Duke University/Brown University

Fiji's Vatu-i-Ra and Cakau Levu Reefs Seascape Project

A Case Study of Marine Ecosystem-Based Management

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About the Study

Citing the declining health of the world's oceans, policymakers, managers and scientists have called for expanded efforts at ecosystem-based management in marine and coastal systems (MEBM). In many places in North America and around the world, collaborative, adaptive planning and management processes have developed to enable scientists, managers and stakeholders to move beyond management of single species and single user groups to incorporate complexity, consider larger scales and longer timeframes, and incorporate measures of ecosystem integrity.

The David and Lucile Packard Foundation invested in the development of science to support management in a number of initiatives in California, Mexico and the Western Pacific. The Foundation also recognized the need to capture the lessons from the experiences at these initiatives as well as the many other places that are trying to move toward an ecosystem-based management approach. Accordingly, they provided grant support to research teams at the University of Michigan and Brown and Duke Universities to develop rich case studies of MEBM, documenting the approaches and their accomplishments, and analyzing the challenges the efforts faced and the factors that have promoted progress. Ultimately, the projects seek to provide lessons that can improve the practice of MEBM.

This document contains one of the complete case studies. Others can be accessed through the project website, which can be reached at: *www.snre.umich.edu/ecomgt/mebm*.

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Introduction

Fiji is an island archipelago encompassing more than 300 islands and 1.3 million km^2 of exclusive economic zone in the southern Pacific Ocean. The overwhelming majority of Fiji's growing population lives on or near the coast on two islands that comprise the majority of the country's total land area: Viti Levu and Vanua Levu (Howorth 2006; Lane 2008). Fiji's Vatu-i-Ra and Cakau Levu reefs, located between Viti Levu and Vanua Levu, and in the northern section of Vanua Levu, respectively, are seen by many as having "immense natural value" (Nair et al. Undated). Cakau Levu is the third longest barrier reef in the world and the Vatu-i-Ra passage contains additional healthy barrier reefs (Nair et al. Undated). These areas are considered repositories of globally significant biodiversity and nationally important tourism activities (Nair et al undated).

In 2004, the Wildlife Conservation Society-Fiji (WCS), World Wildlife Fund-South Pacific Program, and Wetlands International-Oceania (WI-O), and communities of Macuata and Kubulau concluded traditional resource management practices, government policies and other environmental management initiatives could not adequately protect the ecosystems encompassing Vatu-i-Ra and Cakau Levu in the face of intensive coastal farming and forestry practices and growing demand for fish. In 2005, in response to these perceived ecosystem threats, the foregoing groups initiated implementation of an ecosystem-based management project to conserve and manage these areas. The ultimate goal of this project, termed Fiji's Vatu-i-Ra and Cakau Levu Reefs Seascape Project, is to "to preserve the functional integrity of the Vatu-i-Ra and Great Sea Reef Seascapes to sustain biodiversity, fisheries and intact linkages between adjacent systems, thereby enhancing ecosystem-scale resilience to disturbance from land and sea and improving quality and abundance of marine resources for Fiji's people and economy" (Manager).

Funded primarily by The David and Lucile Packard Foundation and the Gordon and Betty Moore Foundation, Fiji's Vatu-i-Ra and Cakau Levu Reefs Seascape Project was implemented in two phases over the four-year period 2005-2009. Though the EBM project as a cohesive unit of partners ended in 2009, EBM is still being implemented at both sites. The EBM strategy in Fiji involves working at the community level to implement science-based networks of marine and terrestrial protected areas. While the vision of the project is at a "seascape scale," the project activities focus on the customary fishing ground or "*qoliqolis*"[1] and associated upland areas of two sites on Vanua Levu that project partners consider ecologically representative of the wider "seascape".

[1] Approximately 410 *qoliqolis* have been formally mapped by the Fijian government (Ledua 1005).

Ecosystem Characteristics and Stressors

The EBM project's activities focus on the customary fishing ground (*qoliqoli*) and associated upland areas of two sites in the northeast and southwest of the island of Vanua Levu, located within the main Fiji islands. These sites include the Cakau Levu reef bordering the province of Macuata and the Vatu-i-Ra channel (also known as the Bligh Waters) bordering the district of Kubulau (Figure 1). Both sites were identified in the Fiji Islands Marine Ecoregion Biodiversity Visioning Workshop, hosted by WWF in 2003, as two of five "globally important" sites in Fiji due to their "uniqueness, endemism and high levels of diversity" (Nair et al. Undated). Project partners see these two areas as "ecologically representative of the wider seascape, with Macuata incorporating a large section of the north-facing Cakau Levu Reef, lagoon and adjacent watershed, and the southerly and westerly-facing Kubulau including a significant portion of the Vatu-i-Ra passage, barrier reef, lagoon and adjacent watershed". As such, partners believe "the results from Kubulau and Macuata will form important case studies that represent the wider seascape area and have potential for application elsewhere in Fiji and the Pacific".

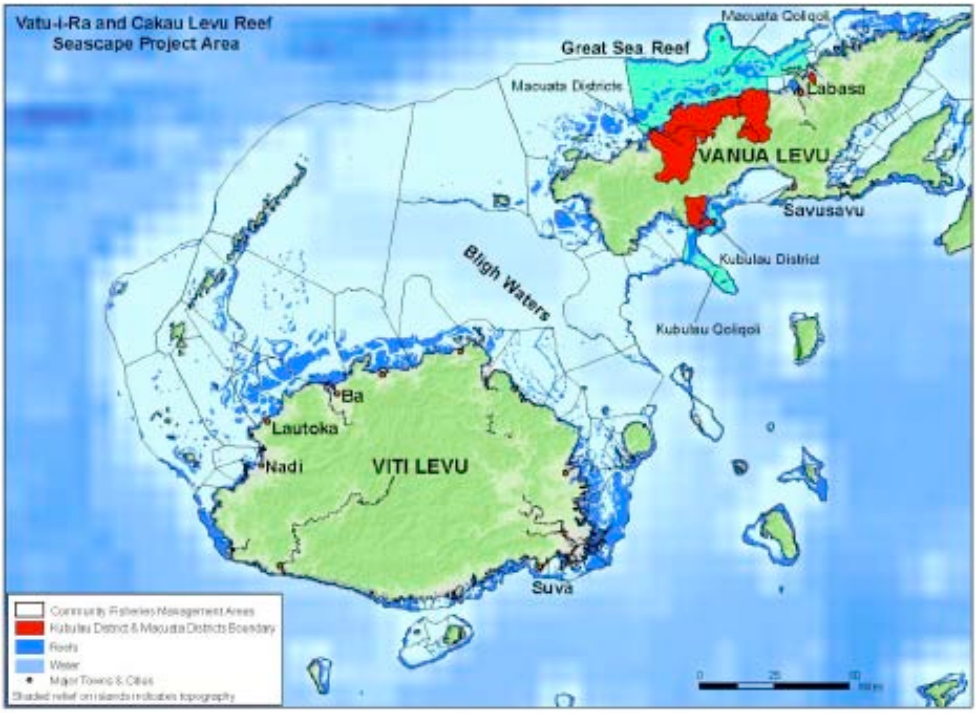

Figure 1. Map of Fiji's two largest islands showing the EBM project sites: land area of districts with traditional fishing rights indicated in red and *qoliqolis* indicated in turquoise (Jupiter et al. 2010).

Macuata Province

The project activities in Macuata are focused in four of twelve districts within the province. These four districts are home to 5,313 people living in 37 villages[2] (Bolabola et al 2006). This population relies heavily on natural resources – including fish from their 1,344 km^2 *qoliqoli* - for basic sustenance, shelter, and livelihood (Packard Report 2007).

Macuata is fringed by the Cakau Levu reef (Great Sea Reef), the third longest continuous barrier reef system in the world (WWF 2004a). Cakau Levu is also the longest and most complex reef system in the Fiji Islands, exposed to many different hydroclimatic and environmental influences (WWF 2004b). The lagoon system bordering the coast of Macuata and Cakau Levu, includes:

> An extensive and complex system of submerged and emergent coral reefs, mangrove and rocky islands, seagrass beds and other marine ecosystems. These systems provide substantial fisheries resources and important geophysical functions of shoreline stabilization and prevention of wave damage. The coastal and island mangroves also act as sediment and pollutant filters for these coastal areas, and provide essential nursery areas for various organisms that inhabit the near shore marine systems. (WWF 2004a)

A biodiversity survey conducted by WWF in 2004 found that "commercially important fish were found in very low numbers and small sizes. Fish important for local subsistence were found in higher numbers, but this varied greatly from site to site" (WWF 2004a). According to project partners, aquatic fauna of upstream Macuata river systems are "highly connected to marine ecosystems with 95% of the fauna using the marine or lower estuarine environment during their lives" and the upland watersheds are modified by land clearance for crops (in particular, sugar cane), settlements and logging (Jenkins and Mailautoka 2010). Also, according to EBM partners, much of the remaining forested area has been logged and is in a disturbed condition (Jenkins and Mailautoka 2010).

Kubulau District

Kubulau is a district of the Bua province in southwest Vanua Levu, Fiji. The total land area of the district is 97.5 km^2, and the associated *qoliqoli* covers 261.6 km^2, stretching from the coastline to the outer edge of the barrier reefs (WCS 2009). The district is made up of of ten villages comprising 50 to 200 people each, with a total population of approximately 1,000 (WCS 2009; Egli et al. 2010). Over 90% of the land in Kubulau is owned by 57 indigenous landowning clans, who also hold rights to the *qoliqoli* extending to the outer edge of the fringing coral reefs. The Kubulau fishing ground includes a diverse range of habitats, and supports a high diversity and abundance of fish (WCS 2009). The main sources of cash income

[2] There are about an equal number of people living in the urban centre of Labasa, in Macuata.

for the seven coastal villages in Kubulau are fishing and copra production, while fishing and farming (cassava, taro, and kava) serve as the main livelihoods for the three inland villages (WCS Unpublished Data 2005). There is also a high dependence on subsistence fishing and farming (WCS Unpublished Data 2005). The most commonly used fishing gear includes nets, fishing lines, spear and snorkel (Cakacaka et al. 2010).

Kubulau borders a significant portion of the Vatu-i-Ra passage and reefs. The strong oceanic currents funneling through the narrow corridor of the Vatu-i-Ra passage promote "high productivity" reefs that are known to rebound quickly from disturbance (Marnane et al. 2003). The Vatu-i-Ra passage together with the Great Sea Reef form two "globally significant ecoregions" identified through expert opinion (WWF 2004a). According to EBM partners, the reefs within the FIME are uniquely resilient to disturbance, distinctive in their biophysical nature, and the most intact reefs in the Fiji Islands.

Marine and Land Tenure

A defining characteristic of Fijian coasts is strong local tenure. Approximately 90% of land in Fiji is owned by customary landowners, who hold land in communal title (Lane 2008). In addition, Fiji's coastal waters and foreshore is:

> Shared under a dual ownership in which the state owns the land beneath the sea while the Fijian tribal groups retain ownership of the customary fishing rights. [. . .] In other words, although Fijians retain ownership of fishing rights, they do not own the seabed, the water column, or the resources therein. In the seabeds up to the Exclusive Economic Zone (EEZ) boundary, the state has sovereign rights. Thus, Fijian tribes' rights are limited to recognized fishing grounds up to and including the reef patches, barrier reefs and reefs fringing the coastal waters and the islands. (Calamia 2003)

The distinction among different types of ownership "has been a source of enormous confusion, irritation, and conflict between local Fijians and the government (Waqairatu 1994; see also Clarke and Jupiter 2010a). This misunderstanding concerning the legal ownership of marine resources has persisted for over 120 years" (Calamia 2003).

Environmental Governance in Fiji

While government in Fiji was designed to implement "command and control" policy, "conditions simply do not exist in Fiji for this kind of government to occur: such an approach would be widely resisted; recognition of customary resource sovereignty prevents it, and the national (and sub-national) politics are characterized by a complex array of inter-organizational networks (operating at different scales), which no sovereign actor can steer or regulate" (Lane 2008). In addition to the foregoing, Lane (2008) identified the following critical governance issues relevant to ecosystem-based management in the coastal environments in Fiji:

(1) There is little integration and coordination in formal government departments, leading to sector-based policy domains of forests, agriculture, environment, etc.

(2) There is an abundance of NGO and donor-based projects and experiments in the domain of coastal and environmental management in Fiji, suggesting that environmental governance is not contained within formal political institutions, and reflecting the absence of a systemic policy regarding coastal environmental use and management.

(3) Transdisciplinary, quality data sets are generally unavailable, which "represents a huge constraint on the ability of government (and others) to adapt to emerging problems or concerns and to design and implement new policies" and there is increased dependence on external NGOs and donor organizations.

(4) Capacity of key organizations to undertake environmental management activities is limited by personnel, financial resources.

As the foregoing suggests, the Fijian government plays a very limited role in managing inshore reef fisheries (Teh et al. 2009). Instead, exploitation of fisheries is largely regulated by the different, but closely related, social groups that hold rights to them (Veitayaki 1998).

As of 2009, over 200 villages across the 14 provinces in Fiji established community-based management in some form (Govan et al. 2009). There are over 10,000 km^2 of locally managed marine areas (Govan et al. 2009). Traditional systems of control over resources typically include seasonal closures, limits on the number of users, quotas, temporary closed areas (known locally as "tabus") and taboos on certain species or practices (Veitayaki 1998). These methods are driven by Fijian culture and tradition, i.e., the concept of sacred fishing grounds or reefs and temporary closure for traditional ceremonies (Veitayaki 1998). Outsiders who wish to fish within a specific *qoliqoli* are required to obtain a license from the national Fisheries Department, which must first ask permission of the respective *qoliqoli* rights owners before granting the license (Teh et al. 2009). Authority over the fishing rights is vested in the chiefs, but authority over the *qoliqoli* rests with the state (Clarke and Jupiter 2010a). In practice, one study found that "the majority of fishers in northeast Macuata province (Vanua Levu) did not have a fishing license, due to the high cost of obtaining one. In addition, the application process is long and tedious, requiring fishers to obtain approval from several government ministries"(Teh et al. 2009). Although the *qoliqoli* rights owners and the Fisheries Department may include restrictions on fishing licenses, such as gear, area, or size restrictions, this is rarely done in practice (Calamia 2003).

To offer support to and build capacity of communities that wish to implement marine management, a consortium of NGOs and donors groups initiated the Fiji Locally Managed Marine Area network (FLMMA) in the mid-1990s. It is important to understand the FLMMA framework not only because of its extensive application in Fiji, but because both Macuata and Kubulau *qoliqolis* are also FLMMA sites, with Macuata being an FLMMA site prior to EBM

implementation and Kubulau joining FLMMA after EBM initiation. In 2009, there were 217 LMMA sites in Fiji, including the project sites in Macuata and Kubulau *qoliqolis* (Govan et al. 2010). Project partners, the Wildlife Conservation Society-Fiji (WCS) and World Wildlife Fun-South Pacific Program (WWF), are members of the FLMMA network.

A locally managed marine area is defined as "an area of nearshore waters and coastal resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside or are based in the immediate area" (Govan 2009). The community itself must request to participate in the FLMMA network and is responsible for identifying the management issues and plan of action (Tawake and Tuivanuavou 2004). Moreover, communities are:

> Fully involved in the *qoliqoli* monitoring and management plan, which can include long-term tabu areas, reduction of licenses and banning of destructive fishing measures. The activities of the LMMAs are not limited to marine management, but include capacity building, awareness raising, policy lessons (shared at the national level, including through the Great Council of Chiefs (GCC)), and sharing of information with international networks. The GCC is always involved and assists in the implementation of the FLMMA. Success of FLMMAs is measured in terms of species, habitat and ecosystem health, reduction of threats, and the overall well-being of people. In the past six years, thanks to the development of LMMAs, the number of tabu sites and *qoliqolis* has increased significantly. (Tawake and Tuivanuavou 2004)

In general, livelihoods are the major priority in setting up LMMAs, which are typically aimed at restoring or securing food sources (Govan 2009). Proponents of the approach also hold that "LMMAs can have beneficial impacts on biodiversity and fisheries and this has long been the operating assumption" (Govan 2009). Lessons learned regarding LMMA implementation and management are shared among practitioners and communities throughout Fiji through informal learning during exchanges and meetings as well as formal meetings (Govan 2009).

A final element important to marine management in Fiji is the nation's commitment to conserve at least 30% of Fiji's inshore and offshore marine areas by 2020. Fiji made this commitment in 2005 at the 10-Year Review meeting of the Barbados Program of Action for Small Island Developing State in Mauritius. The government has since tasked FLMMA "to take the lead in the protection and management of the 30% inshore marine areas" and the contribution of community-based management strategies to national biodiversity targets in Fiji is currently being assessed (Jupiter et al. 2010a).

Stressors

Fiji's Vatu-i-Ra and Cakau Levu Reefs Seascape Project was initiated in response to perceptions that the long-term health of Fiji's marine habitats and fisheries resources are in jeopardy, and consequently so too are the livelihoods and well-being of local communities if management efforts are not improved and coastal resources conserved. Partners identified three chief ecosystem forces and threats to Vatu-i-ra and Cakau Levu during WWF's Fiji Islands Marine

Ecoregion Biodiversity Visioning Workshop in 2003 and community consultative meetings (Table 1 and Figure 2).

Table 1. Threats to ecosystems of Vatu-i-ra and Cakau Levu (WWF 2004a).

Key Threats	**Drivers**
Loss of marine biodiversity through illegal longline and local over-fishing, and destructive fishing practices	- Lack of effective enforcement - Lack of awareness and poor understanding - Lack of infrastructure support - Poor fisheries management - Increased use of resources through increased local population - Shift to monetary economy
Destruction of coral reefs, rivers, and lagoon systems through siltation and nutrient enrichment (Macuata only)	- Logging and forest cover removal in vicinity of waterways and coast - Widespread sugar cane farming in vicinity of waterways and coasts - Shift to monetary economy
Decline in coral reef health	- Climate change

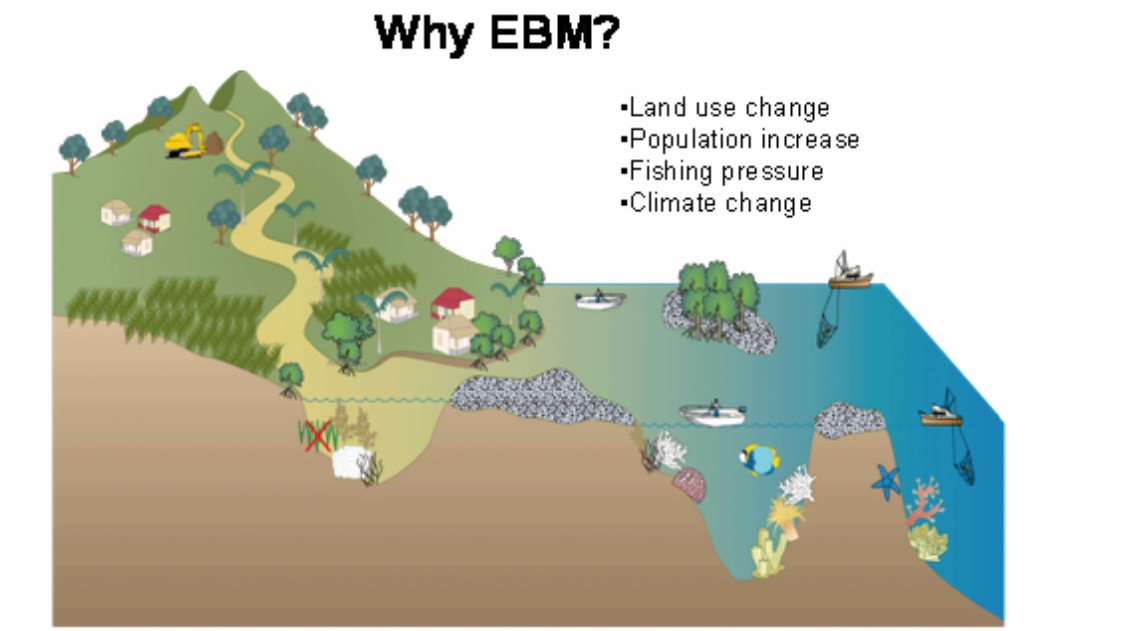

Figure 2. Conceptual model linking ecosystem threats to need for EBM in Fiji (Packard Report 2009).[3]

The primary driver of resource exploitation is not attributed to subsistence resource use, but rather, a shift to a monetary economy (Cakacaka et al. 2010; Adams et al. 2010). A concern about commercial fishing, for example, is echoed in peer-reviewed literature:

> Illegal fishing is now a major problem in the customary fishing areas close to the main urban centers because the use of contemporary fishing gear, such as speedboats and underwater torches, has enabled the commercial fishers to encroach into customary fishing areas belonging to others. In addition, disputes are now common as people from the same social groups differ over the utilization of their resources. (Veitayaki 1998)

Overfishing is considered a threat to the marine environments in both Macuata and Kubulau, but there are important differences in the type of land-based threats experienced in these places. One partner explains:

> Kubulau has relatively intact forests [with a plantation forest and limited amounts of logging and mining]. On the other side of the island, Macuata, [there

[3] This model was produced by WCS with symbols from the Integration and Application Network (see http://ian.umces.edu/symbols/).

is] a long history of [agriculture], primarily sugar cane farms [and] large-scale logging.[4] (Scientist)

MEBM Initiative

Program Initiation and Motivation

In November 2004, the Wildlife Conservation Society–Fiji (WCS), World Wildlife Fund -South Pacific Program (WWF), Wetlands International–Oceania and University of the South Pacific–Marine Studies Program submitted a collaborative proposal to The David and Lucile Packard Foundation and the Gordon and Betty Moore Foundation to implement an ecosystem-based approach to conservation and management of the seascape encompassing the Vatu-i-Ra and Cakau Levu reefs of Fiji. The key motivations for undertaking this project included a desire to implement a more holistic and science-based approach to environmental management than pre-existing approaches:

> We said, "Why don't we try to put together a more integrated package," because [WCS] had really only been working on marine issues, WWF had been working on community engagement, others were working on freshwater issues at that time. [. . .] We decided to pull this all together into a more holistic kind of approach. (Manager)

More specifically, EBM partners felt that revival of traditional management practices alone could not address new ecosystem threats, and the FLMMA approach needed to be scaled up to match the scale at which ecosystem processes operate:

> Communities are no longer the same. Those traditional systems happened when there were very minimal threats to their fisheries –these threats that they are now facing didn't exist then. Have we adjusted the traditional management and governments to meet those threats? No. We still stick to them as if they could withstand the new issues that communities are facing. (Manager)

> Given that there's a high rate of environmental change, [. . .] there's a strong need to think beyond the scale of local management and to scale up. [...] If you want to talk about protecting ecosystem services for the future, you need to be managing at the relevant scale. (Manager)

While partners recognized that compliance, implementation, and a sense of local ownership were enhanced by the "socioeconomic basis" of the FLMMA approach, they believed this

[4] To preserve anonymity, interviewees are described as "scientist, manager, or stakeholder" depending on the role from which they are speaking at any given time. In other words, a single interviewee may be referred to as a scientist, a manager, and a stakeholder at some point in this study.

approach on its own was inadequate for protecting key species and habitats, and achieving fisheries goals. Partners argued that communities needed ecological information regarding functioning of coastal and marine ecosystems to guide decision-making such that reserve placement could be more effective in sustaining biodiversity and accomplishing other environmental objectives and community livelihood objectives (Jupiter and Egli Forthcoming). Thus, this desire to integrate FLMMA strategies with larger science-based networks of protected areas served as the major impetus for the EBM project proposal (Jupiter and Egli Forthcoming).

Goals and Objectives

The original overarching goal of the project voiced in 2004 and 2007 was to:

> Facilitate a shift of marine ecosystems across the Vatu-i-Ra and Cakau Levu Reefs Seascape back to their "natural" state (i.e., natural range of variation of biodiversity and ecological features), and enhance resiliency of marine ecosystems to disturbance by promoting functionally intact marine communities and enabling marine ecosystems to sustain high quality and abundant marine resources for Fiji's people and economy.

However, following a comprehensive review of the project in August 2008, EBM partners decided that the goal as previously written was overly ambitious and needed to be grounded in more achievable objectives. Therefore, the text of the goal was revised to:

> To preserve the functional integrity of the Vatu-i-Ra and Great Sea Reef Seascapes to sustain biodiversity, fisheries and intact linkages between adjacent systems, thereby enhancing ecosystem-scale resilience to disturbance from land and sea and improving quality and abundance of marine resources for Fiji's people and economy.

During interviews, EBM partners stressed dual project goals of biodiversity conservation and food security, although to varying degrees, and expressed recognition that food security was the primary goal for participating communities:

> We are interested in biodiversity conservation, and I am a firm believer that in order to enable conservation to happen, we have to be seen meeting their local community needs, from fishing or broadening their income base, what they earn from the land. (Manager)

> The biggest objectives from the communities' perspective are to increase the amount of or halt the decline in fisheries resources. So that's a major objective of these projects. The secondary objective being to preserve the ecosystem functions and processes to preserve the ecosystem services for the future. . . . [As] an organization, we think a lot about biodiversity conservation, but I think about it mostly in terms of protecting ecosystem services. (Manager)

> In 2002, we received a request from Macuata from the chiefs asking us to help facilitate the resource management planning for the area. [. . .] Basically, it was not for biodiversity. The motivation was food security. (Manager)

To work toward the foregoing overarching goals, the project partners set out to achieve two specific objectives and many sub-objectives. In 2006, after the first year of the project, "it was apparent that the initial scope of the project was very ambitious," so like the overarching goal, the objectives were somewhat scaled back to the following:

(1) Implement seascape-scale marine management, with full community engagement and using ecosystem principles at two case study sites at Vatu-i-Ra and Cakau Levu reefs:

(a) Establish effective MPA networks based on an ecosystem-based, adaptive approach.

(b) Strengthen conservation of key forest areas adjacent to the MPA networks, and strengthen and identify key factors for management of rivers and streams in Kubulau and Macuata.

(c) Build Fiji's marine and freshwater expertise and knowledge to support MPA networks and ecosystem-based management.

(d) Communicate project results with key stakeholders, including communities, government, other NGOs and FLMMA.

(e) Develop agreements and explore mechanisms that enable the EBM approaches to be sustained by the communities of Kubulau and Macuata after the project has been completed.

(f) Undertake a dynamic, adaptive approach to project implementation that responds to emerging science and lessons learned.

(2) Obtain new knowledge to assist with understanding and managing coral reef seascapes and their adjacent watersheds:

(a) Identify key marine/terrestrial ecosystem linkages important for effective conservation and management.

(b) Assess effectiveness of MPA networks at Kubulau and Macuata.

(c) Investigate contribution of MPA networks to community marine and riverine fisheries at Kubulau and Macuata.

(d) Assess protected area networks at Macuata and Kubulau using biophysical and socioeconomic criteria, and make recommendations for increased MPA network effectiveness.

(e) Document EBM practices and processes used at Kubulau and Macuata through development of guidelines and case studies, for application elsewhere in Fiji and the wider Pacific.

The most significant change to initial project objectives was arguably the scaling back of research and management activities in the transition from planning to implementation. While the original planning from Phase I envisioned a "seascape" scale, it was only reasonable during Phase II to implement the project at two case study sites on Vanua Levu - Macuata and Kubulau (Figures 4 and 5) given the two-year timeframe. One manager explained:

> The original plan was just way too ambitious. […] It was thinking [at a larger spatial scale] . Then, finally realizing that we can only work at a *qoliqoli* scale, […] the project was scaled down to managing reefs, where you can really manage the community engagement in areas.

The project was originally conceived at the larger "seascape scale" because it was believed that broader scale projects are better able to garner the support and resources needed to develop effective compliance and enforcement programs. Further, conservation area networks are perceived to be more successful at maintaining viable fisheries and biological communities when established and able to interact across larger spatial scales. As mentioned earlier, partner partners still maintain, that "the project focus areas in Kubulau and Macuata covered ecologically significant spatial scales of 260 km^2 and 1,344 km^2, respectively" (Packard Report 2007). In addition, managers have not abandoned plans to work at the seascape scale:

> Our 10-year plan is to get management set up throughout the whole Vaitu-i-Ra area, which is between Viti Levu and Vanua Levu. We'd like to use the already established management committee (in the current sites) to go out to neighbors and share the lessons learned and have them be the teachers of what they've done and help other districts set up similar systems that fit their needs. (Manager)

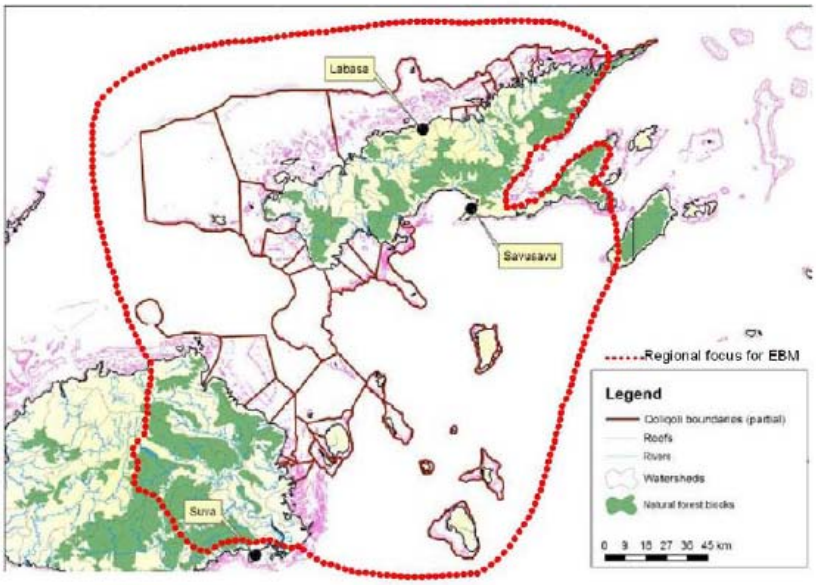

Figure 4. Phase I of the project was proposed at the "seascape" scale (as presented in the Phase I proposals to the Packard and Moore foundations). The target region includes the Vatu-i-Ra Seascape and Cakau Levu Reef.

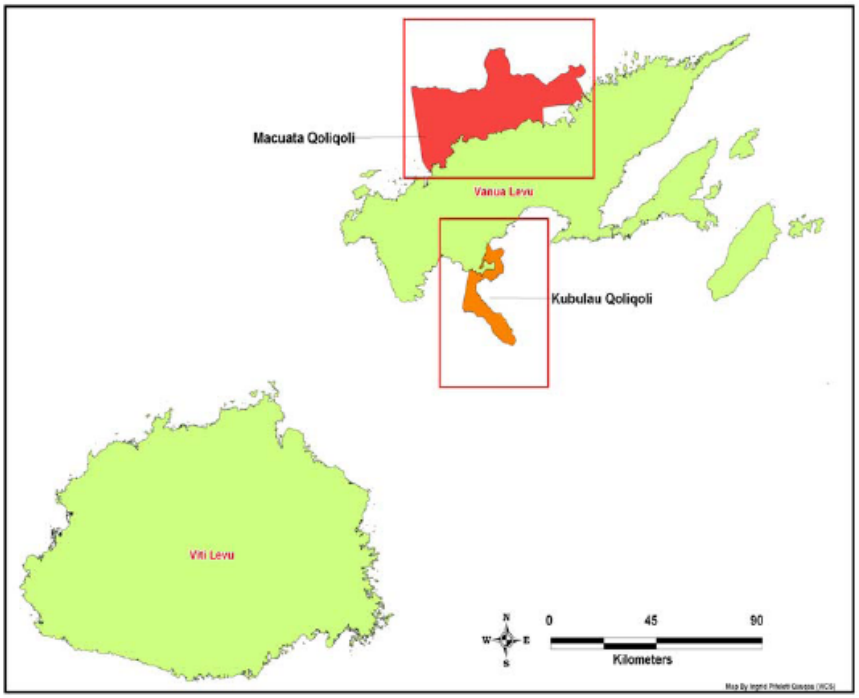

Figure 5. Project activities were later scaled back to the Macuata and Kubulau *qoliqolis* and associated upland areas within the seascape (as presented in the Phase II proposal to the Packard and Moore foundations).

Project Structure

Project activities are primarily carried out by the field offices of three large, international non-government organizations (NGOs):

Wildlife Conservation Society-Fiji (WCS) is an international non-government organization "committed to conservation of wild animals and wild places around the world. The WCS approach emphasizes scientific research, capacity-building, strong partnerships and local engagement" (WCS 2009). The WCS - Fiji country program was established in 2001.

World Wildlife Fund-South Pacific Program (WWF) is also an international non-government organization dedicated to stopping the degradation of the natural environment and creating a future in which people live harmoniously with nature through conservation of biological diversity, making sure natural resources are used sustainably, and pollution and wasteful consumption are curtailed. WWF has been active in the development of community conservation projects in Fiji since 1990.

Wetlands International-Oceania (WI-O) is an international non-government organization as well that works towards restoring and maintaining wetland ecosystems around the globe. In Fiji, WI-O is committed to promoting integrated landscape

> management from the beginning of catchment basins down to the ocean, including associated lagoons and reef habitats.

WCS is the project principal and is primarily responsible for implementing project activities in Kubulau, while WWF is responsible for project activities in Macuata. In terms of research responsibilities, generally speaking, WCS is responsible for marine biological surveys and monitoring and reserve design; WWF carries out socio-economic surveys; and WI-O carries out freshwater fish surveys and collects data on interconnectivity of freshwater, estuarine and nearshore marine systems. While the Marine Studies Program of University of the South Pacific (USP) was intended as a principle partner for the first phase of the project, USP was not included as a core partner for the second phase due to other academic commitments at the time.

Though key partner responsibilities were outlined in the project proposal for the first phase of the project, the lack of a management framework proved to be a serious stumbling block for the partnership:

> Co-ordination of the different work programs amongst the partners proved much more challenging than had been anticipated. [. . .] With the value of hindsight, it would have been important for the project to have a structured project management approach developed at its inception and the project's progress tracked throughout its two-year period. (Packard Report 2007)

This shortfall was addressed in the project's second phase by the creation of an Executive Committee comprised of lead individuals from each of the three core partners; appointment of a full-time EBM coordinator; and a memorandum of cooperation between the three implementing organizations. The Executive Committee kept community partners and other interested parties informed of project activities. EBM partners and the FLMMA Network also signed a memorandum of understanding that "details ongoing attendance at FLMMA meetings, as well as broader scale statements of support and engagement" (Packard Report 2009). As mentioned in the introduction, the EBM project as a cohesive unit of partners was completed in 2009, although EBM is still being implemented at both sites. Thus, the EBM Executive Committee is no longer meeting.

Project partners have also worked with communities in Macuata and Kubulau to set up and build capacity of *qoliqoli* management committees comprised of traditional leaders. These committees are intended to serve as liaisons between EBM partners and communities and are responsible for making resource management decisions and plans, though all final decisions must be approved by a council of chiefs (Manager). Kubulau's management committee includes a chairman and representative from each of the ten villages, which togather lead "district-wide management of all natural resources: terrestrial, freshwater, coastal and marine" (WCS 2009). More specifically, the functions of the Kubulau management committee, as outlined in the Kubulau EBM plan, are to: coordinate implementation of the management activities identified in the EBM plan; raise awareness of the management rules and activities; coordinate enforcement of the management rules; assess proposed resource use and development activities, to ensure they are consistent with this management plan, national laws and

ecosystem-based management principles; provide information and advice on resource management and alternative livelihoods; organize training on sustainable resource management and alternative livelihoods; liaise with stakeholders, including resource users, conservation partners and donors; manage and distribute funds for resource management and other activities; and monitor and report to resource owners and stakeholders on implementation of the EBM plan (WCS 2009). However, partners are seeking to clarify these functions as "the roles and responsibilities of the resource management committees are often misunderstood within the communities" (Packard Report 2009). Moreover, community members have been known to bypass the committees, instead operating through traditional governance structures and appealing straight to the high chief (Manager). One partner reflected that "the *qoliqoli* management committees don't have that much authority unless they have good relationships with the chiefs or they are made up of the chiefs" (Manager). WCS supported the committee by providing advice, coordination and assistance with meeting costs, and the committee now funds its meetings from income derived from diving fees at the Namena Marine Reserve (Packard Report 2007). Kubulau also has established sub-committees to increase community involvement in resource management and to provide a focus for activities relating to community education, science, community development and finance, and communication (WCS 2009).

Macuata's management committee was set up in 2004, prior to EBM implementation, and collects fees from fishermen licensed to fish in their *qoliqoli* to help fund meeting costs and management plan development and implementation (Packard Report 2007). Despite the challenges mentioned above, these committees are seen as "critical in the process of designating MPAs, building awareness, and gaining local support for them" (Packard Report 2006).

While the seascape project itself lacks formal authority, it has governmental support. The project has successfully created operational networks among relevant national government departments such as the Departments of Fisheries, Tourism and Environment, Culture and Heritage; district and provincial governments; communities and *qoliqoli* committees; and different NGOs.

Strategies and Tools

The main strategy for EBM implementation in Fiji includes collecting and using biophysical and social data to inform the design and community-based management of networks of marine and terrestrial protected areas. Secondary implementation strategies include the creation of community communication networks and new knowledge that can be communicated and applied at a broader scale throughout Fiji and the Indo-Pacific region. These strategies are represented in Figure 6, described by EBM partners as the "cornerstones" of EBM in Fiji.

Figure 6. "Cornerstones" of EBM in Fiji identified for the project's second phase: 1) Science (biological, socioeconomic and traditional knowledge), 2) Management Plan (recommendations for management options based on the science), 3) Communication (scientific results have to be communicated effectively so they can be formed into management options both at community levels and national levels, links 1 and 2) (Packard Report 2009).

Feeding Science into Protected Area Planning Efforts

As mentioned above, the main strategy for the EBM project in Fiji involves collecting biological and social data and using that information to craft recommendations to communities about protected area (marine and terrestrial) configuration and management:

> In Fiji, an alternative, complementary approach was initiated . . . in 2005, representing one of the first efforts in Oceania to design and implement . . . ecologically functional MPA network[s]. Initial placement of MPAs was based on baseline biological surveys and design criteria which considered size, spacing and representation of habitats and critical 100 processes (e.g. spawning aggregations) in a multispecies framework. The design[s were] subsequently modified following extensive socioeconomic assessments and consultations with resource owners in order to spread cost and maximize compliance. (Jupiter and Egli Forthcoming)

EBM partners see science-based networks of protected areas as effective EBM tools because such networks may enhance resilience among coral reef ecosystems, have been found to reduce threats to marine habitats and species, and are considered an important tool for long-term conservation of high priority marine environments globally (Roberts et al. 2001; Halpern and Warner 2004; Freidlander et al. 2007). Moreover, EBM partners explain that protected areas are particularly appropriate in the Fijian context because:

> There's a culture in the Pacific of setting up closures. It's a revival of that culture, but then also trying to put it in an ecological context. (Manager)

In Kubulau, tabu sites and marine reserves comprising the MPA network were sited according to biological information, socioeconomic surveys, traditional knowledge and resource use maps that were shared and discussed with communities at workshops (Clarke and Jupiter 2010). While communities followed most of WCS's science-based recommendations, local social and political factors influenced the final decisions. For example:

> We were just there to make recommendations on what the EBM concept was all about and where the best places would be, based on science, to be MPAs. [. . .] Not all of the recommendations we made were followed. (Manager)

> I think some of [the community's decisions regarding the MPA network] had to do with traditional fishing right boundaries and some of it definitely had to do with what was recommended from WCS. (Manager)

Community Communications

Given the geographically dispersed nature of communities in Macuata and limited communication infrastructure, a critical element of WWF's EBM strategy includes communication methods that seek to promote community involvement in EBM activities and ensure that management measures are clearly explained to community members. First, EBM partners fundraised for travel expenses for community members to attend planning meetings (Clarke and Jupiter 2010). Second, after initially relying on village and district leaders to communicate information to villages through existing provincial, district, and village meetings, EBM partners began integrating discussions of EBM activities into such meetings directly (Clarke and Jupiter 2010). According to EBM partners, this has mainstreamed EBM issues, made more efficient use of limited resources, and helped overcome past complaints that villagers were uninformed of fisheries management rules and measures that were not "trickling down" (Clarke and Jupiter 2010). Finally, WWF also established a "Community Messaging" network with the goal of improving community awareness and ownership of EBM in Macuata (Clarke and Jupiter 2010). The Community Messaging network engages village leaders in disseminating project information to each household in 37 villages (Clarke and Jupiter 2010). This made it possible for information to be distributed, feedback to be solicited and monitoring to take place (Clarke and Jupiter 2010). The system is based on a 3-4 page newsletter distributed every two months that is written in the local vernacular (Clarke and Jupiter 2010). The process is as follows,

> Sufficient copies for every household are posted to each village headman, who distributes the newsletter to each household and obtains a signature from the head of each household to confirm that they have been delivered. If the newsletter has questions requiring responses from the households, the responses are given to the village headman who posts them back to WWF, using a stamped, self-addressed envelope provided. Community comments are published in the newsletter, and villagers are encouraged to submit questions about issues they would like addressed in the newsletter. (Clarke and Jupiter 2010)

EBM partners believe this strategy has increased opportunities for women and youth to be involved in management debates, while maintaining "a direct line of communication between the project management team and every household in all 37 villages in the province" (Clarke and Jupiter 2010). Overall, partners describe this network as a successful means of disseminating information and improving understanding of natural resources management concerns (Clarke and Jupiter 2010).

Generating and Sharing EBM Science

The EBM projects at Kubulau and Macuata are intended to serve as pilots for EBM within the Indo-Pacific region:

> The project reserve networks set an important precedent for Fiji and the region, especially in terms of the scale of protection and the application of the science for marine protected areas and management of whole ecosystem. This project is providing the model that the Fiji government and local practitioners are considering for its approach fordistributiing Fiji Network of MPAs to protect 30% of Fiji's nearshore and offshore waters by 2020. (Packard Report 2006)

Toward this end, partners are using EBM science to create 'scientific rules-of-thumb' to communicate lessons learned to a wider audience. Some of these rules-of-thumb are presented in a technical report published by WCS and WI-O in 2010, *Effectiveness of marine protected area networks in traditional fishing grounds of Vanua Levu, Fiji, for sustainable management of inshore fisheries*. For example:

> The factors which appear to have the most influence on the success of management include: size; placement of reserves in naturally productive habitats; visibility by villages or others authorized to enforce management rules; distance from potential poachers; and longevity of protection. (Jupiter et al 2010)

New knowledge has also been communicated through a number of other avenues as well. The EBM partners organized and hosted the inaugural Fiji Islands Conservation Science Forum in 2009, which was the first opportunity for researchers and students in Fiji to come together to present and discuss findings from local research. The EBM partners presented findings from the Fiji EBM project in 13 separate presentations. Proceedings were widely distributed to participants and stakeholders and are available for download on WCS Fiji website (www.wcsfiji.org). In addition, all of the findings from Phase II of the EBM effort have been published as technical reports and guides, which have been submitted to publicly searchable libraries at SPREP and Reefbase public digital libraries. Some of the results have been or are being published as scientific papers. Further, all lessons are communicated to communities for adaptive management of their protected area networks. The major lessons learned have been incorporated into an EBM Guide for the Tropical Western Pacific (Clarke and Jupiter 2010), which is being launched at a side-event co-hosted by WCS and the Fiji Government at the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity in October 2010. Finally, the project has been presented at major international conferences such as the

International Coral Reef Symposium 2008 and International Marine Conservation Congress 2009.

EBM Decision-Support Tools

EBM partners in Fiji believe "that there is a place for EBM tools [in Fiji], but that top-down planning always needs to be integrated with bottom-up prioritization from the community level" (Manager). Partners have found that planning maps such as those that include "overlays of biological information and traditional ecological knowledge on readily available platforms such as Google Earth" and conceptual modeling diagrams and other visualization tools that help convey complex ecological ideas and oceanographic processes are useful in this context (Clarke and Jupiter 2010). More specifically, the EBM software program Miradi was used in Fiji to identify eight conservation targets "(amphidromous fish, redundancy in functional groups, food fish, complex reef structure, seagrass, mangroves, riparian vegetation and upland forests) that are directly impacted by twelve major threats" (Packard Report 2009). Using this tool enabled the EBM partnership to realize it is only actively addressing two of those twelve threats (i.e., overfishing and anchor damage) (Packard Report 2009). The partnership also integrated all monitoring and evaluation activities into Miradi, and WCS will continue to use this program to monitor Vatu-i-Ra after this EBM project has officially concluded (Manager). As an EBM partner explains, such tools are used primarily in the context of NGO internal planning processes and not among the communities:

> I use Miradi, but we all pretty much agree that it's good for internal planning within our own NGOs, but not so much for community unless you make it very simplified. There are too many spider web, crazy-looking things. (Manager)

WCS has also used Marxan software to design reconfiguration options for the protected area network at Kubulau.

In general, however, spatial planning tools are usually unnecessary for management decisions regarding establishment of protected areas in Fiji at the individual community level because options are usually few and are easily evaluated against socioeconomic constraints (Clarke and Jupiter 2010). Further, input data are often deficient in the western Pacific, which limits tool outputs as "the tools are only as good as the input data" (Clarke and Jupiter 2010). Technical capacity for operating the models is also low in the western Pacific, which limits their application and, in some cases, people are skeptical of computer-generated models and, thus, their outputs (Clarke and Jupiter 2010).

Role of Knowledge

The "contemporary scientific information" produced by EBM research is intended to supplement traditional knowledge with the ultimate goal of enabling communities, decision-makers of Fiji, and the wider region to "make more informed management decisions that incorporate land and sea system connectivity" (Packard Report 2009).

Type of Information Collected

The topics of EBM research include:

- The aquatic fauna that utilize "wet" ecosystem types during different life stages (living connections between the land and the sea) (Jenkins et al. 2010);
- Identification of priority conservation regions (ecoscapes) for Fiji Islands to preserve ecosystem connectivity (Jenkins et al. 2010);
- Seasonal differences in freshwater fish communities (Jenkins and Jupiter In Review);
- Spatial patterns of community resource use (Cakacaka et al. 2010; Adams et al. soon to be In Press; Jupiter and Egli Forthcoming);
- Perceptions of ecosystem change (Egli et al. 2010; Navuku et al. 2010);
- Potential influence of terrestrial sediments on nearshore environments (Jupiter et al. 2010);
- Effects of intensive harvesting of a traditional MPA on reef fish communities (WCS Unpublished Data);
- Fish community responses to management in Fiji (Jupiter and Egli Forthcoming);
- Habitat mapping approaches for Pacific Islands (Roelfsema et al. 2010); and
- Connectivity between marine habitats, including understanding the movement ranges of adult reef fishes from MPAs (Egli et al. 2010).

Science for Decision-Making

Protected area network design and management were based on participatory planning methods informed by scientific research, biological and socioeconomic surveys as well as local and traditional knowledge (WCS 2009). Principles of marine reserve network design, "including habitat representation, size considerations based on target fish territory size, and critical habitats and phenomena, such as spawning aggregations," were combined with socio-economic survey results and consultations with resource owners to inform protected area placement. Recommendations to communities were modified to:

> Minimize hardship to local communities, spread equally the benefits and burdens, and to maximize compliance. For example, networks of small- and medium-sized reserves are a necessity in the coastal portion of the 30% since local subsistence fishers might be excluded from their entire fishing grounds if very large nearshore reserves were to be established. (Packard Report 2006)

EBM science has also been used to verify the traditional knowledge upon which nine MPAs were established in Macuata prior to initiation of the EBM effort in Fiji:

> In May 2008, there was a review of the community-selected set of MPAs. The review was facilitated by the information that had been collected throughout the EBM project. [. . .] All nine of the protected areas selected by the community using traditional knowledge were for high bioactive areas. The traditional knowledge used to set up

> MPAs was good enough in the first place. The science information provided a lot more backing for those areas. (Manager)
>
> EBM science and traditional knowledge presented during that 2008 workshop also resulted in the community selecting an additional 16 coastal protected areas and two forest reserves that brought previously unrepresented habitats such as mangroves and river systems into the Macuata network (Manager).

In addition to its site-specific uses, EBM science is intended to yield information that may be used more extensively throughout Fiji and the Indo-Pacific region. To communicate lessons learned, partners are translating EBM science into "rules of thumb" relating to the design and management of protected area networks in oceanic islands (Scientist).

Some practitioners feel that EBM science in Fiji has focused more on biophysical science than social science. One partner explains there were "stronger personnel on the ecological aspects and more money spent on that than on social and economic aspects." As mentioned before, social science data has been relied upon in the development of recommendations for protected area network configuration and management. Social science has also been used to understand decision-making processes and social hierarchies so as to determine how to generate support for EBM and how to best communicate science to affect decision-making. As one project manager explains:

> At a minimum level, you want to know what are the community's perceptions of threats, what is the community government structure system, who are the main players, who makes the decisions basically. And it will be the role of the chiefs in that traditional hierarchical structure. But it's also a good idea to figure out who are the pressure points … it may not be the high chief who really has the biggest sway with the majority of people. (Manager)

Finally, social science is being used to study factors affecting MPA success, and to gather information for engaging communities. A project partner describes this approach,

> We went out into the communities with surveys, and we took down information about the different resource use and management systems they had in the past and what the ecosystems were like in the past. We interviewed different age groups and saw the differences in responses. […] And over time we saw the baseline shifting. [. . .] We presented that phenomenon with the results we got from the communities. Through that visual presentation, they accepted that there really isn't an [abundance] of resources. That was a tool we used as an engagement tool, as a motivation tool, for communities. But we mostly focused on food security at first, and then further developed into things that have been happening in the present. (Scientist)

Although a main goal of EBM science is to provide information to communities and decision-makers in Fiji and beyond that enables them to make better decisions for entire land and

seascapes. Several EBM partners felt that the scientific information collected through the EBM project was used mainly:

> To satisfy the scientific community, [to convince them] that what they were doing was actually scientifically based. With the communities, it doesn't really matter. (Manager)

Another partner echoed this sentiment that:

> Investing in the science is for partners, in my mind, to be really comfortable with the decisions that they make and be really clear. It's not so much a community need. (Manager)

Outcomes

The two main project outcomes include:

> (1) Design of, and implementation begun for, seascape-scale marine management for Vatu-i-Ra and Cakau Levu Reefs; and,
>
> (2) New understanding of ecosystem-based management and conservation design and implementation for tropical coral reef ecosystems and adjacent watersheds (Packard Report 2007).

Kubulau- Specific Outcomes

Twenty marine protected areas were established by communities in Kubulau, including three district marine reserves and 17 village tabu areas, covering more than 30% of the customary fishing grounds (Figure 6). This network is comprised of larger offshore reserves and smaller inshore reserves representing a variety of habitats (Clarke and Jupiter 2010a). MPAs or reserves are typically larger, permanently closed areas while tabu areas are smaller and periodically harvested. No-take reserves are key elements of this network that shifts functions from "temporary enhancers (traditional and other LMMA reserves) to long-term source pools that will sustain good fishing throughout coastal ecosystems" (Packard Report 2006). The protected areas in Kubulau include Namena Island, a legally protected 40 hectare terrestrial area that covers 0.4% of Kubulau District (WCS 2009). With the expectation that 90% of the island with be managed as a strict nature reserve, the landowning clan has leased Namena Island for a tourist resort (WCS 2009). Fiji's first EBM plan has been finalized for Kubulau:

> We've helped them develop the first EBM management plan for Fiji, which presents in the same document all the management measures from the forest to the outer reef. (Manager)

Moreover, a generalized template for EBM plans was created and presented at the 2009 FLMMA annual training meeting; this template is currently being used to develop the Macuata EBM plan (Manager).

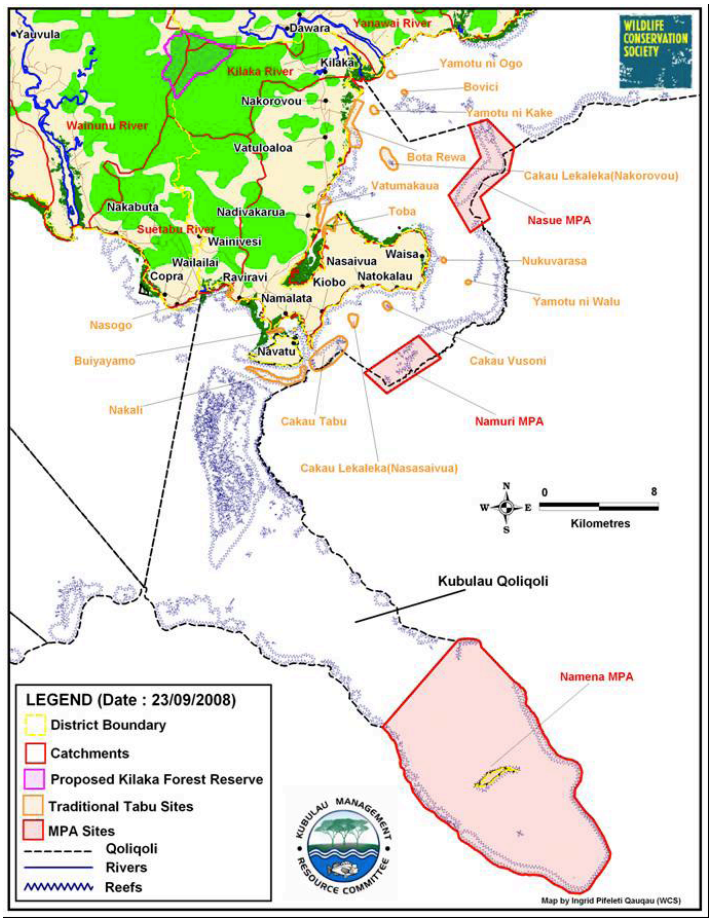

Figure 7. Kubulau *qoliqoli* MPAs (red) and tabu areas (orange) (Clarke and Juptier 2010).

Macuata-Specific Outcomes

A protected area network based on traditional ecological knowledge had already been established in Macuata prior to the EBM initiative. FLMMA and WWF facilitated this effort, which culminated in eight areas being designated as protected areas (for goals of "fish breeding and nurturing"). To manage these areas, a Tikina Dreketi, Macuata, Sasa and Mali Traditional Fishing Area *(Qoliqoli)* Management Plan had been developed "at the request of the Tui Macuata (the Traditional Chief of the Macuata Province)" (Phase I Report, 2007). However, "since placement of the tabu sites, there has been a high level of dissention and non-observance of the rules set out in the management plan" (Phase I Report, 2007).

In 2008, WWF convened a community-based management planning process that led to a "significant expansion and reconfiguration of the protected area network, based on the findings of the ecological and socioeconomic research undertaken by the EBM partners" (Clarke and Jupiter 2010). Local communities agreed to increase the network to include 25 coastal and marine reserves and two forest reserves, covering more than 175 km^2 (Figure 8) (Clarke and

Jupiter 2010). The resulting configuration encompasses a variety of ecosystem types and ecological features such as spawning aggregation sites, turtle nesting beaches, mangroves, and riparian corridors (Clarke and Jupiter 2010). At the time of writing, a revised management plan for Macuata was still under review (Manager).

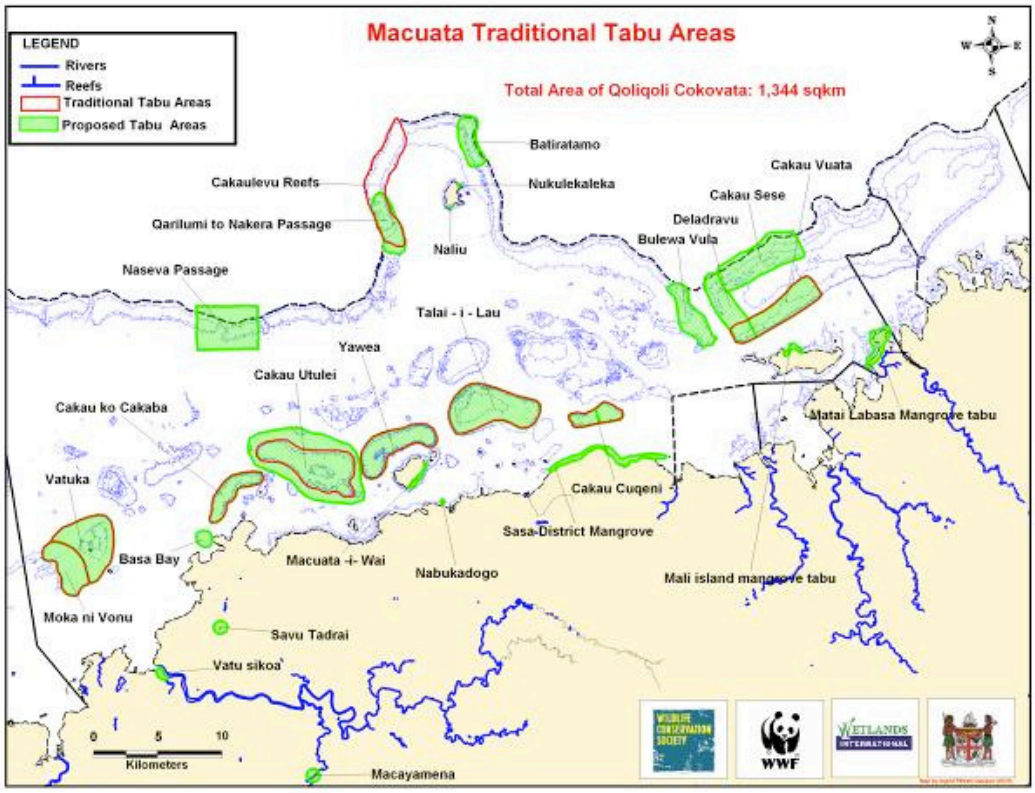

Figure 8. Map of the Macuata Traditional Tabu Areas (Clarke and Jupiter 2010).

The EBM activities in Macuata and Kubulau are cited as the first successful attempt in Fiji to use biological and ecological science to implement an "ecologically-interactive marine reserve network" or:

> An aggregation of reserves that are sufficiently clustered, sizable, numerous, and well-placed such that the complex interacts ecologically and provides synergistic fisheries benefits well beyond that of the combined individual contributions of each single reserve. (Packard Report 2006)

While progress has been made toward establishing and managing protected area networks in Kubulau and Macuata, according to EBM partners, there is still much to do:

> We're getting there, but having a vision of a truly integrated mosaic of habitats that are all managed together is still a ways off. (Scientist)

New Knowledge

EBM partners explain that a major outcome of their project is the production of scientific knowledge that can be applied broadly throughout Fiji and the region (Manager), and to the broader Pacific region through the publication of an EBM guide tailored for managers and conservation practitioners in the western Pacific (Clarke and Jupiter 2010). The biological and ecological research conducted has informed the development of rules of thumb for protected area networks that can be applied in similar tropical island contexts. Further, experience gained through communication efforts between project partners, customary leaders and community members are expected to enable better communication regarding resource management throughout the country in the future. Lastly, new knowledge has already been communicated through the FLMMA network, Fiji's Inaugural Conservation Science Forum, at international conferences such as the International Marine Conservation Congress, and through technical reports, guides and journal articles which can be accessed online at: http://www.wcsfiji.org/. Additionally, all technical reports have been submitted to SPREP and Reefbase public digital libraries.

Protected Area Success

Social and biological outcomes of the protected area networks in Kubulau and Macuata are being monitored to evaluate progress over the period since initial baseline surveys were completed (Clarke and Jupiter 2010). Partners are citing anecdotal evidence from fishermen that attest to "significant positive changes" since the marine reserves were established, which has been backed to a certain degree by increases in fish biomass observed outside protected areas (Jupiter and Egli Forthcoming; Clarke and Jupiter 2010). This includes the return of the endangered humphead wrasse (*Chelinus undulatus*) to areas they have been absent from for years, and bigger individuals of other fish species are being seen closer to shore (Clarke and Jupiter 2010).

Challenges

Existing Sector-Based Institutions and Agencies

Among the most significant challenges facing EBM progress in Fiji are constraints produced by the existing sector-based institutional landscape. EBM calls for a restructuring of this landscape such that all agencies are integrated. As one project partner explains,

> Certainly, the biggest challenge is that institutions and agencies and academia and the funders […] have already been set up in very vertical, very compartmentalized structures. […] It's going to take some sort of fundamental paradigm shift in the way donor agencies, international development aid works, conservation aid works, academia works, communities operate – in order to really work. (Manager)

Merging EBM with Existing Management and Community Priorities

The EBM project has encountered some difficulties integrating EBM principles with pre-existing management initiatives and community priorities. The EBM effort is trying to move towards a "hybrid management system" that brings "some more western type structures within the traditional management system" (Manager). As such, EBM requires a greater commitment by communities to biodiversity conservation:

> EBM is going to call for much higher commitment because we are implementing permanent MPAs. [. . .] When a new opportunity comes for [communities] to either harvest the tabu area or open the closed area to build a church, you have to see if the closed area is still closed. [...] At the end of the day, the value that is placed on conservation is still low. (Manager)

> The partners don't have control of the internal disputes within the communities. [. . .] We went through the whole process of consulting them on the sites to establish, making recommendations. [...] Even the chief was supportive towards what we were doing, but we still had issues coming up [...] that some people wanted to fish the MPA. [...] Some local communities are arguing amongst themselves that they have the right to fish the *qoliqolis*, the site that has been protected. (Manager)

Compliance and Enforcement

Enforcement of protected area rules is described as a major challenge. "Infringements" in the form of fishing and cutting down trees within protected area boundaries are taking place, but are expected to be mitigated with additional management planning and improved communication (Packard Report 2009). Partners think such infringements are most often the work of people outside of participating communities (Packard Report 2009). In the words of a project partner:

> The biggest challenge has been addressing the poaching issues and enforcement, surveillance and compliance. These seem to be the most common challenges to these networks. (Manager)

According to EBM partners, enforcement efforts are constrained by a lack of legal bedrock:

> The penalties for offenses are very very low, and so people get much more financial gain from illegally fishing and selling, [...] In most cases they are not prosecuted. [...] For example, when we were in Macuata in 2008, the communities there had done all this great work and set up their tabu areas, and they were seeing tons of external poachers come in. [...] They felt like they were powerless to do anything about it under the current Fisheries Act because the police aren't helping. (Manager)

Furthermore, traditional enforcement methods are no longer legal:

> "Fish wardens have been prosecuted for confiscating people's boats, destroying property or beating people up." (Manager)

Balancing Expectations

Balancing EBM project objectives and use of project resources with community expectations has been a challenge. For example, surveying efforts have needed to allocate additional field time to building community relationships:

> As well as the necessary protocols being observed when in the field, the survey teams faced considerable pressure from communities to participate in village social gatherings. This slowed survey work, increasing the time required in the field and hence field costs, but strengthened relationships with the villages and helped build community support for and engagement in the project. (Packard Report 2007)

Also, communities have voiced expectations regarding livelihood alternatives because they "perceive that MPAs close off fishing opportunities" (Packard Report 2007):

> If the issue of alternative income generation is not addressed, it could undermine the progress made to date through disengagement of members whose consensus may have been temporarily acquired in the hope of assistance. (Packard Report 2007)

Lastly, community expectations of the EBM partners and MPA performance need to be carefully managed. Partners are addressing this issue by carefully tending to their relationships with communities and by developing memorandums of understanding (MOUs) and related agreements with villages. Further, they are raising awareness of MPA science and outcomes and their utility within management frameworks.

Organizational Issues

The first phase of the EBM project was limited by staff transitions, a dearth of scientific leadership, and problematic relationships with the conservation community in Fiji. According to one manager:

> When we were designing the EBM project, people were disagreeing right from the start… People were saying, "It will really confuse the process we're trying to develop here". I think some of those reservations still exist. One of the main issues was the high cost of the EBM project, which no one could replicate in Fiji. (Manager)

Qoliqoli Ownership Issues: Anticipated Challenges of Scaling Up Management

All of the protected areas established by this project have been set up within the context of a single fishing ground. Some partners anticipate challenges relating to scaling the effort up to encompass multiple fishing grounds. As a project partner explains:

> These EBM projects in Macuata and Kubulau have been implemented in one fishing ground. Although there are 37 villages [in Macuata], there's one fishing ground there. There haven't been any cross-boundary [MPAs] from one fishing ground to another to actually look at the entire system, the entire habitat. There are going to be, in my mind, a lot of challenges for that, but I don't think it's impossible. (Manager)

Political Instability

There has been significant political instability in Fiji resulting from the military takeover of the elected government in December 2006, abrogation of the constitution in 2009, and attendant uncertainty over whether laws and policies passed currently will be rejected when and if Fiji returns to a democratic state. Among other things, this instability has made it difficult for the project to establish and maintain relationships with government departments, mainly due to extensive shifts in employees (Packard Report 2009).

Broad Spatial Scale and Scope of Objectives

As discussed earlier, "the two-year timeframe of the project was too short to undertake the seascape-scale work as originally envisaged" (Packard Report 2007). As the initial expectations were 'unrealistic' (Packard Report 2007) the project focus was narrowed to the areas of Macuata and Kubulau, and activities and outputs were revised to the satisfaction of the donors. The larger of the two areas, Macuata, was the most challenging, particularly with regard to the freshwater work that required a river by river assessment and the need to consult with a large number (37) of villages (Packard Report 2007).

Project Coordination

As mentioned earlier, coordinating different partners' work programs turned out to be more difficult than anticipated during Phase I of the project (Packard Report 2007). Looking back, the EBM partners recognize the importance of having a structured management approach developed from the onset and tracking progress throughout the project's existence (Packard Report 2007). Such an approach would enable early identification of shortfalls, "thus, providing opportunities to revise approaches and identify solutions" (Packard Report 2007). Despite the challenges posed by a lack of a structured management approach during Phase I, partners did help one another with training, staff, and equipment where capacity was scant (Packard Report 2007). This challenge was addressed in the project's second phase by the creation of the Executive Committee comprised of lead individuals from each of the three core partners; appointment of a full-time EBM coordinator; and a memorandum of cooperation between the three implementing organizations.

Facilitating Factors

Traditional Tenure Arrangements

Traditional marine management structures and land tenure systems have contributed to EBM implementation because communities have a strong sense of ownership of the resources and, therefore, a vested interest in their long-term health (stakeholder; Clarke and Jupiter 2010a). One project partner explains:

> The nature of resource ownership here just lends itself to EBM. We work with the same communities who own [rights to] the land and the seas. […] Some of the threats to the i*qoliqoli* fishing areas are actually their own actions, so it made sense to make a plan for their resources. (Manager)

Also, in the more remote areas, traditional management systems are strong, which facilitates compliance among participating communities; this represents "a very high contributing factor to the success of management" (Manager). In addition, *qoliqoli* boundaries have been mapped as have land tenure boundaries; this has helped the project team identify who to talk to and who owns what piece of land, which increases efficiency and reduces the potential for conflict (Manager).

History of Spatial Marine Management

Although there are important differences between the goals and management of traditional Fijian practices such as tabus and western-style marine protected areas, EBM partners note that Fijians' longstanding traditional practice of spatial marine management via tabu areas facilitates community support for networks of protected areas. As one EBM project partner explains:

> For us, talking about [MPAs] to the communities is easy because it's the traditional practice anyway. […] They already knew it. It would be easier than coming in with a brand new idea and trying to sell it. (Manager)

Dependence on Natural Resources

Most Fijians are dependent on natural resources for subsistence use. According to EBM partners, this tight coupling between communities and environment in Fiji allows communities to perceive environmental degradation and motivates them to address it:

> One of the big things in small island nations is there's a huge dependency on marine resources [. . .], so that puts a lot more pressure on marine resources. People have been perceiving declines. In both of the communities in Macuata and in Kubulau, there were direct requests from the communities to get outside assistance to help stem that. (Manager)

Pre-Existing Community Management Initiatives

EBM partners mentioned that implementation and communication of EBM principles and science has been greatly facilitated by the FLMMA network. As one of the project partners explains:

> The biggest opportunity is with the LMMA network and helping it through the adaptive management process […]. Within the network, [...] I think there are quite a few opportunities to practice EBM. Increasingly, […] communities that attend these meetings are interested in EBM and looking at how they can use principles or activities or tools from EBM. (Manager)

Lessons Learned

Ecosystem-based management practitioners in the tropical Pacific find little in common with the experiences of initiatives taking place in other areas of the world, but have particular characteristics in common with one another (Clarke and Jupiter 2010). This section presents lessons learned from the perspective of those implementing EBM, in a new guide for EBM practitioners in the tropical Pacific (Clarke and Jupiter 2010), which was partially based on discussions during a two day workshop held in August 2009 to discuss shared experiences with implementing EBM among EBM practitioners in Fiji, Palau and Indonesia.

Importance of Community-Based Management

Community-based management has become a popular approach to natural resource management and biodiversity conservation in this region. Community-based management acknowledges and respects the interests, needs, rights and objectives of local resource owning communities, and it facilitates and enriches local conservation and development goals. Ecosystem-based management is a hybrid approach that integrates community engagement and authority with variable amounts of external guidance and assistance. To be successful, EBM efforts must uphold existing community-based structures and ensure local perspectives are considered, not only national and international ambitions. Fiji EBM partners also learned that long-term success of community-based resource governance is more likely when planning processes acknowledge and bolster the roles of traditional leaders while accommodating broad community involvement. This may be accomplished by directly involving local communities in management planning and decision-making, which fosters community ownership of the management process and outcomes.

Need for Adaptive Management

Data limitations and the complexity of target ecosystems in the western Pacific necessitate an iterative and dynamic approach to managing ecosystems. Larger-scale adaptive management is improbable, however, because limited financial, human and technical resources restrict the region's capacity . Management of ecosystems can be improved over time and able to respond to emerging challenges such as climate change through community-based adaptive

management whereby local and traditional knowledge is combined with scientifically robust monitoring approaches and responsive decision-making processes.

Utility of Local and Traditional Knowledge

Ecosystem-based management provides opportunities to integrate local knowledge and expertise with existing and emerging scientific knowledge of ecosystem functions and processes. The Western Pacific region has a rich heritage of local knowledge and traditional resource management practices that may be integrated with EBM science.

Productive Partnerships

For EBM to be effective, the full spectrum of stakeholders must be recognized and strategic decisions must be made regarding community involvement in the process of ecosystem management transformation. Management success is facilitated by collaborative alliances that bring together institutions with diverse expertise, skill sets, responsibilities, and resources. Partnerships that harmonize and integrate management activities enhance efficiency and promote mutually accepted solutions to ecological issues.

Importance of Understanding Existing Institutions and Decision-Making Processes

EBM practitioners need to fully understand the context in which they are operating and must identify opportunities to connect their work to co-existing organizations, policies, programs and management processes. In the Western Pacific, customary tenure is a major feature of natural resource management regimes; therefore, effective conservation must recognize and understand existing traditional and legal resource rights and decision-making protocols. In many contemporary Pacific island communities, traditional governance systems are still in practice and serve as key mechanisms for regulating terrestrial and marine resource uses. Understanding these systems will enhance EBM efforts. Further, engaging traditional leaders in planning and decision-making processes is a critical component of effective EBM implementation in the western Pacific context because traditional leaders possess significant influence in rural communities and, to generate support for the reserve network, it is essential to bridge the information divide between the Fiji Government and villages (Clarke and Jupiter 2010a). Engaging local personal will help gain insights into traditional authority structures and community administrative procedures. Socio-cultural research may also inform understanding of formal and informal decision-making processes. Finally, because EBM is inter-sectoral, it may require participation of several existing institutions, the establishment of new organizations, coordination mechanisms between entities and/or a combination of these approaches.

Successful Management Planning

For EBM to be effective, conservation targets and project goals must "reflect the interconnected nature of ecosystems and their multiple natural, social, cultural and economic values." These goals and targets are best identified through collaborative planning processes that engage resource owners and users, experts and management agencies and provide opportunities for

diverse stakeholders to convey priorities and anxieties, and integrate these with traditional ecological knowledge and scientific understanding of these systems. Presentations and workshops with provincial offices, district representatives, provincial councils and traditional leaders are seen as crucial for local conservation plans to be accepted by diverse stakeholder groups (WCS Marine Fiji Program Document).

Using Science Effectively

According to EBM practitioners, science can make a variety of contributions to management planning particularly with regards to identifying management targets, threats, and actions . Biological and biophysical datasets can be used to understand the complex nature of target ecosystems and inform design of reserve networks (Clarke and Jupiter 2010a). To ensure scientific recommendations are implemented, research needs to address prioritized management questions, including social and economic issues. EBM practitioners argue that scientific investigations should have practical application and research results need to be clearly communicated to decision-makers.

Protected Area Design

Establishing and managing networks of protected areas has become an important conservation strategy for maintaining ecosystem integrity. Such networks are seen by EBM practitioners to be most effective and resilient to climate change impacts when areas are "large, representative, and connected." EBM practitioners argue that particular "ecological processes that promote resilience to disturbance" should be emphasized. In the tropical Western Pacific, however, EBM practitioners have found that socioeconomic and governance constraints typically receive more consideration than ecological concerns when determining a protected area's size, shape and placement. They argue that it is important to acknowledge and work with existing governance and socioeconomic constraints because MPA network effectiveness in this region is contingent upon social acceptance within the customary marine tenure framework. Successful management implementation also requires that users feel biological and social costs and benefits of protected area closures are equally distributed. Lastly, protected areas are most successful when they are situated within a broader ecosystem management system that offers protections outside of reserves.

Effective Means of Education and Communication

Education and communication are seen as important elements of EBM. In the Western Pacific context, important messages are usually communicated most effectively through casual gatherings, and newsletters and fact sheets in the local language that are focused on essential topics are effective within communities. It is important to follow up printed messages with verbal communication and allocate sufficient time and resources to such activities in project proposals and plans.

Project Monitoring

A program for ongoing monitoring of key indicators is seen as necessary to measure EBM

effectiveness. Practitioners have found EBM monitoring plans need to be directly linked to management targets and threats and include a variety of biological and socioeconomic indicators across all ecosystem types contained by the management area.

Utility of EBM Decision-Support Tools

Because many EBM decision-support tools were developed for application in developed countries, they may have limited applicability to the western Pacific context where technical capacity is lower, data is often scarce, and people are skeptical of computer-generated models, in some instances.

How to Scale up EBM

According to EBM practitioners, while EBM is a place-based approach, it is not solely about site-based conservation. EBM principles are applicable at larger spatial scales and can be incorporated into national and sub-national policies and programs. EBM practitioners argue that conservation practitioners in the western Pacific can facilitate efforts to scale up EBM by conveying EBM principles, methods and results in the field; promoting integration of government policy and decision-making processes; encouraging policy and law reform that reflects EBM principles; and working in partnership with government agencies on program design and fundraising.

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