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Monitoring and evaluation of reef protected areas by local fishers in the Philippines: tightening the adaptive management cycle

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Abstract. Monitoring by local community managers tightens the adaptive management cycle by linking management more closely with its evaluation, so management actions become more responsive to the field situation. Local community volunteers, usually fishers, managing coral reef protected areas in the Philippines used simple methods (e.g. snorkeling fish visual census) to periodically monitor and evaluate reef protection together with professional marine biologists. Except for estimates of hard coral, data collected by local volunteers were not significantly correlated with data collected by biologists (specifically abundance estimates of sand, major reef fish carnivores, and fish herbivores). Community-collected fish data generally have higher variance and show higher abundances than biologist-collected data. Nonetheless, though the data was less precise, the locally based monitoring identified or confirmed the need for management actions that were generic in nature (e.g. stronger enforcement, organizational strengthening, etc.). The locally based monitoring also encouraged cooperation among stakeholders and prompted a management response. Little time and financing is required after initial establishment and replication has been increasing. However, sustainability depends upon the communities' perceived added-value of undertaking the monitoring and input from a paid and/or more committed local person (e.g. government) who occasionally conducts monitoring himself/herself and supervises the community monitoring. Management impact depends heavily upon good integration with active management interventions outside the monitoring effort *per se*.

Introduction

The Philippines is part of the global center of marine biodiversity but this diversity is also one of the most highly threatened globally (e.g. rated the 'hottest of the hotspots' by Roberts et al. 2002). The Philippine coastal area is densely populated with approximately 174 persons/km^2 (Bryant et al. 1998). Its 26,000 km^2 of coral reefs are threatened by overfishing and destructive fishing, sedimentation, and pollution from domestic, agricultural, mining and other industrial sources (Uychiaoco et al. 2000; Burke et al. 2002).

The number of Marine Protected Areas (MPAs), and especially municipal 'no take' MPAs, has grown enormously in the Philippines over the past two decades because (1) they can potentially protect both habitats and species and restore fisheries stocks at the same time and (2) they can be established using municipal legislation. Some small-scale fishers are eager to have one in their village merely from hearing about them from other fishers or from seeing one in their travels. Nonetheless, successful MPAs require knowledgeable and a strong-willed local community convinced of their value and dedicated to their enforcement (Pollnac and Crawford 2000).

Reef monitoring in the Philippines used to be done only by professional marine biologists: SCUBA divers trained in the scientific identification of marine organisms. These studies are expensive, often take months to produce, are not written for a lay audience, are often not distributed, and are rarely explained to the communities. Reef monitoring by volunteer SCUBA divers, often enthusiasts who are not resident on-site, has also been undertaken in the Philippines for more than a decade (White 1993; White and Calumpong 1993; White et al. 1999). Similar volunteer monitoring programmes have also operated in Belize (Mumby et al. 1995), Tanzania (Darwall and Dulvy 1996; Roxburgh 2000), the USA (Schmitt and Sullivan 1996; Pattengill-Semmens and Semmens 1998; Brown 1999), Australia (Musso and Inglis 1998; Barrett et al. 2002) and in over 60 countries through the efforts of Reef Check (www.reefcheck.org; Hill 2004). With sufficient training, practice and feedback, volunteers have helped provide reef monitoring information of sufficient quality to augment the limited availability of professional marine biologists (Pattengill-Semmens and Semmens 1998; www.coralcay.org; www.frontier.ac.uk, www.reefcheck.org).

In most developing countries local communities are not equipped with SCUBA equipment and hence are not directly involved in monitoring and thus unable to relate to monitoring information on coastal ecosystems collected by professionals and non-resident volunteers. In the past two decades, resource managers have increasingly recognized the important role of local community participation to the success and sustainability of resource management efforts (e.g. White and Christie 2000; Crawford et al. 2000). In Tanzania, trained local fishers have proven effective in monitoring their reefs (Obura 2001; Obura et al. 2002). Joint local and scientific monitoring and discussions facilitate complementation between local and scientific knowledge and monitoring (Obura et al. 2002).

In the Philippines, the importance of local community participation in the management of marine MPAs had been recognized since the late 1970s (Castañeda and Miclat 1982). In 1991, the Philippines' Local Government Code (Republic Act 7160) decentralized much of the actual authority and implementation for environmental management from the national government's Department of Environment and Natural Resources (DENR) and Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR) to the local government units (particularly the municipal and city governments). Hence, local government staff are the ones expected to manage and monitor municipal and village MPAs in collaboration with local community MPA managers.

A marine protected area monitoring program has been established in the Philippines to institutionalize regular, locally-based and data-based evaluation of the effectiveness of MPA protection. In addition to collecting data on the status of the MPA and its resources, the monitoring programme aims to empower local-community managers to use monitoring data to inform management decisions. The ultimate goal is that the MPA management will be more strategic, appropriate, responsive and effective. This paper describes the monitoring system used in Philippine MPAs and outlines some of the results that it has generated.

Study areas

The Guiuan Development Foundation started participatory monitoring in seven municipalities of Eastern Samar in 1995 to address the need for sustainable monitoring and evaluation of MPAs. Voluntary Service Overseas and Bohol Integrated Development Foundation had begun participatory monitoring in three municipalities of Bohol in early 1996 to help sustain the interest of fishers after the establishment of their MPAs.

The specific sites for the MPA monitoring programme in the Philippines were selected from these early initiatives in the municipalities of Salcedo and Calape. Later participatory MPA monitoring was introduced to Loon, Bolinao, Sibulan, Cordova, Kiamba, San Vicente, Mabini, and Masinloc (Table 1 and Figure 1). Individual site descriptions for most of these MPAs are available in Coral Reef Information Network of the Philippines (2003).

A number of criteria were used in selecting the sites for the MPA monitoring programme. First was the potential for visible improvement of the site within 3 years, i.e. a newly-established MPA with few other threats (e.g. siltation) that might mask the effects of decreasing exploitation. Second was the presence of strong community organizations willing to be involved in day-to-day MPA management. Third was the local teams' (fisher organization and NGO) potential for multiplying the experience to adjacent areas later on (i.e. their willingness, the scope of their area of operations, their track record, and early initiatives in and presumably commitment to participatory monitoring).

Methods

Monitoring and training

Simple methods to monitor reef resources and habitats (methods # 1–2, 4–5, 7) were introduced to all sites (Tables 2 and 3; Uychiaoco et al. 2001). In most

Table 1. Brief description of the marine protected area sites in the Philippines where monitoring data were collected.

Study area	Province	Year protected	Size (ha.)	General description
Salcedo	Eastern Samar	Mar 1995	12.7	15–50° slopes on patch reefs
Calape	Bohol	Nov 1995 (effective 1998)	8.6	Reef slopes around a sandy depression in the reef flat
Loon	Bohol	Nov 1997	11.8	80° hard coral wall
Bolinao	Pangasinan	2000[a]	> 100	20–50° reef slope with occasional spurs and grooves
Sibulan	Negros Oriental	Jul 1997	6.0	Coral bommies on a gently sloping sandy bottom
Cordova	Cebu	1992–1995, 1999-present	14.9	20–80° slope of a fringing reef
Kiamba	Saranggani	Unofficially since 1998	10.0	20–70° slope of a fringing reef
SanVicente	Palawan	May 1999	74483	Large multi-zoned marine protected area within a bay with islands and fringing reefs
Mabini	Batangas	1991	10.0	Gentle slope of a fringing reef
Masinloc	Zambales	1989	127.0	Broad fringing coral reef flat, spur-and-groove crest then sudden drop-offs

[a]Declared but not yet implemented as a Marine Protected Area.

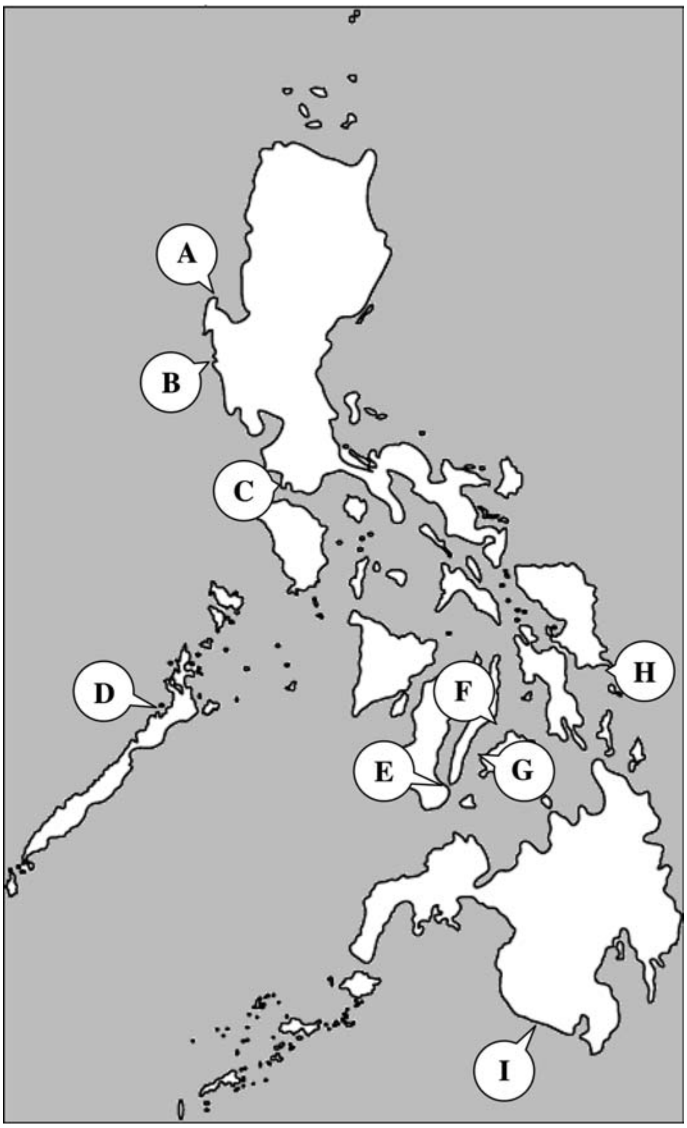

Figure 1. Map of marine protected area monitoring sites in the Philippines (A, Bolinao; B, Masinloc; C, Mabini; D, San Vicente; E, Sibulan; F, Cordova; G, Calape and Loon; H, Salcedo; I, Kiamba.

sites, resource use and threats in and around the MPAs (method # 8), and in a few sites fisheries catch and effort (method # 3 and 6), were also measured. These simplified methods were developed from coral reef monitoring protocols used internationally: Global Coral Reef Monitoring Network (English et al. 1994), ReefCheck (Hodgson 1997) and ReefBase's Aquanaut (McManus et al.

Table 2. Monitoring methods, the order in which they were introduced to the local monitoring teams, suggested frequency of measurement and estimated total time required per year.

Method number and order (and approx. year) of introduction	Method	Suggested frequency of measure-ment	Estimated time required	Days/year	Remarks
1	Manta tows to estimate benthic substrate types	Annual	Half-day to whole-day per site/year (depending on the size of the site)	1	
2	Snorkeling fish visual census to estimate fish composition and abundance	Seasonal	Two persons for half-day for each transect (at most); 1 half-day/season to analyze data	8	Identification to family level only, count estimates and length estimates to 10-cm size classes
3	Fish catch monitoring to estimate fishing catch and effort	Weekly for 1 month per season	15 min for each of 12 days/yr/fisher x as many fishers as possible (preferrably at least 5 representatives of each gear type); 1–2 h/season for core monitoring team members to summarize	1	Date, fishing grounds, number of fishers, number of fishing hours, fish types caught, catch quantity in kg
4 (c. 1998)	Macrobenthos belt transects to estimate abundance of benthic biota and substrate	Annual	Included in fish census time estimate		Percentage bottom cover estimation
5 (c. 1999)	*Diadema* urchin and *Acanthaster* starfish abundance estimates	Annual	Included in fish census time estimate		
6	Total fishing effort estimate	Annual, seasonal	Interview (half-day once every 1–5 years); mapping (half-day/season)	2	Interviews and actual mapping of fishing effort around the marine protected area
7 (c. 1999)	Macro-invertebrate abundance estimates (in addition to *Diadema* and *Acanthaster*)	Seasonal	Included in fish census time estimate		For compatibility with ReefCheck (Hodgson 1997)
8 (c. 1999)	Estimates of human/natural stresses/threats	Seasonal to annual	Included in fish census time estimate		Semi-quantitative
			Total time =	12	

Methods are described in more detail in Uychiaoco et al. 2001.

Table 3. Monitoring methods introduced and number of samples of fish visual census data available for trainer (number before the slash) and community (number after the slash) data comparison. Fish counts compared (in Table 5) are shaded in gray.

Site	Methods introduced	Years participatory monitoring was undertaken	1998	1999	2000	2001	2002	2003
Salcedo	1–5,7–8	1995–1999	comparative data not available					
Calape	1–8	1996–2003	10/8	8/9	10/10			10/7
Loon	1–8	1997–2003	10/7					10/3
Bolinao	1–8	1998–2003	comparative data not available					
Sibulan	1–2,4–5,7–8	1998–2003	8/6		8/7			8/8
Cordova	1–2,4–5,7–8	1998–2003						10/10
Kiamba	1–2,4–5,7–8	1998–2003						8/10
SanVicente	1–2,4–5,7–8	1999–2003						10/10
Mabini	1–2,4–7	2000–2001			8/2	8/4		
Masinloc	1–2,4–7	2001–2002				10/5	8/4	

1997). Methods were developed with the aim that (1) data summaries would be comparable with that collected by as many of the above international reef monitoring programs as possible. (2) It should not be necessary to use SCUBA to collect the data nor should it take much time ($\leq$ 4 days per season) for a team of fishers to collect and summarize it. (3) The data should be of sufficient scope, power and resolution as to be relevant and useful for local MPA management and its evaluation. The use of SCUBA was discouraged because of safety considerations and expenses that would have been difficult to sustain locally. Snorkeling was believed to be sufficient for areas of good visibility and shallower depths (6–7 m). During the training sessions, trainees were encouraged by the trainers to share their own local monitoring methods and/or suggest improvements to the introduced methods. Methods developed and field-tested were codified into a comic-book-style guidebook on 'Reef Monitoring for Management' (Uychiaoco et al. 2001) for local communities.

The training initially focused on core groups of local fishers, usually members of the fishers organization delegated with day-to-day management of the MPAs including local deputized fisheries wardens, or (in Saranggani) municipal government staff, and personnel of their supporting local development organizations (i.e. NGOs and provincial government staff; Table 4). Monitoring and evaluation was introduced to community managers after they had already understood basic marine conservation issues and set-up an MPA. For greater participation and sustainability, a monitoring team of six to eight rather than just a couple of individuals were trained at each site. While the team effort makes standardization between observers more difficult, pooling the records of two observers each recording one side of each fish transect potentially helped average out individual biases (Musso and Inglis 1998; Barrett et al. 2002). None of the community monitoring team members was paid specifically for monitoring. Volunteers' formal education ranged from

Table 4. Composition of local monitoring team (M) and consistent local team members (C).

Site	Local fishers	NGO	Municipal Gov't	Provincial Gov't	Local university	DENR	BFAR
Salcedo	C	M					
Calape	C	M		M	M		M
Loon	M	M		M	M		M
Bolinao	C	M					
Sibulan	C	M		M			
Cordova	M	M			M	C[a]	
Kiamba			C		M		
SanVicente		M	C	M	M		
Mabini	C						
Masinloc	C						

[a]Team leader is a local fisher who was later hired by DENR.
Abbreviations: DENR, Department of Environment and Natural Resources; BFAR, Bureau of Fisheries and Aquatic Resources.

completion of four years of primary school to 4 years of high school (in the case of most fishers) to four years of college and some years of graduate school (in the case of municipal government staff). Later on, personnel from DENR, DA-BFAR, other NGOs and other universities would sometimes join the participatory monitoring activities (Table 4). There are no protected area staff in these municipal MPAs except for the volunteer guard of Gilutongan Island MPA in Cordova who was later hired by DENR.

A 3-year training program was developed so that training content could be imparted in an incremental fashion and mentoring provided as monitoring was being learned and practiced. The longer time frame also allowed the trainers to observe changes in the MPA together with the trainees. The national team of trainers visited each community twice a year for the first three or more years for three to five training and monitoring days per visit. After the initial orientation, training and survey visit, succeeding visits evolved into a regular sequence of (1) feedback regarding the results of the previous monitoring activities (Table 6), (2) discussion of management issues (Table 6), (3) brief review of previously taught methods and introduction of additional monitoring or summarization methods as the trainees became proficient in the previous topics taught, and (4) supervised field data collection and summarization. (5) Data interpretation, taking into account management issues identified, and options for management action were discussed after each monitoring session. The approach used was largely that of learning-by-doing as local community teams and trainers jointly recorded, compiled, summarized, graphed and discussed field observations.

Monitoring was done by the trainers in parallel with the community teams (except for the fisheries data) for comparisons between monitoring by trainers usually using SCUBA and by the community team using snorkeling, and for standardization across project sites. Since we alternated focus on scientific monitoring and community training/monitoring on our semi-annual trips, we sometimes either had only trainer-collected data on some sampling periods and only community-collected data on the other periods. Also since the focus was on community training and the philosophy was that community-collected information belonged to the community, community data originals and summaries were left at the site. Through the years, some community-collected data was lost through improper storage. Usually little follow-up and supervision in monitoring was done by local NGO and/or government partners in between visits by the national trainers.

Only data from two methods, manta tows and fish census, and from those sites and years where both trainer and community-collected data were available are used in this paper. Estimates of key habitat and reef fish groups are used to compare trainer and community volunteer observations. Trainers recorded habitat features by manta tow (a snorkeller records observations onto a slate that is slowly towed by a boat over the reef edge; English et al. 1994) as boat traveled from the southeastern end to the northwestern end of the village of Cangmating (town of Sibulan), the community recorded habitat features on the return trip. Manta tow estimates of hard coral and sand cover were compared using Kendall's coefficient of rank correlation. Hard coral and sand are major elements of the reef benthos which were among those benthos features least likely to be misidentified (Hill 2004). Nine and eleven tow observations of Sibulan in 2000 and in 2001, respectively, were pooled (n = 20) for the comparison of each of the two types of benthic cover. Communities either recorded fish starting from the opposite end of the 50-m transect from where trainer-divers began recording fishes or laid another 50-m transect with the same starting point but in the opposite direction as the trainers' transect. Averages across several transects (Table 3) of visual count estimates of major reef fish carnivores (groupers *Epinephelinae*, snappers *Lutjanidae*, emperors *Lethrinidae* and sweetlips *Haemulidae* taken together) and herbivores (surgeonfishes *Acanthuridae* and parrotfishes *Scaridae* taken together) were also compared using Kendall's coefficient of rank correlation. Though less experienced monitors often miss groupers (Roxburgh 2000), spear fishers are often skilled in spotting them. Data of 13 site and year combinations (shaded cells in Table 3) were pooled for the comparison of each of the two groups of reef fish.

Management

The trainers led the discussions with the community team on the implications of observations. On the first few trips, monitoring results were fed back on the following visit; later, monitoring results were summarized on the last day of the monitoring and discussed the same day. Comparing observations on site with observations of other coral reef and MPA sites, the trainers would also share their opinion on each site's condition relative to its duration of legislated protection. The community team validates and relates these trends to their own observations and management practices. Unfortunately, some of the local development workers were not interested in understanding for themselves how to monitor and undertake joint evaluations with the local community; they mostly just left it up to the external facilitators. The organizations represented by the monitoring team members are the ones who act based on the findings. The cycle is repeated every 6 months or so.

In late 1999, representatives (two community team members and one representative from the local development organization) from six out of the eight monitoring teams attended a contest and evaluation workshop. Trainee skills and observations in an area new to all participants were scored by representatives from the partner development organizations and compared with data recorded by a trainer observer, respectively. Improvement and dissemination of the training program were also discussed. In 2004, the core trainer team enumerated the benefits of the monitoring program to MPA management for each site through anecdotes. Types of benefits (i.e. the items on the first column of Table 5) were then identified from these short stories of each site. These types of benefits were then used to uniformly assess the presence or absence of various management benefits at each site (Table 5). This way benefits which may not have been initially reported but actually occurred at one site (say site A) but reported in another (say site B) might hereby be identified and reported in site A as well.

Table 5. Comparison of community and trainer average count estimates (and one-half 95% confidence intervals; CI) for major carnivorous and herbivorous reef fishes in eight marine protected area sites.

Site and year	Community (snorkeller)				Trainer (diver)			
	Carnivore		Herbivore		Carnivore		Herbivore	
	Average	1/2 C.I.	Average	1/2 C.I.	Average	1/2 C.I.	Average	1/2 C.I.
Cordova 2003	60.5	54.0	115.6	99.2	10.2	4.2	38.9	16.0
Kiamba 2003	9.0	5.8	28.5	15.3	2.6	1.5	31.0	7.8
Loon 2003	2.0	2.0	18.0	3.0	5.9	4.6	15.3	6.8
Mabini 2001	15.3	12.6	71.5	72.2	8.5	4.3	23.4	10.6
Masinloc 2001	4.8	1.9	30.4	15.7	4.8	1.6	54.5	27.8
SanVicente 2003	7.2	3.8	28.3	16.0	3.7	1.9	6.6	3.4
Calape 1998	11.4	14.9	65.6	36.6	2.3	1.4	22.1	14.2
Calape 1999	19.1	27.5	155.6	175.9	5.8	5.1	57.4	41.8
Calape 2000	20.9	18.4	156.7	79.5	4.3	1.8	17.5	14.8
Calape 2003	56.1	62.2	162.4	200.0	6.2	2.3	26.9	14.9
Sibulan 1998	5.2	4.8	218.0	198.5	0.5	0.5	15.5	12.5
Sibulan 2000	12.9	11.9	227.0	204.1	1.0	0.6	7.9	4.7
Sibulan 2003	26.1	24.0	274.4	256.4	0.8	0.8	18.0	5.3

Results

Monitoring and training

Communities were most proficient in manta tows and fish visual census (methods # 1 and 2) because these were the first methods introduced and they had the most practice with them. Fisheries catch monitoring and gear mapping (methods # 3 and 6), because of its year-long nature, was heavily dependent on the interest of and follow-up by on-site facilitator partners. Macrobenthos belt transects (method # 4) proved difficult to do, though not impossible, without the use of SCUBA. Probably due to the number of different monitoring methods, community teams sometimes forgot to record macroinvertebrate counts (methods # 5 and 7) and estimates of use and stresses (method # 8).

One of the greatest challenges was that community team members changed all the time depending on whomever was available and came to participate (sometimes none were available). Usually more people, as recommended or invited by the community organization leaders and/or partner development workers/facilitators, joined the initial training sessions. After the initial training some of the originally-trained volunteers would stop joining and new volunteers would join, as they pleased. Team composition was more clearly defined in some sites and less clearly defined in others.

Local monitoring team members who were local fishers usually had little difficulty identifying reef organisms from color photographs in books. Spear fishers were particularly good at identifying fish types. Usually only those local government officials and development workers who had less experience with the sea had any such trouble. Those who participated more consistently performed better. Women were particularly keen in data transcription, storage and summarization in contrast to male team members who have often forgotten to transcribe data from the underwater slates and have thereby lost information. While locals are less prone to change over the long term than outsiders (e.g. NGOs and trainers who are not permanent residents in the area), sometimes trained people lose interest or leave without passing on the capability to others in the village.

Sampling by the professional marine biologists using about the same number of replicates as that used by the local volunteers, analyzed at the fish family level, was powerful enough to detect changes through time (Uychiaoco Tiu unpublished). Major carnivorous fishes increased both inside and adjacent to protected reefs though rates of increase were not significantly different inside as compared to adjacent to the reserves. Hard coral cover changes through time were not significant.

Trainer and community percentage hard coral cover estimates (using observations of Sibulan in 2000 and 2001, data from both years taken together, $n = 20$) were significantly correlated while estimates of sand cover were not correlated (Figure 2, Kendall's tau-b hard coral = 0.387 [$p = 0.028$] and

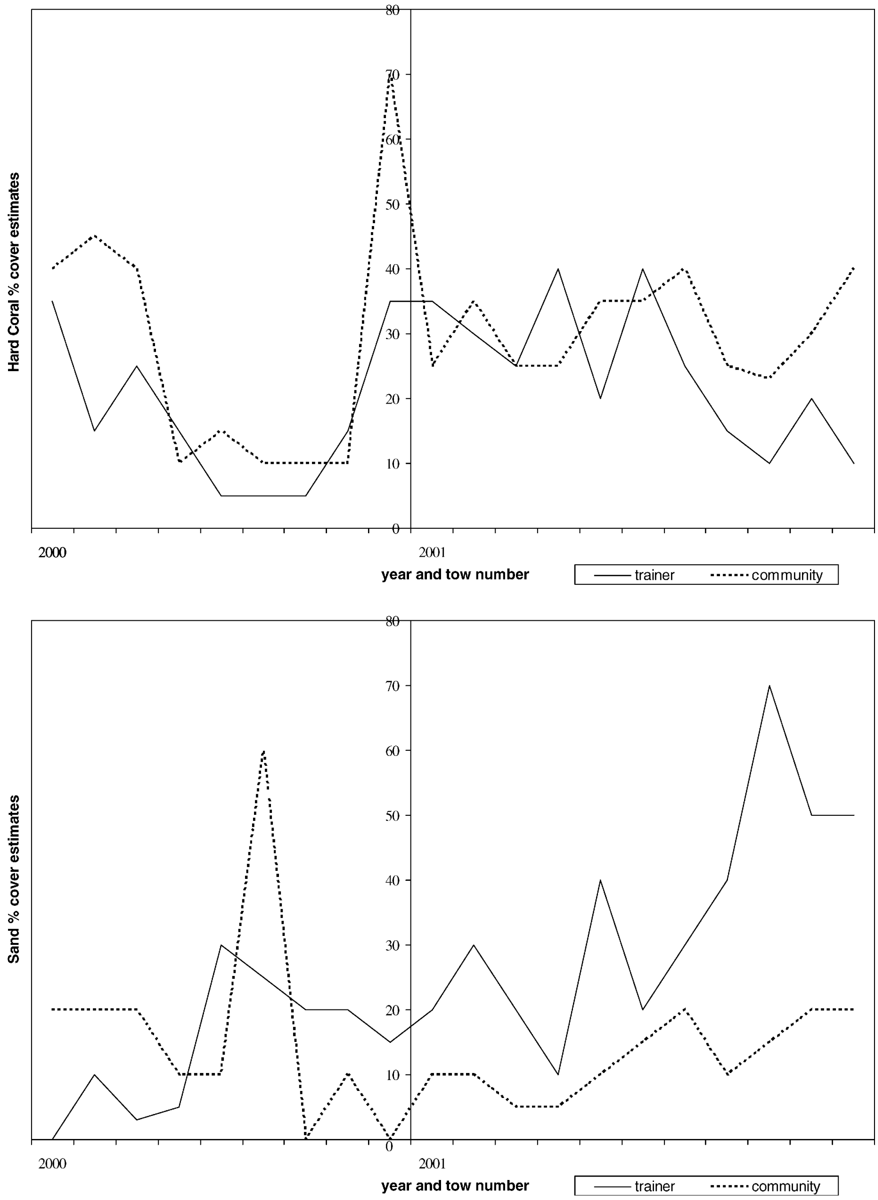

Figure 2. Comparison between trainer and community percentage-cover estimates of hard coral and sand in Sibulan, the Philippines.

sand = 0.117 [p = 0.516]). Trainer and community observations of reef fishes were not significantly correlated with each other (Table 5, Figure 3, Kendall's tau-b carnivores = 0.154 [p = 0.464], herbivores = −0.051 [p = 0.807]).

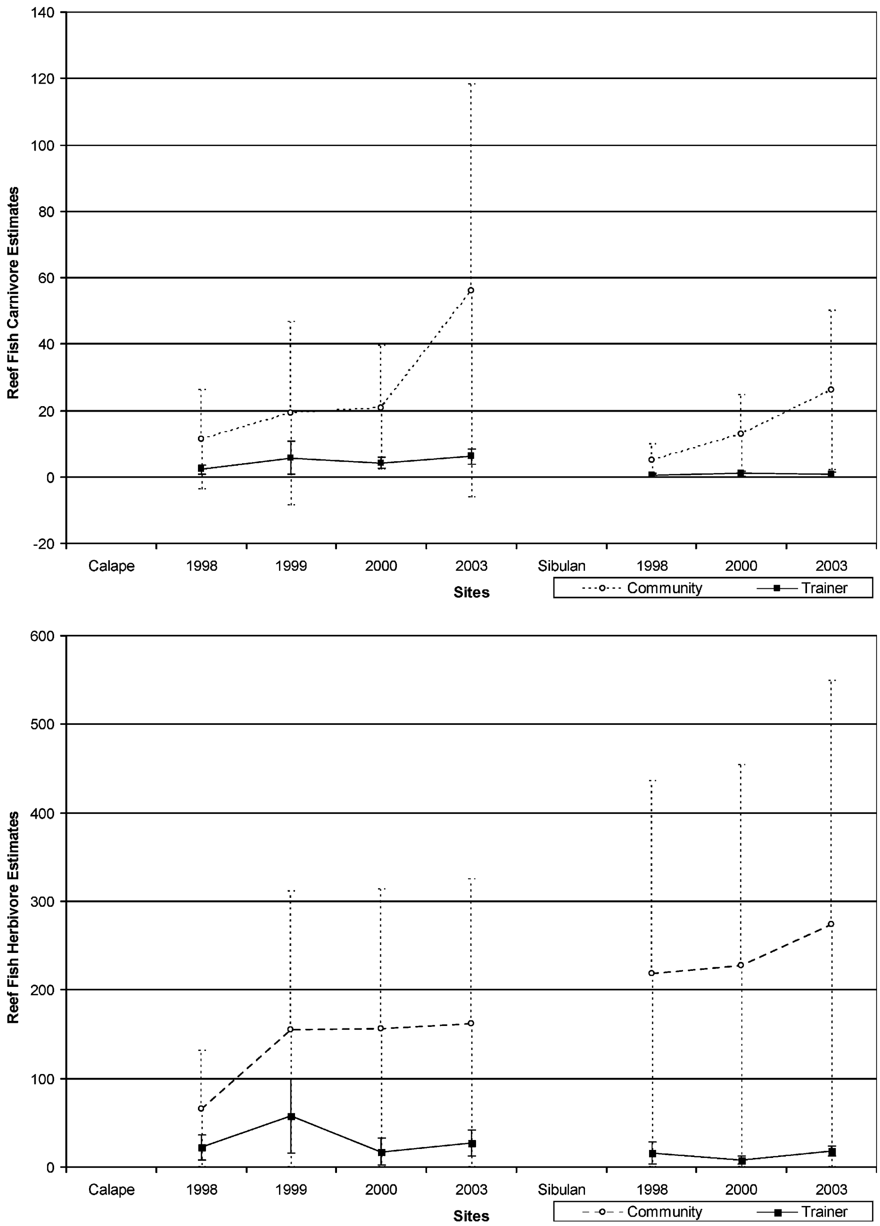

Figure 3. Comparison between trainer and community reef fish counts in Calape and Sibulan. the Philippines.

Community-collected data generally have higher abundances and variances than that of trainers Table 5, Figure 3). Fishers have also recorded many things they found interesting beyond the 10 m width confines of the standardized transect and, of course, community team observers changed very often.

Management

The most common benefits of participatory monitoring were to provide information (not only of things directly being monitored) and to encourage cooperation and management action (Table 6). Showing underwater video footages of the MPA and billboards depicting the gains observed in the MPA helped build community support for the MPA and also helped enhance the site's appeal to visitors. The usually uncontroversial nature of monitoring also provided an activity around which relationships within the community and among various stakeholders (e.g. government, NGOs, fisher organizations, academics) were built, strengthened and fostered collaboration on other management activities (e.g. enforcement). Monitoring trips also served incidentally as surveillance and patrolling; local teams have accosted violators and potential violators many times during our monitoring trips together. Regular post-monitoring discussions of the observations with the local community and development partners have helped reveal or confirm directions for improved management action. Seeing the issues for themselves has helped change attitudes and catalyze action; seeing increased fish stocks (or the lack of it) has encouraged volunteers to remain committed and/or spurred them on to improve their management efforts. Seeing only few fish inside the MPA and then being told that their MPA did not have as much fish stocks compared to other MPAs of comparable age has led the local community to assess and improve the effectiveness of MPA guarding.

Discussion

Monitoring can indicate whether interventions are making a difference and help direct efforts and limited resources where they would be most necessary and effective. However, monitoring also requires time and money; hence, with more resources for monitoring, more things can be monitored. With limited resources, MPAs are not monitored at all, or only management inputs and sometimes uses and threats are monitored by coastal managers. As more monitoring resources become available, attention should be and is sometimes put into monitoring the actual improvement of the habitats and resources (e.g. fish abundance, algae–coral ratio, fisheries catch, etc.). This paper has shown that although in the Philippines MPA monitoring by community volunteers was able to provide only very general trends on MPA habitat and resources, MPA monitoring activities facilitated information communication, multi-stakeholder cooperation and management actions (e.g. stronger enforcement).

Table 6. Benefits of participatory monitoring observed (1) or not observed (0) in 10 sites.

Benefits of participatory monitoring	Calape	Salcedo	Loon	Cordova	Bolinao	Masinloc	Sibulan	Kiamba	Mabini	San Vicente	Total
Helped team learning/mentoring and insight/understanding	1	1	1	1	1	1	1	1	0	1	9
Provided an indicator of protection effectiveness	1	1	1	1	1	1	1	1	1	0	9
Provided an indicator of organizational strength (or lack thereof)	1	1	0	1	1	1	1	1	1	0	8
Facilitated increased public awareness	1	0	1	1	0	0	0	0	0	0	3
Helped build broader community support for the reserve	0	1	1	0	1	0	0	0	0	0	3
Augmented surveillance (for enforcement of the reserve)	1	1	1	0	1	1	1	0	0	0	6
Information used to back-up lobbies	1	0	0	1	0	0	0	0	0	0	2
Fostered collaboration and mutual accountability (among stakeholders)	1	1	1	1	1	1	0	0	0	1	7
Provided a regular venue to discuss management issues	1	1	1	1	1	1	0	0	1	0	7
Prompted management response	1	1	1	0	0	0	0	0	0	0	3
Helped sustain commitment to management	1	1	1	1	0	0	0	1	0	0	5
Greater efficiency and complementation in the use of management resources	1	1	1	1	1	1	1	1	0	0	8
Total	11	10	10	9	8	7	5	5	3	2	

Monitoring and training

Similar to volunteer monitoring efforts using SCUBA divers, local fisher volunteers sometimes also recorded interesting species that were beyond the transect confines and failed to properly document observations (Roxburgh 2000; Barrett et al. 2002). More attention should have been put into comparing data collected by the community monitoring team and data collected by the trainers and standardizing observations through feedback and examinations (Darwall and Dulvy 1996; Miller and De'ath 1996). On-site facilitators and trainees suggested that more popular education methods (e.g. games, visual aids, local dialect, underwater data forms) would improve the training program. Towards the end of the training programme trainers also observed that trainees had not been taught planning (time allocation and logistics preparation) and team management skills (tasking).

Management

The more closely the monitoring was integrated with management action (i.e. the more monitoring results were considered during management decision-making), the greater was the impact of participatory monitoring (see also Danielsen et al. 2005 (this issue)). Monitoring results summarized right after sampling could be fed back to the rest of the community very quickly. Local monitoring team members understand the results and can explain them to others. Better relationships with professional biologists and understanding of the underlying thinking also made the community more open to technical recommendations. Monitoring by communities is hence not just a token gesture to community participation but can be a force for improved management of marine ecosystems.

Replicability and sustainability

The monitoring methods are gaining popularity in the country and beyond. The use of the methods are slowly being expanded by USAID/DENR Coastal Resources Management Project and Coastal Conservation and Education Foundation, UNDP-GEF-Small Grants Programme, Department of Agriculture (DA) – Agriculture and Fisheries Modernization Act's flagship project on marine fishery reserves, and USAID/DENR's Eco-Governance Project. DENR's Protected Areas and Wildlife Bureau is also considering using these methods in large DENR-run protected areas (see also Danielsen et al. 2005 (this issue)). Community reef monitoring is now being replicated in North Sulawesi, and the guidebook has been translated into Filipino, Bahasa (Indonesian), Vietnamese, Chinese, Thai and Khmer.

It is estimated that it should take no more than a total of 12 days per year for a local team of around six persons to monitor an MPA (Table 2). Unless volunteers are committed for the long term, it may be more effective to increase team size, distribute workload over more team members, reduce the expected level of individual volunteer commitment to even less than 12 days per year, and complement volunteers with a paid and/or more committed local person. Such a person might come from the municipal agriculture, fisheries or environment office, or may even be a trained local community facilitator, may conduct monitoring himself/herself for around 3 days per year, supervise the community monitoring on other occasions, and train new volunteers as team members change. The reduced level of effort may be focused on manta tow, fish census, fisheries monitoring, and the uses and stresses checklist only.

During the initial development of methods, approximately $15,000 was spent per site (total for 3 years including travel to/from Manila). System initiation per site now costs less as the methods have been developed. The costs to sustain the monitoring system once it is operational are minimal. The municipal governments of Salcedo, Cordova, Kiamba, Calape and San Vicente have played a major role in sustaining this initiative after the project lifetime sometimes by simply providing fuel, lunch and snacks for the monitoring team (worth approximately US$10/month). Only a boat, fuel, four sets of masks and snorkels, underwater slates, illustrated identification guides of the organisms being estimated, rope, a manta board, 50-m surveyor's tape, paper and pens are needed. These have to be stored properly in between monitoring occasions and some of these would have to be replaced every few years.

The major problem with the method has been sustaining long-term interest by volunteers (see also Barrett et al. 2002). This is critical as a certain amount of experience and feedback to correct methods, identification, etc. (including exams) is needed before volunteers become accurate enough to be useful (Darwall and Dulvy 1996; Miller and De'ath 1996; Lang 2002). The level of commitment and training needed also increases as the number of monitoring tasks increases. The solutions used by Coray Cay and Frontier, where a week or more is allocated for training time (Mumby et al.1995; Darwall and Dulvy 1996) might be potentially expensive and time-consuming to use where volunteers are marginal fishers. Since volunteers are not financially compensated for monitoring and time in training, team members probably change often because they also need time to earn a living. Thus, requiring more training time would either require compensation to keep team members joining more consistently or would require much training time as volunteer team members changed. Nonetheless, volunteers who joined consistently improved through the years.

Complementing casual volunteers with a few stable volunteers (Pattengill-Semmens and Semmens 1998; Keller 2002; Lang 2002; www.reefcheck.org) and/or paid staff (Barrett et al. 2002) might provide a solution to this issue. Later to help provide financial incentives, some of our more experienced volunteers were paid to help train other community teams and/or may potentially even be paid to do contractual monitoring by the government or even by the community if and when the MPA starts to yield fisheries benefits. Coral reef protected area use-rights wherein the local managers have first rights to the benefits of the area they are protecting (e.g. should tourism develop in the area), similar to those being provided to mangrove managers in the Philippines, are currently being explored in Pangasinan.

Finally, our results show that volunteer-collected data are generally less precise than trainer-collected data. This is not an inherent limitation of participatory reef monitoring as the experience in Tanzania shows (Obura et al. 2002); rather in the future, more attention should be put into standardizing volunteer observations through feedback and examinations. However in our sites, this did not matter much in terms of management utility because both the volunteer data and the trainer data observed similar trends, both were used in discussions for management action, and both either pointed out or confirmed the need for management actions that were generic in nature (e.g. stronger enforcement, organizational strengthening, etc.; see also Poulsen and Luanglath 2005 (this issue)). It is the working together between locally-based volunteers and professionals, linked to the practical goal of better management of natural resources that is the main benefit of this participatory marine monitoring approach.

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