The Role of Marine Habitat Mapping in Ecosystem-Based Management

Annual Science Conference 2008
Theme Session “G”: Sediment – biota interactions and mapping marine habitats

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Acknowledgements to: ICES Working Group on Marine Habitat Mapping, David Connor Chair.

Extended Abstract

Overview:

Ecosystem-Based Management (EBM) and the related concept of large marine ecosystems (LMEs) are sometimes criticized as being too broad for many management and research applications. At the same time there is a great need to more effectively develop substantive methods to empower EBM. Marine habitat mapping (MHM) is one example of an applied set of technologies and field methods that directly support EBM science and contribute essential elements for conducting integrated ecosystem assessments. This paper places MHM practices in context with biodiversity models and EBM. Marine habitat mapping is shown to be a critical process closely integrated with much needed progress on the broader topic of ecosystem-based management. Advances in MHM and EBM are dependent on evolving technological and modeling capabilities, conservation targets, and policy priorities within a spatial planning framework. To examine the commonalities between MHM and EBM, we also address issues of implicit and explicit linkages between classification, mapping, and elements of biodiversity with management goals. Policy objectives such as sustainability, ecosystem health, or the design of marine protected areas are also placed in the combined MHM–Biodiversity–EBM context.

Why Ecosystem Based Management for Marine Systems?

Ecosystem-based management represents an effective and much needed approach to conserve and manage marine systems. With increasing pressures from a growing human population, we are depleting the ecosystem capital from the world's marine ecosystems and altering habitats in ways we are only recently able to measure and monitor. Depleting our capital, is an economic analogy describing non-sustainable degradation of ecosystems and their production of goods and services (Costanza et al. 1997). Closely related to parallel developments in terrestrial ecology, the concepts of ecosystem-based management (EBM) evolved from original propositions, such as those written by Aldo Leopold in the 1940s (Leopold 1941, Leopold 1949), through to modern global biodiversity initiatives such as the Convention on Biodiversity (United Nations Environment Programme 1992), and national legislative actions such as the U.S. Sustainable Fisheries Act of 1996 and the recent reauthorization (2006) of the Magnuson–Stevens Fishery Conservation and Management Act. Recent publications that call for an increased pace of implementation of marine EBM include the Pew Oceans Commission (2003), the U.S. Commission on Ocean Policy (2004), the Millennium Ecosystem Assessment (2005), a Scientific Consensus Statement on Marine Ecosystem-based Management (McLeod et al. 2005) and the Joint Ocean Commission Initiative report to the U.S. Senate (2006).

Unfortunately, while EBM is widely acknowledged to be urgently needed, it is not always implemented effectively and its theoretical and operational concepts are often poorly understood amongst the extended community of scientists, policy makers and stakeholders (Ehler and Douvere 2007, Young et al. 2007). Part of the difficulty with implementing and communicating the concepts of EBM is due to misunderstandings amongst governance institutions (Murawski 2007) and the appearance of insurmountable complexity. In this paper, we deconstruct the key components of EBM, building on previous theory from the terrestrial and marine ecological literature. By working with ten separate EBM components (Table 1), we present a new perspective on the position and role of MHM within EBM frameworks and establish some of the key guidelines that can help us use MHM effectively in managing human interactions within the natural complexity of ecosystems.

1) Hierarchical Context
2) Ecological Boundaries
3) Ecological Integrity
4) Data Collection
5) Monitoring
6) Adaptive Management
7) Interagency Cooperation
8) Organizational Change
9) Humans Embedded in Nature
10) Values

T able 1. Ten dominant elements of ecosystem-based management that can guide marine habitat mapping. From Grumbine (1994).

In spite of the overwhelming evidence that marine EBM is needed, and that we are now poised to combine science and policy to improve marine management practices, EBM applications are not trouble-free. As one example, EBM and the related concept of large marine ecosystems (LMEs) are sometimes criticized as being too broad and lacking in specificity to allow any "real progress" in management (Longhurst 2003). In addition, technological challenges remain emphasizing the need to more effectively develop "tool kits" to empower EBM (Tudela and Short 2005) and governance issues exist when working with wide-ranging ecosystem scales (Young et al. 2007). To help alleviate some of these criticisms and concerns over methodological approaches it is helpful to place EBM in context with examples of ongoing research and management, and show how existing methods and organizational guidelines are – when carefully planned – solid examples of marine EBM. To quote Grumbine (1994):

Ecosystem management is not just about science nor is it simply an extension of traditional resource management; it offers a fundamental reframing of how humans may work with nature.

Fortunately, reframing marine management practices does not require a complete alteration of established methods and tools developed over the last 100 years or more. What is required is a rethinking as to how our methods can be more broadly applied to best support an ecosystem-based strategy.

Integrating Marine Habitat Mapping, Biodiversity, and Ecosystem-Based Management

In addition to ever-changing technologies and modeling capabilities, MHM must also respond to changes in conservation targets and to policy priorities. One fundamental element of EBM –"adaptive management" – specifically calls for flexibility that must be supported by MHM. Another EBM element – "organizational change" – also suggests transitions in policy. One way to bring higher value to marine habitat maps is to design them specifically to support general biodiversity analysis, which in turn supports EBM, which further supports a wide array of specific management goals (Figure 1). The alternative of producing habitat maps for single goals – marine protected areas for example – is likely to result in habitat maps with lesser value.

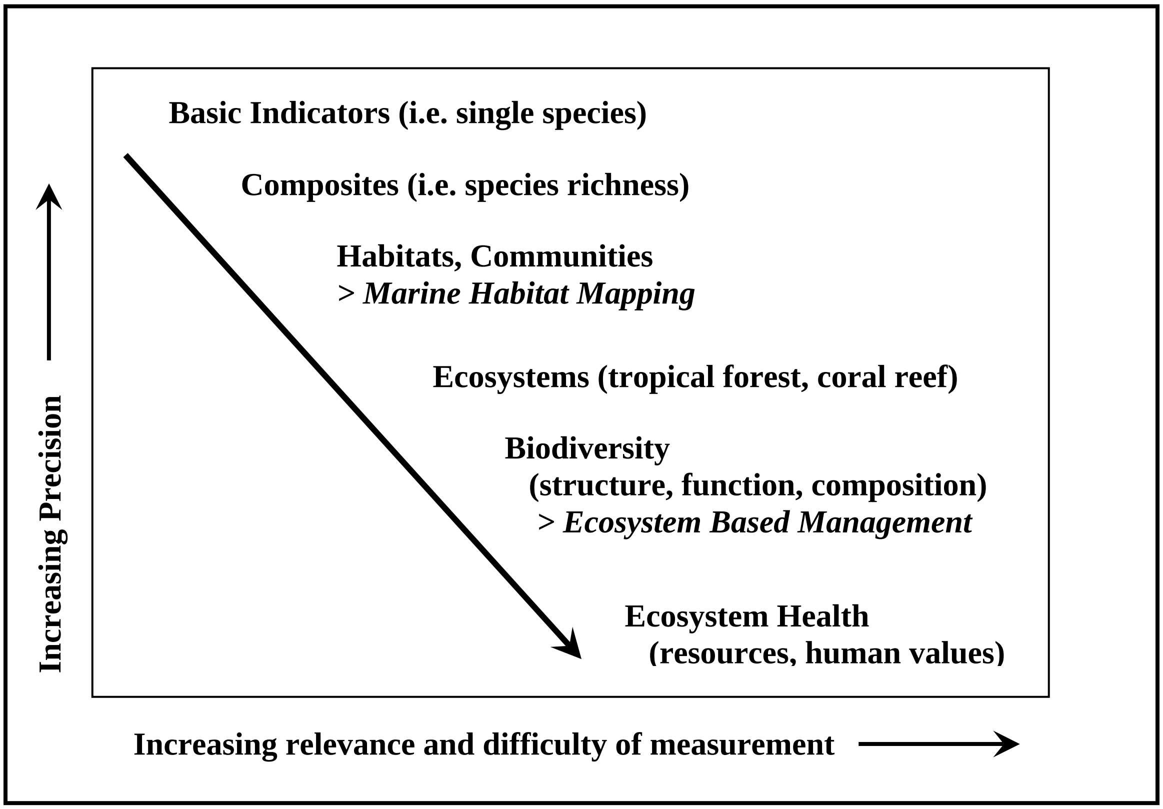

Figure 1. Thematic Scales & Conservation Targets. Biodiversity in context with tradeoffs between precision and relevance, prerequisite research elements to support increasing relevance, and trends in marine science to incorporate more relevant (but less precise) types of research. Marine habitat mapping is approximately associated with the habitat community level, while ecosystem-based management is more closely associated with biodiversity analysis. Adapted from Costanza (1992) and Redford (2003).

Following after the prerequisite MHM, but sequenced before EBM is biodiversity assessment (Figure 1). While biodiversity is sometimes thought of as an equivalent of species richness, in the context of EBM biodiversity is a multi-dimensional complex of structural, functional, and compositional elements occurring over a range of spatial and temporal scales (Cogan and Noji 2007). Following such a biodiversity template, marine habitat maps can logically inform on a range of key biodiversity elements such as functional disturbances, habitat structure and physiognomy, and habitat components associated with species and community composition.

Summary and Conclusions

Marine management based on ecosystem level processes is a daunting task and, many would say, an important responsibility for current and future generations. Such management programs are by necessity broad-scale endeavors and it is sometimes difficult to navigate the path from starting point research projects to management actions that address such overarching ecological goals. In this paper, we draw from both the terrestrial and marine ecological sciences to re-identify the ten essential components of EBM and show how each of these are directly supported by MHM. By directly positioning the science of MHM to support biodiversity assessment and EBM, a specific set of research priorities is suggested, and existing progress on marine EBM is clarified. By outlining the linkages between classification systems, MHM, biodiversity, and EBM, we identify a series of compelling reasons to build on existing MHM programs world-wide. We also offer guidelines for improving the science of MHM, building a stronger theoretical base to support and guide future MHM developments.

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