



Introduction to the Themed Section: 'Case studies in operationalizing ecosystem-based management'

Introduction

Operationalizing and implementing ecosystem-based management

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Introduction

There is now a large literature on the “ecosystem approach”, or “ecosystem-based management” (EBM; hereafter the terms are used synonymously, albeit with an emphasis on EBM) for dealing with the myriad issues impacting marine ecosystems. We will forego a treatment of the “what’s, why’s, and when’s” of EBM, pointing the interested reader instead to the many reviews of that extensive literature (e.g. [Browman and Stergiou, 2004, 2005](#); [Arkema et al., 2006](#); [McLeod and Leslie, 2009](#); [Link, 2010](#); [Berkes, 2012](#); [Link and Browman, 2014](#)). Rather, given our sense that EBM is moving—albeit slowly—from the “what’s, why’s, and when’s” to the “how’s” of operationalization and implementation, it seemed timely to develop this article theme set (TS). The objective of this TS is to advance EBM by offering practical examples of its implementation—or attempts at such—in a variety of incarnations and at various scales, including what has or has not worked, suggestions for best practice, and lessons learned.

The degree to which EBM has been implemented, or not, varies considerably at regional, national, and international levels. Part of this variability stems from how EBM is perceived (see [Link and Browman, 2014](#)), which depends upon where one works—in terms of geography, ocean-use sector emphasis, and disciplinary focus—and what role one has—as a researcher,

manager, stakeholder, etc. Therefore, we aimed for a wide range of perspectives in this TS in an attempt to capture at least some of this variability to stock-take EBM implementation. We hope that the eight articles in this TS, described below, contribute to and advance the ongoing discussion of the issues surrounding EBM implementation.

The articles in this TS

[Marshak et al. \(2017\)](#) note there is a convergence of understanding of EBM across many of the groups listed earlier, implying that inconsistency in the perception of EBM may be less of an impediment than it was, even a few years ago. Instead, the main impediments quantified by [Marshak et al. \(2017\)](#) centered on knowledge generation, communication of and about EBM, and governance frameworks established to deal with multisectoral issues. Similarly, [Oates and Dodds \(2017\)](#) reiterate that stakeholder engagement was absolutely critical in operationalizing EBM in the Celtic Sea, particularly as it pertains to the Marine Strategy Framework Directive (EC, 2008, 2010). As both [Oates and Dodds \(2017\)](#) and [Marshak et al. \(2017\)](#) note, clear, consistent and continuous communication with all parties is key. These authors also identified the need to measure all salient facets of the ecosystem

that are germane to management needs, while recognizing that identifying and agreeing upon these can pose challenges.

Zador *et al.* (2017) report on indicators used to inform the management of living marine resources in Alaska. The list of practical lessons learned, in terms of how to develop and use indicators, should prove relevant elsewhere. Indeed, these lessons resonate with those learned from analogous efforts (e.g. Hobday *et al.*, 2007; Shin *et al.*, 2010), but represent one of the few examples of management practices being changed as a result of the broader ecosystem context revealed by indicators. Incorporation of ecosystem information into ocean-use management is an ongoing process that is not yet fully and quantitatively integrated. Zador *et al.* (2017) provide an example of how such information can be informative, even if not fully treated quantitatively, and note that even qualitatively this is no less powerful or informative.

In terms of protocols to operationalize EBM, Harvey *et al.* (2017) highlight practical lessons from the application of Integrated Ecosystem Assessments (IEAs) in the United States. As a delivery and vetting mechanism for analytical products of ecosystem information, the IEA process seems to be emerging as one of the more flexible and appropriate approaches for conducting EBM. Harvey *et al.* (2017) note that the lack of clarity in how IEAs are related to and can be used to operationalize EBM, and the need for clarity in the use of ecosystem-related terminology, remains a major challenge. Harvey *et al.* (2017) also call for clear governance structures, particularly fora for the uptake of ecosystem information, as have others (e.g. Dickey-Collas, 2014; Samhouri *et al.*, 2014). They also emphasize the importance of scalability (spatially, especially with respect to governance of nested jurisdictions), something that is often understood but not always made explicit. Harvey *et al.* (2017) also note the need to ensure that analytical products and outputs are specifically tailored to the governance or management needs under consideration.

Cormier *et al.* (2017) also reinforce the need to tailor analytical products to management needs. Unpacking policy objectives into operational measures are an important part of developing and using indicators to implement EBM. This is comparable to the indicator suite described by Zador *et al.* (2017), but goes somewhat beyond it in attempting to set desirable (from a management perspective) reference levels for these measures. Cormier *et al.* (2017) again emphasize the lack of clarity often seen in governance regarding specific objectives, but emphasize the role of unpacking general policies that is needed in Canada and elsewhere. Although long-recognized as important (e.g. O'Boyle and Jamieson, 2006), the uptake of these more operational, "unpacked" measures remains limited. Cormier *et al.*'s speculations about the challenges that are limiting this uptake echo other works in this TS, and will resonate with practitioners attempting to implement EBM.

Llope (2017), and Bryhn *et al.* (2017), emphasize attempts to implement EBM in specific regions and across multiple ocean-use sectors. These are at scales much smaller than Large Marine Ecosystems. Again, both struggled with appropriate governance fora, but also with the limited amount of adequate information available at appropriate spatial and temporal scales, competing objectives among stakeholders, and the balance between different interests and obvious tradeoffs. Although no generalized, immediate or obvious solutions emerged, both attempts tabled the issues and discussed them transparently. This latter observation is

a major part of operational EBM—accounting for and addressing multiple uses, objectives, and tradeoffs.

Finally, Österblom *et al.* (2017) document how, although governance in Sweden has shifted towards EBM, the political will to enact it in practice remains elusive, possibly because of the multiplicity of competing interests. Yet a detectable shift towards EBM has been seen there, evinced by increasing numbers of proposals for operational practices across ocean-use sectors.

Brief synopsis of the state of EBM

We will close by summarizing the lessons learned from these eight snapshots of the state of EBM and our own overviews of the field.

Clear communication and engagement with all interested parties—particularly non-scientists—is critical. That may not be easy, nor something with which most scientists are comfortable (or have any training with), but where EBM has been attempted, this aspect has been categorically identified as a critical component of success. This comes both from instances that recognized this need *a priori*, and from those in which it was learned the hard way, *a posteriori*.

We recognize that EBM is complex and, therefore, difficult to operationalize. Attempting to characterize, understand well enough, and make decisions regarding marine ecosystems is in itself a Herculean task. Layer on top of that the social, economic, and political considerations that any such management decisions necessarily require makes the task seem nearly intractable. Certainly, the allure of discovery remains, and we cannot monitor and measure all the variables that we would like, but the works herein demonstrate that general theories and principals, and a generic knowledge base, are sufficient to at least bound the scope of tradeoff space needed to implement EBM for most marine ecosystems. A clear set of operational indicators, and associated reference levels for decision support, are rapidly emerging (Shin *et al.*, 2010; Cormier *et al.*, 2017; Zador *et al.*, 2017).

The need to identify a more focused set of governance conditions that better facilitate EBM seems clear. There is no shortage of vague national and international policies, laws, orders, and treaties calling for or requiring EBM (c.f. Browman and Stergiou, 2005; EC, 2008, 2010; McLeod and Leslie, 2009; Link, 2010; Foran *et al.*, 2016; for reviews thereof). These mandates result in various governance structures, frameworks and fora in which ocean-use decisions can be made. Yet, in all of the articles in this TS, the need to clarify objectives and the choices among them, particularly across different sectors and competing interests, consistently emerged as an important consideration for the success of EBM. This is consistent with what others have been communicating for some time (e.g. O'Boyle and Jamieson, 2006; Link, 2010; Dickey-Collas, 2014). A more obvious set of institutional arrangements, mandated demands for increased systemic information and decision-making, fora for the uptake of ecosystem information and ecosystem-level decision-making, and clarity in decision criteria to address tradeoffs among multiple objectives are needed for truly operational, multisectoral ocean use management—i.e. EBM (Harvey *et al.* 2017). Conversely, where EBM has been attempted in a more focused manner, within one or across a limited number of sectors, progress is notable.

Instances of truly multisectoral EBM remain rare. Although growing, the number of case studies of operational EBM is still limited. We recognize that this TS captures only a few. Nonetheless, our sense from these, and from discussions with our colleagues around the world, is that there is not yet a well-known

and widely accepted example of true multisectoral, multiple ocean-use, multi-stressor, multiple driver, tradeoff-evaluated EBM that is fully operational. Certainly EBM has advanced farthest within specific ocean-use sectors. There are some examples that are becoming close to a full EBM operationalization, particularly in the IEA communities of North America and Europe (Harvey *et al.*, 2017; Dickey-Collas, 2014), as well as in parts of Australia. Perhaps this TS, crystallizing the state of the EBM discipline, will spur someone to prove us wrong. We predict that there will be examples of much more fully implemented case studies within the next 5 years.

Finally, although progress towards implementing operational EBM has been somewhat limited, and although EBM is by its very nature difficult, there has been progress nonetheless. The works herein demonstrate that the imperfect steps taken towards operational EBM are better than no steps at all. The attitude of “you have to start somewhere” holds. As each of the works herein demonstrates, attempting EBM generates and encounters barriers and challenges, which then become more clearly articulated, such that solutions can be proposed and tried, and then the process iterates.

We trust that the science executed, and the management based upon that science, will continue to evolve and improve as we collectively sort out what it means to actually do EBM in practice. We hope that the articles in this TS will spur on even further operationalization of EBM.

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References

- Arkema, K. K., Abramson, S. C., and Dewsbury, B. M. 2006. Marine ecosystem-based management: from characterization to implementation. *Frontiers in Ecology and the Environment*, 4: 525–532.
- Berkes, F. 2012. Implementing ecosystem-based management: evolution or revolution?. *Fish and Fisheries*, 13: 465–476.
- Browman, H. I., and Stergiou, K. I. 2004. Perspectives on ecosystem-based approaches to the management of marine resources. *Marine Ecology Progress Series*, 274: 269–303.
- Browman, H. I., and Stergiou, K. I. 2005. Politics and socio-economics of ecosystem-based management of marine resources. *Marine Ecology Progress Series*, 300: 241–296.
- Bryhn, A. C., Lundström, K., Johansson, A., Stabo, H. R., and Svedäng, H. 2017. A continuous involvement of stakeholders promotes the ecosystem approach to fisheries in the 8-fjords area on the Swedish west coast. *ICES Journal of Marine Science*, 74: 431–442.
- Cormier, R., Kelble, C. R., Anderson, M. R., Allen, J. I., Grehan, A., and Gregersen, Ö. 2017. Moving from ecosystem-based policy objectives to operational implementation of ecosystem-based management measures. *ICES Journal of Marine Science*, 74: 406–413.
- Dickey-Collas, M. 2014. Why the complex nature of integrated ecosystem assessments requires a flexible and adaptive approach. *ICES Journal of Marine Science*, 71: 1174–1182.
- EC. 2008. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environment policy (Marine Strategy Framework Directive). *Official Journal of the European Union*, 164: 19–40.
- EC. 2010. Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters. *Official Journal of the European Union*, 232: 14–24.
- Foran, C. M., Link, J. S., Patrick, W., Sharpe, L., Wood, M., and Linkov, I. 2016. Relating mandates in the United States for managing the ocean to ecosystem goods and services. *Frontiers in Marine Science*, doi: 10.3389/fmars.2016.00005
- Harvey, C. J., Kelble, C. R., and Schwing, F. B. 2017. Implementing “the IEA”: using integrated ecosystem assessment frameworks, programs, and applications in support of operationalizing ecosystem-based management. *ICES Journal of Marine Science*, 74: 398–405.
- Hobday, A. J., Smith, A., Webb, H., et al. 2007. Ecological risk assessment for the effects of fishing: methodology. Report R04/1072 for the Australian Fisheries Management Authority. Canberra, ECT. 186 p.
- Link, J. S. 2010. *Ecosystem-Based Fisheries Management: Confronting Tradeoffs*. Cambridge University Press, Cambridge, UK.
- Link, J. S., and Browman, H. I. 2014. Integrating what? Levels of marine ecosystem-based assessment and management. *ICES Journal of Marine Science*, 71: 1170–1173.
- Llope, M. 2017. The ecosystem approach in the Gulf of Cadiz. A perspective from the southernmost European Atlantic regional sea. *ICES Journal of Marine Science*, 74: 382–390.
- Marshak, A. R., Link, J. S., Shuford, R., Monaco, M. E., Johannesen, E., Bianchi, G., Anderson, M. R., Olsen, E., Smith, D. C., Schmidt, J. O., and Dickey-Collas, M. 2017. International perceptions of an integrated, multi-sectoral, ecosystem approach to management. *ICES Journal of Marine Science*, 74: 414–420.
- McLeod, K. L., and Leslie, H. M. (Eds) 2009. *Ecosystem-Based Management for the Oceans*. Island Press, Washington, DC.
- Oates, J., and Dodds, L. A. 2017. An approach for effective stakeholder engagement as an essential component of the ecosystem approach. *ICES Journal of Marine Science*, 74: 391–397.
- O’Boyle, R., and Jamieson, G. 2006. Observations on the implementation of ecosystem-based management: experiences on Canada’s east and west coasts. *Fisheries Research*, 79: 1–12.
- Österblom, H., Hentati-Sundberg, J., Nevenon, N., and Veem, K. 2017. Tinkering with a tanker - slow evolution of a Swedish ecosystem approach. *ICES Journal of Marine Science*, 74: 443–452.
- Samhuri, J., Haupt, A., Levin, P., Link, J., and Shuford, R. 2014. Lessons learned from developing integrated ecosystem assessments to inform marine ecosystem-based management in the USA. *ICES Journal of Marine Science*, 71: 1205–1215.
- Shin, Y. J., Bundy, A., Shannon, L. J., Simier, M., Coll, M., Fulton, E. A., Link, J. S., Jouffre, D., Ojaveer, H., Mackinson, S., et al. 2010. Can simple be useful and reliable? Using ecological indicators for representing and comparing the states of marine ecosystems. *ICES Journal of Marine Science*, 67: 717–731.
- Zador, S. G., Holsman, K. K., Aydin, K. Y., and Gaichas, S. K. 2017. Ecosystem considerations in Alaska: the value of qualitative assessments. *ICES Journal of Marine Science*, 74: 421–430.