

A Framework of Lessons Learned from Community-Based Marine Reserves and Its Effectiveness in Guiding a New Coastal Management Initiative in the Philippines

MARIA BEGER*

The Ecology Centre
University of Queensland
St Lucia, QLD 4072, Australia

ALASTAIR R. HARBORNE

Coral Cay Conservation Ltd
Colliers Wood, London SW19 2JGUK

TERENCE P. DACLES

Philippine Reef and Rainforest Conservation Foundation Inc.,
#3 Doña Ceferiña Bldg.
Mandalagan, Bacolod City
Negros Occidental, Philippines

JEAN-LUC SOLANDT

Coral Cay Conservation Ltd
Colliers Wood, London SW19 2JGUK

GERARDO L. LEDESMA

Philippine Reef and Rainforest Conservation Foundation Inc.,
#3 Doña Ceferiña Bldg.
Mandalagan, Bacolod City
Negros Occidental, Philippines

ABSTRACT / Community-based coastal resource management has been widely applied within the Philippines. However, small-scale community-based reserves are often inefficient owing to management inadequacies arising because of a lack of local support or enforcement or poor design. Because there are many potential pitfalls during the establishment of even small community-based reserves, it is important for coastal managers, communities, and facilitating institutions to have access to a summary of the key factors for success. Reviewing relevant literature, we

present a framework of "lessons learned" during the establishment of protected areas, mainly in the Philippines. The framework contains summary guidance on the importance of (1) an island location, (2) small community population size, (3) minimal effect of land-based development, (4) application of a bottom-up approach, (5) an external facilitating institution, (6) acquisition of title, (7) use of a scientific information database, (8) stakeholder involvement, (9) the establishment of legislation, (10) community empowerment, (11) alternative livelihood schemes, (12) surveillance, (13) tangible management results, (14) continued involvement of external groups after reserve establishment, and (15) small-scale project expansion.

These framework components guided the establishment of a community-based protected area at Danjugan Island, Negros Occidental, Philippines. This case study showed that the framework was a useful guide that led to establishing and implementing a community-based marine reserve. Evaluation of the reserve using standard criteria developed for the Philippines shows that the Danjugan Island protected area can be considered successful and sustainable. At Danjugan Island, all of the lessons synthesized in the framework were important and should be considered elsewhere, even for relatively small projects. As shown in previous projects in the Philippines, local involvement and stewardship of the protected area appeared particularly important for its successful implementation. The involvement of external organizations also seemed to have a key role in the success of the Danjugan Island project by guiding local decision-makers in the sociobiological principles of establishing protected areas. However, the relative importance of each component of the framework will vary between coastal management initiatives both within the Philippines and across the wider Asian region.

Coral reef management, including fisheries and biodiversity conservation, is often executed using ma-

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*Author to whom correspondence should be addressed; *email:* mbeger@zen.uq.edu.au

rine protected areas (MPAs), particularly in developing countries (Hatcher and others 1989; Polunin and Roberts 1991; Jones and others 1992; Allison and others 1998; Bohnsack 1998; Lauck and others 1998; Salm and others 2000; Roberts and others 2001). Unfortunately, a large number of MPAs are not effective (McClanahan 1999) and represent "paper parks" that are designated but in reality do not achieve their goals. In developing countries, a lack of effectiveness can occur because of

limited acceptance and support by adjacent communities that are almost always required for the establishment of a sustainable MPA (Bunce and others 2000; Salm and others 2000; Vanderklift and Ward 2000; White and Vogt 2000). Community support and involvement within an integrated coastal zone management scheme increases the likelihood that, for example, fisherfolk respect reserve regulations (Pomeroy and Carlos 1996; Alcala 1998; Cicin-Sain and Knecht 1998; Russ and Alcala 1999; Olsen and Christie 2000). Fishers who fish illegally or despite voluntary agreements will substantially reduce the efficacy of a reserve and a resumption of fishing quickly decreases fish populations (Davies 1977; Russ and Alcala 1989; Russ and Alcala 1996b).

The Philippines is one of the leading proponents of community-based coastal zone management in Southeast Asia (Rivera and Newkirk 1997; Uychiaoco and others 2000) and is often looked to for model approaches (White and Deguit 2000). The archipelago supports extensive coral reef, mangrove, and coastal resources, which are under increasing threat from over-exploitation, damage, and pollution (Gomez and others 1994; Bryant and others 1998; Courtney and White 2000). Many coastal communities rely on the sea for income and food, commonly at subsistence level, and, therefore, declining resources combined with population growth lead to increased poverty. The resulting urgent need for resource management has been recognized by many institutions and local communities that have initiated marine resource management projects. In addition to the establishment of marine reserves, such initiatives generally also focus on some of the following objectives: (1) resource assessment and scientific monitoring, (2) community preparation and organizing, (3) capacity building, (4) provision of alternative livelihoods, and (5) conservation education (Rivera and Newkirk 1997; Alcala 1998; Uychiaoco and others 2000). However, many of these projects have proven unsustainable, particularly when external intervention and funding ceases. There are about 565 marine reserves and coastal management schemes in the Philippines, but only 10% have been rated as effective (Aliño and others 2000). A recent case study rating existing MPAs found that 19% of a small number of selected MPAs scored the “enforced” or “sustained” rating after at least 2 years existence, and only one MPA was rated as “institutionalized,” which constitutes the top score (White and others 2003a).

Unsuccessful marine reserves can usually be related to a failure to incorporate all necessary components of preparation, implementation, and evaluation in close participation and collaboration with the local community and governmental agencies (Pomeroy and others

1997; Alcala 1998; White and Vogt 2000). The “lessons learned” during the establishment of both unsuccessful and successful protected areas have been documented within an extensive body of literature, some of which is unknown in countries aiming to establish marine reserves. The approach of this article is to synthesize and apply existing knowledge to assist the building of a framework for establishing sustainable and effective reef management initiatives. We feel that because a large number of MPAs have been established in the Philippines and the Asia-Pacific region, most of the general principles have been proven and it is now important to understand which are the most successful. Although every proposed protected area will be subject to different conditions, a listing of key factors would be invaluable to managers with limited resources and maximize their chances of success.

This article, therefore, has four clear aims: (1) synthesize the previously disparate literature on lessons learned establishing community-based MPAs, principally in the Philippines; (2) describe how the resulting framework of knowledge and experience could be used to guide the establishment of a MPA in the Philippines; (3) provide additional examples of successful practices for establishing marine reserves; (4) highlight the relative importance of different lessons learned in establishing MPA.

A Synthesis of Previous Lessons Learned Establishing Marine Reserves

A full review of the literature dedicated to establishing community-based MPAs in the Asia-Pacific is beyond the scope of this article. However, the literature has been summarized in Table 1 and represents a clear framework of current knowledge for establishing successful MPAs. Table 1 separates published “lessons learned” into three categories; optimal initial conditions, best practices for establishing protected areas, and key factors to consider when managing and existing protected area. Readers are referred to the original sources for further details.

Applying the Synthesis of Lessons Learned to Establish a New Marine Reserve

Following the synthesis of the available literature, we wished to examine how the framework presented in Table 1 could be applied to guide the establishment of a MPA. The subject of the study was the Danjugan Island Marine Reserve and Sanctuaries (DIMRS) that was formally established in February 2000 as one of the

Table 1. Review of previously documented ideal conditions, key factors and lessons learned for the successful establishment of a marine reserve

| | References |
|--|---|
| Lessons learned about favorable initial conditions | |
| 1. Small coastal island are a good location for marine reserves. | White and Vogt 2000 |
| 2. A small local population size in nearby communities and limited access to the resources by nonlocals communities is highly beneficial. | Pomeroy and others 1997; Russ and Alcala 1999; Pollnac and others 2001a |
| 3. Land-based development should not affect marine resources significantly. | Jameson and others 2002 |
| 4. Successful reserve initiation often results from a "bottom-up" approach, where local interest in resource protection is a consequence of declining catches or adjacent examples. | Pomeroy and Carlos 1996; Pomeroy and others 1997 |
| Lessons-learned about establishing a marine reserve | |
| 1. Most marine reserves result from projects facilitated by an external organization providing guidance, advice, and, in some cases, funding. | Olsen and Christie 2000; White and Vogt 2000 |
| 2. Acquisition of ownership of a site by a conservation organization is a means to ensure that conservation goals are met. | Mwandotto 1996 |
| 3. A scientific information database is essential to base reserve selection and management on data allied with local preferences and to illustrate resource condition to communities. | Savina and White 1986; Cicin-Sain and Knecht 1998; Vanderklift and Ward 2000; White and Vogt 2000 |
| 4. All stakeholders and community groups should participate in the decision-making process, including reserve design and management. | Massinga 1996; Pomeroy and others 1997; Done and Reichelt 1998; Uychiaoco and others 2000; White and Vogt 2000) |
| 5. Legislation decreases the vulnerability to changes in government. | Heinen and Laranjo 1996; Agbayani and others 2000; White and Vogt 2000 |
| 6. Education provides an understanding of how management strategies will improve the environmental situation. Community work and organization is critical for self-reliance and acceptance of both the reserve and the responsibilities that result from a successfully implemented project. | Savina and White 1986; Heinen and Laranjo 1996; Rivera and Newkirk 1997; Courtney and White 2000; White and Vogt 2000; Elliott and others 2001 |
| 7. The introduction of alternative livelihood schemes is vital to reduce poverty generally and to compensate for the loss of fishing grounds that are included in no-take zones. | Rivera and Newkirk 1997; Pollnac and others 2001a |
| Lessons learned managing an existing reserve | |
| 1. Surveillance is important, as intruders who violate the reserve can seriously damage the recovery process of fish populations. | Russ and Alcala 1996b |
| 2. People must see some results of their efforts to continue a management program aiming to improve their marine resources. | Pomeroy and others 1997; White and Vogt 2000 |
| 3. Continuing advice is required from the organization that facilitated the establishment of a marine reserve, with a potential inclusion of new advising bodies as the project grows. | Pomeroy and others 1997; Pollnac and others 2001a |
| 4. A local project can expand into a regional MPA network. | Beger and Harborne 2000 |

results of the ongoing Philippine Reef and Rainforest Project (PRRP) in Negros Occidental. The PRRP began in 1995 with the aims of conserving reef and coastal resources, improving the understanding of coastal environmental issues, as well as alleviating poverty (Ledesma and others 1998). The project was facilitated by the Philippine Reef and Rainforest Conservation Foundation Inc. (PRRCFI), which worked with the local community, local government, and international collaborators.

Because the establishment of DIMRS marked a milestone in the evolution of PRRP, this article describes the progress during the first 6 years of PRRP from 1995 to 2000. DIMRS is located around Danjungan Island in Negros Occidental, Philippines, on the west coast of southern Negros (Figure 1). The island is uninhabited and relatively small, with an area of 48 ha, a length of 1.65 km, and a maximum width of 300 m (Aliño and others 2002). The island is covered by dense rainforest, and with its surrounding reef, it could be considered a

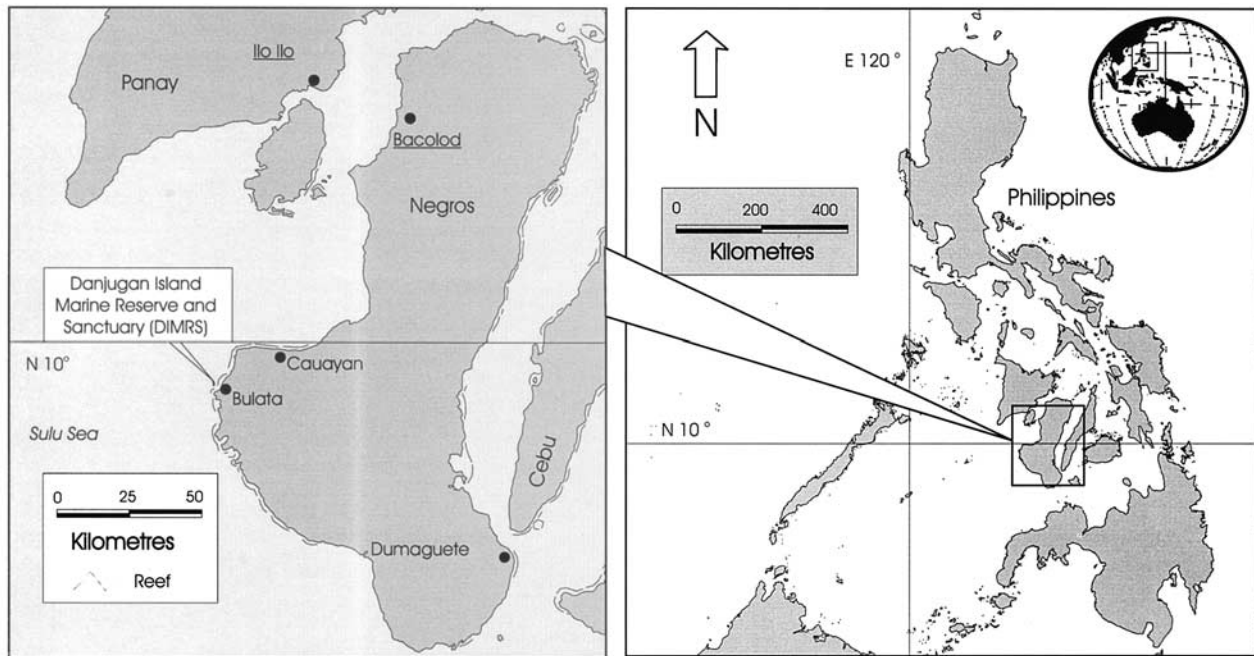


Figure 1. Location of DIMRS within the Philippines.

biodiversity hot spot where a multitude of species and habitats occur. The island is ~3 km from the mainland and is under the jurisdiction of Barangay Bulata. A *barangay* is an independent administrative unit at village level dating from before the Spanish colonization (Ferrer 1991). The local government at village and municipality levels hold jurisdiction over fisheries and marine resources in municipal waters for up to 15 km from the coast (White and others 2002). Bulata is a small village [4379 inhabitants in 1991 (Aliño and others 2002)] where people rely on fishing or gleaning from the sea as their main source of income or food. The fishery is a subsistence activity and the majority of boats are not powered.

Lessons Learned About Favorable Initial Conditions

Islands Are a Good Location for Marine Reserves

Small coastal islands represent discrete areas with clear borders and spatial buffering from coastal populations and influences. Therefore, they form ideal units for marine reserves. Owing to their location off the mainland coast, such islands commonly fulfill marine reserve selection criteria such as high water quality, larval sources for adjacent reefs along the coast, and, because of high water-exchange rates, a lower susceptibility to climate-change-related coral bleaching (Salm

and others 2001). Furthermore, small coastal islands are close enough to mainland areas to facilitate regular surveillance and support by management agencies. It is also easier to establish stewardship of marine resources in small island communities (White and Vogt 2000). Indeed, it is no coincidence that the most successful marine reserve in the Philippines is based around an island (Russ and Alcalá 1996a). Danjugan Island is similar to Apo Island in scale (72 ha) and distance from the shore (< 5 km) and was, therefore, an ideal location for a reserve.

Small Local Population Size and Limited Access to the Resources by Nonlocal Communities Is Highly Beneficial

The size of coastal populations is positively correlated with the pressure placed on a given unit area of marine resources and, hence, establishing no-fishing areas generally becomes more difficult with increasing population density. Similarly, the resources needed for the effective environmental education of local residents scales to the size of the local population. Experience from other community-based marine reserves in the Philippines has shown that those reserves adjacent to small communities tend to be more successful (Pollnac and others 2001a). Danjugan Island was unusual because it was uninhabited and there were no issues regarding the acceptance of management initiatives by

people directly living within the proposed reserve area. The population of the nearby village of Bulata was utilizing the marine resources at Danjungan Island, but the small population size made it easier to involve most fishers affected by the closures in the planning and discussion phase of establishing DIMRS.

Land-Based Development Should Not Affect Marine Resources Significantly

The concept of integrated coastal zone management involves a holistic approach to managing the entire coastal zone by ensuring that development is compatible with conservation (e.g., Kenchington and Crawford 1993). In practice, it is extremely difficult to mitigate detrimental factors occurring within the watershed of a putative marine reserve. Upstream factors such as sedimentation caused by deforestation, which can cause significant coral mortality (e.g., Wesseling and others 1999), are often harder to alleviate than the direct impacts on the marine resources (Jameson and others 2002). Danjungan Island, as a small offshore island without a resident population, had the advantage of a spatial buffer of a minimum of 3 km from impacts caused by coastal factors. Furthermore, threats to reefs in southern Negros Occidental caused by coastal development and land-based pollution were classified as relatively low to medium in the "Reefs at Risk" project (Burke and others 2002). Mainland impacts were predominantly the result of land-use change to facilitate rice plantations, coconuts, and small food crops. The forests of the island itself were relatively intact (Turner and others 2002), which minimized local sedimentation impacts.

Successful Initiation of a Marine Reserve Is Often the Result of a "Bottom-up" Approach

The imposition of coastal zone management practices against the will of local communities is rarely successful and previous work has shown reserves to be most successful where local interest in resource protection initiates the establishment of a reserve (Pomeroy and Carlos 1996; White and others 2002). Ideally, the impetus for a reserve should develop for reasons such as declining fishery catches or local communities seeing the benefit of adjacent successful reserves (Pollnac and others 2001a). The bottom-up initiation of conservation measures was a major contributing factor in the successful establishment of the DIMRS. Founder members of the PRRCFI had visited Danjungan Island since the 1970s and established close links with the local community. Therefore, these founder members were well placed to address the growing concerns of fisher-

folk about declining fish catches in the early 1990s and advise on the benefits of a marine reserve.

Plans for a marine reserve could be closely integrated to the needs of the local community. White and others (2002) gave a detailed description of the legal and institutional framework of marine reserves in the Philippines, which highlighted that local and municipal governments hold a high degree of independence from national legislation. Thus, it is critical to have support for marine reserves by the local government (Alcala 1998; Pollnac and others 2001a; White and others 2002). This support was also present in the case of Danjungan Island, where all layers of local government ranging from barangay leaders, the acting mayor of the Municipality of Cauayan, and the acting governor of Negros Occidental were supporting the principles of environmentally sustainable development (Lizares, personal communications, 2000).

Lessons Learned During the Process of Establishing a Marine Reserve

Most Marine Reserves Result from Programs Facilitated by an External Organization

Most marine reserves result from programs facilitated by an internal or external organization, which guide the community and provide advice and, in some cases, funding (Heinen and Laranjo 1996; Rivera and Newkirk 1997; Olsen and Christie 2000). In the case of the Danjungan Island project, PRRCFI initiated a strong link with two international collaborators based in the United Kingdom: Coral Cay Conservation Ltd. (CCC) and the World Land Trust (WLT). WLT was primarily responsible for fund raising. From 1995, CCC provided (1) nonprofessional diver volunteers to assist with natural resource assessment, (2) training of local counterparts in SCUBA diving, marine ecology, and identification skills, and (3) assistance with the presentation of results to the local community, government, and other stakeholders. CCC has given such technical assistance to organizations in a range of countries (Raines and others 1992; Wells 1995; Harborne and others 2002).

The field collaboration between PRRCFI and CCC led to the presence of a diving and research facility and operation on Danjungan Island for ~4 years until the resource assessment was completed in 1999. In addition to the provision of data and training, discussed in more detail later, the continuous presence of foreign expertise and a workforce in the project area provided the local community with contact with foreign cultures, expertise, and attitudes. This interaction was beneficial because, for example, exposure to the English lan-

guage and Western culture on a long-term basis provided the grounding for a subsequent introduction of nature-based tourism. There were also immediate tangible benefits of the PRRCFI and CCC program such as the establishment of basic living facilities, subsequently donated to PRRCFI, and provision of significant additional local income through food and equipment purchases and boat hire.

Acquisition of Title

In order to mitigate short- and long-term damage once a marine reserve is established (e.g., from coastal development, tourism, or fishing), a management plan that is accepted by all stakeholders is commonly adopted (e.g., Gabriele and others 1994; Gibson and others 1998). Acquisition of ownership by a conservation organization is another mechanism by which conservation goals can be achieved (Mwandotto 1996) and should ideally occur in conjunction with a management plan.

Danjungan Island was bought by PRRCFI in 1995 and converted into a small, privately managed wildlife reserve. The island was paid for through an international fund-raising scheme with the assistance of the WLT and CCC, which, for example, established the sale of “shares” in the island and marketed the opportunity to “adopt an island” and aid conservation. The private ownership of Danjungan Island represents an unusual situation in the Philippines and, indeed, Asia. The acquisition of Danjungan Island has been important in convincing local stakeholders of the long-term commitment of the PRRCFI as a facilitator of DIMRS. It guaranteed a high level of control of land-based activities on the island itself, which would be more complicated if there were multiple owners or free access to the island. Because the current owners are committed to conservation of terrestrial and marine environments, land-based activities on the island aim for sustainable practices. Ownership by an organization rather than a person ensures that sustainable management will continue, as the organization is committed to its statutory objectives. Whereas limited access to the private island ensures a minimal impact to the environments, a negative result was the loss of a popular recreational site for the villagers and required continual discussions to mitigate any resentment within the community.

Private ownership only extends to the shoreline, and the reefs below the mean high-tide mark are public resources under the jurisdiction of local governments. In order to pass legislation, the community members voted for or against it in a public hearing. This led to a successful establishment of DIMRS by municipal ordi-

nance. Although the PRRCFI are heavily involved with developing and implementing an integrated coastal zone management plan, its acceptance and enforcement is managed by the local government and community groups. DIMRS is managed by a local DIMRS management council whose members operate on a voluntary basis. Large and colorful information posters are mounted at the local bus stop and the management council’s office to inform others about DIMRS, its boundaries, and associated regulations. A fee is collected from each visitor who dives within the reserve, which benefits the local government and the management council.

A Scientific Information Database Is Essential

A scientific information database is essential for the success of coastal resource management (Cicin-Sain and Knecht 1998; Vanderklift and Ward 2000; White and Vogt 2000). Marine reserve siting, design, and management depend heavily on biological information such as the diversity and pattern of habitats, the location of larval sources and sinks, the vulnerability of the area to human and natural threats, and changes in aspects of reef health. A detailed subtidal survey of the marine resources has been recommended for optimal reserve design (Salm and others 2000), yet it has been lacking in the majority of coastal management projects around the Philippines, often owing to restricted funding, time, or expertise.

In order to designate a scientifically sound marine reserve around Danjungan Island, the PRRP drew on the expertise and services of the CCC. This organization specializes in utilizing volunteers to collect baseline information on natural resources, particularly through the creation of habitat maps. Habitat maps and their associated databases, generated from a combination of field surveys and remotely sensed imagery, play a key role in coastal zone management provide an inventory of habitat types and their statistics (Mumby and others 1995b; Spalding and Grenfell 1997) and the location of environmentally sensitive areas (Biña 1982), allow representative networks of habitats to be identified (McNeill 1994), permit changes in habitat cover to be detected (Loubersac and others 1989), and allow boundary demarcation of multiple-use zoning schemes (Kenchington and Claasen 1988). Furthermore, the conservation of marine habitats could serve as a practicable surrogate for conserving other scales of diversity including species and ecosystems (Gray 1997).

A discussion of the techniques and results of CCC’s surveys is beyond the scope of this article and readers are referred to Mumby and others (1995a) for an over-

view of the semiquantitative technique used and to Mumby and Harborne (1999) and Mumby and others (1996) for a synopsis of data analysis protocols. Furthermore, a full description of the technical aspects of producing the habitat maps for Danjungan Island with an acoustic ground discrimination system is provided in White and others (2003b). The reef habitats around Danjungan Island and the adjacent reefs were mapped using data from ~ 50 transects collected by international and local volunteers. These maps and biodiversity reports acted as a focal point during discussions with local stakeholders and provided a scientific rationale for both the concept of a reserve and the best areas to protect from fishing. The range of outputs were also important, as these fulfilled the various needs within the Philippines such as appraisal of the detailed data analysis by academics to the maps which were a highly effective tool to enable decision-makers and government representatives to visualize the environment. Although the database was not used for detailed spatial analysis that can assist the design of reserves (e.g., Clark and Slusher 2000; Begor and others 2003), these data ensured that representative examples of each habitat type were incorporated in no-take zones.

The volunteer surveys were supplemented by specialist datasets and anecdotal information collected by local and international experts who, for example, collated species lists for marine and terrestrial biota. The ability to highlight the high diversity of coral species (~ 240 species; Fenner, personal communication, 2001) played a key role in raising national and international awareness of the importance of establishing a marine reserve at Danjungan Island. Figures of species richness immediately resonate with people's understanding of the importance of biodiversity. Furthermore, at national and local scales, there was considerable interest in the fact that the reefs around Danjungan Island might support new coral species. This interest helped to generate support and funding toward the reserve's formation. The scale of scientific work completed by experts and volunteers on the island during the planning of the DIMRS and the role that these data played in the success of its establishment were significant compared to other projects in the Philippines.

Stakeholders and Community Groups Must Participate in Reserve Design

Experience from other community-based coastal resource management projects has highlighted the significance of incorporating all stakeholders in making decisions about reserve design and management (Pomeroy and others 1997; Rivera and Newkirk 1997; Pestano-Smith and others 1999; Courtney and White

2000; Uychiaoco and others 2000; Pollnac and others 2001a; White and others 2002). During establishment of the DIMRS, community empowerment enabled community members to both lobby for the reserve and contribute significantly to its design and siting. Initially, recommendations for the reserve's location, zonation, and management were established from the environmental information available. The recommendations aimed to include factors such as representative areas of each habitat and particularly healthy reef area in no-take zones while also leaving some productive areas accessible to fishing. Recommendations were then discussed with People's Organizations, local fishermen, and community groups, and, subsequently, plans were drawn up based on preferences of different user groups and local government units. Importantly, previous community work and education had laid a foundation for this process to be fully understood by community stakeholders.

Legislation Decreases the Vulnerability to Changes in Government

The final reserve design consists of three no-take sanctuaries [special management areas (SMA)] and a 500-m buffer zone (reserve), where traditional fishing methods are permitted (Figure 2). Only boat travel, research, and educational activities are allowed inside the sanctuaries. The influence of local communities in the design of these SMAs is apparent in the available fishing grounds to the northeast and southwest of the island, which provides leeward reefs for fisherfolk during different seasons when prevailing winds are from these directions. The relevant legislation was approved by the barangay government and the municipal government and was endorsed by the Province of Negros Occidental in February 2000. Thus, all government levels passed the ordinance for the DIMRS into law (Municipality of Cauayan, Municipal Ordinance 99-52-Dec. 99). This ordinance was particularly encouraging for the project because it has been recognized that there needed to be a commitment of resources from the local government and such support is often lacking (Makoloweka and others 1996; White and Vogt 2000). Although local support for reserves is regarded as key to the success of marine reserves, this ordinance was considered equally important as the reserve became less vulnerable to changes in government. The changing attitudes toward the reserve formed around Sumilon Island [see review by Russ and Alcala (1996b)] highlights the need to get both local support and legislative backing for long-term sustainability.

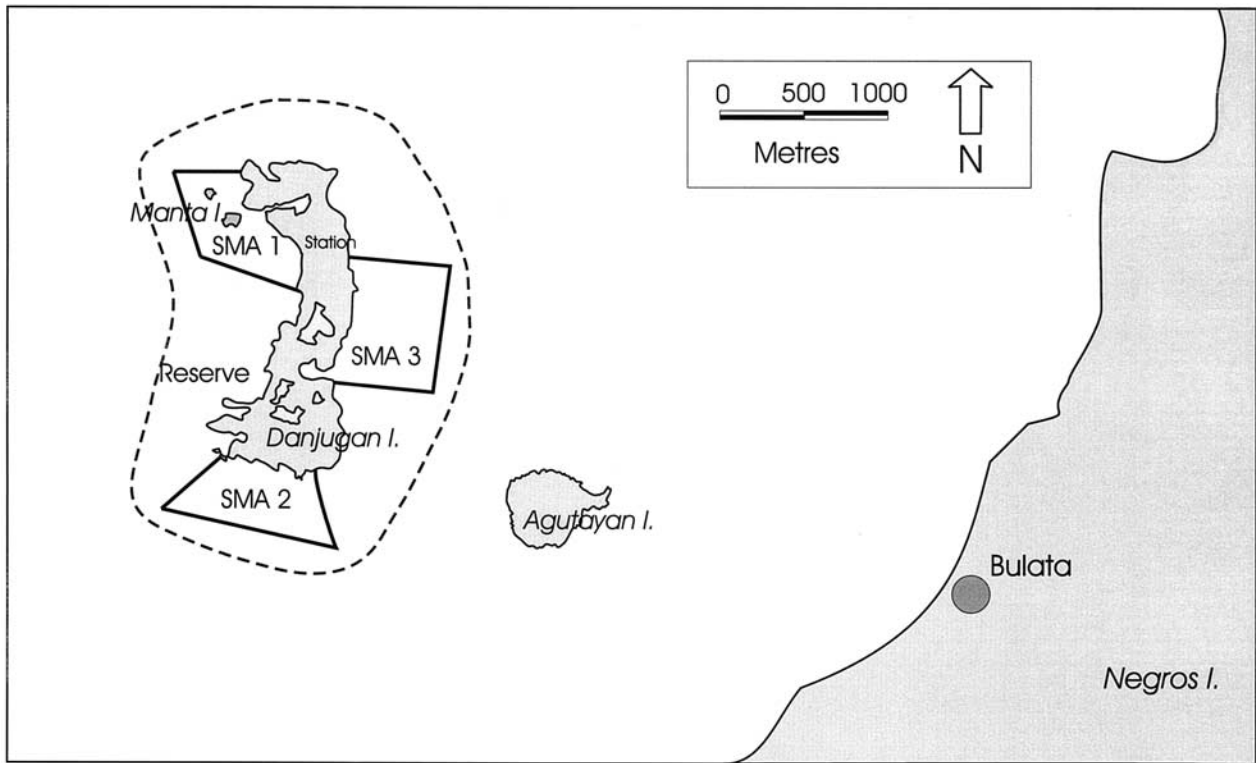


Figure 2. Danjugan Island Marine Reserve and Sanctuaries zonation. Fishing and collecting has been regulated by permits inside the reserve area (dotted line) and prohibited in the special management areas (solid line); anchoring, destructive activities, and extraction of minerals is prohibited throughout the reserve.

Community Work, Education, and Empowerment Are Vital

An essential element of community-based coastal resource management is the empowerment of local people and communities, through self-governance by people's organizations and conservation education. Typically, environmental conservation education and highlighting sustainable resource use is the first step toward this goal because a community's willingness to participate in management is heavily influenced by their understanding of reef ecology and the anthropogenic impacts on reef health (Russell 1997). Overarching community work is then a key aspect to achieve full community involvement and empowerment (Rivera and Newkirk 1997). Such community work requires coordination of all social, scientific, and operational activities incorporated in the project and total transparency of all project components.

The PRRP conducted community organizing work in three barangays opposite Danjugan Island, employing resident community workers (Rivera and Newkirk 1997). Resident workers were important, as community acceptance is more efficient than if they make only

occasion visits. In Barangay Bulata, native workers based in the communities were known to the community and understood local culture and problems in the village. Several community groups were organized in this process, including a women's group, a fisheries cooperative, and several groups that were implementing different alternative livelihood schemes as cooperatives. A voluntary DIMRS management authority and a "Bantay Dagat" (voluntary coast guard scheme) group were formed.

Community understanding of the underlying issues of nature conservation and the principles of alternative livelihoods aids a successful implementation of sustainable management. In adopting a variety of educational activities, community members can be led to make informed decisions (Massinga 1996). Conservation education is part of community work and should have specific targets, such as the local school. During the PRRP, educational activities were conducted at three levels: (1) short-term practical activities, (2) lessons and workshops, and (3) resource assessment training (Table 2). Danjugan Island is an ideal "natural laboratory," where training and workshops for teachers and pupils

Table 2. Activities, workshops, and research conducted within the local community

| Activities | Workshops | Training/research |
|-------------------|--|------------------------------|
| Coastal cleanup | Marine and wildlife camp | Socioeconomic questionnaires |
| Turtle tagging | Guest lectures at school | CRM course |
| Training | Poultry farm course | Catch monitoring |
| Mangrove planting | Mud-crab farming course | Underwater surveys |
| | Swine raising course | Underwater monitoring |
| | Coastal Resource Management (CRM) course | |

alike have been conducted. Marine ecology lectures and practicals were held and a large undersea mural was painted visibly on the school wall. Participation of pupils, people's organizations, and women's groups in conservation activities such as a coastal cleanup day, mangrove planting, and participation in the national turtle tagging initiative also helped raise awareness of coastal resources. The mangrove multispecies nursery project was particularly promising, as it provided an opportunity to both learn about this habitat and regularly monitor its health.

With the understanding that today's youth are tomorrow's managers, fishers, and conservationists, PRRCFI has been running "Children's Marine and Wildlife camps" on Danjungan Island. These were 4-day workshops held at least annually for mixed groups of children from cities and local villages. The curriculum included an introduction to marine and terrestrial ecology, forest walks, snorkeling training, and reef observations. The camps aimed to introduce conservation awareness to children from diverse backgrounds and let them experience the various environments. Since 1995, ~ 250 children have participated. A workshop for environmental teacher training was also organized on the island, training 32 local teachers in conservation issues.

Research and monitoring of resources are also crucial to a successful adaptive management scheme and, therefore, ~ 15 men and women were trained to conduct marine and coastal surveys. This training included a coastal resource assessment course, SCUBA training, and participation in survey activities during the baseline assessment of Danjungan Island's marine resources. Some of the persons were trained to a very advanced level of diving (PADI Dive Master) and surveying (reef monitoring abilities) skills; this represent a key local resource for monitoring the efficacy of the DIMRS and communicating the benefits of sustainable resource use.

The approach used during the PRRP was unusual in that community involvement and research were volunteer driven, although grants were available to subsidize fishermen and their families while involved in the

project. The project depended on voluntary participation of the community in the initial, preparatory stages of community work for community organization, education, or alternative livelihood schemes, as well as after establishment of such schemes. Voluntary participation made the process extremely slow but sustainable beyond the availability of external funding. It contrasts with conventional approaches, where the continuous success can be compromised when financial support from partner organizations ceases after 2 or 3 years (Alcala, 1998).

Introduction of Alternative Livelihood Schemes Is Vital

Alternative income-generating activities have been considered necessary to provide substitute and supplementing income sources for fishing communities faced with resource decline and closed fishing areas (Rivera and Newkirk 1997; Pollnac and others 2001a). Alternative income was also judged to be an important component of the PRRP, although alternative livelihood projects were only initiated 2 years after community preparation had commenced. The presence of the volunteer research project provided income away from fishing at the start of PRRP. Through purchase of groceries, fuel, and boat hire and employment of locals as boat drivers and cooks, the village economy received an initial boost. Although these incomes were phased out with the completion of the survey activities, the community was ready to receive more sustainable livelihood ideas. The temporary jobs provided local people with the time to gain skills and knowledge for more sustainable alternative employment to fishing.

The introduction of alternative livelihoods was carried out through the people's organizations that were created as an outcome of community organizing work and were run on a voluntary basis, although grants were available to subsidize fishermen and their families while involved in the project. Hence, the community groups chose a preferred project after they had learned about advantages, work requirements, investment, revenues, and the risk involved in each. This information was

relayed by community organizers or external experts prior to making the decision. Many projects aimed to provide supplementary income to fishing, as fisherfolk like their occupation and rarely wish to give it up completely (Pomeroy and others 1997; Pollnac and others 2001b). The main alternative livelihood schemes in Bulata centered around two projects: mud crab (*Scylla* spp.) farming and pig raising. The mud-crab pens were placed in between the roots of adult mangrove plants, thereby also promoting the need for restoration of mangrove habitats along the coast. The pig-raising project focused on swine fattening and breeding. Other complementary alternative income schemes were weaving products from pandanus palms (*Pandanus* spp.), production of banana chips, and waste-utilization schemes.

The success of these activities varied. The mud-crab farming required expertise, maintenance, and diligence, which the community group initially had problems achieving. The first harvest yielded fewer mud crabs than expected, mainly because of holes in the pen that had escaped the attention of farmers. The idea of feeding snails collected from rice paddies, thus recycling energy from a waste source, proved not to be viable, as the snails attracted rats into the pen. As a result, crab farmers needed to feed small fish fry, which the villagers would usually consume themselves, to the carnivorous crabs. The main impediment to the aquaculture project appeared to be the lack of a suitable animal protein waste product to feed the crabs. It became increasingly obvious that the benefit of aquaculture income was far outweighed by the risk associated with it and, as such, it did not comply with the needs of the subsistence lifestyle in the village. In comparison, aquaculture of herbivorous species might alleviate this conflict and could be a more viable option.

The pig-fattening project was more successful because the activity was already known in the village and household waste products were available as feed. Raising pigs had less risk of escape and predation and, therefore, a higher success rate. Furthermore, piglets and pork were easily sold locally or in adjacent communities. Supplementary activities such as weaving or producing banana chips depended on access to markets, particularly tourists. Although initial success was guaranteed by sales to CCC volunteers, it was extremely difficult to establish a viable market on a sustainable time scale and those involved were not enticed by projected profit margins. As tourist numbers in Negros Occidental are generally low, better sales were achieved by approaching local buyers. In summary, alternative livelihood projects around Danjungan Island appeared

to be more successful when fostering existing skills or practices and where local markets were targeted.

Lessons Learned Managing an Existing Reserve

Surveillance Is Important for the Success of a Marine Reserve

Community-based resource management projects in the Philippines often aim for self-enforcement and monitoring of a reserve (Gauran 1996; Mascia 2001). This surveillance is important, as intruders (locals or from other villages) who violate the marine reserve can cause serious damage to the recovery process of fish and invertebrate populations (Russ and Alcala 1996b). Enforcement requires efficient use of trained personnel and resources, and for the DIMRS, several community members were trained to be qualified as “Bantay Dagat” members. However, funding for a boat and fuel was not included in government budgets at the time of reserve establishment and community members could not afford to support this activity themselves. Furthermore, intruders were often armed and apprehending an illegal boat was perceived to be a dangerous operation. The lack of formal surveillance represented a weakness of the DIMRS because it has been shown that poor enforcement by responsible groups might result where resources are scarce and responsibilities unclear (Makoloweka and others 1996).

Initially, observance of SMA boundaries had largely been maintained because of peer pressure among local fisherfolk and the activity around the island (e.g., volunteer surveys), which deterred other intruders. In 2002, the DIMRS was voted the “Best Managed Reef” in the Philippines by the Department of Environment and Natural Resources, Philippines, the Department of Agriculture, and PhilReefs. The award is “a recognition given to a management entity for its conservation initiatives for coral reefs which have demonstrated positive impacts on the ecology of the area and contributed to the socio-economic well-being of the local community” (PCAMRD 2002). The prize money in combination with a grant from the municipal government enabled the management council to acquire a boat and cover operating costs. The “Bantay Dagat” boat operates mainly at night from Bulata and is manned by local volunteers and members of the management council.

People Must See Results of Their Management Efforts

White and Vogt (2000) highlighted the importance of showing some benefits of a newly established reserve to local stakeholders in order to maintain support for

its aims. Typically, this might be via presentation of data showing increased fish populations or might arise independently by local communities perceiving increased tourism revenue or increased catches caused by spill-over from the no-take zones. Within the PRRP, it was effectively possible to combine these approaches by training local people to carry out monitoring of fish and coral populations inside and outside the SMAs. As discussed previously, the presence of a permanent volunteer project allowed the training of many former fishermen from the adjacent village of Bulata.

Trained people then formed a local survey team capable of conducting reef assessments on behalf of adjacent communities (e.g., for further reserve planning), which might be unique in the Philippines [but see Uychiaoco and others (1999) for an example of community-based monitoring by local fishers]. The survey team also conducts the annual DIMRS Monitoring Programme (Beger 2000) under the guidance of PRRCFI science staff and is advised by external researchers. Although these capabilities are a long way from absolute self-regulated planning and still depend on external assistance for equipment, planning, and data management, they provide an important conduit for highlighting the benefits of the reserve via both the resulting data and anecdotal observations by the survey team, which are inevitably circulated around local communities.

Continuing External Advice Is Beneficial

The establishment of a truly community-based marine reserve run entirely by local stakeholders is extremely difficult to achieve and collaborating organizations and individuals routinely remain involved with the reserve, even after the original program itself has been phased out (Pomeroy and others 1997; Pollnac and others 2001a). Often the role of collaborating organizations decreases with time and could change from practical assistance to more informal advice and monitoring of ongoing management issues. This involvement has been required for the DIMRS because, despite being relatively successful, many of the community organizations and institutions that have been organized and trained still lack any noticeably strong capacity toward self-reliance and self-development. Hence, PRRCFI is still actively involved in raising additional funds for new and existing projects in the area and providing overarching guidance to local communities. There are plans for an information and community training center in Bulata to further strengthen this link. CCC's involvement is more limited, but it remains a repository for the project's databases and provides scientific guidance when necessary. Further-

more, the associated charitable trust is a partner in a large grant with PRRCFI to increase the variety of land and marine livelihood opportunities through skills training and conservation. Indeed, as projects develop, new project partners are required. For example, additional skills are necessary with the development of tourist facilities to generate revenue. The DIMRS project has worked with the Provincial Bantay Dagat Task Force in the training of Bantay Dagat volunteers and the Provincial Environment and Management and Municipal Agriculture offices have assisted with alternative livelihood programs.

Small Initiatives Might Lead to Larger-Scale Projects

The project at Danjungan Island raised a broader awareness of environmental issues and sustainable coastal resource use at a municipal level and this led to the establishment of a Southern Negros Coastal Development Programme (SNCDP). The SNCDP is a provincial government program to accommodate coastal zone management and sustainable natural resource use in southern Negros, building on the methods proven during PRRP at Danjungan Island. To support these efforts, the volunteer project surveyed the reefs in the municipalities of Sipalay (1998–2000) and Hinoba-an (2000–2001). Survey results and ensuing discussion with stakeholders provided recommendations for an additional five protected areas to be established in the municipalities of Sipalay and Hinoba-an (Beger and Harborne 2000). One such area is within Barangay Elihan where collaborative efforts between local community members and PRRCFI scientists have led to the identification of a reserve site around a small (100×50 m) section of fringing reef near the community. This reef will be managed by barangay community members, but legislation still pending. The expansion of the marine conservation initiative into a regional program was largely unforeseen at the start of work on Danjungan Island. This demonstrates how a relatively small-scale project can grow into a much more substantial program.

Discussion

The establishment of a marine reserve as part of a community-based coastal resource management program is a multifaceted and complex undertaking requiring a multitude of interlinked factors to be addressed simultaneously (Courtney and White 2000; White and Vogt 2000). Principles of conservation biology and social sciences are applied to improve the status of the marine environment for and with the local communities who utilize these resources. Long-term

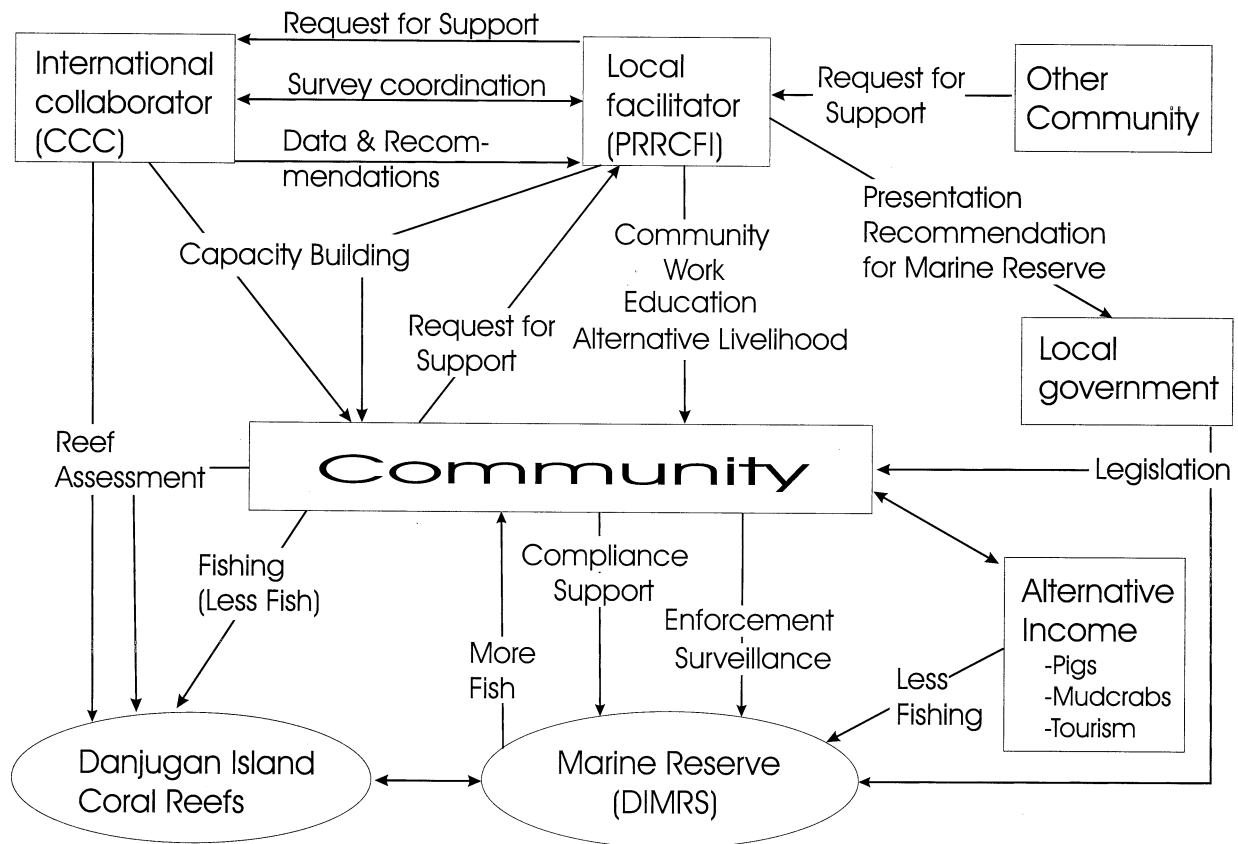


Figure 3. Schematic showing the components and main stakeholders of the PRRP.

sustainability requires a local network of legislation, skills, awareness, organization, and empowerment that will last beyond external interventions (Rivera and Newkirk 1997). The multidisciplinary approach required is inevitably a challenge, rendering even relatively simple guidelines for establishing marine protected areas an important tool in coastal management. The principles drawn from the available literature and described in this article aim at providing the basis for a framework that will assist with the successful establishment of MPAs and that can be extended and refined with additional case studies.

At Danjugan Island, integrating the framework of lessons learned into the process of establishing the protected area required a complex variety of activities and project components that “prepared” the community to accept the challenge of maintaining and continuously supporting the protected area. The integration of these consecutively implemented project components and multiple stakeholders is summarized in Figure 3. Many of the project components have now been completed, but continued community work will be important to guide the community further and to facilitate adaptive management should this be required.

Using a newly established rating system of MPAs in the Philippines (White and others 2003a), the DIMRS rates as “enforced” to “sustained,” fulfilling the criteria of site selection, biological survey, advanced education programs, a formalized and functioning management council, an extant management plan, an approved ordinance, installed boundary buoys and surveillance, biophysical monitoring conducted with the assistance of community members, and an allocated budget from the municipal government. The DIMRS is too young an MPA to fully fit into the higher categories. The rating achieved by DIMRS, along with the 2002 award as the “Best Managed Reef” in the Philippines, suggests that the project could be considered successful in establishing a sustainable MPA. However, only future surveys of the ecological health of the reefs and socioeconomic measures of increased standards of living among the local community can truly assess its efficacy. We feel that the apparent success of the protected area was made much more likely by attempting to implement the lessons learned by previous workers. The framework of lessons learned provided in this article synthesized from existing literature, proved an extremely use-

ful guide for establishing a community-based marine reserve in the Philippines.

It is clearly impossible to assess the use of our proposed framework by studying one reserve. We cannot establish how the DIMRS would currently be functioning if a number of the lessons learned had been ignored. Such problems of “experimental design” are common in coastal management. Meta-analysis approaches that compare quantitative effects on fish stocks different for MPAs from published sources (Mosquera and others 2000) or compare lessons learned and lessons ignored relative to their success (using several measures of success) for a number of marine reserves (Pollnac and others 2001a) can help to consolidate the proposed framework. Furthermore, as the human population increases, changes in lifestyle and expectations might cause new perceptions and attitudes. If the community fails to observe resource improvements, acceptance of the reserve could cease and fishing resume, as occurred in Sumilon Island (Russ and Alcala 1996b).

We derived 15 framework components important for establishing a community-based marine reserve from the literature (Table 1), but expected that some of these lessons would be inapplicable or of minimal importance at Danjungan Island. For example, access to a scientific information database was not perceived as important by Pollnac and others (2001a). Instead, we feel that all of the components were necessary and a key result of this study is that to establish the DIMRS, each of the principles was important to implement. The differences in our findings from Pollnac and others' (2001a) study are likely to be caused by different measures of success and differences in “age” of the MPAs studied and DIMRS. Pollnac and others (2001a) imply that MPAs studied were well established at the time of assessment so that improvement of coral health, perceived improvements in resource abundance by the community, and socioeconomic measures could be studied and quantified. They correlated assessed success measures across all 35 MPAs sampled. In this article, we focused on the establishment process of one particular MPA, which had specific circumstances. The DIMRS was still a very young MPA, where several of the success criteria used by Pollnac and others, such as coral health or degree of adherence to rules, were unlikely to be measurable yet. Because all of the lessons were considered essential in our case study, it is difficult to attempt a “ranking” of which factors are most important. However, we feel that local stewardship was particularly critical in the initial success of the Danjungan Island project. The importance of local involvement

mirrors the experience of other community-based projects in the Philippines.

A lasting improvement of fisheries resources by reaching preexploitation levels might require up to 40 years of protection in the case of coral reefs (Russ, personal communication, 2002). There are few marine reserves to date that have existed long enough to evaluate their long-term sustainability over such a timescale, and the DIMRS is no exception. Such long-term sustainability can only be achieved through local stewardship, initiatives, and interest in the marine resources. Protected areas that are established by an external facilitator employing the “top-down” approach are unlikely to succeed over such long timescales. Although the local support for DIMRS was perhaps the greatest strength of the PRRP, the reserve has not existed long enough to evaluate fully whether support will continue and achieve long-term sustainability. The work required *after* the establishment of a marine reserve is rarely documented in the literature and represents a section of the proposed framework that needs expansion following examination of existing reserves.

It was also confirmed by the DIMRS project that an external intervention that guides communities and contributes principles of conservation science was highly efficient in empowering the local fisherfolk and villagers to sustainably manage their coral reefs. In reality, scientific principles of establishing reserves are often not considered by or known to local decision-makers (Prendergast and others 1999) and most small-scale projects lack the resources to accomplish a coral reef survey required as a scientific basis for siting and zonation of the reserve. However, a project which only focuses on community work and lacks scientific information might not be able to choose effective management tools (Alcala 1998). The alliance with an international organization that could contribute this expertise and collect data at no cost for the project proved an excellent solution to this problem at Danjungan Island. International collaboration also allowed the community to benefit from new sources of income and gave opportunities for training, participation, and practice in MPA-related issues. This involvement was subsequently beneficial for the empowerment of villagers in reserve management and monitoring.

Marine protected area projects such as the PRRP are riddled with difficulties and a multitude of factors that can influence success. It is important, therefore, that scientists, coastal managers, and local stakeholders build effectively on previous case studies to give themselves the highest chance of reef conservation being effective at any particular location. Although the literature used means that the framework presented here is

most appropriate for the Philippines, we feel that most, if not all, of its principles are applicable throughout the wider Asia-Pacific. Furthermore, the DIMRS provides an interesting case study in the establishment of community-based marine reserves and suggests that implementing the framework components would give a new project a reasonable chance of achieving its goals.

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Literature Cited

- Agbayani, R. F., D. B. Baticados, and S. B. Siar. 2000. Community fishery resources management on Malalison Island, Philippines: R&D framework, interventions and policy implications. *Coastal Management* 28:19–27.
- Alcala, A. C. 1998. Community-based coastal resource management in the Philippines: A case study. *Ocean and Coastal Management* 38:178–186.
- Aliño, P. M., Palomar, N., and Arceo, H. (2000) Marine protected areas: Renewing the urgent needs for coral reef management. Report, Global Coral Reef Monitoring and Philippine National Workshop. Marine Science Institute, Manila.
- Aliño, P. M., E. F. B. Micalat, C. L. Jr. Nanola, H. A. Roa-Quiaoit, and R. T. Campos. 2002. Atlas of Philippine coral reefs. Philippine Coral Reef Information (Philreefs). Goodwill Trading Co., Inc, Quezon City, Philippines.
- Allison, G. W., J. Lubchenko, and M. H. Carr. 1998. Marine reserves are necessary but not sufficient for marine conservation. *Ecological Applications* 8:79–92.
- Beger, M., (2000) Danjungan Island Marine Reserve and Sanctuaries — Monitoring Programme. Methodology. Guidelines for PRRCFI, Bacolod, unpublished report.
- Beger, M. and A. R. Harborne, 2000. Southern Negros Development Programme. Summary report to the Municipality of Sipalay. Coral Cay Conservation Ltd., London, unpublished report.
- Beger, M., G. P. Jones, and P. L. Munday. 2003. Conservation of coral reef biodiversity: A comparison of reserve selection procedures for corals and fishes. *Biological Conservation* 111:53–62.
- Biña, R. T. 1982. Application of Landsat data to coral reef management in the Philippines. In Proceedings of the Great Barrier Reef Remote Sensing Workshop, 1–39.
- Bohnsack, J. A. 1998. Application of marine reserves to reef fisheries management. *Australian Journal of Ecology* 23:298–304.
- Bryant, D., L. Burke, J. McManus, and M. Spalding. 1998. Reefs at risk. World Resources Institute, New York.
- Bunce, L., P. Townsley, R. S. Pomeroy, and R. B. Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville.
- Burke, L., E. Selig, and M. Spalding. 2002. Reefs at risk Southeast Asia. World Resources Institute, Washington, DC.
- Cicin-Sain, B., and R. W. Knecht. 1998. Integrated coastal and ocean management: concepts and practices. Island Press, Washington, DC.
- Clark, F. S., and R. B. Slusher. 2000. Using spatial analysis to drive reserve design: A case study of a national wildlife refuge in Indiana and Illinois (USA). *Landscape Ecology* 15:75–84.
- Courtney, C. A., and A. T. White. 2000. Integrated coastal management in the Philippines: Testing new paradigms. *Coastal Management* 28:39–53.
- Davies, G. E. 1977. Fishery harvest in an underwater park. Pages 605–608 in Proceedings 3rd International Coral Reef Symposium, 1977, Miami, Florida.
- Done, T. J., and R. E. Reichelt. 1998. Integrated coastal zone and fisheries ecosystem management: Generic goals and performance indices. *Ecological Applications* 8(S):110–118.
- Elliott, G., B. Mitchell, B. Wiltshire, I. A. Manan, and S. Wismer. 2001. Community participation in marine protected area management: Wakatobi National Park, Sulawesi, Indonesia. *Coastal Management* 29:295–316.
- Gabrie, C., S. Planes, J. Baldwin, J. Bonvallot, C. Chauvet, Y. Vernaudon, C. Payri, and R. Galzin. 1994. Study of the coral reefs of Bora Bora (Society Archipelago, French Polynesia) for the development of a conservation and management plan. *Ocean and Coastal Management* 25:189–216.
- Gauran, D. T. 1996. The Fishery Sector Program—Community-based coastal resource management in Panguil Bay, Mindanao. in E. M. Ferrer, L. P. dela Cruz, and M. A. Domingo. (eds.), Seed of hope. College of Social Work and Community Development, Quezon City, Philippines.
- Gibson, J., M. McField, and S. Wells. 1998. Coral reef management in Belize: An approach through Integrated Coastal Zone Management. *Ocean and Coastal Management* 39:229–244.
- Gomez, E. D., P. M. Aliño, H. T. Yap, and W. Y. Licuanan. 1994. A review of the status of Philippine reefs. *Marine Pollution Bulletin* 29:62–68.
- Gray, J. S. 1997. Marine biodiversity: Patterns, threats and conservation needs. *Biodiversity and Conservation* 6:153–175.

- Harborne, A. R., D. C. Afzal, M. J. Andrews, and J. M. Ridley. 2002. Beyond data: The expanded role of a volunteer programme assisting resource assessment and management in the Bay Islands, Honduras. Pages 667–672 in *Proceedings 9th International Coral Reef Symposium*, 23–27 October 2000, Bali, Indonesia.
- Hatcher, B. G., R. E. Johannes, and A. I. Robertson. 1989. Review of research relevant to the conservation of shallow tropical marine ecosystems. *Oceanography and Marine Biology Annual Review* 27:337–414.
- Heinen, A., and A. Laranjo. 1996. Marine sanctuary establishment: The case of Baliangao Wetland Park in Danao Bay. in E. M. Ferrer, L. P. dela Cruz, and M. A. Domingo. (eds.), *Seed of hope*. College of Social Work and Community Development, Quezon City, Philippines.
- Jameson, S. C., M. H. Tupper, and J. M. Ridley. 2002. The three screen doors: Can marine “protected” areas be effective. *Marine Pollution Bulletin* 44:1177–1183.
- Jones, G. P., R. C. Cole, and C. N. Battershill. 1992. Marine reserves: Do they work? Pages 29–45 in C.N. Battershill, D.R. Schiel, G.P. Jones, R.G. Creese, and A.B. MacDiarmid (eds.). *Proceedings of the Second International Temperate Reef Symposium*, 7–10 January 1992. NIWA Marine, Wellington, Australia.
- Kenchington, R. A., and D. R. Claasen. 1988. Australia’s Great Barrier Reef — Management technology. Pages KA2.2—KA2.13 in *Proceedings Symposium on Remote Sensing of the Coastal Zone*, Gold Coast Queensland, Brisbane.
- Kenchington, R., and D. Crawford. 1993. On the meaning of integration in coastal zone management. *Ocean and Coastal Management* 21:109–127.
- Lauck, T., C. W. Clark, M. Mangel, and G. R. Munro. 1998. Implementing the precautionary principle in fisheries management through marine reserves. *Ecological Applications* 8:S72–S78.
- Ledesma, G. L., M. Beger, G. Goby, A. R. Harborne, and P. S. Raines. 1998. The Philippine Reef and Rainforest Project: An integrated approach to establishing marine protected areas. In *Proceedings The Symposium on Marine Biodiversity in the Visayas and Mindanao*, Ilo Ilo, Philippines.
- Loubersac, L., A. L. Dahl, P. Collotte, O. LeMaire, L. D’Ozouville, and A. Grotte. 1989. Impact assessment of Cyclone Sally on the almost atoll of Aitutaki (Cook Islands) by remote sensing. Pages 455–462 in *Proceedings of the 6th International Coral Reef Symposium*, 8–12th August 1988, Townsville, Australia.
- Makoloweka, S., M. Gorman, J. C. Horrill, H. Kalombo, C. Kawau, Z. Lugazo, K. Shurcliff, G. Uronu, and van Ingen, T. (1996) Establishing coastal management in Tanga Region, Tanzania. Pages 255–267 in O. Linden and C.G. Lundin (eds.). *The journey from Arusha to Seychelles — Successes and failures of integrated coastal zone management in Eastern Africa and island states*. World Bank and SIDA.
- Mascia, M. B. 2001. Designing effective coral reef marine protected areas. Report, IUCN/WCPA-m, Washington DC.
- Massinga, A. V. R. (1996) Coastal zone management in Mecufi, Mozambique. Pages 234–240 in O. Linden and C.G. Lundin (eds.). *The journey from Arusha to Seychelles — Successes and failures of integrated coastal zone management in Eastern Africa and island states*. World Bank and SIDA.
- McClanahan, T. R. 1999. Is there a future for coral reef parks in poor tropical countries. *Coral Reefs* 18:321–325.
- McNeill, S. E. 1994. The selection and design of marine protected areas — Australia as a case-study. *Biodiversity and Conservation* 3:586–605.
- Mosquera, I., I. M. Côté, S. Jennings, and J. D. Reynolds. 2000. Conservation benefits of marine reserves for fish populations. *Animal Conservation* 3:321–332.
- Mumby, P. J., and A. R. Harborne. 1999. Development of a systematic classification scheme of marine habitats to facilitate regional management and mapping of Caribbean coral reefs. *Biological Conservation* 88:155–163.
- Mumby, P. J., K. R. Clarke, and A. R. Harborne. 1996. Weighting species abundance estimates for marine resource assessment. *Aquatic Conservation—Marine and Freshwater Ecosystems* 6:115–120.
- Mumby, P. J., A. R. Harborne, P. S. Raines, and J. M. Ridley. 1995a. A critical-assessment of data derived from Coral Cay Conservation volunteers. *Bulletin of Marine Science* 56:737–751.
- Mumby, P. J., P. S. Raines, D. A. Gray, and J. P. Gibson. 1995b. Geographic Information Systems: A tool for integrated coastal zone management in Belize. *Coastal Management* 23:111–121.
- Mwandotto, B. A. J. (1996) The integrated coastal area management initiative in the Nyalí–Bamburi–Shanzu site, Mombasa, Kenya. Pages 214–220 in O. Linden and C.G. Lundin (eds.). *The journey from Arusha to Seychelles — Successes and failures of integrated coastal zone management in Eastern Africa and island states*. World Bank and SIDA.
- Olsen, S., and P. Christie. 2000. What are we learning from tropical coastal management experiences. *Coastal Management* 28:5–18.
- PCAMRD, 2002. The PCAMRD waves. Volume 15. Number 1. Available at <http://www.pcamrd.dost.gov.ph/wavesjanmarch2002.htm>.
- Pestano-Smith, R., C. A. Courtney, M. Y. Grieser, and A. E. Sia. 1999. Into the mainstream: Promoting coastal resource management in the Philippine National Agenda. Pages 1–21 in *Proceedings North American Association for Environmental Education Conference*, Cincinnati, Ohio.
- Pollnac, R. B., B. R. Crawford, and M. L. G. Gorospe. 2001a. Discovering factors that influence the success of community-based marine protected areas in the Visayas, Philippines. *Ocean and Coastal Management* 44:683–710.
- Pollnac, R. B., R. S. Pomeroy, and I. H.T. Harkes. 2001b. Fishery policy and job satisfaction in three southeast Asian fisheries. *Ocean and Coastal Management* 44:531–544.
- Polunin, N. V. C., and C. M. Roberts. 1991. Are marine reserves effective in management of reef fisheries. *Reviews in Fish Biology and Fisheries* 1:65–91.
- Pomeroy, R. S., and M. B. Carlos, 1996. A review and evaluation of community-based coastal resources management projects in the Philippines, 1984–1994. Report to International Center for Living Aquatic Resource Management.
- Pomeroy, R. S., R. B. Pollnac, B. M. Katon, and C. D. Predo. 1997. Evaluating factors contributing to the success of com-

- community-based coastal resource management: The Central Visayas Regional Project-1, Philippines. *Ocean and Coastal Management* 36:97–120.
- Prendergast, J. R., R. M. Quinn, and J. H. Lawton. 1999. The gaps between theory and practice in selecting nature reserves. *Conservation Biology* 13:484–492.
- Raines, P. S., J. M. Ridley, D. McCorry, and P. J. Mumby. 1992. Coral Cay Conservation — Survey techniques and their application in Belize. Pages 122–126 in *Proceedings 7th International Coral Reef Symposium*, 22–27 June 1992, Guam, Micronesia.
- Rivera, R., and G. K. Newkirk. 1997. Power from the people: a documentation of nongovernmental organisations' experience in Community-Based Coastal Resource Management in the Philippines. *Ocean and Coastal Management* 36:97–120.
- Roberts, C. M., J. A. Bohnsack, F. Gell, J. P. Hawkins, and R. Goodridge. 2001. Effects of marine reserves on adjacent fisheries. *Science* 294:1920–1923.
- Russ, G. R., and A. Alcala. 1999. Management histories of Sumilon and Apo Marine Reserves, Philippines, and their influence on national marine resource policy. *Coral Reefs* 18:307–319.
- Russ, G. R., and A. C. Alcala. 1989. Effects of intense fishing pressure on an assemblage of coral reef fishes. *Marine Ecology Progress Series* 56:13–27.
- Russ, G. R., and A. C. Alcala. 1996a. Do marine reserves export adult fish biomass — Evidence from Apo Island, Central Philippines. *Marine Ecology Progress Series* 132:1–9.
- Russ, G. R., and A. C. Alcala. 1996b. Marine reserves: Rates and patterns of recovery and decline of large predatory fish. *Ecological Applications* 6:947–961.
- Russell, S.H. (1997) Coral reef conservation and management: providing scientific training to the community. Pages 2087–2088 in *Proceedings of the 8th International Coral Reef Symposium*, Panama.
- Salm, R. V., J. Clark, and E. Siirila. 2000. Marine and coastal protected areas: A guide for planners and managers. IUCN, Washington DC.
- Salm, R. V., S. E. Smith, and Llewellyn, G. (2001) Mitigating the impact of coral bleaching through marine protected area design. Pages 81–88 in H.Z. Schuttenberg (ed.). *Coral bleaching: Causes, consequences, and response*. Coastal management report 2230. Coastal Resources Center, Narragansett, Rhode Island.
- Savina, G. C., and A. T. White. 1986. A tale of two islands: Some lessons for marine resource management. *Environmental Conservation* 13:107–113.
- Spalding, M. D., and A. M. Grenfell. 1997. New estimates of global and regional coral reef areas. *Coral Reefs* 16:225–230.
- Turner, C. S., T. King, R. O'Malley, M. Cummings, and Raines, P.S. (2002) Danjogan Island Biodiversity Survey: Terrestrial. Final Report. Coral Cay Conservation Ltd., London, unpublished report.
- Uychiaoco, A. J., S. J. Green, M. T. dela Cruz, H. O. Arceo, and Aliño, P.M. (1999) Integrated coastal management in Negros Oriental, Philippines: Participation in coastal habitat assessment and management. Pages 155–162 in *Proceedings International Tropical Marine Ecosystems Management Symposium (ITMEMS)*, November 1998, Townsville.
- Uychiaoco, A. J., P. M. Aliño, and A. L. Dantis. 2000. Initiatives in Philippine coastal management: An overview. *Coastal Management* 28:55–63.
- Vanderklift, M. A., and T. J. Ward. 2000. Using biological survey data when selecting Marine Protected Areas: On operational framework and associated risks. *Pacific Conservation Biology* 6:152–161.
- Wells, S. M. (1995) *Reef assessment and monitoring using volunteers and non-professionals*. University of Miami, Miami, FL.
- Wesseling, I., A. J. Uychiaoco, P. M. Aliño, T. Aurin, and J. E. Vermaat. 1999. Damage and recovery of four Philippine corals from short-term sediment burial. *Marine Ecology—Progress Series* 176:11–15.
- White, A. T., and Deguit, E. (2000) Philippine community-based coastal management: Evolution and challenges. *Intercoast* 3: 6–31.
- White, A. T., and H. P. Vogt. 2000. Philippine coral reefs under threat: Lessons learned after 25 years of community-based reef conservation. *Marine Pollution Bulletin* 40:537–550.
- White, A. T., C. A. Courtney, and A. Salamanca. 2002. Experience with marine protected area planning and management in the Philippines. *Coastal Management* 30:1–26.
- White, A. T., A. T. Meneses, and M. F. Ovenden. 2003a. Rating system for marine protected areas: An important tool to improve management. Pages 2–7 in DA-BFAR, (ed.). *In turbulent seas: The status of Philippine marine fisheries*. Coastal Resource Management Project, Cebu City, Philippines.
- White, W. H., A. R. Harborne, I. S. Sotheran, R. Walton, and R. L. Foster-Smith. 2003b. Using an acoustic ground discrimination system to map coral reef benthic classes. *International Journal of Remote Sensing* 24:2641–2660.