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## Perspectives: Where Do We Go from Here?

As part of MEAM's launch, we sought leaders in the EBM community for their viewpoint on EBM's status and where it is headed. Their views are below.

### A. Need to adopt novel approaches

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Widespread declines in the state of marine ecosystems and the services they provide have led to global calls for ecosystem-based management (EBM). Scientists describe the degradation and loss of services in technical language. The Millennium Ecosystem Assessment (2005) highlights that globally 60% of ecosystem services have been degraded - e.g., the provisioning service of seafood, the regulating service of protection of coasts from storm damage, and the cultural service of recreation. The informed lay public identifies many of the same problems but with different language, saying that the things they value most about oceans are gone or at risk: healthy seafood, clean beaches, resilient fisheries, abundant wildlife, vibrant coastal communities, and recreational opportunities. Regardless of the language, it is increasingly apparent that more effective approaches are needed to help ensure delivery of key services. EBM is a promising approach because it recognizes that healthy, productive, resilient ecosystems are the key to providing the services people want and need. EBM differs from conventional approaches that focus on a single sector or species. EBM integrates management across key sectors of human activity and accounts for their cumulative impacts. By focusing on protection of multiple (vs. single) services, EBM provides opportunities to restore and maintain whole ecosystems and therefore the long-term delivery of multiple benefits.

Importantly, EBM will allow managers to do their jobs more efficiently and effectively by streamlining the increasingly complicated policies and regulations that govern the plethora of activities affecting the oceans. Explicit decisions about inevitable tradeoffs between management scenarios are more feasible under EBM (e.g., evaluating use of a wetland for resort development vs. a working waterfront vs. providing juvenile fish habitat).

In the United States, EBM is gaining traction in science, management, and policy circles on the heels of the Pew and U.S. Ocean Commissions' reports in 2003/2004. EBM is progressing along several parallel tracks, including within-sector approaches, regional ocean governance, pilot projects at multiple scales, and other actions that pave the way for larger, overarching changes. Improving management within a sector - e.g., the incorporation of EBM provisions into last year's reauthorization of the Magnuson-Stevens Fisheries Conservation and Management Act - will strengthen the long-term viability of the sector.

However, sectoral EBM cannot integrate across sectors or provide the authority to consider the fate of whole ecosystems. A key remaining policy challenge is to determine how to work across sectors toward a shared goal of ocean health.

Promising endeavors to coordinate ocean governance at the state (e.g., California, Massachusetts, New Jersey, and New York) and regional levels (e.g., West Coast Governor's Agreement on Ocean Health and Gulf of Mexico Alliance) are moving forward throughout the country and across borders (e.g., Northeast Regional Ocean Council of U.S. State Governors and Eastern Canadian Premiers). Internationally, Australia, Canada, and the European Union have already implemented overarching national oceans policies. While the United States has made headway in legislating initial aspects of EBM, a timeline for moving forward with a comprehensive governance framework in the U.S. remains uncertain.

Where do we go from here? Recent decades have witnessed dramatic changes in the world's oceans but also increasing awareness of the need for change and the emergence of new solutions. Addressing the numerous, complex threats to the oceans and associated human communities will require a more interdisciplinary scientific enterprise in support of EBM. This enterprise must prioritize integration of the human dimensions (e.g., anthropology, sociology and economics) and better integrate these with ecology, fisheries science, aquaculture science and oceanography.

There is a parallel need for improved connections between science and management so that management is informed by the latest science, and scientists are addressing questions for which managers need answers.

Given the changes on the horizon, both scientific and management enterprises will need to adopt novel approaches. The emerging science of resilience and complex systems has much to offer, as it (1) seeks to better understand how systems change in response to disturbances, (2) provides guidance to manage in the face of uncertainty and change, and (3) cautions us to anticipate surprises, because change may sometimes be slow and predictable, but at other times rapid and unexpected.

Much work remains to be done to enable responsible decisions that maintain, not foreclose, future options. Ultimately comprehensive EBM in the United States will require a new, overarching oceans mandate. This step is crucial because no existing management entity has the authority to consider overall ocean health or to conserve the full suite of services that coasts and oceans provide. Responsible management and stewardship will require comprehensive EBM.

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### B. Investigating the roots of confusion

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The Ecosystem Approach to Management (EAM) of human activities in the sea is becoming everyone's panacea. Like the Hogwarts Room of Requirement,\* it always

contains what you think you need to solve today's most vexing problem. And like the Room of Requirement, in containing the solution to everyone's problems, each person finds it in a different way, finds different things in it, and uses what it contains differently.

This analogy holds up when considering EAM for marine ecosystems. The concept is widely endorsed as the next great hope for addressing the unsustainable uses of marine resources. However, people have come to EAM from different directions and want to use it to address different problems. So EAM, already complex, is becoming confused. Investigating the roots of the confusion may contribute to faster progress in getting EAM into practice.

Advocates of EAM promote four classes of change, compared to cartoons of "classic" management:

1. Consider effects of all major environmental forcings on the dynamics of the resource(s) being used;
2. Consider impacts of the activity being managed on all major ecosystem properties, not just the resource(s) directly used;
3. Consider the consequences of all human activities in the sea, not just one's own sector;
4. Make the governance process more participatory and effective.

Few experts consider all four classes equally important. Many ignore some of them, yet the experts all provide guidance on EAM.

Ecologists may consider 1 and 2 central to EAM. Oceanographers may consider ocean physics and chemistry to ecosystem dynamics (1) as the important ecosystem issue. Benthic ecologists may consider the impacts of resource uses on ecosystem structure and function (2) as the important class. Ecologists taking energetics approaches perhaps emphasize bottom-up processes and variation in productivity (1); those studying predators - prey relationships - may emphasize how fishing changes pathways (2). All ecologists seem to grapple with 3 less frequently, and 4 rarely.

Experts in coastal management come to EAM through Integrated Management and focus on 3. They emphasize cumulative effects of chronic disturbances and synergies of impacts from several concurrent activities. Concerned that cumulative effects remain sustainable, they also may place more emphasis on 2 than 1. The interest in governance changes has been strongest among social scientists seeking solutions to community problems. Their efforts to build sustainable coastal communities have made them deal with experts interested in all three other perspectives. They are more likely to recognize the interconnectedness of all four classes of change and see the package most completely.

There actually is no choice to make between 1 and 2 in practice or in concept. Failure to do either well will eventually lead to unsustainable choices. Which one should get more attention will be case-specific. Oceanographic forcings can so dominate dynamics of some marine systems that they must be considered in management, whereas in other systems single forcings rarely dominate dynamics, and careful management can adapt to slow environmentally driven trends in resources. Poor management or poor compliance with management can result in serious ecological consequences however strong the environmental forcing, whereas reasonable precaution, adaptive management and high compliance can succeed even in variable systems.

There is a real conceptual distinction between the Ecosystem Approach and Integrated Management. In practice, though, EA and IM quickly converge. When fisheries management tries to take account of environmental forcings, other human activities are found to affect the pathways. Managers cannot ensure the footprint of one industry is sustainable without considering the ecosystem effects of other activities. A manager pursuing IM quickly learns that how the integration is best done depends on many physical, chemical and biological features of the ecosystem.

Hence, starting down either the path of EAM or IM, one is soon taking both journeys at once. Progress can be made on either alone, though - an important point because governance systems are likely to have very different appetites for changes of types 1, 2 and 3. True IM often encounters so many jurisdictional issues that movement becomes glacial. Until governance issues are resolved, efforts to apply ecosystem knowledge much better in 1 and 2 should still be encouraged.

In the end, the fourth aspect of EAM - governance systems that work - may matter most. Governance is the most independent of the four components of EAM because one can improve governance at scales from local to international, and in settings addressing considerations of types 1, 2 or 3 alone or in all combinations. It is simultaneously the most co-dependent of the four components. None of the other factors can be addressed without effective management tools. One lesson emerging from the many failures in fisheries management is that collaboration among the ecological, social and economic scientists is essential if management tools are to be developed and used effectively. EAM will probably remain ill-specified - found by different paths and used for different things. But as in Hogwarts, it will be where the most promising wizards from social, biological and physical sciences meet to pool their talents into something that is an effective approach to management of human activities in the sea, and oppose the Dark Arts of unsustainability.

\* Note: This is a reference to the *Harry Potter* series of fiction books.

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