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Marine Spatial Planning advancing the Ecosystem-Based Approach to coastal zone management: A review

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ABSTRACT

Planning a sustainable future for coastal populations requires the effective implementation of ecosystem management frameworks that explicitly incorporate human activities. A coupled framework of the Ecosystem-Based Approach with Marine Spatial Planning has been discussed and promoted by coastal managers for more than a decade. The proposed framework supports a balanced approach between development needs and the natural environment. This paper presents a qualitative review of Marine Spatial Planning case studies to gain insights into methodological approaches that account for human systems as components of the coastal environment. A total of twelve Marine Spatial Planning case studies were evaluated. Their use and integration of the Ecosystem-Based framework was assessed through a linguistic scale linked to a score of fuzzy numbers. Two management issues of interest were highlighted: how social, economic and environmental values were integrated into the spatial planning analysis; and how cross-realm connectivity was addressed by planning teams. Although the majority of case studies claimed to use the Ecosystem-Based Approach as the guiding framework, mixed results were observed. Relevant features of the Ecosystem-Based Approach were rarely included; such as the standardization of pressures from human activities, the integration of frameworks to assess ecosystem services and the implementation of Precautionary and Adaptive Management approaches. Important knowledge gaps were observed with regards to the assessment of social values, including the lack of spatial representation of 'social connections' to the marine environment and the lack of economic estimates of non-market values. Terrestrial and catchment units were not included in the majority of case studies; however, water quality management was used as a key element for the consideration of transboundary impacts. This comparative study reveals major differences in how coastal managers understand and integrate Ecosystem-Based Approaches with Marine Spatial Planning.

1. Introduction

1.1. Background

Human preference for coastal environments is deeply tied to the economic and social wealth of our society. Almost 90% of world trade relies on the oceans and approximately two thirds of the planets 'mega-cities' exist on a coastline [1]. Oceans and near-shore environments are responsible for 59% and 38% of ecosystem-derived benefits to human society, respectively [2]. Planning a sustainable future for our sea-bounded society demands improved management over multiple human uses of the ocean and improved knowledge of the responses of natural and socio-economic systems to our actions.

The world's focus on achieving sustainable management of marine resources is centred on two arguments: (i) the underlying pressures on biodiversity are caused by unsustainable demand and consumption of natural goods and services, and (ii) the loss of biodiversity and ecosystem functioning aggravates global poverty and undermines economic development [3]. Moreover, urban areas are considered a centre piece of global sustainable strategies given they consume approximately three quarters of global resources, and their population is expected to double by 2050 [3]. In addition, it is estimated that 40% of expected new population by 2027 will be born within coastal areas [4,5]. The exacerbating demographic, economic and social pressures associated with these trends cannot be dismissed by environmental planners, government and natural resource managers.

The Ecosystem-based Approach (EBA) to natural resource

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Table 1
Summary of knowledge gaps indicated in previous reviews of MSP processes highlighting relevant management issues.

Summary of challenges and lessons learned from MSP processes	*Review sources*[a]				
	S1	*S2*	*S3*	*S4*	*S5*
MSP is still considered a new tool with few implemented cases	X	X			
There is no single approach to MSP, it needs to be adapted to local context	X				X
MSP performance is hard to judge using metrics such as improvements in ecosystem condition and reduction in conflicts and permitting costs	X				
MSP addresses large marine areas, however, it has the potential to encompass terrestrial parts of the coastal zone; and **should be integrated with plans for adjoining coastal areas** (terrestrial land-use plans) and **coastal watershed** (catchment plans)		X	X	X	
MSP boundaries frequently do not (and do not have to) coincide with administrative or political boundaries.					X
Integrating **the human dimension into MSP requires a multidisciplinary approach**.			X		
The MSP process **should consider the plans and objectives of other local sectors of the economy**, due to reciprocal implications between them.			X		
To fully implement a sustainable EBA–MSP, current national MSP initiatives would **need to be expanded into cross-border and regional marine spatial plans**.				X	
The nature of future climate changes holds a great deal of uncertainties, thus marine planning must be enabled to change and respond.				X	

[a] **Review sources:** S1: Collie, Adamowicz [16]; S2: Portman, Esteves, Le and Khan [17]; S3: Ehler [14]; S4: Katsanevakis, Stelzenmüller [13]; and S5: Gilliland and Laffoley [18].

management is an approach that recognises human society as an integral part of ecosystems [6,7]; however it has lacked well-described planning tools to achieve its implementation in a marine environment [8]. As a result, the coupling of the EBA with existing Marine Spatial Planning (MSP) processes is an emerging paradigm in sustainable ocean management [9–13]. The most substantial challenge to this coupling has been the incorporation of 'non-environmental' factors into EBA-MSP processes. Accordingly, this paper reviews contemporary EBA-MSP frameworks from around the world, focusing on their approach to incorporating human systems as components of the natural environment and hence fulfilling the requirements of an integrated EBA framework.

1.2. Review scope and objectives

Five previous evaluations of MSP were identified through a comprehensive literature review, and are summarised in Table 1. This task confirmed the ongoing challenges associated with incorporating human values (e.g. social and economic values), multidisciplinary approaches and cross-realm connectivity into MSP [14]. Building on the knowledge gained from these previous reviews, this paper renders a new analysis of a selection of MSP case studies in tackling such challenges.

The review interrogates the competence of EBA-MSP in addressing the notion of sustainable development in the marine environment. Specifically we ask (1) Is the EBA facilitating the recognition and integration of social and economic systems into MSP? (2) Is there a perceivable and increasing priority given to cross-realm connectivity within MSP processes? And (3) what are main implementation challenges faced by MSP planning teams? To this end a review of MSP case studies was conducted and results were discussed under an EBA framework proposed by the Convention on Biological Diversity [15].

Given that a single prescribed approach to MSP is not considered feasible [16], new initiatives can greatly benefit from this comparative review that highlights methodological frameworks and proposed solutions to common MSP problems [19].

The following section outlines how the notion of sustainable development has been progressively incorporated into marine resource management and ultimately into MSP. It describes how EBA has been presented in the literature as an initial planning framework that advocated for sustainable development, and how it has transitioned from terrestrial systems into the marine realm. A brief summary follows in Section 2 of the origin and development of MSP as a highly regarded tool to deliver an EBA. This background provides a general understanding of MSP as preamble to the analysis of MSP case studies in Section 4, the discussion of results in Section 5, and the conclusions presented in Section 6.

2. Development of the EBA-MSP

2.1. The Ecosystem-based Approach (EBA): an overarching planning framework

The origin of EBA is closely related to the concepts of Integrated Coastal Management (ICM) and Large Marine Ecosystem Management (LME). The latter were introduced by the United Nations to overcome the perceived failure of the single-species approach to fisheries and the intensification of land-based impacts [20]. These concepts facilitated the incorporation of human systems [20] while the EBA additionally focused on the health and resilience of marine ecosystems, as a means to ensure the long term provision of goods and services to human society [21].

The management focus of EBA is area-based, departing from a previous focus on single issues (e.g. single species or activities) [11]. Additionally, the approach implies the adoption of the precautionary principle as necessary to achieve adaptive management [22]. EBA acknowledges two types of connectivity elements: the connection among natural systems (e.g. cross realm); and the interdependence between ecological, social, economic, and institutional systems [21].

Implementation challenges of EBA are frequently addressed by the Convention of Biological Diversity (CBD) [15,23] as its primary framework for action. Two of these challenges are of particular interest to this review. Firstly, the lack of an implementation description and associated guidelines; and secondly, poor availability of planning tools to implement the approach. The CBD's Subsidiary Body, Scientific, Technical and Technological Advice (SBSTTA) developed operational guidance and 12 principles (currently known as the Malawi Principles) to overcome the lack of clear guidelines.

MSP goes someway in overcoming the second implementation challenge. MSP can be considered a planning tool that can efficiently deliver an EBA to the management of coastal marine resources [10]. This notion is supported by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). Through its current MSP Initiative, the IOC aims to support the operationalization of ecosystem-based management specifically by advancing MSP through providing documentation on initiatives worldwide, training opportunities and implementation guidelines and manuals in their website [24].