Community-based management and conservation

Shellfish monitoring and women's participatory management in Roviana, Solomon Islands

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Abstract

This paper summarizes the results of a women's community-based marine protected area that has been successful in sustaining invertebrate biological resources and in promoting strong community support. In 1999, the women of Baraulu and Bulelavata villages in Roviana Lagoon, Solomon Islands, created a spatio-temporal marine closure to sustain marine resources that are valuable for nutritional and income-generating purposes. The aim of this paper is three-fold: 1) to outline the project and the associated biological results; 2) to describe the process involved in attaining a committed level of community participation; and 3) to review additional lessons that have been learned during the project. We find that a high level of community involvement is achieved when positive scientific results generated by the monitoring protocol are returned to the community. This educational process, which cross-fertilizes indigenous and Western knowledge, has increased women's interest in the project and their direct participation in monitoring and enforcement. Also, the initiative's perceived success has encouraged several nearby villages, which otherwise would have no marine protection strategies, to launch other conservation initiatives. We hope that the project's findings can be generalized to other regions of the world and help to increase the effectiveness of establishing community-based marine protected areas (CBMPAs) across the Pacific region.

Introduction

This paper summarizes the results of a women's community-based marine protected area project in the Solomon Islands that has been successful in sustaining invertebrate biological resources and in promoting strong community support. Marine protected areas are emerging as a critical means to protect marine biodiversity in coastal zones around the world. In the insular Pacific, most marine protected areas and other conservation initiatives have targeted resources traditionally harvested by men (e.g. Bidesi 1994). Yet, the fishing activities of Pacific Island women, particularly the harvesting of diverse marine invertebrates, are vital in providing a source of protein and income to coastal communities. Despite their significant role, women are rarely included in community fisheries management because governments, industry, and banks hardly recognize the significance of women's artisanal and small-scale commercial activities (e.g. Chapman 1987; Mathews 2002). Since the harvest of marine invertebrates, particularly shellfish, is predominantly a female activity, the decline in these resources may have the dual effect of altering their position within their households and communities, and causing declines in households' levels of food security and operating income. In the Solomon Islands, women are frequently ignored by fisheries development and conservation projects, and until recently, scant attention has been paid to the need to manage resources that are vital to women locally. Among the two most important bivalve species harvested by Solomon Island women are the mangrove *Anadara granosa* or blood cockle, and the *Polymesoda* (*Geloina*) spp. or mud clam. These organisms are vital subsistence resources for coastal communities across the country as well as in other Indo-Pacific island nations (e.g. Fay-Sauni and Robinson 1999).

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Figure 1. **The Western Solomon Islands.**

In the Roviana Lagoon, Western Solomons (Fig. 1), these bivalves are harvested for subsistence and for cash, and their importance stems from their historic abundance, large size and accessibility.

Scant scientific research on these species has been conducted and little is known about the environmental requirements, biology, population status, and tolerances of most of these bivalves (Thu and Hung 1999). The causes for localized declines in shellfish abundance, for instance, are unknown, and there is little understanding of the effects of overfishing or modification of water quality due to land-based activities such as timber harvesting, which is prevalent in the region. The most complete studies on the biological aspects of *Anadara* spp. are by Broom (1982, 1985) and Narasimham (1969, 1988), but these studies are limited to the Philippines, Malaysia, Thailand, South Korea and Indonesia. We believe that drawing from indigenous ecological knowledge is of key importance in designing scientific research and in building a comprehensive image of marine species that are poorly understood by marine scientists. By studying different aspects of indigenous ecological knowledge, we have been able to formulate a number of working hypotheses regarding the distribution and abundance of various marine invertebrates, and we have tested these using current marine science methods (Aswani and Weiant n.d.). This information has been crucial for establishing and improving ongoing resource management plans. In this paper, we argue that the long-term environmental and social success of the project depends on a continued incentive that hinges upon a positive feedback loop between a strong level of community involvement and scientific research results that are disseminated through educational campaigns, and which are understood by all stakeholders.

The resource management project

The Baraulu/Bulelavata Women's Shellfish Project (aka The Baraulu/Bulelavata Women's Sewing Project) was established in 1999 to encourage the management of two bivalve mollusks, *Anadara granosa* (locally referred to as *riki*) and *Polymesoda* spp. (locally referred to as *deo*) with outside support from Dr Aswani. This project forms part of two larger multidisciplinary initiatives funded by the MacArthur and Packard Foundations entitled the "Roviana and Vonavona Lagoons Marine Resource Management Project" (2000–2003) and "Establishing Marine Protected Areas and Spatio-temporal Refugia in Roviana and Vonavona Lagoons, Solomon Islands" (2002–2004). These projects seek to investigate a spectrum of issues concerning human dimensions of marine resource utilization. The applied aims are to economically and educationally empower rural communities through rural development and capacity building programs (see Aswani 2000), while simultaneously promoting resource management and conservation. For instance, a small-scale sewing project has been designed to provide local women with a measure of financial independence to support local enterprises such as the construction of a permanent facility for women's activities. This incentive, which is presented as an integral component of the project and not as a trade-off, has facilitated the

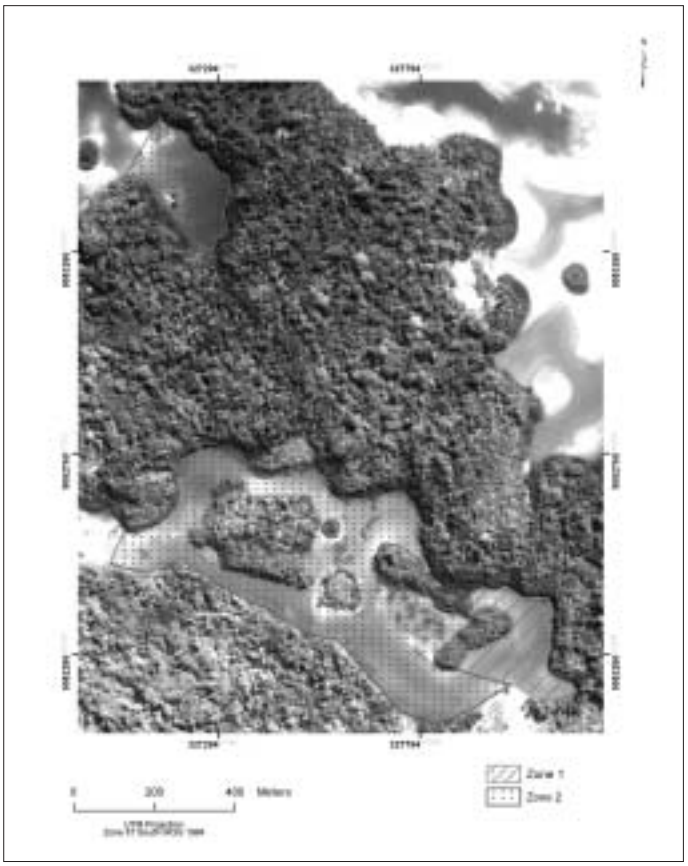

Figure 2. The Rereghana and Duduli spatio-temporal marine invertebrate refugia.

establishment of permanent marine protected areas and spatio-temporal refugia by providing women with an economic venue to offset the income they lose by not selling shells. In addition, we are assisting several communities in building clinics, schools, and water supply systems. The overarching conservation goal of the projects is to create a network of marine protected areas in southwestern New Georgia.

In the late 1990s, community leaders in eastern Roviana began discussing the possibility of developing and implementing a resource management regime to arrest the continued decline of marine invertebrates. The Baraulu and Bulelavata communities joined together to address the issue of resource loss and discuss the various available avenues that could be taken to curb the overexploitation of marine invertebrates. Members of both communities agreed to the closure of two large mangrove and associated habitat areas — locally referred to Duduli and Rereghana (Fig. 2) — to shellfish gathering during the *odu rane* (daytime high-tide) season from September through May. The area was selected due to the anecdotal decrease in shell size and abundance, and high fishing pressure due to site preferences and village proximities. The spatio-temporal closure mimics the community's traditional use of the resources: 1) the shellfish areas within Duduli and Rereghana are typically harvested less during the *odu rane* season, and 2) specific shellfish areas within these areas have been previously closed for extended periods in preparation for special community and religious events at which times ample supplies of food would be needed (although for much shorter periods). Since 1999 these two areas have been consecutively closed during the *odu rane* season. This form of preventive management (Johannes 1998) is a less intrusive regime that allows women continuing access during the most accessible times of the year. Note that other mangrove areas in which the same resources can be harvested remain open throughout the year. To evaluate the appropriateness of this management strategy in terms of its biological objectives and potential effects, we set out to design a participatory monitoring protocol. The objective of the monitoring research was two-fold: 1) to assess the effect of the temporal refugia on the two overexploited mangrove-associated bivalve populations (*riki* and *deo*) by comparing trends in abundance and size over time and between control and experiment sites, and 2) to foster community involvement in the project, especially by women and children. This has been accomplished through education on the monitoring methodology, direct participation in the monitoring, and participatory workshops. The ultimate goal is for the community to conduct their own monitoring.

Shellfish monitoring and associated biological results

The shellfish monitoring was conducted following two strategies: *in situ* (in the field) and *ex situ* (household surveys). Despite the difference in monitoring approaches, the data collected from these efforts is highly integrated and depends heavily upon community involvement. *In situ* monitoring was carried out in September 2000 (pre-closure), May (post-closure) and August (pre-closure) 2001, and May 2002 (post-closure). No baseline data was collected when the closure was put into effect in 1999, and the number of monitored sites fluctuated over time due to financial and community constraint. In September 2000,

eight sites were sampled (three experiment and one control site for *riki* and *deo*, respectively). In 2001, the number of sampled sites was increased to sixteen sites (four experiments and four control sites for *riki* and *deo*, respectively) in an attempt to yield more accurate scientific results. In 2002, however, only 14 of the 16 sites were monitored due to a local management decision (e.g. Koqu Piu was selected as a permanent closure and Koreke was closed in preparation for a religious festival, thus could no longer be used as a control site) (Table 1). The selections of experiment and control sites were based on women's knowledge of principal shellfish harvesting locations. Employing indigenous ecological knowledge, therefore, was crucial for selecting the sites in which to conduct our scientific monitoring.

Table 1. **Monitored sites in the experiment and control areas.**

Areas monitored within closed area (experiment sites)		Areas monitored within open area (control sites)	
riki	*deo*	*riki*	*deo*
Koqu Piu	*Koqu Piu*	*Miho Rereke*	*Miho Rereke*
Duvulani	*Duvulani*	*Kopo I*	*Kopo I*
Koqu Kanada	*Koqu Kanada*	*Kopo II*	*Kopo II*
Duduli	*Duduli*	*Koreke*	*Koreke*

Data collection

A rotating team of six to ten Roviana women, and on occasion men and school children, conducted the *in situ* monitoring. At each site, the range of suitable shellfish habitat was monitored, with the starting point selected at random. Transects for *riki* were run every 20 feet in the water at the mangrove-estuarine interface and samples were collected every 10 feet using a 0.25 m^2 quadrant (Fig. 3). Women customarily collect *riki* by wading in the water and digging their feet and hands into the muddy substrate. This method was used to collect the shells during sampling. Transects for *deo* were laid every 40 feet and samples were taken every 20 feet using a 1 m^2 quadrant. Women collect *deo* on land in the mangrove forests adjacent to the lagoon water and *deo* is gleaned by spotting the shell in the mud and then removed by digging (Fig. 4). This method was also used to sample *deo*. All shells were counted and sorted by size class (Fig. 5). Size was measured using a standard based on the size range of shells harvested in the lagoon and on other research regarding size correlation to reproductive maturity and fecundity (e.g. Broom 1985) (Table 2). The total number of shells and their per-site number per m^2 quadrant was tallied and entered into Excel spreadsheets.

Ex situ monitoring of household harvest yields was conducted at a time when Duduli and Rereghana were open to harvest. Five women were trained to instruct all village households in how to record catch data onto a standardized form during May 2001. The following were recorded: harvest sites, number of shells gathered sorted by species and

Figure 3. **Baraulu women monitoring *riki*.**

Figure 4. **Baraulu women monitoring *deo*.**

Figure 5. **Baraulu women measuring shells using size classes.**

Table 2. **Size class measurements for *deo* and *riki* in centimeters.**

	Size class			
	1	2	3	4
riki	0–2.9	3.0–4.4	4.5–5.9	≥ 6.0
deo	0–5.9	6.0–7.9	8.0–9.9	≥ 10.0

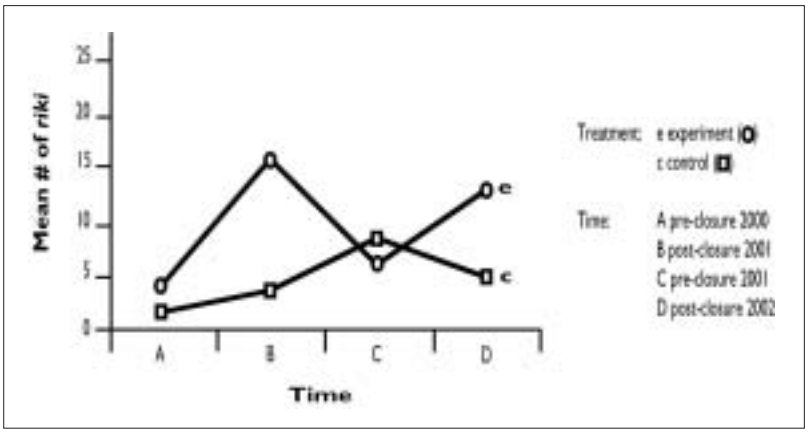

Figure 6. **Abundance of *riki* per m² quadrant by treatment and time.**

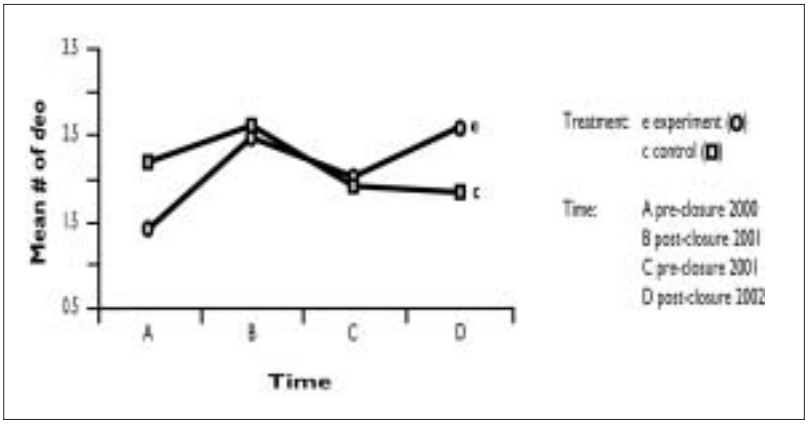

Figure 7. **Abundance of *deo* per m² quadrant by treatment and time.**

Table 3. **Average number of *riki* and *deo* harvested per harvesting event per household during the first month of the "open" season in 2001 and 2002.**

Species	Year	No. of divers	Hours per bout	Size class 1	Size class 2	Size class 3	Size class 4	Total # of shell
riki	2001	1	2.4	15	155	104	6	281
	2002	2	2.6	54	95	61	14	225
deo	2001	1	2.6	39	89	36	7	171
	2002	1	1.9	45	66	46	9	167

size, number of gleaners per trip, and number of hours spent foraging. The data was entered into Excel spreadsheets, and the average household harvest catch per bout were calculated. The purpose was to quantify daily household harvests and to document variation in catches during the open season, as well as to better understand the fishing behavior of women (i.e. the choice locations, hours employed per trip, and the trip's purpose). Simultaneously, specialized indigenous ecological knowledge regarding the ecology of *riki* and *deo* were documented.

Biological results

Shellfish abundance was compared by time (pre-closure 2000 through post-closure 2002) and treatment (experiment and control) using the statistical package JUMP. Post-test comparisons were performed using a least square means difference Tukey's honestly significant difference (HSD) test, which compares all possible pairs of means to predict where the significant differences occur. Two significant results are that: 1) there is a statistical difference in abundance of *riki* and *deo* in the experiment sites over time, with no statistical difference at the control sites; and 2) there is a statistical difference in abundance of *riki* and *deo* between treatments, most notably during post-closure 2002 for both species, and post-closure 2001 for *riki* (Figs. 6 and 7). A less significant difference between experiment and control sites prior to the 2002 open season for *deo* (Fig. 7) could have resulted from poaching. Readers interested in complete results and a full discussion of the biological findings may refer to Aswani and Weiant (n.d.). Results from the *ex situ* monitoring reveal that the mean number of *riki* and *deo* harvested per household in one fishing event during the first month of the open period were similar, with slightly more shells harvested in 2001 (Table 3). In both years, size class 2 contributed most signifi-

cantly to the catch, followed by size class 3. In 2002, the contribution to total catch from size classes 1 and 4 increased, suggesting time to grow to the next size class (with the largest size class being the most fecund) (Broom 1985).

Project structure and community participation

The increase in abundance of shellfish stocks is a significant finding, but this project's most important contributions come from its investigations of the economic and social needs of women rather than just men. The women are actively engaged in both designing and monitoring the conservation strategy. We find that this high level of their participation is having a positive impact on management decisions, and is encouraging the women to adopt sustainable harvesting practices. The women have assumed an active role, and have created an appropriate, effective, and equitable reserve design for the conservation of marine resources. This cooperation has been triggered by the growing perception among local people that shell beds have recovered rapidly, and scientific evaluation has helped to reinforce this belief.

The women have been willing to accept restriction rarely implemented in other marine conservation projects. Local communities often opt for closing fishing areas that are either less productive or more difficult to access. Baraulu and Bulelevata women, by contrast, have chosen to close areas that are of primary importance for shellfish collection. Moreover, the women have decided to permanently close a key area for harvesting *riki* within the Duduli/Rereghana closure as a result of the preliminary positive assessment of the closures. This area, called Koqu Piu, is commonly referred to as the *riki* "hospital" by the community because it is locally considered to be a source population. In September of 2002, this permanent "no-take" zone was extended to cover a larger area (see Zone 1 in Fig. 2).

Although the current trend in marine protected areas is to ensure community involvement during all the critical phases of the reserve design process (e.g. planning, establishing and enforcement) (e.g. Salm and Clark 2000; Bunce et al. 2000), few case studies demonstrate how to achieve this goal, and even fewer acknowledge the obstacles encountered that may hinder success. Here we focus on three interrelated factors that have contributed to the community's support and the project's initial success: 1) the project's time-frame; 2) the participatory design of the conservation strategy; and 3) the direct involvement by the women in the monitoring strategy.

Project's time frame

Two aspects of time contribute to the success of the conservation strategy: the amount of time the project leader has spent in the region and the long-term duration of the project. The project leader (Aswani) has over 11 years of experience working with this community and continues to reside in the area several months per year. Due to his long-term presence, the community trusts that the project is not a fly-by-night operation. Further, the project leader understands the community's social mores, customs, ways of living, resource concerns, and needs, and thus is able to present management options that are locally appropriate. In addition, the field research assistant leading the monitoring component of the project (Pam Weiant) has spent two full field seasons working with the community to ensure that women were sufficiently trained in the monitoring protocol. Since time constraints are an issue for almost any project that entails monitoring and community assistance, a substantial amount of time during the first field season was dedicated to properly training the community by holding workshops and preparing an efficient and workable monitoring schedule. In the future, the community is expected to monitor the shellfish beds on their own, although the project leader will continue to assist the community if needed. We realize that most projects are constrained by time and financial restraints. The value of time, however, should not be trivialized, as long-term projects are more likely to assure a community's commitment and, therefore, to succeed.

Design of the conservation strategy

The conservation strategy, which includes spatio-temporal and permanent closures, corresponds with the women's traditional use and management of the marine resources in this area. It also integrates an adaptable sea tenure regime with a resource management and development plan (see Aswani 1999, 2000, 2002). Despite a tangential association during the early planning of the project, an expatriate consultant hired by WWF-Solomon Islands, criticized the closure schedule and argued that the project was subsidizing women with a financial incentive (i.e. a sewing project) for continuing a practice that they have traditionally done for centuries, the periodic closing of shellfish beds (Foale 2001).[3] However, we do not perceive the project's harnessing of local forms of

3. In fact, Foale's criticism is based on a single two-day field trip to the area during the project's initial stages.

sea tenure and management to be a weakness, but a tremendous strength, and the management regime's foundation. The plan builds upon a practice that the community is familiar with, and therefore, they can better grasp its biological value and understand the use restrictions it requires. The strategy is also practical in that it fits the geographical seascape. For example, policing restrictions on catch size and shell size is a problem due to the extent of the lagoon area, but spotting poachers entering and exiting the closures is not difficult. The project also reinvigorates a management strategy that had previously been implemented on an ad-hoc basis. Because this is a community driven project, we believe that this strategy will result in the long-term management of the area with long-lasting positive conservation results. In sum, the project's preliminary success in terms of improved shellfish biomass, enhanced local environmental awareness, and the reinvigoration of cultural management practices has resulted from a realistic management strategy — one that invokes strong community support and adherence, and has paved the way for the establishment of more strict conservation tools (i.e. no take areas).

Women's direct involvement in monitoring

The monitoring protocol was established to enable all women to participate in the field monitoring, the household harvest recording, the expert workshops, and in field logistics. Village women who were physically able to gather shellfish (which excludes women with small children, those pregnant or nursing, and the elderly) were divided into four groups of approximately 30 women. Each group was assigned to one day each week on which a minimum of six and a maximum of 10 women were asked to volunteer for the monitoring, and two women were asked to prepare lunch for the team. A leader and an alternate leader were nominated within each group to organize and oversee the monitoring procedure. We attempted, as best as possible, to coordinate the monitoring effort with the women's other domestic and community duties in mind. For instance, we did not monitor on Fridays (women's local market day), Saturdays (fishing day), and Sundays (church day). Given the size of each group, the women could select a week to monitor that best fitted their household responsibilities and community commitments. To bolster enthusiasm, various foodstuffs were provided to women during the monitoring, and a meal was shared upon return to the village. The women repeatedly voiced satisfaction with their participation in the monitoring, and also enjoyed the camaraderie. As is common in so many areas of the Pacific, their enthusiasm was given its most public voice during village feasts.

From the onset, women were aware of the declining shellfish stock and recognized to some degree the potential impact the project would have for their community, especially for their children. After the first year of the closure, however, the willingness of the women to engage in the project was enhanced due to: 1) their involvement in the monitoring, 2) the circulation of scientific results showing the closure's benefits, and 3) their perception that the shellfish were once again easier to find after the area was re-opened. Despite these achievements, we have encountered a number of obstacles, and our management strategy has had to be adaptive enough to work necessary modifications into the management prescription. When an issue arises, expert workshops and group consultations are arranged to discuss possible solutions, such as how to increase adherence to the fishing restriction and prevent poaching, or how to increase the effectiveness of the temporal closure. In what follows we summarize some of the problems encountered.

First, despite the long field seasons and the women's dedication, our team was often limited by the short amount of time available for monitoring. Solomon Islanders have multiple social obligations that sometime preclude them from full dedication to a particular activity. For instance, the group leaders often had difficulty in assembling their groups, which delayed departure and prevented completion of the monitoring planned for that day. This of course increased the number of days required to complete the job. Such relatively minor setbacks in the monitoring schedule were compounded with other delays caused by heavy rains and community obligations (in particular, a death in the village means all work is suspended for four to five days). We also found that community involvement and enthusiasm wanes and waxes over time, with a significant slowing of momentum following unplanned pauses in the monitoring schedule. The point is that a project leader must be cognizant of these types of logistical problems when designing a project that entails a high level of community involvement, and must structure deadlines appropriately.

A second problem, from the start of the project, has been the trade-off between a temporal closure versus other management strategies (such as a "no-take" zones and size and catch restrictions) was recognized. The advantage of the temporal closure, as discussed above, is that the design formalizes an aspect of traditional fishing practices, and thus the community already understands the strategy, the guidelines, and the restrictions. During the "open" harvest season, however, there are no limits on the take and this results in a free-for-all use of

resources. The lack of harvest restrictions may hinder the long-term effectiveness of the closure by potentially offsetting any increase in shellfish abundance that occurs when the area is closed. If we compare time-period B (monitoring that occurred after the eight month of closure) and time-period C (monitoring that occurred after the four months of harvest) in Figures 6 and 7, we see that there is a decline in shellfish abundance. The effect of the open-access regime during the open season has been recognized by the community, and we are discussing the possibility of setting size and bag limits, although this has not yet gone into effect.

A third problem is poaching. During the closed period of 2002 a small group of women poached in some areas where *deo* is found. The preference to poach for *deo* rather than *riki* is linked directly to the market — *deo* is easier to poach (women can stay dry and can hide from passing boats within the mangroves) and the shells are larger, hence fewer are needed to fill a palm basket to sell at the market. In August of 2002, by-laws were written by the Baraulu Resource Management Committee (RMC), which detail the repercussions of failing to adhere to the seasonal closure guidelines. This informal step also has been sanctioned by the leader of the local Christian Fellowship Church (the "spiritual authority"), which gives the project tremendous legitimacy. Long-term legislative enforcement of management initiatives to manage *riki* and *deo*, and other species, will be achieved though the Western Province "Customary Land Resource Management Orders" statute. We have begun the formal process of codifying this and other management initiatives that are being designed to protect important habitats and species (see Aswani and Hamilton, in press).

Last, although we would like to expand the number of sites currently being monitored, it seems improbable given the time and financial constraints involved. The monitoring of the 16 existing sites already takes approximately a month (due to non-working days and weather conditions), two times a year (pre- and post-closure). We do not think that we could ask the women to spend more time monitoring, and when the monitoring drags on for too long community involvement tends to diminish. The bottom line is that, realistically, monitoring can only be conducted for several weeks once a year or every few years.

The community has established other areas as permanent closures, such as Koqu Piu (and extension to cover neighboring waters), and we believe these are good decisions. Preliminary findings reveal that after 18 months of being closed, the abundance of *riki* at Koqu Piu had increased significantly. While the adjacent mangrove is also closed for gleaning *deo*, the area is not considered prime *deo* habitat. Thus, the community is considering if it should establish a permanently closed area for *deo* as well. While ideally they would select no-take areas that encompass source and sink populations, no scientific evidence is available to indicate where these areas are, or even to test the local wisdom regarding where they are. To make management decisions, therefore, we have had to rely on a preventive-management strategy that integrates indigenous and marine science knowledge.

Lessons learned

- While the strategy negotiated with the women of Baraulu has increased the level of participation and dedication to the project, the community still seeks financial assistance to motivate and manage the monitoring, as well as direction in modifying the management strategy. It is unrealistic to expect a CBMPA to succeed with only short-term expert guidance and financial support. Nevertheless, continued environmental educational campaigns are of key importance if we are to move beyond the economic dependency created by financial incentives as a central component of conservation projects.
- Many projects are criticized for their dependence on outside assistance. However, outside help is important for two reasons. First, communities may have good intentions to establish a conservation project, but generally lack the finances and expertise to do so. A project can be expensive and it is naïve to think that a community can support it. Second, national and provincial governments have had little interest in assisting rural communities to manage their marine resources. Marine resources that villages depend upon for subsistence are declining due to population growth and fishery commercialization. The long-term implications of this project are already visible, as other nearby communities are seeking to launch similar conservation efforts in their tenured seas. Without these small-scale CBMPAs, there would be no effective marine-protection strategies in this region.
- The ultimate long-term success of the project depends upon a positive feedback loop between a strong level of community involvement and positive scientific results. In the Roviana case, positive scientific findings have facilitated and secured community support for the project. The project leader's long-term commitment to the region will assure continued monitoring and assistance after the project is considered "complete".
- Children must be involved in the conservation strategy. In our project, children were able to accompany women during monitoring and

assist with the *ex situ* counting the household harvests (when they are most enthusiastic about sorting and counting the shells). Through conversations with the researchers, children learn about the purpose of the project, about how their marine resource fit into the larger global picture of marine conservation, and about the value of their resources.

A number of environmental and socioeconomic challenges remain to be addressed before the future of this conservation and development project can be assured. We believe that it is important to assess the early effects of the Duduli/Rereghana closure on the abundance of *riki* and *deo* to determine if the project is a success from a biological perspective, but the results from monitoring need to be widely disseminated to increase community support for the project and to provide the community with the information to formulate additional management policies. This integrated approach should contribute to the project's long-term success.

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