

# MARINE ECOSYSTEMS and Management

International news and analysis on marine ecosystem-based management

MEAM

www.MEAM.net

Vol. 1, No. 2

Dec. '07 - Feb. '08

## Issues of Scale: Ensuring that EBM Works at All Levels, from Local to National and Beyond

Ecosystem-based management commonly involves “scaling up” from how other management practices have typically worked:

- From single-species fisheries management to management of multi-species assemblages;
- From looking at isolated drivers of change to considering all environmental and human impacts;
- From design of individual protected areas to planning MPA networks; and
- From conservation of a fragment of habitat to comprehensive spatial management.

This process of scaling up, and assuring harmony between scales of management, presents an array of challenges. In this issue of MEAM, we discuss issues of scaling in marine management, and focus on examples of how disconnects between scales have been overcome.

Planning often occurs at larger scales than management or conservation interventions. The end result can be that management on the ground is more *ad hoc* than the idealized scenarios or “management dreams” of regional planners. EBM often runs into trouble when attempts to establish regulations, design research, conduct monitoring and enforcement, or forge international agreements are planned with the big picture in mind but fail during on-site execution. Sometimes top-down governance operates unaware of what is actually happening with more bottom-up management. Even worse is when planners and managers at various scales have clashing interests or employ conflicting methods to achieve management. To progress toward larger-scale, more-holistic EBM, all the parts of management should work in harmony, moving in the same general direction.

In the previous issue of MEAM, we presented a case study of the Southwest Indian Ocean Fisheries Project (SWIOFP) as a salient example of EBM. We return to Africa in this issue of MEAM, focusing on the different approaches to meeting challenges of scale that have been embraced in two places: by MPA network planners in West Africa and by a national effort to institute EBM in the United Republic of Tanzania. We contrast these with other cross-scale EBM efforts elsewhere in the world.

### What are the critical disconnects between scales?

If it is true that all politics is local, it is most assuredly not the case that all policies are accepted by locals. So the thorniest issue of scaling in EBM concerns how one can avoid having the best-laid plans for EBM falter when management is actually applied. A key question becomes:

How can users of marine resources, and the entities that make decisions concerning uses, be guided to tailor management that not only solves local problems but results in better, more effective management of entire ecosystems or regions? And who steers this ship?

Kimberly Heiman and Dean Wendt have been working on both theoretical and practical aspects of EBM in North America. Heiman is EBM science coordinator for COMPASS ([www.compassonline.org](http://www.compassonline.org)), a collaborative effort to advance and communicate marine conservation science, and Wendt is a biologist at California Polytechnic University at San Luis Obispo. They address the issue of scale in an article they submitted to MEAM, “Connecting the many scales of marine EBM”, available at <http://depts.washington.edu/meam/Heiman-Wendt.pdf>. In the article, Heiman and Wendt write of the need to develop flexible, responsive management structures. These structures link local management, scientific understanding, and stakeholder interests to regional and national management while maintaining the ability to respond rapidly and endure for decades.

“Local scales are where people connect with ecosystems,” write Heiman and Wendt. “It is where people ‘feel’ the effect of management. Thus, EBM must have a presence at local scales. Indeed, local-scale EBM is often a bottom-up (stakeholder-driven) effort to create a forum for communication among management agencies, scientists, and the community. Such programs focus on finding solutions to local issues and better managing resources in a particular location. The conundrum is that place-based efforts usually do not have legal authority to change management regulations. Moreover, smaller scales are necessarily impacted by ecological and political events occurring at larger scales. If small-scale efforts are to be effective, they must connect to larger-scale activities.”

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*Marine Ecosystems and Management* is published quarterly by Marine Affairs Research and Education (MARE), a 501(c)(3) not-for-profit corporation, in association with the School of Marine Affairs, University of Washington. Financial support is provided in part by a grant from the David and Lucile Packard Foundation.

All content has been written by the MEAM editorial staff unless otherwise attributed. The views expressed herein are those of the author(s).

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Heiman and Wendt address the policy/governance issues of scales as well, suggesting that large EBM efforts tend to be top-down policy efforts. "However," they write, "these policy efforts are often without a roadmap for how to implement EBM at small scales, leaving local managers wondering how to interpret policy language or find resources to realize needed changes. There is a disconnect between these two efforts because governance structures are not built to connect different sectors of human uses or able to integrate between large and small efforts. Thus a 'marine EBM paradox' exists that can only be resolved if EBM efforts integrate their activities across scales."

In 2005, a theme section on the politics of EBM in the journal *Marine Ecology Progress Series* made a similar assessment of the disconnect between scales that often occurs in the development of MPA networks. (The journal section is available for free at [www.int-res.com/abstracts/meps/v300](http://www.int-res.com/abstracts/meps/v300). Scroll down to "Theme Section".) But demonstrating that disconnects can and do occur does not further EBM. Fixing those disconnects does. We thus highlight practical examples of overcoming scaling challenges.

### Scaling up from MPAs: West African Regional MPA Network

Our look at practical examples of linking scales begins in West Africa, where EBM at the scale of a large marine ecosystem (LME) is being built on the foundation of a regional MPA network — see the case study on p. 4 for details. The West African Regional MPA Network (RAMPAN) was created in April 2007 and currently includes 15 MPAs, spread among the countries of Mauritania, Senegal, Cape Verde, The Gambia, Guinea Bissau, Guinea, and Sierra Leone. According to Charlotte Karibuhoye, MPA program coordinator for Fondation Internationale du Banc d'Arguin, the aim of the network is to ensure, at the scale of the West African marine ecosystem, the maintenance of a coherent set of critical habitats. "These habitats are needed for the dynamic functioning of ecological processes, which in turn are necessary for the regeneration of natural resources and conservation of biodiversity for the benefit of society," says Karibuhoye.

EBM in the region is embodied in the Regional Strategy for Marine Protected Areas in West Africa, which states that developing effective conservation "hinges on bringing together local, national and regional strengths." The Strategy (available online at [www.fibarguin.org/var/plain/storage/original/application/b5cbded23840211ccdf9d60838afb302.pdf](http://www.fibarguin.org/var/plain/storage/original/application/b5cbded23840211ccdf9d60838afb302.pdf)) explicitly takes on the issue of scale by stating how RAMPAN addresses conservation and management at multiple levels. It states, "Clearly, the sustainability of conservation measures depends both on the effectiveness of on-site management and on the support provided by national-level guidelines, policies and legislation. It is at the national level that a country's environmental priorities are established, and it is at this level that conflicts at the local level may find resolution."

### Scaling up while also scaling down: Tanzania

Thus the regional effort in West Africa aims to achieve EBM by starting with the establishment of an MPA network, through cooperation between the seven countries in the region. In contrast, the United Republic of Tanzania is moving toward an ecosystem approach by simultaneously scaling up from local initiatives, and scaling down from national governance. The core pieces that allow the forging of connections include national coastal zone planning, a new fisheries management act, a nascent MPA network initiative, and a sustainable development/poverty-alleviation strategy. All these broad-scale initiatives have explicit links to management at the community or site level. And the marine management efforts in Tanzania span temporal scales as well. The new marine initiative not only involves looking into the future through planning, but also looks back at the full suite of marine projects undertaken in the past, to derive lessons learned.

In 2005, a report entitled *Blueprint 2050* presented a vision for EBM in Tanzania: it was a flexible framework for overall marine management in mainland Tanzania and Zanzibar, identifying possible priorities for MPA networks, fisheries management, and sustainable development projects. *Blueprint 2050* explicitly tackled the question of scale by discussing connectivity, comprehensiveness, and adequacy, and by linking coastal and marine planning to sustainable financing and alternative livelihood projects at the community level. The presentation of this vision, in plain terms and in a storytelling format, has garnered understanding and support for EBM at the national level.

There have been significant new developments in Tanzania. The Deep Sea Fishing Authority Act Amendments Bill was passed by the Parliament in February 2007. The Amendments incorporated difficult, long-debated but finally-resolved agreements on revenue sharing and other contested issues relating to proceeds from the high-value commercial fisheries of Tanzania's Exclusive Economic Zone. Indu Hewawasam, senior environmental specialist at the World Bank and a co-author of *Blueprint 2050*, hails this development as a "historic and monumental achievement", and points out that it is in line with a goal of the Tanzania Marine and Coastal Environmental Management Project to establish a common and ecologically sustainable governance regime for offshore fisheries management. One of the Amendments' features is the Marine Legacy Fund. This fund will generate financial support for sustainable development and conservation through revenues from fisheries licensing fees, as well as biodiversity offsets from other sectors such as oil and gas. It complements Tanzania's already existing Coastal Village Fund, which supports alternative livelihood ventures.

As Tanzania's marine management program continues moving forward, it will keep an eye to an even bigger scale: that of the western Indian Ocean. Projects are

already underway to explore transboundary cooperative management of coastal and marine areas shared by Kenya to the north and Mozambique to the south. And the country is a key player in larger-scale regional initiatives, including the Southwest Indian Ocean Marine Fisheries Project (described in the last issue of MEAM) and the Western Indian Ocean Marine Science Association.

### **Community-based management with national-level guidance: Philippines**

The Philippines demonstrates a different approach entirely. The nation has been heavily invested in community-based management. This is a logical response to the fact that the population is so widely distributed among the far-flung islands of the archipelago, and the fact that traditional social institutions still hold sway in many places. Yet marine and coastal management in the Philippines has grown systematically, with the national government providing technical support to the increasing number of local government and community initiatives spread across the country.

An assessment of marine management in the Philippines by Alan White and Philippine colleagues is featured in the forthcoming book, *Integrated Coastal Zone Management*. The book documents a stepwise development of integrative policies, between local, regional and national scales. White, a senior scientist with The Nature Conservancy, emphasizes that achieving integration across scales is a learning process, which requires continuous communication between stakeholders, civil society and governmental institutions. According to White, this underlines the need to embed ICZM in a set of measures, which together form a system of coastal and marine governance. “The ‘system’ of coastal and marine governance has evolved through the development and implementation of a set of ICZM benchmarks around which each coastal municipality/city in the country can organize its coastal and fisheries management programs,” he says. “This benchmark system is providing the foundation for each local government to plan and implement coastal and fisheries best practices that are consistent with their neighbors — an essential step on the road to EBM. For instance, in several areas in the Visayas, Philippines, coastal municipalities are forming management councils that are bounded by true ‘fisheries ecosystems’ that transcend municipal jurisdictions.”

White continues: “A common thread among EBM programs that are beginning to work as planned is that the stakeholders affected are involved in planning and at the same time are gaining an improved understanding of what EBM means. In the Philippine case, small-scale fishers working with their local governments have begun to realize that by maintaining habitats, curtailing destructive fishing and limiting effort in nearshore waters, their fish catch stabilizes and increases over time. This translates into an understanding of EBM that encourages sustainability.”

### **Top-down strategic approach: Great Barrier Reef Marine Park**

Finally, we contrast the bottom-up, additive approach of the Philippines with the top-down strategic approach used in the Great Barrier Reef Marine Park in Australia. The responsible agency, the Great Barrier Reef Marine Park Authority (GBRMPA), has tackled issues of scale since its creation. The fact that the Marine Park is widely considered one of the better working examples of EBM may reflect that it has successfully addressed many of the scaling problems touched upon in this issue of MEAM.

GBRMPA operates on a very large physical scale: the Marine Park is about the size of Japan and is bigger than many of the countries in the EU. Yet the management regime is fine-tuned to reflect the complex range of related and interconnected habitat types, represented by 70 bioregions, that collectively make up the broader region. Zoning is only one of many spatial management tools used. Other tools include statutory plans of management over high-use areas, permits, site plans, and temporal closures.

Jon Day, one of the directors at GBRMPA, says, “While the Marine Park is largely confined to the ‘wet’ bits, the integrated management approach extends well outside those areas to include all the islands, all the tidal lands/tidal waters, and even some activities in the catchments.” Legislation since 1975 effectively incorporates an ecosystem approach for GBRMPA, and allows for regulatory controls on activities well outside the jurisdictional area. For example, regulations were introduced controlling aquaculture — fish ponds — up to 5 km landward. (Although the State of Queensland oversees regulation of that industry, the Australian Government — represented by GBRMPA — requires audits to confirm that Queensland law has delivered adequate protection for the Marine Park.)

Over the last 30 years, management has evolved and adapted, and despite the jurisdictional complexities, continues to be well-integrated. The national and state-level management efforts are in harmony largely due to complementary legislation for adjacent state and federal waters. According to Day, “There is very good cooperation between government and most sectors, especially the tourism industry.”

### **Conclusions**

A June 2007 workshop in Colombia reviewed Latin American initiatives that have adopted the ecosystem approach. In an English summary of this workshop (available at <http://depts.washington.edu/meam/Andrade.pdf>), Angela Andrade Pérez of the IUCN Commission on Ecosystem Management writes, “As a strategy endorsed at global level by the Convention on Biological Diversity, there is only one Ecosystem Approach. When it comes to implementation, however, the Ecosystem Approach can be applied in many different ways, all consistent with the strategy. The application of the Ecosystem Approach

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should reflect, and be tailored to, the different ecological, social and political situations in a specific geographic area.”

Likewise, a diversity of approaches to ensure that management at all scales is coordinated or harmonized suggests that there is no formula for overcoming disconnects. Why some regions adopt one approach while others adopt different approaches, starting points, or tools may have much to do with the physical lay of the land and corresponding laws or jurisdictions: EBM in more-bounded ecosystems can be more top-down, while EBM in widespread and less-bounded ecosystems may necessarily have to be more decentralized. Another important factor is of course the human/social dimension — which is, after all, what EBM is all about.

Countries with a history of centralized government and government-dominated governance exhibit a different way of coordinating management from cultures in which governance extends to other, non-governmental institutions. And finally, the scale of the “E” in EBM makes a huge difference, such that the larger the geographic and sectoral scales, the greater the need for a hierarchical or integrated strategy to maintain linkages between scales.

Clearly a critical step in being able to practice effective EBM is to recognize disconnects, anticipate them in planning, and take necessary measures to promote awareness, understanding, and cooperation. Subsequently, wherever EBM is taking place, linkages are forged in a delicate interplay between top-down and bottom-up planning, management, and governance. ■

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## Case Study: Connecting Scales of Management in West Africa

The challenge of coordinating across scales in EBM is being met in different ways in different parts of the world. As highlighted in the preceding article, cross-scale EBM is being undertaken in West Africa using an MPA network as a starting point.

West Africa’s coastal zone is strategically important to the development of all seven countries of the region — Mauritania, Senegal, Cape Verde, The Gambia, Guinea Bissau, Guinea, and Sierra Leone — and supports nearly 15 million inhabitants. (For a map of these countries, go to <http://depts.washington.edu/meam/West-Africa.gif>.) The marine ecosystem, which includes offshore upwelling areas, shallow banks, and nearshore estuaries, is highly productive. Yet like many other areas around the world, coastal and marine systems here have been compromised in recent years due to excessive use and/or poor regulation in fisheries, tourism, development of oil and gas industry, and other ocean and coastal uses. It appears that traditional rules and conventional management have been insufficient in maintaining the fragile equilibrium, given globalization, increasing population, and the push for economic development.

Charlotte Karibuhoye is MPA program coordinator for Fondation Internationale du Banc d’Arguin (FIBA), an organization whose mission is to protect the Banc d’Arguin, a Ramsar site in Mauritania. She says, “Governmental and non-governmental organizations (NGOs) from the sub-region have recognized that the existing problems need to be addressed at a regional scale if the structure and the functions of the marine and coastal ecosystems are to be conserved at a regional scale.”

Recognizing the common problems, concerns for migratory species, shared resources, and mobility of users, governments and NGOs throughout West Africa see a continuing need to address coastal zone and marine resource management at the eco-regional level. With the help of organizations listed in the table on p. 5, an initia-

tive was launched in 2001 to develop a common strategy. That strategy, called RAMPAAO, aims to build a regional network of MPAs within the framework of a regional coastal and marine conservation program (PRCM, by its French acronym — [www.prcmarine.org](http://www.prcmarine.org)).

The RAMPAAO network has a dual nature: physically connecting ecologically or socio-culturally critical sites, and linking people and institutions through a human network for exchanges, mutual reinforcement, and economies of scale. It has involved all types of stakeholders (government administration, local and international NGOs, research, fishermen associations, local communities) and has political support from each of the seven countries. Importantly, the network’s regional objectives take into consideration interests and needs at national and local levels.

Karibuhoye says the RAMPAAO project aims to improve the partnerships and co-management mechanisms with local communities by promoting participatory mechanisms and community management. “Such MPAs can be considered one of the main tools for biodiversity conservation and sustainable fisheries management, but are also important for sustainable development,” she says. “Witness the involvement of local communities in MPA management, preserving their cultural heritage but also providing reference sites for a better understanding of ecosystem functioning at very large scales.”

RAMPAAO’s Regional MPA Strategy document details how coastal and marine management at the site level contributes to more effective management at the regional scale. “Each marine protected area operates at a local level, where the participation and support of local communities and stakeholders is absolutely imperative,” states the Strategy document. “Impacts (both positive and negative) are more immediately felt at this level where people are often asked to make significant investments of time and space. The success or failure of any protected

area depends on adapting management approaches to their unique socioeconomic and natural environment to resolve problems that they themselves have identified.” At the same time, notes the Strategy, conservation must operate within a context defined by national policy and legislation.

Studies carried out at regional level on the distribution, abundance and ecology of important coastal and marine resources are being used to identify areas in need of protection or management from the “bigger picture” perspective. This is particularly important for the management of migratory species. Regional-level analyses of environmental monitoring data can also help establish whether changes observed at particular sites are simply a local phenomenon or reflections of larger, more-widespread environmental changes. Other activities of mutual interest like professional training, exchange visits and preparation for international conferences can also benefit from coordination at the regional level.

Since the program goes well beyond standard MPA-based management, it is fast becoming a bona fide EBM initiative. Included under the framework of the program are fisheries management, species and habitat conservation, sustainable tourism, scientific research, and education and outreach.

A very recent example demonstrates how this cross-scale effort goes beyond protected areas. Conservationists are mobilizing across West Africa to help provide informa-

tion to the country of Guinea Bissau as it evaluates whether to allow the export of dolphins from its waters. This information includes population size estimates and dynamics, fishing-related mortality, and other potential threats. According to Mathieu Ducrocq, coordinator of IUCN’s Marine and Coastal Regional Program for West Africa, distilling information across the wide geographical scale of the West African region should enable Guinea Bissau to look at trade-offs and make its unilateral decision armed with the best possible information.

As articulated in the Strategy, multi-level cooperation can open the door to special fundraising opportunities — a high priority for everyone. Many bilateral and multilateral agencies as well as private foundations recognize the importance of coordinating environmental management on a larger scale. Karibuhoye maintains that by creating a network of MPAs that respects local needs while integrating national and regional priorities, the regions’ institutions create an opportunity for the international community to support economic and environmental development at all levels simultaneously.

This is how she summarizes the lessons about cross-scale EBM that have emerged even in the early stages of this program:

- Wide (and lengthy) consultations are essential for defining clear and shared objectives and for the definition and adoption of site-selection criteria;
- Involving all key actors in the whole process is crucial (managers, local communities and resource users representatives, NGOs, research institutions, technical bodies, administration);
- Political support from the States was decisive (a general policy declaration was signed by ten ministries from six countries);
- The network’s (regional) objectives must take into consideration the concrete needs at local level, in addition to national priorities;
- The (human) network is a formidable opportunity for mutual learning and reinforcement; and
- Technical and financial support from international partners was essential.

The shared vision for EBM in West Africa is now embodied in the regional strategy. That there is strong political support to this regional strategy can be seen in the general policy declaration signed in 2003 supporting large-scale regional management. It was signed not only by ministries in charge of protected areas, but also by those of fisheries and the environment as well. The large number of NGOs and community representatives participating in the effort is further testimony to the solid support that cross-scale EBM has in this region of the world. ■

### **International institutions involved in developing the Regional Strategy**

- Subregional Fisheries Commission (CSRP)
- Regional Network for Coastal Planning in West Africa
- United Nations Educational, Scientific and Cultural Organisation (UNESCO)
- RAMSAR Convention Secretariat
- World Conservation Union (IUCN)
- Worldwide Fund for Nature (WWF)
- International Foundation for the Banc d’Arguin (FIBA)
- Wetlands International
- Centre National de la Recherche Scientifique / Géomer, France
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# EBM Perspective: A Planner's View on Working Across Spatial Scales

## Editor's note

James Dobbin is a Canadian coastal planner with several decades of experience conducting coastal and marine assessment and management worldwide.

By James Dobbin

I believe it is impossible to achieve EBM without a comprehensive and integrated planning process. Planning helps to determine issues and identify solutions (i.e. management interventions) across both sectors and spatial scales. It can also help engage everyone, including stakeholders, in achieving coherent strategies that solve not only local management problems but also steer whole regions toward sustainability.

My background as a landscape architect and coastal planner has taught me the need not only to work across spatial scales, but to keep going back and forth across scales to find a set of solutions to management that are appropriate to the local situation, yet advance the sustainability of ecosystems and ecoregions.

Planning involves the “resolution of issues in context.” When planners assess coastal and marine management issues to offer management solutions, we involve various stakeholders: first at central or national levels, then at provincial or state levels, and finally at the district or local community levels. Assessing issues at each level leads to priority actions necessary to resolve the issues – but these actions are specific to the scale of stakeholders, and do not in and of themselves constitute wider-scale EBM. Planning then becomes an iterative process to winnow through many management options, evaluating how the full complement of actions work together at all scales. As long as the focus remains on resolving the issues in context and the necessary management, investment, communication, marketing and education actions that emerge are feasible (appropriate to the scale), and as long as the actions are evaluated with regard to how they complement one another, the sum total is an EBM plan that will have significant impact.

I cannot overstate the power of graphical presentations to overcome challenges of scale. Having people actually see the scale of marine and coastal ecosystems, the distribution of free-ranging species, the connections between habitats, and the scale of human use and impacts, is so much more powerful than just describing it in words. This is where my landscape architecture background has come in handy for addressing the challenges of eco-regional planning coupled with site-level planning and management.

Maps are also critical to show the linkages – for instance, the linkages between upstream and downstream processes, such as land-sea interactions and watershed impacts on coastal zones. Maps can also forge better stakeholder participation and improve understanding of linkages across sectors. I have been repeatedly amazed that local people who are most affected by EBM approaches may have never seen maps before. When planners provide

these graphic tools, local users immediately relate to them and often refine and correct the work of the science community. This cross-linkage – between scientists and users – is also facilitated by mapping and GIS tools.

A project with which I have been involved for the last 16 years in Cuba illustrates these points.

The project was originally conceived as a biodiversity protection assessment of Cayo Coco, a small island off the north coast of Cuba. However, a rapid assessment indicated serious environmental degradation of the coral reefs, beaches, sand dunes, and coastal vegetation. Given that Cuba's Ministry of Tourism had a proposal to construct 50,000 new hotel rooms on the fragile and sensitive cays of the north coast, it was clear that a large eco-regional approach that addressed different issues at different scales was necessary.

The project ended up as a multi-phased Global Environment Facility project, managed by the Cuban Ministry of the Environment, covering the last remaining frontier in Cuba — the Sabana-Camaguey Ecosystem region, comprising almost the entire north coast. This region, encompassing 75,000 km<sup>2</sup>, spans five provinces and includes watersheds, coral reefs, coastal lagoons, and more than 2500 islands. It extends out to the limits of the 200-nm Exclusive Economic Zone. Our strategic planning process involved over 600 experts and 63 institutions, and developed a 100+ theme GIS database on all relevant socioeconomic and biophysical factors as one key tool for analysis and decision-making.

No one ministry or agency could address the myriad of inter-connected problems and develop institutional actions to address these. Bringing a wide variety of authorities together into an iterative planning process resulted in a host of complementary management actions. These actions now steer development of the north coast of Cuba in a sustainable direction, and provide benefits to people at the local, sub-regional, and national level. We achieved good results through inter-sectoral and inter-disciplinary teamwork and by working up and down the different scales. We have used similar processes at different spatial scales in other parts of the world, too, including in the Arctic's Lancaster Sound region, in the Anosy region of Madagascar, and at central, provincial and district levels in Mozambique.

There is no single, simple pathway from science to management. Planners recognize this and undertake concerted and comprehensive eco-regional processes, working across all scales continually, to achieve large scale, ecosystem-based management. ■

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# Globalization and Scaling in Ecosystem-Based Management

By Michael Sissenwine

The inaugural issue of *Marine Ecosystems and Management* (MEAM, Vol. 1, No. 1) was interesting reading and should provoke a healthy exchange of ideas over the months and years to come. I particularly like Jake Rice's essay on ecosystem-based management titled "Investigating the roots of confusion". I want to extend Jake's investigation by addressing another source of confusion about EBM. It is the issue of scale. A closely related issue is fragmentation.

Some think of EBM at the scale of the MPA that's important to them (as a manager, researcher, or stakeholder). Others have promoted EBM at much larger regional scales, such as the scale of Large Marine Ecosystems (LMEs). However, with globalization, even the LME scale is not large enough for some aspects of EBM.

Globalization affects people, institutions and ecosystems on all scales from local to global, and is enabled by advances in technology that allow rapid communication, and movement of people and commodities. As a result, products that were once exchanged only locally are now bought and sold on global markets. Globalization is also a natural feature of our biosphere, connecting local environmental conditions to global processes that regulate climate, ocean circulation, and ocean and atmospheric chemistry.

Globalization is a reality that presents new challenges for ecosystem-based management. Globalization can increase demand for some ecosystem goods and services, such as increasing the demand for fish products as a result of global markets. One new challenge is that not only must conservation and management of these resources balance local needs and desires with sustainability of ecosystems, but they must also respond to global pressures. Even locally, culture and traditional values are evolving rapidly in response to globalization of communications and information, which challenges institutions for conservation and management to be flexible and adaptive so that they can keep pace.

So what is the proper scale for implementing EBM in a globalized world? Ultimately, EBM needs to be implemented at a nested hierarchy of scales from global to regional to local. The appropriate scale of a particular EBM project within the nested hierarchy depends on the (a) characteristics of the ecosystem that are priority considerations for EBM, (b) natural processes that are most relevant to the priority ecosystem characteristic, (c) anthropogenic drivers of change in the priority ecosystem characteristics, and (d) the governance institutions that are available to implement EBM. It is interesting that three of the four factors related to the appropriate scale for EBM are determined by humans, not nature. Let me elaborate.

## (a) Characteristics of the ecosystem

In general, EBM is aimed at conserving and sustaining ecosystem services to benefit current and future human generations. No one disputes such a generic goal for EBM or something like it, but it does not give practical guidance for implementing EBM, setting priorities or deciding on scale. In practice, EBM is usually implemented to protect a place that many people value, such as an estuary, bay, gulf or the site of a coral reef. In such cases, practical or operational objectives are formulated usually focusing on a few characteristics, such as aesthetics, recreational opportunities, fishery production, and factors that affect public health and safety. I refer to this type of EBM as place-based, and the size of the place of interest determines scale.

Ecosystem-based management can also be sector-based. For the fisheries sector, it is often referred to as an ecosystem approach to fisheries (EAF). Of course, EAF also occurs in a place. But there is an evolution from traditional fisheries management (which usually has the goal of a large sustainable yield) to EAF — which takes account of non-fishing factors that affect fisheries, as well as direct and indirect impacts of fishing on ecosystem services other than fishery yield. Like traditional fisheries management, the starting point of EAF is typically at the scale of fish stocks. But it may evolve from there to take account of non-fishery factors that impact fisheries, and impacts of fisheries on non-fishery services of ecosystems.

Place-based EBM and sectoral approaches such as EAF should not be viewed as competitive, or either superior to the other. Depending on the specific situation, they will evolve at different paces. For example, the legal framework for traditional fisheries management may also allow progress to be made with EAF in situations where there is not a framework for place-based EBM. This is generally the case in the U.S., although there are some specific places that are exceptions. Ultimately, place-based EBM and sectoral approaches, such as EAF, should converge and be mutually supportive.

## (b) Natural processes

Marine ecosystems do not have impenetrable barriers that create closed ecosystems. Regardless of the location of ecosystem boundaries established for the purpose of EBM, there are almost always some biotic and abiotic exchanges across the boundaries. However, boundaries can be chosen to minimize these exchanges based on topography and ocean circulation.

## (c) Anthropogenic drivers

In some cases, the anthropogenic drivers that affect priority characteristics of ecosystems occur on the same scale as the ecosystem characteristic. For example, fish

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productivity may be primarily affected by fisheries that take place at the same scale as the range of target fish stock. However, there are many cases where the scale of priority ecosystem characteristics and anthropogenic drivers of change do not match. For example, the health of a coral reef may be more affected by anthropogenic ocean acidification at the global scale, or sedimentation resulting from coastal development, than by any of the activities that occur in the vicinity of the reef. Globalization is a generic anthropogenic driver that affects ecosystems at all scales.

#### (d) Governance institutions

Governance includes both (i) non-binding arrangements that facilitate communication, priority identification and goal setting, and coordinated planning, and (ii) legally binding instruments that can be used to regulate human activities. Legally binding instruments are often available to implement sectoral EBM, such as EAF. Non-binding arrangements may be a useful vehicle for harmonizing sectoral approaches. In practice, the scale at which EBM is implemented will depend on the scale of available governance instruments (local, regional, global). It will often be necessary to decide if it is better

to use existing governance institutions even if their scale is not very appropriate, or to delay EBM until a governance institution with a more appropriate scale can be created.

The scale for EBM will usually require a compromise between considerations of factors (a-d). These compromises should not be much of a problem if there is good connectivity (in terms of communication and integration) among the elements of the nested hierarchy of EBM implementations. This connectivity needs to be both vertical and horizontal. An example of horizontal connectivity is adjacent community-based EBM projects taking account of how their actions impact their neighbors. Vertical connectivity needs to be two-way. EBM at lower levels needs to fulfill higher-level policies and goals. Higher-level EBM needs to control anthropogenic drivers that impact lower levels. Unfortunately, there is relatively little experience creating effective connectivity between EBM at a hierarchy of scales. This could lead to fragmentation. In a globalized world, fragmentation has the potential to undermine even well-executed EBM at any particular scale. ■

#### Next issue of MEAM: capacity building

Many government agencies and multilateral bodies are striving to adopt ecosystem approaches to marine management. But the capacity of existing management to implement such approaches is often lacking. In the next issue of MEAM, we will explore capacity building for EBM.

Do you have personal experience in building management capacity for EBM? Do you know of good case studies on how capacity has been improved? If so, please let us know! E-mail us at [editor@meam.net](mailto:editor@meam.net). We look forward to hearing from you.

### The EBM Toolbox

By Sarah Carr

Editor's note: The goal of this feature, The EBM Toolbox, is to promote awareness of technology tools that can facilitate EBM processes, and provide advice on using those tools effectively. It is brought to you by the EBM Tools Network ([www.ebmtools.org](http://www.ebmtools.org)), a voluntary alliance of leading tool users, developers, and training providers to promote awareness, development, and effective use of technology tools for EBM in coastal and marine environments and the watersheds that affect them. The EBM Toolbox will be a recurring feature in MEAM.

Ecosystem-based management of coastal and marine environments requires the integration of information about a vast array of environmental and human systems. Many different kinds of technology tools have been developed to help policymakers and managers collect, visualize, and analyze this information and engage stakeholders in the EBM decision-making process. For example, EBM tools can help:

- Collect local knowledge on resource use, such as favorite areas for fishing or diving;
- Visualize the impact of development on a coastal community and coastal ecosystems;
- Select optimal areas for conservation, restoration, or development; and
- Collect stakeholder feedback on management alternatives.

When you get started using EBM tools, you should:

- 1) Determine what you want to get from using tools, what resources you have available to use them, and how you will integrate tools in your management decision-making process. The EBM Tools Network provides a series of questions to help with these decisions at [www.ebmtools.org/using\\_tools.html](http://www.ebmtools.org/using_tools.html). The webpage also offers several best practices for using EBM tools, gathered from practitioners worldwide (scroll down to "Using EBM Tools Effectively").
- 2) Research the available EBM tools and what each can and cannot do for your project. On the [ebmtools.org](http://ebmtools.org) website, click on "Find Tools" to access a searchable database of EBM tools. Once you have located tools that might be useful, you should contact the tool developers and other tool users for more detailed information and advice.

Sarah Carr is coordinator for the EBM Tools Network. Learn more about EBM tools and the EBM Tools Network at [www.ebmtools.org](http://www.ebmtools.org) or by contacting Carr at [sarah\\_carr@naturereserve.org](mailto:sarah_carr@naturereserve.org).