activities in the marine environment.	Spatial and temporal allocation of uses considering the ability of the use to reconcile primary activities with ecosystem needs.
Advantages for conservation	Enhancing conservation opportunities by recognizing multiple areas in which it can take place.	Enhancing conservation by spatially allocating uses and separating them, if needed.	Integrating conservation approaches into the planning of the marine environment.
Possible Impediments	Implementation focuses on discrete conservation initiatives at a local level and is absent from planning practices at various scales. Means of implementation (even conservation initiatives at a local scale) is unclear.	Does not readily use or integrate conservation approaches.	Implementing MSP which enhance EBM. The outcomes of the integration between human activity and conservation are hard to predict. The integrated nature of the approach may be difficult to communicate; conservationists and developers tend to occupy opposing camps with each viewing the use of the approach as selling out to the other 'side'.
How can impediments be addressed	Integrating the approach into planning by considering opportunities to enhance conservation at all areas during the planning process and later in management of the areas, while constantly examining the compatibility with conservation goals.	Including a consideration of integrative conservation approaches and on updated ecological data related to conservation objects in a way which aligns with planning approaches.	The integration could be examined using ecosystem modelling and management scenarios at the planning stage. In addition, integration opportunities should be examined using surveys and experiments in the field. Communicating the integrated approach to conservationists and planners using practical examples rather than just theoretical concepts.

by reducing conflicts (such as habitat degradation and pollution), between human uses and marine ecosystem (e.g., Barcelona Convention, 1995; IUCN, 2008). However, designation of conservation actions through planning, in addition to allocation of marine protected areas, may be required in order to bring about the desired results of implementing ecosystem-based approach to marine planning (e.g., De Santo, 2011).

Actions supporting EBM are needed to successfully integrate anthropogenic elements with conservation goals, in order to reduce the pressure on the natural environment and to integrate existing anthropogenic elements for marine conservation needs (Arkema et al., 2006; Douvere, 2008; Gilliland and Laffoley, 2008; Katsanevakis et al., 2011). Such actions or measures may consist of establishing additional marine protected areas and ensuring that they are effective. However, in most cases setting aside marine protected areas alone is insufficient for achieving conservation goals, (Agardy et al., 2011; Mora and Sale, 2011; Roff and Zacharias, 2011). EBM should account also for the conservation value of the areas outside marine protected areas.

The idea of extending conservation measures beyond defined conservation areas, and particularly into areas of human activity, was suggested by Rosenzweig (2003 p.7) as the *reconciliation ecology approach*: "the science of inventing, establishing and maintaining new habitats to conserve species diversity in places where people live, work, or play." Although some species may exist only in protected areas, there are many more species that could and should exist within areas of intense and dominant human activity. Therefore, conservation should take place in areas beyond those declared as 'protected areas'. In such "non-protected" areas people should use the sea in a way that reconciles their needs with conservation goals; thus, some level of wildlife protection could be achieved even in areas dedicated to industry and infrastructure (Table 1).

In the current study, our goal is to develop a planning framework that integrates planning and conservation biology, and by doing so, operationalizes marine conservation approaches and enhances EBM. This requires that the planning process is based on well-defined conservation goals. By adopting this framework, planners involved in MSP can aim to reconcile human activity with conservation of the marine environment while taking advantage of new types of areas where conservation could take place to enhance overall marine conservation. One specific type of area includes those where human activity is significantly restricted (hereafter: enclosures). Here we focus on the use of marine enclosures as a type of protected areas; our approach can be used as part of an experimental process for identifying conservation opportunities related to existing enclosures but our approach could also be used for large scale conservation through an MSP process.

2. Using reconciliation ecology to enhance ecosystem-based planning

Conservation-oriented marine planning involves designing and allocating marine protected areas. However, conservation planning could account broadly for allocating all uses and needs. This may shift the focus away from an emphasis on the transfer of benefits from nature to humans (ecosystem services), to an emphasis on the relationships between humans and nature, and could therefore consider benefits for the natural environment as well as for humans (Table 1).

The concept of reconciliation ecology can help to identify anthropogenic elements that conserve wild species. It can also help to enhance conservation in areas which have been degraded by providing guidance on the most suitable management methods for wildlife conservation purpose (Chapman and Underwood, 2011; Francis and Lorimer, 2011; Lundholm and Richardson, 2010; Moyle et al., 2012). For example, Dyson and Yocom (2015) conclude that integrating ecological design for new or modified marine infrastructures may lead to improvement in the quality of urban ecosystem function and provide suitable habitats for many marine species. They also suggest that the daily operation of the area in the vicinity of the infrastructure protects the ecosystem within it.

Here, we propose to enhance the potential of anthropogenic environments to support the natural ecosystem and to form broad conservation networks. Specifically, we propose to integrate the concept of reconciliation ecology into planning at multiple scales. In terrestrial environments, anthropogenic elements have been incorporated in conservation networks for urban planning and implemented through various approaches, including reconciliation ecology (Colding, 2007; Francis and Lorimer, 2011). In contrast, for planning of the marine