

Is a new mandate needed for marine ecosystem-based management?

Introduction: Heather M Leslie

Two views: Andrew A Rosenberg and Josh Eagle



Heather Leslie

*Center for Environmental Studies and
Department of Ecology and Evolutionary
Biology, Brown University, Providence, RI*

Humans are intimately linked to the ecosystems in which they live through ecosystem services. Coastal and marine ecosystems, in particular, provide critical services, such as storm protection, pollution mitigation, and food, as well as opportunities for research, education, recreation, and preservation of natural and cultural heritage. Yet human activities now impact almost every aspect of coastal and marine ecosystems and threaten the continued production of valued services (UNEP 2006). These impacts are increasing in extent and intensity, and are predicted to continue to do so, unless dramatic changes in policy occur (MA 2005).

Historically, human activities and impacts on coastal and marine environments have been managed in a piecemeal manner. For example, in the US, dredging of coastal areas is overseen by the US Army Corps of Engineers, while commercial fishing is regulated by the National Oceanographic and Atmospheric Administration (NOAA) Fisheries and a host of state agencies, depending on exactly where the activity occurs. In total, more than 15 federal agencies and departments are involved in managing ocean resources in the US. Considerable evidence indicates that this fragmented approach has not adequately sustained coastal and ocean resources (POC 2003; USCOP 2004). Recently, therefore, there has been increasing interest in the US and around the world in moving toward more ecosystem-based approaches to coastal and ocean management (WSSD 2002; POC 2003; USCOP 2004; UNEP 2006).

Ecosystem-based management (EBM) is an integrated approach that considers the entire ecosystem, including humans (POC 2003; USCOP 2004; McLeod *et al.* 2005). Marine EBM goes beyond traditional marine management approaches, which usually focus on only a single species or sector, by incorporating the interactions among ecosystem components and cumulative impacts of multiple activities into management decisions. Approaches to implementing marine EBM vary, but share a focus on protecting the structure, functioning, and key processes of coastal and marine ecosystems, so as to sustain the services that humans want and need (McLeod *et al.* 2005). This broad objective and the inclusion of humans as inte-

gral elements of these systems lead naturally into discussions about how to better align or even reinvent ocean governance and management institutions, to enable ecosystem-based management of the oceans.

Needless to say, the concept of marine EBM is not without controversy. The complexity of marine ecosystems, and the human systems associated with them, and our ability to predict how management strategies may influence the future of these coupled systems are just two of the scientific challenges to implementing this new approach. In addition, there are broader obstacles to implementing marine EBM that transcend the scientific realm, including defining a common vision of what EBM is meant to achieve in a particular place and developing appropriate institutional frameworks that enable marine EBM (Leslie and McLeod 2007).

The conversations about marine EBM in science and policy circles echo similar dialogues focused on forests and other terrestrial landscapes in recent decades, as well as discussions among coastal zone managers, fisheries scientists, and others seeking more holistic approaches to marine management. While we can learn a great deal from the experiences of these diverse communities, there are several reasons why EBM of coasts and oceans requires more than merely borrowing from what has been learned in other ecological settings.

First, the distinct characteristics of marine ecosystems – the three-dimensional, fluid environment, the magnitude and rate of dispersal of nutrients, the many early life stages, and the structure and interactions of marine food webs – create challenges for management not found in other aquatic or terrestrial environments (Carr *et al.* 2003). At the same time, these characteristics create opportunities for restoration rarely encountered on land. For example, the demographic and physical connectivity created by the oceans' fluid environment make some species (although, importantly, not all) fairly resilient to certain types of disturbance. Moreover, when areas of the ocean are protected from exploitation in marine reserves the mobile stages of fish and other marine species can often repopulate previously "fished-out" habitats. Second, scientists' understanding of the importance of interactions – among species, across ecosystems, and increasingly, between human and non-human elements of ecosystems – has grown tremendously in the past decade, and this knowledge is just beginning to be applied in the coastal and ocean realm (Guerry 2005;

Leslie and McLeod 2007). Finally, property rights and legal regimes are quite distinct in many coastal and ocean settings: we don't necessarily use the same tools or use those tools to the same degree as we do on land. Many ocean resources, including fisheries, are common-pool resources, meaning that use of the resource by one person reduces availability of the resource for others. Moreover, excluding users is particularly difficult (Ostrom *et al.* 1994). The push toward individual fishing quotas notwithstanding, ocean resources are primarily seen as common property, held in trust for the people and managed for the benefit of the public by the state (Osherenko *et al.* 2006).

Debate on the feasibility of marine EBM is particularly timely. In the US, for example, there have been a number of efforts to incorporate ecosystem-based elements at both the national and state levels. And, globally, non-governmental organizations and foundations are increasingly engaged in facilitating marine EBM ini-

tiatives and related scientific efforts.

Given the magnitude of human, political, and financial resources focused on moving marine EBM forward, it is worth pausing to consider if the lofty objective described above can be implemented. In addition to the scientific challenges associated with marine EBM, there is also concern that more traditional management strategies have not yet been exhausted or perhaps even appropriately applied. Moreover, ecosystem-based approaches create jurisdictional challenges in the US and in many other parts of the world. Is it worth rocking these regulatory boats? Are the ecological, economic, and social pay-offs of marine EBM so much greater than those of business-as-usual that it makes sense to invest in changing the legal, scientific, and management enterprises? These are tough questions; fortunately, two knowledgeable experts in this area have agreed to share their thoughts on the future prospects for marine EBM.



Andrew A Rosenberg

Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, Durham, NH

EBM is predicated on the goal of conserving ecosystem services that support human well-being. Current policy, by and large, focuses on one sector of human activity at a time, such as fisheries, coastal development, transportation, energy production, and so on. The question is, if each of these sectors were well managed, would that be sufficient to conserve ecosystem services in a particular area? I would argue that good sectoral management is necessary, but not sufficient to ensure a sustainable, complete suite of ecosystem services. There are three features of EBM that go beyond the sectoral approach to the proximate set of services, such as resource extraction or transportation infrastructure, to consider sustainability of ecosystem structure and function.

The first is that the cumulative impacts of activities across the sectors need to be considered. Impacts are potentially cumulative, because multiple activities can affect the same components or functions of an ecosystem. Although there is a weak mandate in the US, as in other countries, to consider cumulative impacts on the environment in the course of preparing an environmental impact statement, in practice such impacts are not addressed in policy implementation to any great extent. This is unsurprising – how should policy in a single sector, like fisheries, address the cumulative effects of, say, loss of biodiversity due to fishing and coastal development, including filling and dredging, mining, and other activities? The only way this could occur is if there were common goals set for the various sectors and then a considered policy on how each sector would address those goals, in light of the full set of activities impacting a particular

ecosystem – that is, an ecosystem-based approach.

If it is accepted that cumulative impacts are a valid concern, this raises the second feature that distinguishes an EBM system from sectoral management: the explicit consideration of trade-offs between services resulting from management actions. In a sector-by-sector management approach, how should the impacts of one sector on the services that another depends upon be addressed? How are societal decisions made concerning how much conservation is enough for each of the key services? Suppose habitat loss is a concern for biodiversity conservation, but so is access for transportation and port facilities. In order to construct ports or dredge channels, habitat will be lost. How much loss is acceptable, given biodiversity concerns, fishery interests, and concerns for protected species such as those that are endangered? Under the current approach, each sector seeks to maximize the viability of the activities it is mandated to manage, but without common goals or a common framework with the other sectors. So trade-offs are implicit rather than explicit. Setting ecosystem-level goals and coordinating management allows the trade-off discussion to occur in a structured manner, based on information, not just political muscle.

Finally, EBM explicitly considers the interactions among management policies within and between sectors. While some policy actions might affect only a single sector of activity, many have impacts on multiple sectors. Protected areas for conservation of endangered species such as whales might affect various types of recreational and commercial fishing, mining, shipping, and energy production. Should each sector or conservation issue design measures in isolation, as if the others didn't exist? This is essentially what occurs under the current system and the result is an astonishingly complex set of policies. An ecosystem-based system sets common goals across sectors and allows coherence and, hopefully, efficiency of policy.

EBM is all about common goals and coordination of policy. It may be difficult because it is a change from sector-by-sector management to a new structure for policy making. But the whole is greater than the sum of the parts, because even a collection of good sectoral management policies, if unconnected and uncoordinated, will not fully conserve ecosystem structure, function, and, hence, services.



Josh Eagle

*University of South Carolina School of Law,
Columbia, SC*

I agree with many of the points Andy Rosenberg makes above. First, “conserving ecosystem services that support human well-being” is an appropriate goal. Second, current laws and management institutions do not seem to be keeping us on the path toward this end. Third, each kind of resource use, or non-use, limits other uses of that same resource. Fourth, use of a particular resource may also constrain uses of other resources.

I disagree, however, with two of the conclusions Andy draws from these points. It is not clear to me that the failure of current laws and institutions is due to their inability to consider intra- and inter-use trade-offs. Second, I am not convinced that new, overarching, meta-agency or meta-process (EBM) is the most efficient or effective means of getting us back on the path toward healthy oceans.

Why have current laws and institutions failed to produce healthy oceans? The three primary stressors on the marine environment appear to be decades, or centuries, of excessive fishing pressure, land-based pollution, and development of near-shore habitats (Jackson *et al.* 2001; USCOP 2004). The reasons that these activities have occurred at such levels vary, but are, fundamentally, economic and political. In some cases, the law has failed to address the external costs of fishing, pollution, or development. In others, the law has attempted to do this by requiring regulatory agencies to take into account external costs during permitting processes.

In the case of fishing, the Magnuson–Stevens Act has, for more than a decade, required the Regional Fishery Management Councils and the National Marine Fisheries Service to take into account the impacts of fishing on marine ecosystems by, among other things, minimizing bycatch, rebuilding overfished stocks, and protecting habitat from the harmful effects of certain fishing equipment. Despite these requirements, as Andy has pointed out elsewhere, fishing that is excessive both in amount and kind has continued (Rosenberg 2003; Harrington *et al.* 2005; Rosenberg *et al.* 2006).

As he has also noted previously, excessive fishing is a political problem (Rosenberg 2003). Political science tells us that concentrated interests, such as the fishing industry, will be able to out-muscle diffuse interests, such as the general public, in political processes (Olson 1971). My question is: how will a larger, more inclusive decision-making process or more statutory mandates (such as those already

found in the Magnuson–Stevens Act) change this dynamic? It seems logical to conclude that bringing to the table more powerful interests, such as the oil and gas industry and farmers, will only further subsume the public interest in sustainable ocean use. Politics can often overwhelm legal mandates when high levels of scientific uncertainty exist.

I am also worried about the extent to which engaging in the introduction and implementation of EBM will delay the process of addressing the problems of excessive fishing, pollution, and development. By including more interests in decision-making processes, and by making calculations more complex, there seems to be a very real possibility that we would end up with a slower, more cumbersome regulatory institution. This is dangerous. It hinders adaptive management, which requires flexible and responsive decision making (Holling 1978). It favors concentrated groups, who have more resources to invest in contesting science and who benefit from preserving the lax rules that are currently in place. Each year of delay not only imposes further costs on the public, but also makes ecological recovery more difficult and renders the eventual cut-backs in concentrated-group resource use more politically challenging (Hutchings 2000; Schoenbrod 2005).

Since this is a friendly debate, Andy, I will make a friendly proposal. You take the east coast and I'll take the west coast. On your coast, you can begin today with the effort to implement EBM. On my coast, I (in my longed-for role as benevolent dictator) will take over the Fishery Management Councils and immediately implement conservative catch limits, strict caps on the percentage of legally permissible bycatch, and a ban on fishing gear that has been demonstrated to cause long-lasting damage to habitat. I will also take over the state environmental agencies and develop meaningful limits on runoff under the Total Maximum Daily Load provisions of the Clean Water Act. (All of these things are permissible under current law.) If your ocean is doing better in 2017, you win.



Andrew A Rosenberg replies

Unquestionably, policy is political, intensely political, and that will always be the case, whether management is by sector or ecosystem-based. But in a sector system, the politics are largely confined to the participants in that sector, and the rest of the public pays little attention. Fisheries is a prime example of this pattern. The political pressure is intense from the affected community (recreational and commercial fishermen) and elected officials respond to these constituents. Environmental groups bring other political pressure to bear, but the regulated community concerns usually dominate. The result is that regulatory agencies like the National Marine Fisheries Service are pressured to back off on control measures and they often have little choice, because they must respond to

elected and political appointees. Thinking about what could be accomplished by a benevolent dictator doesn't really help the discussion because that isn't, and shouldn't be, the working model. One reason EBM may work better in this political setting is because the constituency is broadened and the policy making not so dominated by one set of interest groups. The other reason is that sharing common ecosystem goals, if those can be agreed upon – and I don't minimize the difficulty of doing this – creates a different setting for policy making.

Josh points out that there is some risk of delaying action on addressing major problems like overfishing, pollution, and development, while trying to create an EBM system. This is a fair point, but my counter-concern is that, by only focusing on the proximate problems, we may implement better sectoral management and still be far from the goal of fully functioning marine ecosystems. I am also concerned that progress on sectoral management improvements will continue to be slow. Sure, there is authority to do a better job of environmental management without new mandates. But, it is not as if we haven't ever tried this before. After all, the Fisheries Conservation and Management Act has been in place for 30 years, the Clean Water Act for longer than that. It is not that these efforts have failed, but that we need to do better. Having worked in a government agency with regulatory responsibility, I am not convinced that the same institutions, working under the same mandates in the same structure, will really take a new and different approach. That is just not human nature. New mandates and institutions force people to take new perspectives.

To Josh's friendly proposal, I think if I was to "take" the east coast and have the authority he outlined, I could do a very good job of EBM that is far better than the existing system. But the problem with the example is that Josh would not be able to do the things he says he would do on the west coast. I know this well because I was in the position of Northeast Regional Administrator for Fisheries. Negotiating the groundfish recovery plan in New England was extraordinarily difficult, but also rewarding because it was partially successful. I knew then and now what other measures were needed to make it more successful, including some of those Josh lists. I didn't implement them because it was (and is) politically impossible. The comparison is not between an apolitical regulatory system and one affected by politics; it is between two systems – sectoral management and EBM – working within an inevitably difficult political system. I believe that changing perspective, goals and political dynamics may enable greater progress than just doing more of the same.



Josh Eagle replies

Participatory democracy is not only fundamental to our political system, but also a critical component of a successful ocean-governance system. The problem, though, is that members of the public do not have the same incentives to participate in decision-making

processes as fishermen and others who have direct financial interests in the outcomes (Olson 1971). History teaches that, in agency decision-making processes, public participation plus concentrated–diffuse dynamics plus scientific uncertainty equals little emphasis on conservation. We have seen this not only in the Magnuson–Stevens Act context, but also in other areas, such as management of National Forests (Dixon and Juelson 1987). Given that the ecosystem-based approach, as defined by NOAA, emphasizes more agency process, more participation, the inclusion of more concentrated groups, and the consideration of more science, I do not see how this approach will change outcomes for the better (http://ecosystems.noaa.gov/general_information.htm).

It is worth looking to the public lands to see how Congress has previously remedied the low-conservation sum of the above-stated equation. The principal method of mitigation has been the application of a form of zoning to the public lands. So, for example, Congress has designated certain public lands as National Parks, where resource extraction is prohibited. By zoning areas for specific uses, Congress has eliminated the possibility that the agencies that manage those places can be swayed by more powerful interests (Curtis 1973). Also, by giving management responsibilities for those areas to mission-specific agencies, Congress has eliminated the need for agency officials to worry about pleasing powerful constituencies and their allies on Capitol Hill.

The reason that public lands zoning has transpired is that concentrated–diffuse dynamics play out differently in Congress than they do in multiple-use agency processes. In Congress, representatives are directly accountable to the diffuse public and are more likely to take national interests into account. In the context of the public lands, at least, Congress has recognized that, while concentrated interests thrive in agency balancing processes, diffuse interests often do not. This, I believe, is why Congress has created so many National Parks and Wilderness Areas and so few National Petroleum Reserves, National Mining Areas, and National Grazing Lands. At the same time, loggers, miners, and ranchers remain free to seek access to resources on and under the more than one-third of public land that remains unzoned, where multiple-use and ecosystem management principles govern agency decision making.

Instead of giving more power to new or existing agencies, Congress ought to recognize that doing so will only sustain or exacerbate the problems that have plagued Magnuson–Stevens Act implementation. As it has for the public lands, Congress (and state legislatures for state waters) should take responsibility for protecting interests, such as the public's interest in a healthy ecosystem, that have not fared well and cannot fare well in agency processes. In legislatively protected areas of public seas, we will have true EBM. In the other parts, we can experiment with new, multiple-use agency processes and hope they work better than they have on the public lands.



Andrew A Rosenberg replies

Josh's examples on public lands are interesting. Zoning, including protected areas, is clearly an important tool in protecting public resources and marine ecosystems (Crowder *et al.* 2006). Both are highly controversial because they often focus on conserving more than just target species (ie broader ecosystem properties and functions, just like parks). But current efforts to establish zones for certain activities or protections in the ocean are fragmented and disconnected in many cases. I was involved in establishing large closed areas to protect groundfish and scallops in the northeast, protected areas for right whales, protected areas for harbor porpoise, and habitat. But instead of developing a coherent system of protection zones, each area was created under a different authority and the result is a confusing patchwork of rules in the ocean. An ecosystem-based approach should try to bring together the conservation goals across the ecosystem to make this system coherent, but this is unlikely to be done without a clear mandate to integrate management.

Josh suggests Congress and state legislatures should exercise this authority to protect interests and resources, not agencies, but recall that the Congressional track record is not strong in this regard for the ocean. If one were to ask a group of citizens what they thought about the establishment of National Marine Sanctuaries, I suspect most would think of national parks in the ocean. But most of the marine sanctuaries designated by Congress still allow fishing and a host of other activities and provide relatively few protections, not because of lack of agency will, but because of the way the sanctuaries were created by Congress. I hope this can change and stronger protections can be implemented to protect the public interest, but it will take a change of mindset and mandate to do this, not just hoping for greater protections under the existing systems.



Josh Eagle replies

Andy has hit on a key question: how do we motivate Congress (and state legislatures) to take steps to improve the condition of marine ecosystems? Both the agency-led approach that Andy (and the US Commission on Ocean Policy) have proposed and the direct legislative zoning alternative that I have described would require legislative action.

Motivating Congress to act on ocean issues is difficult, but not impossible. Congress has made substantial revisions to the Magnuson–Stevens Act twice in the past 10 years. Congress passed the Oceans Act of 2000, which led to the creation of the US Commission on Ocean Policy. Congress passed a law authorizing NOAA to create National Marine Sanctuaries and stepped in to create sanctuaries when it became convinced that NOAA was taking too long to do it. State legislatures, like California's, have also shown that

they are willing to act when presented with evidence that the marine environment is in need of better management.

But the truth is that Congress will not spend an inordinate amount of time on ocean issues in this or any other year. Thus, the follow-on question is: if Congress can be convinced to act, what single and simple change to existing ocean governance statutes would be most likely to make a difference in outcomes?

I've already laid out the reasons why direct legislative involvement in resource allocation is more likely to improve the condition of the marine environment than a new, larger-scale, broader-mission, marine super-agency. Specifically, Congress should center its next piece of ocean legislation on a plan for zoning the Exclusive Economic Zone (EEZ).

Such legislation needs to have two components in order to make a difference. First, Congress should not delegate the responsibility for ocean zoning to an administrative agency such as NOAA. Second, the zoning must include no- or limited-extraction zones that function to protect marine ecosystems. (These are not particularly novel propositions. Similar ideas can be found, for example, in a 1966 report of President Johnson's Science Advisory Committee, entitled *Effective use of the sea.*)

One might think that Congress does not have the capacity to divide the ocean into use-priority zones, and that agencies would be better-suited to this chore, given their technical expertise and larger staffs. There are reasons, however, that legislatures can and should take the lead role.

The fact that Congress has directly zoned in the past, establishing National Parks and Wilderness Areas, illustrates that it has the capacity to zone. If it chose to take a more comprehensive approach to zoning the EEZ, Congress could create a planning commission and charge it with developing and submitting, within a fixed time, a proposed zoning plan for Congressional approval. Legislative bodies have successfully used this model in zoning public seas (this is how the Great Barrier Reef was zoned) and in zoning large, complex cities such as New York, Los Angeles, and Chicago (Ascher 1940; Day 2002).

At the same time, agencies have not proven adept at zoning. When Congress has delegated the zoning task to agencies, as it has in the Marine Protection, Research, and Sanctuaries Act, the Federal Land Policy and Management Act, and the Magnuson–Stevens Act, agency establishment of zones has been extremely slow (eg Chandler and Gillelan 2004). Examples of agency zoning at the state level, such as the implementation of California's Marine Life Protection Act, also illustrate the likelihood of delay; more than 8 years after it was passed, the Act remains only partially implemented. More importantly, the same political imbalances that shape low conservation outcomes in current multiple-use, balancing regimes are likely to plague administrative zoning plans.

It is important to remember that zoning the ocean will not

require technical expertise so much as it will require tough political decisions. Those who are directly accountable to voters are in a better position to make those decisions.

■ Recommended next steps



Andrew A Rosenberg

The immediate science and policy needs for EBM should come as no surprise, and I believe are achievable within 5 years. From a scientific perspective, we need a comprehensive, dynamic data system that is geo-referenced and crosses all sectors of human activity, so that it is possible to readily access data on marine ecosystem attributes and human activities. We need a consistent and powerful biophysical modeling framework that allows management scenarios to be considered at high spatial and temporal resolution, and we need the ability to analyze trade-offs between ecosystem services under different management options, be they zoning or within-sector efforts. From the policy side, there needs to be a national mandate for ecosystem-based management, including clear goals, integration across sectors, and consideration of cumulative impacts and trade-offs. This national mandate needs to be supported at a regional level and with science infrastructure to provide advice and support. That mandate can be for zoning, or for sectoral integration of management, or, preferably, both. Finally, we can and should do a better job of management. It means doing the work of science and policy implementation differently, not throwing out all the good work that has been done, but changing the approach to the problem of sustaining ocean resources.



Josh Eagle

In order to improve the condition of the marine environment, Congress and state legislatures should take an active role in establishing marine parks, where extractive uses are strictly limited or prohibited. Where permitted by constitutions and law, governors and the President should do this as well. (President Bush has already done this in establishing the Papāhānaumokuākea Marine National Monument.) It would be best if legislatures gave management responsibilities for these areas to agencies whose sole or dominant mission is conservation rather than multiple uses. In the mean time, marine scientists should prepare for the zoning process by developing a list of ocean areas that are particularly in need of protection.

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