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Tropical Marine EBM Feasibility: A Synthesis of Case Studies and Comparative Analyses

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This overview compares and synthesizes the articles of this theme issue. It highlights that progress has been made toward the goals of marine ecosystem-based management (EBM) in tropical regions. Four key findings are presented: (1) Tailoring EBM to specific contexts ultimately determines success. (2) Employment of a wide variety of marine management tools is necessary and complementary to spatial management through marine protected areas (MPAs). (3) Although EBM approaches may be usefully defined using oceanographic and ecological principles, the design and implementation of feasible EBM will require, at least, equal consideration of governance and social conditions. (4) Interest in EBM has grown rapidly; however, this approach only improves ocean resource management if sustained by commitments from, at least, policymakers, resource users, and donors. Practical program design principles stressing the importance of leadership development, awareness raising, institutional reform, conflict resolution, adaptation, and evaluation are derived from these case studies and comparative analyses. A suite of empirically based EBM evaluative criteria, which can be adapted to local contexts, are suggested to fostered learning and progress.

Keywords feasibility, governance, marine ecosystem-based management

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Introduction

Ecosystem-based management (EBM) has emerged within the marine resource management field with remarkable influence. One widely accepted definition is that marine EBM is:

> . . . an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors. . . (McLeod et al., 2005, 1)

EBM brings new concepts, information, and ways of thinking to marine management in need of expanded commitment and reform and is shaping the efforts of research, management, and advocacy by conservation, donor, policy, academic, and resource user institutions. For the purposes of this article, EBM is taken to be consistent with the approaches discussed in the various articles of this special issue, in particular that of an ecosystem approach to fisheries (EAF) (FAO, 2003).

The sense of loss and understandable anxiety stemming from forecasts of deteriorating ocean conditions may have provoked a paradigm shift (Francis et al., 2007). A sentiment that previous frameworks, such as integrated coastal management, either ignore ecological limits or overvalue social goals at the cost of ecological systems may underpin this shift. In any case the shift toward EBM has proceeded largely on theory with little analysis of field efforts.

The condition of the ocean has changed substantially in a relatively short period of time. Without considerable new effort and reform, it is likely that the dramatic decline in ocean resources witnessed in the past generation will continue and accelerate. If current trends continue, future generations will inherit a much diminished ocean environment. We now know that ocean habitats have been degraded on a global scale (Halpern et al., 2008). Certain marine organisms, especially those that are highly sought after or particularly vulnerable, have been eliminated from large areas of their range (Pauly et al., 1998). The implications for ocean and society alike are literally world-changing as we depend on the ocean for food, climate regulation, recreation, and inspiration among other ecosystem services.

It is clear that management changes need to take place, but in what order, and how tradeoffs are handled under a new, more sustainable regime is less clear. In this high-stakes context, there are distinct and countervailing perspectives on EBM. Decades from now, the creation and diffusion of a new management framework, predicated on a more profound understanding and respect for ecosystems and their function, may be described as a timely and positive reorientation. Alternatively, the EBM reorientation may be described as an example of displacement behavior—choosing to ignore the known and challenging problems by creating and debating esoteric policy framework re-orientations. EBM may also be described as a rebalancing of the types of knowledge brought to bear on a problem. In a positive sense, ecological knowledge can be used as a tool to define the thresholds for sustainability beyond which ecosystems are diminished—with serious consequences for life. Alternatively, EBM may be perceived as privileging some types of knowledge and worldviews. Namely, EBM could serve to position natural science as more central than social

science–derived knowledge in framing issues and solutions—and thereby marginalizing sectors of society that are already vulnerable.

These are challenging issues, partly because so much is at stake and so much has already been committed to EBM. There are no correct and complete characterizations of ocean problems or management frameworks, in part, because it seems that individuals and organizations differ widely in approaches.

This theme issue poses a seemingly simple question that leads to more interesting underlying questions and detailed analyses: "Is EBM feasible in tropical contexts?" This question was explored by a group of researchers and practitioners as part of a National Center for Ecological Analysis and Synthesis (NCEAS) working group (http://www.nceas.ucsb.edu/projects/11281). The working group included practitioners and social and natural scientists involved in EBM programs in the Philippines, the Caribbean Large Marine Ecosystem, the Benguela Current Large Marine Ecosystem, and Hawaii. Cases were selected to consider a range of scales, approaches, and contexts. Some of the case study areas, such as the Benguela Current area, include non-tropical areas, but the focus of the analysis presented in this theme issue is on EBM in tropical contexts. EBM case studies generally followed a mutually agreed upon structure, which were augmented with comparative, multi-site analyses within the Philippines. This theme issue is an outcome of this working group, and will be complemented by an educational workbook and training module.

What are our overarching conclusions after four meetings of international experts at NCEAS, three months of focused field research in the Philippines, and analysis of emergent EBM efforts in the Caribbean, Benguela Current, Hawaii, and the Philippines? Four overarching conclusions and various design principles emerged from this effort:

1. Tailoring EBM to specific contexts is what ultimately determines success.
2. A wide variety of tools, in addition to marine protected areas (MPAs), are necessary.
3. Although EBM approaches and field site boundaries may be usefully defined using oceanographic and ecological principles, the design and implementation of *feasible* EBM will require, at least, equal consideration of governance and social conditions.
4. Interest in EBM has grown rapidly; however, improved ocean resource management occurs only with sustained commitment among all parties.

The sections following develop these overarching conclusions and summarize feasible EBM design principles. This article is grounded in the synthesis of various case studies and two comparative analyses presented in this theme issue.

Adapting EBM to Context

Initially, EBM, and related frameworks, were not well grounded in practice (Christie et al., 2007). In the last few years, there has been a tendency to surround EBM with technical and normative guidelines (FAO, 2003; Francis et al., 2007; Pikitch et al., 2004; World Wild Fund (WWF) for Nature Australia, 2002). Such guidelines are valuable and can serve to guide the practitioner or policymaker. A major governance challenge lies in the fact that in many contexts EBM is necessarily overlaid on existing practice and policy in many contexts. EBM demands both reform in policies and practice, but is dependent on existing policies, institutions, and practitioners. In this way, successful EBM emerges incrementally from existing practice. This incremental growth may be counter to the desires of some proponents of EBM who, out of frustration with current practice and frameworks, may wish to "wipe the slate clean and begin anew." However, from our experience radical

reformation of ocean governance is unlikely and the insistence that it be the goal has the potential to undermine progress toward EBM.

In terms of context we examine the historical situation, the scale, social goals, the governance complexity, and the prospects for sustaining participation. Resource management is embedded in history. This is one reason context shapes its success. Throughout most of the tropics, colonialism and neo-colonialism have left a legacy of impoverished societies, weak states, large disparities between the few wealthy and the majority poor, corrupt governments, and export-oriented natural resource–based economies. Economic integration and globalization are potent economic and governance reformations reshaping ocean and coastal contexts. Large demographic shifts toward coastal areas also pose a considerable challenge (Olsen & Christie, 2000). In this historic and rapidly changing context, ocean governance is an extraordinarily complex process.

While the tropical context generally is not conducive to large-scale, expensive, and science-dependent ocean governance, these case studies demonstrate various pathways that can be developed to implement EBM. Notably, each path is distinct and context-specific. The Benguela Current Large Marine Ecosystem (LME) effort emphasizes multinational management of important pelagic fish stocks within a common ecosystem (Cochrane et al., 2009). The Caribbean LME case suggests a networked multilevel approach to planning in order to facilitate, coordinate, and expand current management efforts (Fanning et al., 2009). The Hawaii case study shows how local efforts can emerge and coalesce into larger scale efforts within a relatively centralized governance context (Tissot et al., 2009). The Philippine cases exhibit creative solutions to the challenge of scaling up within a highly decentralized governance context through multimunicipal government clusters (Armada et al., 2009; Eisma-Osorio et al., 2009; Lowry et al., 2009). In short, there is no single overarching blueprint for EBM.

In the Benguela Current LME context, differences in the economic and scientific conditions of the three countries, Angola, Nambia, and South Africa, pose some challenges for scaling up cooperation and EBM management to the regional level but the rebuilding phase that each of the countries is currently experiencing represents not only a challenge but also an opportunity for multinational EBM. The Caribbean LME context, which includes the United States and the West Indies, is distinct in its governance complexity and extremes of wealth and poverty among many countries. This context shapes what is possible, and has resulted in recommendations to create and enable a network of coordinated efforts and communication rather than a deterministic blueprint of EBM. The Hawaii case demonstrates that community leadership and formalized enabling legislation are both critical to progress. The context for Hawaii is much more legalistic and reliant on formal governance processes than most developing country contexts because of its being part of the United States. The Hawaii case suggests the means by which participatory planning processes, which are complementary to legalistic ones, might evolve in other U.S. contexts.

In summary, feasible EBM will be tailored to each context. Attempts to apply models of EBM from the global North to the global South, as was attempted and abandoned with integrated coastal management (Olsen & Christie, 2000) almost certainly fail. Rather, allowance for contextualization and adaptive solutions to constraints are attributes of an appropriate mechanism for progress with EBM.

A Wide Variety of Tools is Necessary

The early literature of marine EBM tends to emphasize the application of MPAs (Christie et al., 2007). The emergence of MPA global targets, documentation and dissemination of

MPA successes, and desire to protect biodiversity and habitats from human activities have fueled the global MPA mandate. While MPAs are potent management tools, especially to restore overfished and demersal fish communities—such as those occupying coral reefs in these case studies—they are a limited tool to address some of the severe problems ahead. Increasing attention to the context in which MPAs are embedded is essential to their long-term success (World Bank, 2006). While some may equate EBM primarily with the use of MPAs, at least three reasons exist for expanding the EBM toolkit beyond MPAs: (1) balancing EBM goals in a manner to engage and enable equitable results for a wide array of constituencies and institutions, (2) problems of free ridership and overfishing near MPAs and subsequent conflicts in MPA implementation, and (3) ensuring that MPAs are not viewed as a panacea.

If EBM resonates mainly with environmental advocacy organizations and conservation-oriented scientists, it will fail to engage a wide range of society, including resource users and consumers of ecosystem services. Empirical research shows that resource users will question the legitimacy of regulations, resulting in low compliance rates (Christie, 2004; Kuperan & Sutinen, 1998; Oracion et al., 2005). Enforcement capacities are generally low in much of the ocean, especially in tropical contexts. EBM, if properly defined and introduced, has the potential to protect ecosystem function, while resonating with diverse constituencies. While natural science drives much of the current EBM discourse and design in the United States context, this is not a strategy that is likely to work in much of the global South (or even in the United States). The lack of scientific data on MPA benefits outside their borders and the desire of local governments and resource users to develop policies which include environmental, resource management and development goals inhibit a natural science–based or environmental advocacy approach. Nonetheless, as shown particularly in the Hawaii and Fisheries Improved for Sustainable Harvest (FISH, Philippines) cases, ongoing monitoring and diffusion of biological monitoring data are essential to documenting progress, as well as fostering long-term commitment to and raising awareness about EBM and MPAs (Armada et al., 2009; Tissot et al., 2009). Raising awareness about population connectivity for valued marine species motivates collaboration between spatially separated social groups and can be used effectively to improve stakeholder cooperation and commitment to MPA networks (Armada et al., 2009; Tissot et al., 2009). Monitoring may consist of resource user–derived indicators that can serve to monitor changes in situations where funds and capacity are limited.

In an open access regime, MPAs are likely to fail eventually (World Bank, 2007). In the Philippine context, MPAs have emerged as the principal and, arguably, only widely utilized management tool in nearshore areas aside from some sporadic coastal law enforcement for fisheries regulations in areas surrounding MPAs. Anecdotal evidence suggests that in a context of overall resource decline and open access outside no-take areas, increasing numbers of fishers are attracted to fish at the boundaries of successful MPAs (Christie et al., 2002). This is particularly problematic for community-based MPAs because "free-ridership" may undermine local community willingness to sacrifice short-term interests for long-term gains. If costs (for enforcement, loss of fishing grounds) are incurred locally while benefits are unequally shared within or beyond community boundaries, incentives to protect any local MPA are reduced. The wide distribution of MPAs throughout the country may tend to reduce this problem, but a lack of control over fishing effort and fisher movement will remain problematic for coastal MPAs and MPA networks.

The tendency to use MPAs as the preferred management tool may preclude consideration of other less popular, but important, fisheries management options. Closing open access to tropical nearshore waters is difficult and may be perceived as closing economic

options for the most impoverished communities. Management techniques such as reduction of fishing effort and control of fisher access to neighboring waters are understandably unpopular among fishers in thirty-six communities surveyed in 2007 (Christie, unpublished data). Project FISH in the Philippines is beginning to engage in MPA and fisheries management (through effort control, seasonal closures) simultaneously as part of their EBM effort (Armada et al., 2009). MPAs might serve as "stepping stones" to other forms of management. Their educational value, if diffused through society, has the potential to provide alternative examples in a context of eroding environmental condition (Pietri et al., 2009). While ambitious MPAs and MPA networks are essential management tools in many contexts, they are not sufficient and will only be effective in the long term if sustainable resource management is practiced in surrounding waters. Otherwise, they will become the last remaining refuges in severely degraded seas (Christie et al., 2002).

Scaling of EBM to Consider both Ecological and Governance Conditions

While incorporating ecosystem boundaries and increasing the consideration of ecological and oceanographic processes is the hallmark of EBM, the *management* of resources is, by definition, a societal activity. As such, EBM program designs cannot ignore governance, jurisdictions, and societal relationships. In fact, starting the EBM boundary designation from a natural science perspective is questionable from a program feasibility perspective unless governance institutions are to be redesigned along ecological principles—an unlikely outcome. A more pragmatic approach, as manifested by these case studies, is the definition of an area of EBM program implementation that functions at sufficient temporal and spatial scales to incorporate the relevant ecological interactions among species and habitats of interest, while not exceeding institutional capacity. Arguing for scaling up beyond institutional capacity in the name of ecological optimal design is likely to result in poor program implementation and program un-sustainability (Christie et al., 2005, 2007), just as mainly considering social and institutional optimal design principles could result in ecological failures. Ecological concepts such as food-web interactions tend to guide designers to larger scales, while social principles such as subsidiarity (McCay & Jentoft, 1996) and the challenges of multi-institutional collaboration encourage smaller- scale efforts. The principle of subsidiarity states that management authority should be vested at the lowest possible level of organization and the "burden of proof" for centralization rests with high-level organizations. Christie et al. (2009) demonstrates that successful dialogues between and among resource user groups, government agencies, and nongovernmental organizations (NGOs) at the level at which management decisions are implemented are essential to management effectiveness on large scales. The art of effective EBM design requires sophistication in holding and resolving this dialectic tension. It is not possible to optimize both social and ecological goals, but useful tradeoffs obtained through compromises are possible.

Finding the so-called sweet spot that addresses both ecological relevance and governance feasibility requires a sophisticated and balanced understanding of social and ecological process interactions and tradeoffs that could occur through adaptive management. The Benguela Current Commission, created to facilitate management of the Benguela Current Large Marine Ecosystem (Cochrane et al., 2009), is an attempt to reach such a compromise. In data-rich contexts, software programs can help this process, as demonstrated by large-scale redesigns of the Great Barrier Reef Marine Park (Fernandes et al., 2005). In data-poor contexts, general guidelines (e.g., Christie et al., 2007), can provide minimum expectations. In all cases, goals should be explicit and the design process should be grounded in a defensible decision framework that integrates multiple sources of information. As

shown in Eisma-Osorio et al. (2009) and Christie et al. (2009), it may be possible for programs to "scale up" to ecologically relevant scales while employing the design principle of management feasibility. In the Philippine decentralized context, this means working with municipal governments. In the Benguela LME context, there has been an explicit attention to fostering management efforts at the local, national, and international levels as dictated by the characteristics of important fisheries (Cochrane et al., 2009). A useful governance and institutional scale framework for the Large Marine Ecosystem context is emerging and will evolve with field testing (Fanning et al., 2007).

Sustained Commitment

Sustaining commitment to EBM in the tropics is challenging because these regions tend to be politically unstable, impoverished, and dependent. The emergence of EBM needs to build on existing strengths and deliver tangible, positive outcomes. Incentives will vary by context and constituency group. Formal institutions tend to pursue EBM to the degree that it supports their mandate, rewards their employees, raises their prestige, and reduces costs (Lowry et al., 2005). With proper incentives and assurances, most resource users are interested in sustaining their employment, which is dependent on an intact ecosystem. Natural and social scientists are increasingly interested in engaging in EBM programs but will require assurances they are allowed to engage in objective research. Donors will require consistent and measurable progress toward stated goals.

Tangible economic, social, and ecological benefits are necessary to sustain resource user commitment to EBM at the local level (Christie & White, 2007; Pollnac & Pomeroy, 2005). This is especially a critical requirement for tropical contexts where self-regulation in addition to enforcement are necessary (Eisma et al., 2005). Documented and welcomed improvements in ecological conditions and marine organism abundances motivate ongoing sacrifice of short-term gains (Armada et al., 2009; Tissot et al., 2009). The generation of and equitable distribution of economic benefits is a strong predictor of field management success and sustainability (Christie et al., 2009; Christie, 2004; Pollnac & Pomeroy, 2005). Positive social interactions, reduction of conflict, and learning are essential elements of commitment (Lowry et al., 2009; Pietri et al., 2009).

Based on assessments of integrated coastal management in tropical contexts (Olsen & Christie, 2000; Christie et al., 2005), the mainstreaming of EBM in tropical contexts will require a continuous commitment. Given the limited financial resources available within tropical countries, international and ongoing financial and technical support may be necessary into the distant future to assure this continuation of commitment. Creation of mechanisms that allow for ongoing investment and complementary efforts, while not creating dependence on external sources, is a delicate balance (Christie et al., 2005).

The replacement by EBM of previously influential frameworks and approaches, such as community-based planning and integrated coastal management, might be perceived as a natural progression or necessary displacement of outdated frameworks. Discussions with policymakers in the Philippines and Caribbean indicate nervousness that models of EBM that compete with, rather than complement, community-based approaches may undermine those institutions that are committed and experienced in ocean governance (Christie et al., 2007). As EBM garners greater attention and funding, a valid concern has been raised in the Philippines by small- to medium-sized, national NGOs as to whether they will be able to "compete" in the highly internationalized, large-scale arena of EBM. These national NGOs, which have been the engine of change in many tropical contexts, commonly lack access to Northern-based private foundations or bilateral donors, may not have the technical or

research capacity for a data-intensive form of EBM, and may operate from a worldview that does not value ecological/large-scale goals over social/localized goals. Valuing the contribution of national NGOs such as the Coastal Conservation and Education Foundation (Eisma-Osorio et al., 2009) to EBM is essential to contextualizing EBM.

Practical EBM Program Design Principles

While respecting the specifics of each context and case study, particular design principles have emerged from this comparative analysis of EBM efforts.

1. **Developing leadership and raising awareness:** Leaders are essential to the development and adoption of new frameworks and tools. Their presence is directly related (at statistically significant levels) to EBM and MPA success (Christie et al., Lowry et al., Pietri et al., Tissot et al., all 2009). Some individuals are natural leaders, but capacity development supporting individual and institutional leadership is essential to EBM diffusion.

   Formal and informal educational processes create human capital and play critical roles in diffusion of innovation (Pietri et al., 2009; Rogers, 1995). Raising awareness about critical threats to the marine environment and resource-based economies are directly related to commitment to policy reform (Christie et al., 2009; Fanning et al., 2009). In other words, investment in human and institutional capacity development and raising awareness is money well spent if the goal is EBM success and diffusion.
2. **Development of hybrid institutions or novel institutional collaborations:** Successful EBM depends on clearly defined new collaborations between historically isolated institutions and the creation of potent new institutions (Hennessey & Sutinen, 2005; Juda, 1999). This might happen at the international (Cochrane et al., 2009; Fanning et al., 2009), national (Lowry et al., 2009), or subnational levels (all theme issue articles) as appropriate to the problem and program definition. These institutions will be inherently unstable due to their broad mandate and multi-institutional membership. Investment in institutional self-evaluation and attention to inter-institutional policies and incentives to improve effectiveness is money well spent.
3. **Establishment of clear and fair rules with conflict resolution mechanisms:** Commitment is created and sustained by perceived success of early management efforts and perceptions that institutions, norms, and sanctions governing resource access and appropriation are legitimate (Kuperan & Sutinen, 1998; Olsen & Christie, 2000). These conclusions are grounded in multinational comparative studies of common property regimes and detailed empirical analysis of marine EBM (Christie et al., 2009; Pollnac et al., 2001; Ostrom, 1990). Resource allocation is inherently controversial as it entails tradeoffs and winners and losers. While tradeoffs and conflict are unavoidable, few EBM or MPA implementation processes explicitly plan for conflict and encourage conflict resolution (Christie, 2004; Christie & White, 2007). The Hawaii MPA network and the enabling legislation were designed to reduced conflict (Tissot et al., 2009). Measures to prevent undo conflict among resource users include an investment in a participatory and ongoing planning process that is inclusive of all major stakeholders (Lowry et al., 2009). The evolution of *context-appropriate* conflict resolution mechanisms is a good investment because it will increase the likelihood of long-term success.

4. **Experimentation and adaptation:** Success will be hastened if careful experimentation, evaluation, and dissemination of experience are encouraged. As such, EBM programs will benefit if allowed to experiment while guided by clear and ambitious benchmarks of progress. Project FISH has clear biophysical benchmarks, including a 10% increase in fish biomass as well as governance benchmarks that lead to this outcome (Armada et al., 2009). The application of quantitative and biophysical benchmarks is unusual and not present in any of the other case studies considered in this theme issue. To avoid the possibility that programs will focus exclusively on biophysical outcomes, process metrics and social outcomes must be incorporated. The interplay between sociopolitical and biophysical characteristics and consideration of complexity, even in contexts of limited monitoring capacity, is necessary and requires experimentation (Adger, 2000). The EBM donor community should consider developing a portfolio of complementary programs, each testing and evaluating different approaches, to accelerate progress in various contexts and in response to various challenges.

Table 1
EBM evaluative criteria (adapted from Christie et al., 2007, 247)

Process criteria
Planning processes and policies consider local context
Transparent and participatory decision-making processes used for program planning and evaluation
Social and natural science–generated information *and* local knowledge influence planning
The EBM program area and goals defined to consider ecological scale and interactions, while considering governance feasibility (e.g., management areas represent ecological boundaries while considering institutional jurisdictions and capacities)
Planning processes and policies evolve based on monitoring information and experience
Education program developed to raise awareness about ocean conditions, consider tradeoffs, and disseminate lessons among practitioners and appropriate constituencies
Sustained commitment to EBM is fostered
Planning processes consider tradeoffs and establish means to equitably distribute costs and benefits while establishing conflict resolution mechanisms
Output criteria
Reference points for resource extraction (e.g., catch-per-unit-effort or biomass) and environmental integrity (e.g., biodiversity, habitat condition) established at a precautionary level
A suite of management tools, including but not limited to MPAs, employed to address resource and habitat goals
Multi-sectoral planning and implementation organizations, which are responsive to ecological scales, established and supported
Formal legal and policy frameworks established to foster EBM
Human and institutional capacity increased to respond to demands of EBM

5. **Develop program evaluation:** Only with ongoing, objective evaluation will EBM programs adapt and succeed. The initial lack of evaluative metrics for the Coastal Zone Management Act in the United States (Hershman et al., 1999) or tropical ICM (Olsen & Christie, 2000) was a remarkable and glaring oversight not to be repeated for marine EBM. The employment of evaluative frameworks has the potential to encourage blue-print planning. Alternatively, the judicious use of evaluative frameworks that are context relevant and attentive to process *and* outcome can foster clear planning, adaptation, measurable progress, and dissemination of experience.

   Various relevant evaluative guidebooks have emerged (Pomeroy et al., 2004; World Wild Fund (WWF) for Nature Australia, 2002), although an empirically grounded guidebook specifically for tropical EBM practice and evaluation is needed. For the Philippines, evaluative criteria have been offered based on an analysis of emergent ecosystem-based *fisheries* management efforts (Christie et al., 2007). The cases in this theme issue, from around the world and broader than fisheries, suggest a new suite of criteria that overlap and augment the Philippine fisheries list (Table 1). Evaluative criteria reflect both process and output. EBM practitioners and donors may wish to use these as a starting point, but should design and justify their own set of criteria based on their context and program goals. Also, the *means* to attain these goals and the methods used to measure progress will necessarily be context specific and allowed to evolve over time.

Conclusion

This theme issue contains a wealth of information that can serve to improve the likelihood of EBM success in tropical contexts. Findings are based on careful reviews of particular cases and comparative analyses. These case studies suggest that EBM has potential as an organizing framework, but needs to be implemented in a manner that is attentive to critical contextual conditions and governance processes. There is value in continued attention to developing feasible EBM that requires integrated engagement of resource users, policy-makers, practitioners, natural and social scientists, and donors in ongoing evaluation and dissemination activities.

References

Adger, N. 2000. Social and ecological resilience: Are they related? *Progress in Human Geography* 24:347–364.

Armada, N., A. T. White, and P. Christie. 2009. Managing fisheries resources in Danajon Bank, Bohol, Philippines: An ecosystem-based approach. *Coastal Management* 37:308–330.

McLeod, K. L., J. Lubchenco, S. R. Palumbi, and A. A. Rosenberg. 2005. *Scientific Consensus Statement on Marine Ecosystem-Based Management*. Communication Partnership for Science and the Sea. Available at http://compassonline.org/pdf_files/EBM_Consensus_Statement_v12.pdf (accessed March 27, 2009).

Christie, P. 2004. MPAs as biological successes and social failures in Southeast Asia. In *Aquatic protected areas as fisheries management tools: Design, use, and evaluation of these fully protected areas*, ed. J. B. Shipley, 155–164. Bethesda, MD: American Fisheries Society.

Christie, P., and A. T. White. 2007. Best practices for improved governance of coral reef marine protected areas. *Coral Reefs* 26:1047–1056.

Christie, P., A. T. White, and E. Deguit. 2002. Starting point or solution? Community-based marine protected areas in the Philippines. *Journal of Environmental Management* 66:441–454.

Christie, P., K. Lowry, A. T. White, E. G. Oracion, L. Sievanen, R. S. Pomeroy, R. B. Pollnac, J. Patlis, and L. Eisma. 2005. Key findings from a multidisciplinary examination of integrated coastal management process sustainability. *Ocean and Coastal Management* 48:468–483.

Christie, P., D. L. Fluharty, A. T. White, R. L. Eisma-Osorio, and W. Jatulan. 2007. Assessing the feasibility of ecosystem-based fisheries management in tropical contexts. *Marine Policy* 31:239–250.

Christie, P., R. B. Pollnac, E. G. Oracion, A. Sabonsolin, R. Diaz, and D. Pietri. 2009. Back to basics: An empirical study demonstrating the importance of local-level dynamics for the success of tropical marine ecosystem-based management. *Coastal Management* 37:349–373.

Cochrane, K. L., C. J. Augustyn, T. Fairweather, D. Japp, K. Kilongo, J. Iitembu, N. Moroff, J. P. Roux, L. Shannon, B. van Zyl, and F. vaz Velho. 2009. Benguela Current Large Marine Ecosystem—Governance and management for an ecosystem approach to fisheries in the region. *Coastal Management* 37:235–254.

Eisma, R. V., P. Christie, and M. J. Hershman. 2005. Legal issues affecting sustainability of integrated coastal management in the Philippines. *Ocean and Coastal Management* 48:336–359.

Eisma-Osorio, R.-L., R. C. Amolo, A. P. Maypa, A. T. White, P. Christie. 2009. Scaling-up local government initiatives towards ecosystem-based fisheries management in Southeast Cebu Island, Philippines. *Coastal Management* 37:291–307.

Fanning, L., R. Mahon, and P. McConney. 2009. Focusing on living marine resource governance: The Caribbean Large Marine Ecosystem and Adjacent Areas Project. *Coastal Management* 37:219–234.

Fanning, L., R. Mahon, P. McConney, J. Angulo, F. Burrows, B. Chakalall, D. Gil, M. Haughton, S. Heileman, S. Martinez, L. Ostine, A. Oviedo, S. Parsons, T. Phillips, C. Santizo, B. Simmons, and C. Toro. 2007. A large marine ecosystem governance framework. *Marine Policy* 31:434–443.

Fernandes, L., J. Day, A. Lewis, S. Slegers, B. Kerrigan, D. Breen, D. Cameron, B. Jago, J. Hall, D. Lowe, J. Innes, J. Tanzer, V. Chadwich, L. Thompson, K. Gorman, M. Simmons, B. Barnett, K. Sampson, G. De'ath, B. Mapstone, H. Marsh, H. Possingham, I. Ball, T. Ward, K. Dobbs, J. Aumend, D. Slater, and K. Stapleton. 2005. Establishing representative no-take areas in the Great Barrier Reef: Large-scale implementation of theory on marine protected areas. *Conservation Biology* 19:1733–1744.

Food and Agriculture Organization (FAO) Fisheries Department. 2003. *The Ecosystem Approach to Fisheries*. Food and Agricultural Organization of the United Nations, FAO Technical Guidelines for Responsible Fisheries 4(2). Rome.

Francis, R. C., M. A. Hixon, M. E. Clarke, S. A. Murawski, and S. Ralston. 2007. Ten commandments for ecosystem-based fisheries scientists. *Fisheries* 32:217–231.

Halpern, B. S., S. Walbridge, K. A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J. F. Bruno, K. S. Casey, C. Ebert, H. E. Fox, R. Fujita, D. Heinemann, H. S. Lenihan, E. M. P. Madin, M. T. Perry, E. R. Selig, M. Spalding, R. Steneck, and R. Watson. 2008. A global map of human impact on marine ecosystems. *Science* 319:948–952.

Hennessey, T. M., and J. G. Sutinen. Eds. 2005. *Sustaining large marine ecosystems, the human dimension*. Amsterdam: Elsevier Press.

Hershman, M. J., J. W. Good, T. Bernd-Cohen, R. F. Goodwin, V. Lee, and P. Pogue. 1999. The effectiveness of coastal zone management in the United States. *Coastal Management* 27(2–3):113–138.

Juda, L. 1999. Considerations in the development of a functional approach to the governance of large marine ecosystems. *Ocean Development and International Law* 30:89–125.

Kuperan, K., and J. G. Sutinen.1998. Blue water crime: Deterrence, legitimacy, and compliance in fisheries. *Law and Society Review* 32:309–338.

Lowry, G. K., A. T. White, and C. Courtney. 2005. National and local agency roles in integrated coastal management in the Philippines. *Ocean and Coastal Management* 48:314–335.

Lowry, G. K., A. T. White, and P. Christie. 2009. Scaling up to networks of marine protected areas in the Philippines: Biophysical, legal, institutional, and social considerations. *Coastal Management* 37:274–290.

McCay, B. J., and S. Jentoft. 1996. From the bottom up: Participatory issues in fisheries management. *Society and Natural Resources* 9:237–250.

Olsen, S. B., and P. Christie. 2000. What are we learning from tropical coastal management experiences? *Coastal Management* 28:5–18.

Oracion, E. G., M. L. Miller, and P. Christie. 2005. Marine protected areas for whom? Fisheries, tourism, and solidarity in Philippine community. *Ocean and Coastal Management* 48:393–410.

Ostrom, E. 1990. *Governing the commons: The evolution of institutions for collective action*. New York: Cambridge University Press.

Pauly, D., V. Christensen, J. Dalsgaard, R. Froese, and F. Torres Jr. 1998. Fishing down marine food webs. *Science* 279:860–863.

Pietri, D., P. Christie, R. B. Pollnac, R. Diaz, and A. Sabonsolin. 2009. Information diffusion in two marine protected area networks in the Central Visayas Region, Philippines. *Coastal Management* 37:331–348.

Pikitch, E. K., C. Santora, E. A. Babcock, A. Bakun, R. Bonfil, D. O. Conover, P. Dayton, P. Doukakis, D. Fluharty, B. Henemen, E. D. Houde, J. Link, P. A. Livingston, M. Mangel, M. K. McAllister, J. Pope, and K. J. Sainsbury. 2004. Ecosystem-based fishery management. *Science* 305:346–347.

Pollnac, R. B., B. R. Crawford, and M. L. G. Gorospe. 2001. Discovering factors influencing the success of community-based marine protected areas in the Visayas, Philippines. *Ocean and Coastal Management* 44:683–710.

Pollnac, R. B., and R. S. Pomeroy. 2005. Factors affecting the long-term sustainability of integrated coastal management projects in the Philippines and Indonesia. *Ocean and Coastal Management* 48:233–251.

Pomeroy, R. S., J. E. Parks, and L. M. Watson. 2004. *How is Your MPA Doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness*. IUCN, Gland, Switzerland.

Rogers, E. M. 1995. *Diffusion of innovation, 4th ed*. New York: Simon and Schuster.

Tissot, B. N., W. J. Walsh, and M. A. Hixon. 2009. Hawaiian Islands marine ecosystem case study: Ecosystem- and community-based management in Hawaii. *Coastal Management* 37:255–273.

World Bank. 2006. *Scaling Up Marine Management: The Role of Marine Protected Areas*. World Bank report # 36635-GLB. Washington, D.C. 100 pp. Available at http://www.worldbank.org/icm

World Wild Fund (WWF) for Nature Australia. 2002. *Policy Proposals and Operations Guidance for Ecosystem-Based Management of Marine Capture Fisheries. Sydney Australia*. Compiled by Trevor Ward, Diane Tarte, Eddie Hegerl, and Katherine Short. Edited by Veronica Thorp. Available at www.wwf.org.au