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The way forward with ecosystem-based management in tropical contexts: Reconciling with existing management systems

Shankar Aswani [a,*], Patrick Christie [b,*], Nyawira A. Muthiga [c], Robin Mahon [d], Jurgenne H. Primavera [e], Lori A. Cramer [f], Edward B. Barbier [g], Elise F. Granek [h], Chris J. Kennedy [i], Eric Wolanski [j], Sally Hacker [k]

[a] Department of Anthropology and Interdepartmental Graduate Program in Marine Science, University of California, Santa Barbara, CA 93106-3210, USA
[b] School of Marine Affairs and Jackson School of International Studies, 3707 Brooklyn Ave NE, University of Washington, Seattle, WA 98105-6715, USA
[c] Marine Program, Wildlife Conservation Society, 2300 Southern Blvd., Bronx, NY 10460, USA
[d] Centre for Resource Management and Environmental Studies (CERMES), University of the West Indies, Cave Hill Campus, St. Michael, Barbados
[e] Aquaculture Department, Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, Philippines
[f] Department of Sociology, Oregon State University, Corvallis, OR 97331, USA
[g] Department of Economics & Finance, University of Wyoming, Laramie, WY 82071, USA
[h] Environmental Science and Management, Portland State University, Portland, OR 97201, USA
[i] Department of Economics and Finance, Dept. 3985, University of Wyoming, WY, USA
[j] Marine and Tropical Biology, Australian Centre for Tropical Freshwater Research, James Cook University of North Queensland, Townsville, Q. 4811, Australia
[k] Oregon State University, Department of Zoology, Corvallis, OR 97331, USA

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ABSTRACT

This paper discusses some of the challenges and opportunities that can arise when implementing ecosystem-based management (EBM) in tropical nations. EBM creates a new series of challenges, problems, and opportunities that must be considered in light of existing governance and management frameworks in a local context. The paper presents five case studies from different parts of the tropical world, including Oceania, insular and continental Southeast Asia, East Africa, and the Caribbean, which illustrate that the implementation of EBM in watershed and marine ecosystems offers a new series of challenges and opportunities for its inclusion with existing forms of environmental governance and management. The paper suggests that EBM is best thought of as an expansion of customary management (CM) and integrated coastal management (ICM), rather than a paradigm shift, and that it has certain benefits that are worth integrating into existing systems when possible. The paper concludes that the cultural and institutional context of CM as well as the experience, technical skills, and legal basis that serve ICM programs are logical platforms from which to build EBM programs. Some guidelines for creating hybrid management regimes are suggested. In sum, declining marine species and ecosystems require urgent action, necessitating utilization of existing paradigms such as ICM and CM as a foundation for building EBM.

1. Introduction

In the last decade, ecosystem-based management (EBM) has emerged as a leading paradigm for fisheries and coastal zone management in developed countries [1–5], and interest in EBM is gradually growing in developing nations [6–8]. In its most basic form, EBM entails the management of a particular ecosystem's structure and function to sustain and foster ecosystem services for human society. It differs from most fisheries or environmental policies, which tend to focus on single species or habitats, in that the interconnectedness of ecological, social, and economic parameters for developing place-based management of an ecosystem is explicitly recognized [9]. Note, however, that EBM is not a universal approach and that various agencies in developed and developing nations are experimenting with different ecosystem-management approaches [10,11].

For all its promise, EBM has rarely been implemented successfully, and even when EBM is ecologically and institutionally attainable, multiple problems can arise from competing interests among stakeholders, undeveloped or inappropriate governance structures, poor science, or lack of political will [1,12]. Furthermore, centralized state-sponsored EBM plans often focus on protecting biodiversity, which, while important for sustaining and fostering ecological services [13], are not a priority in many developing nations. Decisions as to how to manage coastal

* Corresponding first authors.
E-mail addresses: aswani@anth.ucsb.edu (S. Aswani), patrickc@u.washington.edu (P. Christie).

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ecosystems often also ignore important factors that should determine which areas to protect, such as the spatial and temporal variability in key ecosystem services [14,15]. Despite the socioeconomic and scientific uncertainties surrounding EBM, numerous researchers and policy makers have advocated for state-sponsored or NGO-driven top-down approaches to its implementation [16,17] as if there had not been any management system in place prior to the introduction of EBM. At the same time, many developing nations have spent decades working to implement integrated coastal management (ICM) plans [18,19], and in other places, particularly in Oceania, systems of customary management (CM) still prevail locally [20,21]. Local governments and stakeholders, therefore, may be reluctant to accept central government schemes that do not recognize local governance institutions and practices, and which may not be designed for management at ecological and socially relevant scales [6]. For this reason, it is important to understand the benefits and costs of advocating EBM in countries where existing management plans are actively practiced.

This paper discusses some of the challenges and opportunities that can arise when implementing EBM in tropical nations and asks the following questions. (1) What are the differences and similarities between EBM and existing management practices in some example tropical nations? (2) What are the social, political, and economic consequences of incorporating EBM into existing ICM or CM systems? (3) In what ways can EBM be incorporated into existing management practices to increase the success of sustaining these systems? And (4) what specific management practices should be considered when incorporating EBM into existing management systems?

By asking these questions, this paper does not dismiss the importance of EBM for sustaining the resilience of watershed and marine ecosystems, but it suggests that more attention should be paid to local political, socioeconomic, and governance realities in its conceptualization and implementation. EBM creates a new series of challenges, problems, and opportunities that must be considered in light of existing governance and management frameworks in a local context. To illustrate these concerns and possibilities, the paper presents five case studies from different parts of the tropical world, including Oceania, insular and continental Southeast Asia, East Africa, and the Caribbean, which represent different situations for which incorporation of EBM within existing governance institutions will require thoughtful planning and implementation.

1.1. Incorporating EBM into ICM and CM schemes

As stated by McLeod and Leslie [3:5], "it is important to note that the concept of ecosystem-based management is grounded in the idea that ultimately we are managing people's influences on ecosystems, not ecosystems themselves." When considering long-term ecosystem-management goals, it is necessary to understand local social and ecological knowledge systems—which have evolved unique ecological, cultural, and social connections to origin of place. Such knowledge systems, whether developed through CM or through adoption of ICM principles, offer examples in which non-local management goals can be commensurate with local knowledge and needs. This begs the question: why implement EBM in places where functional forms of CM already exist and/or where ICM plans are being developed or are already in place? One answer to this question is that because EBM is in principle holistic—i.e., it recognizes the interconnectedness of ecological, social, and economic parameters for developing ecosystem place-based management—in similar ways to CM and ICM, and because EBM offers a wide array of management options, it offers ample opportunities for combination with existing management systems. The challenge in incorporating EBM into the existing frameworks is to work toward creating hybrid plans rather than replacing one with another.

A first step toward determining an appropriate approach is to study the *historical trajectory* of a country's coastal and watershed management programs in all their dimensions (e.g., political, socioeconomic, scientific, governance, laws, etc.) for their potential integration with EBM objectives and plans. Practically speaking, hybrid programs that operate at the local scale are likely to be more successful on the ground than command-and-control state-sponsored EBM plans [6]. The characteristics of CM and state-sponsored ICM plans are briefly discussed before presenting the case studies.

Forms of CM, which are still common in Oceania and in other parts of the world, provide an important institutional context for their hybridization with EBM [22]. Customary governance and management systems are cultural and historical practices that have evolved to regulate the use of, access to, and transfer of resources locally, and they are informed by indigenous ecological knowledge and embedded in customary land and sea-tenure institutions [23:202]. For instance, forms of marine territoriality, such as common property rights-based systems, are arrangements in which stakeholders enact resource access and use restrictions, gear restrictions, minimum size and catch limits, protection of breeding aggregations, and the establishment of temporal or permanent marine closures [20,21,24], all of which are strategies at the core of EBM. It is important to remember, however, that as noted above CM emerged as a method for locals to manage ecological goods and services for human benefit and well-being through various socially embedded management techniques (which may or may not be successful in strictly ecological or biodiversity conservation terms). In addition, while CM governance includes watershed areas too, it has been unsuccessful at watershed-based management and controlling concomitant impacts on adjacent coastal ecosystems across the Pacific region today (e.g., [25]). This can be attributed to modern capital investment pressures such as logging, industrial agricultural plantations, and mining activities, which are beyond the scope of CM.

In mapping these local institutions and their historical trajectories, a wealth of information has been gathered over the past decades about how different socioeconomic, demographic, and political variables affect human territorial strategies and how such influences determine forms of governance in informal customary rights-based fishery-management institutions (e.g., [20,21]). In fact, mounting evidence is showing that localized and largely community-oriented, rights-based fishery-management systems, albeit context dependent, can sustain biological resources and be successfully adapted to modern marine environmental management such as EBM [26–29]. The theoretical and practical insights from these studies increasingly suggest that customary practices actually display many of the core principles of EBM, including protection of ecosystem structure and processes, focus on placed-based socio-ecological processes, recognizing interconnectivity within and between ecological systems, and integrating human socioeconomic and political processes [9].

ICM is a widely practiced integrated management framework [18,30,31] which is a precursor to EBM. ICM can be defined as: "a process by which rational decisions are made concerning the conservation and sustainable use of coastal and ocean resources and space. The process is designed to overcome the fragmentation inherent in single-sector management approaches … in the splits in jurisdiction among different levels of government, and in the land-water interface" [32:1]. ICM and EBM share related goals and histories. Both frameworks emphasize a systematic approach to sustainable resource use and the balance of

biodiversity conservation and human resource needs. They have emerged from distinct disciplinary traditions, with ICM emerging primarily from planning and social science disciplines and EBM emerging from natural science disciplines [33]. Thus, the experience, technical skills, and legal basis that serve ICM programs are a logical platform from which to build EBM. The EBM framework is best thought of as an expansion and refinement of ICM, rather than as a true paradigm shift, although this linkage is rarely made in technical guides [3] or in advocacy documents [9]. In the next section, case studies from five tropical countries are explored to examine a suite of situations for which incorporation of EBM within existing governance institutions will require variable approaches and thoughtful planning and implementation, without reinventing the process.

2. Case studies

2.1. Oceania

Studies of Oceania's CM have overwhelmingly shown that indigenous institutions are diverse and dynamic and have emerged from an amalgamation of traditional and imported practices [34,35]. Generally, entitlements to sea space are not only characterized by rights to geographical space but can also encompass rights to specific habitats, technologies, and species, or a combination of these. CM, therefore, overlaps with EBM in many ways. First, indigenous people in Oceania conceptualize their territorial estates holistically—i.e., sea and land space exist as a continuum, and indigenous conceptualization of territorial estates do not dissociate these realms as Westerners do [36]. Classical examples of indigenous territorial subdivisions expanding from mountaintops to the reefs and beyond include the Hawaiian *ahupua'a* [37], the Fijian *vanua* [38], and the Marovo *puava* [39]. This indigenous territorial conceptualization corresponds with one of EBM's core principles, which emphasizes the interconnectivity between and within terrestrial and marine ecosystems. The indigenous environmental conceptualization differs, however, in that it is embedded in indigenous socio-cultural and religious practices in a way that EBM is not in Western society, and this presents some challenges in reconciling these distinct world views.

Second, many Pacific Islanders have exclusivity/excludability rights over their states, and this allows for the implementation of key EBM management tools, particularly *limiting effort* through a number of management strategies (e.g., taboo sites or Marine Protected Areas in Western terms). Indigenous tenure rights identify particular users as having exclusive rights over resources and the ability to exclude non-members from accessing and using them. Rights of inclusiveness are distinguished via a number of socio-cultural rules based on birth (primary rights), marriage and residence (secondary rights), and the direct transfer of rights by traditional authorities (e.g., usufruct rights). Entitlements, in any of these forms, allow users access to a benefit stream while excluding non-members. The degree to which entitlement holders can exercise their territorial rights to exclude interlopers and punish inclusive members varies from island to island and is often contingent upon the strength of traditional self-governance, population pressure, fishery commercialization, and a country's legal recognition of customary sea tenure, among other things [34]. Key here is that exclusive rights afford stakeholders the capacity to institute spatial, temporal, gear, effort, species, and catch restrictions [23], or tools that are fundamental in ecosystem management such as EBM. Inclusive stakeholders, therefore, can (1) protect vulnerable species and habitats (i.e., biodiversity and ecosystem function), and (2) protect susceptible life history stages (i.e. spawning and nursery grounds). In sum, CM, presumably like EBM, can result in the protection of ecosystem structure and function, and it is place-based, thus allowing stakeholders to restrict human activities that are detrimental to a local ecosystem.

Finally, CM entails not only ownership and use control of resources but also a set of practices and perceptions that are embedded in the whole indigenous socio-cultural, economic, and political systems. This socio-ecological system, as suggested by Berkes [40:17–18], therefore, nests: (1) indigenous ecological knowledge of plants, animals, and the land- and seascape; (2) a resource-management system in which indigenous ecological knowledge is put into practice; (3) a set of social institutions such as customary sea tenure, which sets the codes of social relationships between resource users and managers; and (4) a worldview that shapes environmental perceptions and gives meaning to the observed natural environment. The success of this integral system, in turn, is shaped by *adaptive management*, or the capacity of the system to change when faced by new social and environmental circumstances, and *social learning*, or when people learn about environmental uncertainty and feed this knowledge back into the management system.

In sum, even though CM and EBM have different origins—one born from scientific managerialism and the other from adaptive socio-ecological and historical processes—their conceptual and operational principles, as illustrated above, have much in common. Thus, the potential for cross-fertilization between traditional and modern coastal-management systems seems significant. However, it is imperative that any adoption of EBM into CM be done with the recognition of the governance and management mechanisms at various spatial and temporal scales that result in positive institutional outcomes in terms of environmental sustainability, social equity, and institutional endurance.

2.2. Insular Southeast Asia (Philippines)

The current practice of Philippine marine and coastal management directly reflects the historic experience of the country. It is likely that CM existed prior to the influences of colonialism and dictatorship, especially considering the country's proximity to Palau and other societies where complex CM and traditional knowledge remain [21]. Hundreds of years of colonization by Spanish, Japanese, and American interests, followed by President Ferdinand Marcos' autocracy, resulted in an almost complete dissolution of CM. But suppression of Filipino civil society spawned an equally strong, and eventually victorious, societal response grounded in "people power"—a term forever associated with the events of 1986 in the Philippines through which Marcos was ousted by widespread civil protest. While not without ongoing problems of widespread corruption or abuse of political power, Philippine civil society, and notably environmental planning, is infused with principles of democracy, participation, and decentralized governance [30,41]. Directly relevant to marine and coastal policy, top-down management systems have largely been replaced with complex, new traditions born of people-power-style governance [42,43]. Community-based coastal management, co-management, and ICM are the main management frameworks that have resulted in a proliferation of hundreds of community-based marine protected areas [42–45]. Fisheries effort control and the closing of marine commons remain ongoing challenges, which are, again, drawing from the previous decades of experience [46]. Another challenge is the donor-driven nature of many ICM projects and the slow adoptions by national governments such that the planning processes frequently are not maintained after external funding and technical support end [18,44,47–49].

Community-based resource management represents a modern recreation of CM regimes that resemble, but are necessarily distinct from, pre-colonial and pre-globalization systems. Today, the central role of community leaders and resource users in creating governance rules, rather than national government or colonial institutions, is similar to CM. The capture of benefits locally, whether through increased fish yields or ecotourism, similarly encourages buy-in and sustains community-based resource management [50]. Communities have re-asserted their authority over resource use and marine spaces [44,46].

Integrated coastal management and community-based MPAs have been the primary framework and management tool, respectively, that have led to the new marine governance system. EBM has recently been introduced into this dynamic environment, and its proponents are encouraging a more thorough consideration of ecosystem function and thresholds [12,51]. The decentralized governance context and commitment to ICM could spawn local commitment and support for EBM efforts, but only if these EBM efforts are scaled and designed to consider governance context. As such, EBM in the Philippines (and much of the tropics) must balance the imperative to scale-up management to encompass ocean patterns and biological connections with the expectation for participatory planning. Effective EBM programs will engage institutions at multiple levels of governance, and carefully consider the capacity of institutions to function effectively over large areas and diverse socio-ecological contexts [7,12,46,52,53].

Experiments in marine EBM in the Philippines represent some of the earliest examples in the tropics [46]. Fisheries for Improved Sustainable Harvest (FISH, www.oneocean.org), a USAID-funded initiative was notable in its definition of implementation boundaries, fisheries management plans, and MPA networks in consideration of ecological function and boundaries. While drawing from scientific monitoring efforts, FISH was equally reliant on community-based and decentralized planning approaches developed over decades of experimentation. It merged consideration of ecological/biodiversity preservation with economic need in contexts with high biodiversity and poverty. FISH demonstrated that it is plausible to develop an ambitious, and context-appropriate, example of EBM. Its success depended largely in incremental policy development and careful attention to incentives and governance opportunities.

2.3. Continental Southeast Asia (Thailand)

Integrated coastal zone management, especially of valuable *de facto* open-access resources such as mangrove forests, has a poor record in Thailand. Mangrove forests are owned by the state, but coastal communities are allowed to access and sometimes manage these resources [54–57]. Although the Government of Thailand has frequently endorsed community-based management of coastal areas, in practice the government has been reluctant to devolve control and decision making to local communities. Instead, the government has tried to encourage communities to assume responsibilities for limited management of coastal resources while maintaining that the legal rights over allocation of these resources still resides solely with the state [55]. The result is that, in recent decades, commercial development of mangroves and other coastal resources has taken precedence over local access to and use of these resources. For example, since 1961 Thailand has lost from 1500 to 2000 km^2 of coastal mangroves, or about 50–60% of the original area [58], as a result of commercial developments. Between 1975 and 1996, 50–65% of Thailand's mangroves were lost to shrimp farm conversion alone [59].

The December 2004 Indian Ocean tsunami, however, generated a change in public attitudes toward both mangroves and ICM in the Asia-Pacific region, including Thailand. The United Nations, the World Conservation Union (IUCN) and the UN Development Programme in October 2006 launched a 6-year, $62 million initiative to replant mangroves and rehabilitate other coastal systems as "natural barriers" in the 12 tsunami-hit Indian Ocean countries, including Thailand [60]. The 2004 tsunami also initiated a rethink of ICM in the Asia-Pacific region, emphasizing the need to tackle problems of conflicting resource uses in coastal zones, coastal degradation arising from various activities, the provision of alternative livelihoods to alleviate poverty, and the inclusion of tsunami mitigation in the large framework of climate-change mitigation [61].

Although the post-tsunami change in the attitude toward mangroves and ICM is welcomed, in Thailand this has translated into promoting mangrove afforestation and reforestation over changing the current institutional arrangements to allow for improved community-based management of coastal resources [54]. This is effectively treating the symptoms, not the cause, since focusing solely on replanting projects is not sufficient to reverse the decades-long decline in mangrove forests. Unless local coastal communities have more of a say in the control, use, and protection of mangroves and other coastal resources, current and future restoration projects will fail to have any lasting results. Instead, a new institutional and policy framework that involves local communities more directly in coastal mangrove management could improve the sustainability of mangrove rehabilitation projects, increase community participation in these projects, and enhance overall ICM [54,56,62].

Several studies of replanting mangroves in Thailand illustrate this connection. An analysis of four coastal communities reveals that awareness of community conservation efforts, of community-imposed utilization rules, and of the environmental damages imposed by shrimp farms is a key motivating factor in the decision by male and female members of mangrove-dependent households to participate in replanting activities [63]. Consequently, there may be more willingness to participate in mangrove rehabilitation to prevent shrimp farm expansion and to increase the degree of control the community has over managing the mangroves. Community surveys throughout Thailand have confirmed that, where local villages have been allowed to design and maintain well-defined governance structures over mangroves, forest cover is greater than open-access state forests [56,64]. Management of other coastal resources is also enhanced through the cooperation and improved management by local communities. For example, past attempts to control beach and coastal erosion in Nakhon Si Thammarat province were thwarted by frequent conflicts between local communities, business interests, and the state over different proposed mitigation measures. However, once local communities were consulted in the design process, they became actively involved in the mitigation measures, and a combination of detached nearshore breakwaters and beach nourishment were welcomed by the communities [65].

The lessons learned from these and similar studies of local mangrove replanting and community-based coastal resource management projects should be considered when designing institutions and incentives for improving integrated coastal management generally. The basis for success appears to lie in identifying resources that are important for local livelihoods, allowing communities to exercise autonomous decision making over these resources, identifying the various stakeholders of the resources and monitoring their use; encouraging effective local leadership to apply sanctions and resolve conflicts, and allowing non-governmental organizations to play a facilitating role, especially as a bridge between local communities and the state and scientific advisors [54,56,62].

However, establishing an improved institutional framework is a necessary but not sufficient step in controlling excessive shrimp farm expansion and subsequent mangrove loss. Reforms are needed to reduce the current perverse incentives for excessive mangrove conversion for shrimp farming, especially in Thailand [54,62]. These include eliminating preferential subsidies for the inputs, such as larvae, chemicals, and machinery, used in shrimp farming; ending preferential commercial loans for clearing land and establishing shrimp ponds; employing land auctions and concession fees for the establishment of new farms in the "economic zones" of coastal areas; and finally charging replanting fees for farms that convert mangroves. Reducing the other environmental impacts of shrimp farming in Thailand is also important, including problems of water pollution, the depletion of wild fish stocks for feed, and disease outbreaks within ponds. Improving the sustainability of shrimp aquaculture and controlling the excessive mangrove deforestation caused by the industry are both critical to ensuring participation of local coastal communities in mangrove replanting efforts as well as their cooperation in long-run management of all coastal resources.

Implementing an improved institutional framework and sound policies for management of coastal resources will be essential if EBM is to be successful in Thailand. The key to this success will be ensuring that traditional community-based management objectives are adequately taken into account [56,62]. The 2004 tsunami has re-opened the debate about including local community objectives in integrated coastal zone management [61]. The future of coastal EBM in Thailand depends on ensuring that adequate policy and institutional steps are taken in Thailand to realize such objectives.

2.4. East Africa (Kenya)

Customary coastal management systems have been poorly described on the Kenyan coast. The early peoples of the Kenyan coast included the Cushitic speakers (Orma, Boni, Sanye, and Somali), who were later displaced by the Mijikenda, Pokomo, Taita, and the Swahili Bantu speakers [66]. The coast was subject to several colonial regimes, first the Portuguese (1500–1700), then the Omani Arab Sultanate of Zanzibar (1700–1895), and later the British (1895–1962), each having a distinctive influence on the socioeconomic and socio-cultural character of the province. The colonial period, particularly the slave trade, profoundly interfered with the ability of coastal peoples to develop extensive CM strategies over the settled land and adjacent marine territories—repercussions that are still felt today.

Before the 20th century, Swahili or Bajuni fishers restricted who could enter the fishery, usually limiting access to sons or apprentices of fishers. Clan sponsorship was also required for trading [67]. Fishing, as with other livelihood activities, was managed through a set of Islamic and spiritual beliefs, and leaders (usually older fishers) conducted rituals and enforced regulations at landing beaches, thereby affecting the use of the environment [68]. As other ethnic groups, such as the Digo and Giriama, moved to the coast, trade links with the Swahili and forced labor on Arab *dhows* resulted in the introduction of fishing in these communities. These groups believed in the spirit realm and had sacred areas associated with forests (*Kayas*), beliefs which could have extended to the coast as they were relocated. In general, fishers viewed resources as controlled through the spirit realm and not related to effort, gear, or habitat [69,70].

Customary management in this region has been shaped by colonial and post-colonial interventions. During the British colonial period, fisheries were regulated through the district office whose role included facilitating loans to fishers through the African district councils. This led to many fisher groups forming cooperatives to gain access to the loans. However, these had a high default rate due to a lack of local understanding of interest rates. The colonial office also regulated when and where fishers could fish and provided concessions for collection of fisheries products such as bêche-de-mer (sea cucumber). Much of the control was focused on regulating the movement of people (e.g., during World War I fishing at night was banned) rather than managing the fishery because it was believed that marine resources were plentiful.

Coastal management during British colonial times mainly focused on trade (maritime and slave), plantations, and control of coastal land. A land adjudication process was carried out in the 1920s that led to the freezing of land ownership into surveyed plots and registered records. Only a few Arabs, Swahili, and plantation owners participated in this division of land, which led to the majority of the coastal population becoming squatters [71]. The relationship between the coastal community at large and the government thus evolved in an atmosphere of victimization first from the Arabs and Europeans, and later from people from the "hinterland," popularly referred to as "upcountry" people, with each wave coming with its own brand and level of discrimination [71]. Therefore, there has been a historical sense of marginalization, and the current political atmosphere is based on the loss of land, jobs, and other coastal resources, and on the continued poor performance of the coastal communities in many social indicators such as health, education, and the economy.

The government institutions including the Fisheries and Forestry departments (responsible for fisheries and mangroves) and the Kenya Wildlife Service (responsible for MPAs) that were established after independence continued to manage coastal resources with a sectoral top-down approach. This caused conflicts especially in the establishment of MPAs and the enforcement of fishing regulations [70,72,73]. The Coast Development Authority (CDA) was established to address the slow pace of development on the Kenyan coast and undertook the responsibility of piloting coastal zone management in 1994 [70]. These pilot projects were centered on the urbanized, highly developed tourist beaches of Bamburi-Shanzu and Diani-Chale. A national multi-stakeholder coastal-management committee was established, and several projects targeted at local communities were implemented [74]. Although these pilot projects served to demonstrate how integrated coastal zone management (ICZM) works, legislation to institutionalize ICZM did not exist until 2000, when the Environmental Management Coordination Act (EMCA) was gazetted. The law led to the establishment of the National Environmental Management Authority (NEMA), which coordinated the consultative process and the drafting of an ICM policy and regulations.

The post-colonial period was a dynamic period that led to many political and socioeconomic changes, and although some of these changes were beneficial to the nation as a whole, the coastal communities continued to remain marginalized due to the lack of resources and skills to take advantage of growing tourism and heavy industries developing at the coast; this struggle culminated in the Likoni clashes of 1997 [75]. The high dependence of the Kenyan population on natural resources, periodic ethnic clashes, and land conflicts led the Kenyan government to recognize the importance of incorporating community interests in natural resource management. Key policies, including the draft Wildlife, Forestry and ICZM, and the National Oceans and Fisheries Policy of 2006, emphasize the importance of co-management and community empowerment for resource management [72]. In addition, the efficiency of government institutions has improved with the introduction of performance contracting and planning mechanisms that are more coordinated and harmonized across

sectors [76]. For instance, many management plans of MPAs (Kisite/Mpunguti), fisheries (prawn fishery), and conservation action plans (Sea Turtle Strategy) were drafted through a process of stakeholder consultations and endorsement using the principles of ICM. In addition, the new Beach Management Unit (BMU) regulation that was gazetted in 2005 empowers fisher communities at the landing beach to manage their fishing grounds, including area and gear management and fish-trading activities [77].

The concept of EBM, although stated as a guiding principle in some policies, has not been tested in Kenya, and the national institutions lack the scientific and administrative capacity to manage resources within an EBM framework. However, some elements of EBM such as place-based management, integration of environmental and societal concerns, and the incorporation of science in management are in use through various institutions. Today, marine resources are managed at three main levels: the national level (NEMA, the fisheries and forestry departments and the KWS), the municipal/county level (seven districts), and the BMU level ($\sim$70 units). National institutions have been exposed to the principles of ICZM, and although there are jurisdictional conflicts between these departments, there is more coordination at the project level, including discussions of joint management and strengthening of collaboration through MOUs. The coordination between national institutions and counties is more problematic, with less awareness and use of integrated management concepts by the coastal counties. This has resulted in poorly managed urban development with consequent pressures on marine ecosystems and resources. At the community level, the BMU movement is slowly increasing the capacity of local communities to manage resources within their fishing grounds. The process of establishing BMUs requires a coordinated and collaborative process that has served to increase dialog between fisher communities, government institutions and other stakeholders. Finally, Kenya enacted a new constitution in August 2010 that largely devolves power and shares government resources at the county level. How the three levels of management of marine resources will interact is currently being formulated. However, the new constitution makes reference to sustainable exploitation, conservation of natural resources, and equitable sharing of accrued benefits, all principles of ICM and EBM.

2.5. Caribbean

Most indigenous peoples of the Caribbean were eliminated from islands and mainland coastal areas early in the colonization process. Any traditional natural resource management practices that may have been present among these peoples would have been lost at that time. There may be some exceptions along the less habitable coastal areas of South and Central America, where some indigenous populations persist. Notable among these are the Kuna Indians of Panama, who have autonomy over coastal management and have developed their own approaches to coastal and marine management with outside assistance. However, for the most part there is little information about traditional management practices among indigenous people in the Caribbean.

Traditional management practices in the region must have either been brought there by the new inhabitants or have developed since they came. The population that followed colonization came from parts of the world where coastal and marine habitats are likely very different from those in the Caribbean—Europe, West Africa, and later India. Any traditional management practices that may have existed in these regions were probably not directly applicable in the new environment. Indeed, many West African slaves are known to have come from inland, upriver areas and thus would have had little familiarity with the sea. Furthermore, the conditions of slavery under which most of the new population lived would not have allowed the autonomy necessary to develop traditional management practices. Consequently, it is likely that any such practices that do occur have evolved locally and relatively recently, over the last 150–200 years, rather than being transplanted [78].

Traditional management has not been much studied in the Caribbean region, but there are diverse examples of emerging self-organization in management or at least tenure. Further investigation may reveal a much greater prevalence and variety of nascent instances of self-management. These must be taken into consideration as the current reality whenever attempts are made to introduce improved management, including EBM. On the west coast of Grenada, there has emerged a complex set of rules among beach seine operators. These are aimed largely at reducing conflict and promoting efficiency. The rules determine who has right of way when a school of fish is known to be at one of the many hauls [79]. Already these rules are being eroded by motorized roving fishers from the city. In Barbados, sea egg fishers were found to engage in a number of "accepted practices" amounting to husbandry and responsible fishing [80]. These did not, however, prevent overharvesting and collapse of the fishery. In the southeastern Caribbean, local knowledge of the relationship between large pelagic fishes and oceanography was found to be accurate and well established among fishers from Barbados, St. Vincent, and Tobago [81]. In Jamaica, trap fishers are known to have divided the inshore reef areas into a series of territories along the north coast, presumably as a means of avoiding conflict.

Today most natural resource management in the Caribbean region is approached in a top-down, government-led mode [82]. The institutional arrangements have mostly followed those of the various countries that colonized the region. These include the conventional approaches to fisheries and coastal zone management (e.g., MPAs). They are not entirely a carryover from colonial times; in many cases they are sustained by the fact that even now most managers are trained in former colonial nations and return to try and implement what they have learned. These conventional approaches have not worked, and as in other parts of the world new approaches are being considered and even tried. Co-management approaches are not well developed in the Caribbean and comprise mainly consultative arrangements. Pomeroy et al. [83] note that external agents are needed to promote capacity building for all stakeholders and to move the co-management process toward shared and delegated responsibility for management.

The aim of moving the co-management process forward is supported in principle by most authorities who have responsibility for coastal and marine management, but in many cases these authorities lack the capacity, from vision to practice, to provide support. Consequently, movement toward increased stakeholder involvement and subsequent increased use of stakeholder knowledge is slow. However, notable efforts in many countries and at the regional level include the initiative to establish a regional network of fisher organizations to give fishers voice at all institutional levels from local to national and regional [84].

In sum, nascent local forms of CM as well as current government initiatives offer some opportunities for hybridization with other approaches to marine resource management such as EBM. The recognition and pursuit of these opportunities will require changes in the way that fisheries administrations pursue management. Currently, fisheries administrations are deeply rooted in the conventional paradigm that focuses on the resource. Consequently, structures and skills are strongly oriented toward the natural sciences. As pointed out by Mahon and McConney [85] and Mahon et al. [86], these administrations will need to reorient toward including more staff with social science-based and

facilitatory skills who can recognize customary practices and adapt or integrate them into current and emerging management programs. These include skills that promote self-organization of resource users so that they are better able to develop and implement the nascent approaches to resource management that are prevalent in many countries.

3. Discussion

The case studies presented in this paper illustrate that the implementation of EBM in marine ecosystems offers a new series of challenges and opportunities for its inclusion with existing forms of marine environmental governance and management in a local context. The paper suggests that although EBM is best thought of as an expansion of CM and ICM, rather than a paradigm shift, it has certain benefits that are worth integrating into existing systems when possible. The cultural and institutional context of CM as well as the experience, technical skills, and legal basis that serve ICM programs are logical platforms from which to build EBM programs. Surprisingly, as suggested by the case studies, the linkage between CM, ICM, and EBM is rarely made by policy makers and in technical guides for EBM, and, therefore, there is an increasing need to mutually articulate these forms of marine management—and there are critically important reasons for this.

First, developing nations have spent decades developing ICM plans, and in many places such as Oceania CM systems are still widespread and functional. Consequently, local governments and stakeholders may not be interested in replacing existing frameworks and implementing new schemes that are not commensurate with local efforts to manage marine ecosystems, and that are not designed for managing resources at ecologically and socially relevant scales. Consider the example in which Western agencies (e.g., USAID) have spent decades working in places like the Philippines, Indonesia, Sri Lanka, and Ecuador to integrate ICM into local governance systems [30]. The momentum generated behind ICM efforts and the legitimacy of CM systems should be harnessed and enhanced, not replaced or changed dramatically.

Second, given the global rate of environmental degradation, tropical nations cannot afford to experiment with new approaches to coastal management unless they are properly hybridized with local practices both at the community and government levels. Top-down and science-dependent EBM in its purest form is likely not an effective way to manage coastal resources given the costs related to research, implementation, and enforcement, and given how local communities are already struggling to manage their marine resources [87]. An adapted approach to EBM that focuses on indigenous knowledge may be a more appropriate and cost-effective goal. Furthermore, focusing on biodiversity conservation and management alone are not effective strategies given that developing nations are hampered by structural constraints and their concerns are centered on human socioeconomic welfare, not necessarily conservation [88].

Finally, in view of rapid human population growth, watersheds are increasingly being developed, and this invariably results in the most serious stresses to coastal marine ecosystems. For coral reefs, the result is invariably disastrous because watershed discharges affect the key parameters of water and substrate quality, which in turn control the success or failure of coral reproduction and recruitment [89,90]. Therefore, any form of marine management, particularly EBM, needs to be extended to the whole watershed and ultimately to other terrestrial ecosystems to ensure the survival of coastal coral reefs. In this respect, any form of EBM cannot neglect the big picture of the watershed; particularly in light of how slowly human behavior and institutions react to developing environmental issues. Thus, to begin protecting watershed ecosystems EBM needs to build on existing institutions.

Fortunately, the cases summarized in this paper strongly suggest that ample opportunities exist for the establishment of context-appropriate EBM that includes watershed and adjacent coastal ecosystems. With the existence of CM in some tropical places (e.g., in most of Oceania) and establishment of ICM in other tropical areas (e.g., Philippines, Sri Lanka, Thailand, Africa, and the Caribbean) [30], a considerable base exists for rapid progress toward EBM if appropriate strategies are employed. This hybridization process should be undertaken quickly because of the rapid degradation of our ocean ecosystems and because there are really no other viable alternatives for holistic and potentially successful management of watershed and marine ecosystems. Researchers should communicate to practitioners, managers, communities, and resource users that EBM is not a new paradigm but rather is based on the best practices of earlier management systems. In doing so, the following guidelines, organized along the easy-to-remember acronym SESAME, which has the potential to open the door to progress, are suggested.

First, any management system (EBM or hybrid) will need to be ***Simple*** and readily understood by policy makers and resource users (who are frequently *de facto* policy makers). Empirical studies show that the success of MPAs and common-pool resource-management regimes [91] are dependent on a clear understanding of rules. Overly complex rules and management boundaries are a recipe for confusion and non-compliance. Priorities should be transparent and threats to ecosystem health should be identified in a way that considers the costs and benefits of management intervention and is informed by local knowledge.

Second, managers need an ***Experimental*** approach—that is, maintaining an attitude of curiosity about local histories, customs, social–ecological interactions, and management options is the hallmark of a seasoned, effective practitioner. Management interventions, designed from this position of curiosity, will necessarily adapt over time as new information is assimilated. Each intervention ought to be conceived as an experiment based on diverse sources of information, which likely will have both anticipated and unanticipated outcomes.

Third, successful management programs need to be ***Strategic*** and evolve from early successes in response to local challenges [30], which may include previous success via CM or ICM. The art of effective management requires a keen ability to listen, synthesize, and create strategic partnerships to solve complex problems. If deemed helpful to improve resource management in any context, the evolution of EBM requires a decadal implementation time horizon. Sustaining initial successes will require long-term investment and institutional support. If this commitment falters before institutions have reached a self-sustaining level of development, it is possible that local resource users and managers will be less likely to extend their trust to future purveyors of management techniques and scientific advice, ultimately eroding the chances of long-term conservation.

Fourth, a standardized approach to EBM (or any management system) will fail unless made context ***Appropriate***. The cases presented herein are only the tip of complex understandings based on practical and research experience. Effective ICM and EBM programs are created by teams of people who intimately know what is or is not appropriate for any given context. CM is grounded in millennia of learning and adaptation. The conclusion that methods and logics cannot mechanically be applied globally has been re-learned over the course of decades of development, health, and environmental management planning.

Fifth, an EBM approach needs to be ***Multi-disciplinary***. EBM has emerged from particular, and not wholly balanced, disciplinary roots. As a framework that has its strongest grounding in the

natural sciences, and not social science or planning disciplines, it has the potential to ignore critical challenges and opportunities. As highlighted above, the needs and interests of people living in tropical contexts emphasize immediate necessities over long-term perspectives. The importance of environmental integrity, as an underpinning of human societies, is increasingly recognized. But righteous indignation over the loss of biodiversity or unsustainability, no matter how strongly felt by some, is unlikely to resonate with impoverished people or those who work in solidarity with them as policy makers or support personnel.

Finally, ***Evaluation*** programs are necessary [92]. Initial experiments in ICM, conservation, or development did not adequately capture lessons learned [30]. Ongoing, multi-disciplinary evaluation has now been mainstreamed in the most successful programs [46] and is fundamental to success [93]. Such programs allow learning and adaptation, and serve to explain failures and document successes. Relying only on beginning, mid-term, and final evaluations (by external consultants) is inadequate. Evaluative programs are best when they are rigorous *and* inclusive of local resource users and policy makers through participatory monitoring methods.

4. Conclusion

EBM needs to resonate with local cognitive frames of reference (e.g., governance, socioeconomic, and cultural idioms) for its acceptance and successful integration with local systems of management, whether traditional or otherwise. The case studies indicate the importance of incorporating lessons learned from ICM and CM and a commitment to building from these existing management forms that have evolved and been tailored to these contexts. Therefore, communication of EBM should be presented as an adaptation and addition to existing paradigms, be it tribal or modern ICM, rather than as a new paradigm in and of itself. The dominant management paradigm for global marine ecosystems espouses the virtues of EBM. While there is much to gain by incorporating the key elements of EBM, this paper illustrates through these case studies that the best available approach to managing resources in tropical areas may more closely represent a hybridized model, one that expands the successes of CM and ICM.

To be successful, EBM must learn an important lesson from a persistent obstacle that has thwarted many well-intentioned ICM initiatives in the past. In many developing countries, the current legal framework and formal institutional structures governing coastal areas do not allow local coastal communities any legal rights to establish and enforce control over the coastal resources on which the livelihoods of these communities depend. Establishing an improved institutional framework does not necessarily require transferring full ownership of coastal resources to local communities, but could involve co-management by governments and local communities that would allow, for example, the participation of the communities in decisions concerning the long-term management, including development and utilization, of these resources on which their livelihoods depend. Rather than deconstructing CM practices, the goals of EBM may be easily and cost-effectively pursued by strengthening the often-informal institutions governing user access to resources. By creating a legal support system for CM and community-based resource management, torts against large-scale commercial interlopers can be pursued. Additionally, as coastal populations expand, it is possible that informal CM and community-based institutions could be compromised. By supporting or formalizing these institutions, the positive conservation incentives associated with a sense of resource ownership (e.g., habitat protection, spawning-stock protection, etc.) can be maintained without much financial investment by governments.

Hybridized programs may not be the panacea for all marine ecosystem-management problems globally. However, there exists a moral and ecological imperative for moving quickly to slow the degradation of our ocean ecosystems. While an academic debate may and should ensue regarding new paradigms and models, it is important not to lose sight of practical "lessons learned" and alternative models that can and should be adapted. It is important to communicate to practitioners, managers, communities, and resource users that EBM is not a new paradigm but rather is built upon the best practices of earlier management systems. Existing management practices, including local traditional/hybrid systems and ICM practices in developing nations, should be seen as a subset of EBM rather than needing a reinvention of the wheel. In sum, the cultural and institutional context of CM as well as the experience, technical skills, and legal basis that serve ICM programs are logical platforms from which to build EBM programs. Declining marine species and ecosystems require urgent action, necessitating utilization of existing paradigms such as ICM and CM as a foundation for building EBM.

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