LINKS BETWEEN ENVIRONMENTAL CONDITION AND INTEGRATED COASTAL MANAGEMENT SUSTAINABILITY

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ABSTRACT

Integrated coastal management (ICM) is practiced throughout Asia with the support of millions of dollars. Unfortunately, many management regimes are not sustained beyond project termination and withdrawal of external technical and financial assistance. This study reports on the impacts of ICM on coral reefs and the hypothesized links between changes in coral reef conditions due to such management regimes and management process sustainability. The study demonstrates that ICM has had positive impacts on coral reefs at one of two study sites in the Philippines. ICM commonly utilizes marine protected areas (MPAs) as a management tool. The MPAs in Mabini are actively managed and have improved fish diversity and abundance. However, these MPAs are contested and at risk of collapse due to conflicts between fishing and tourism constituencies. The second site is without MPAs (Bais Bay) despite considerable investment of time and funding. The environmental condition appears to have stabilized in Bais Bay, but this condition is not readily attributable to ICM.

An analysis of interviews suggests that the condition in the environment is not directly linked to ICM process sustainability as measured by whether stakeholders are motivated to support or participate in ICM over time. Rather, each stakeholder is motivated by the extent to which the particular ICM process agrees with their worldview or helps them meet social and economic goals. The condition of the environment is important to diverse stakeholder groups, but for different reasons.

This paper is part of a larger research project, the ICM sustainability research project, investigating factors impacting ICM process sustainability in the Philippines and Indonesia.

Introduction

One of the main goals of ICM is to improve the management and, therefore, the condition of coastal environments (Cicin-Sain and Knecht, 1998; Kay and Alder, 1999). ICM projects use a variety of management tools to reach this goal. In the Philippines, environmental education, community organizing, marine protected areas (MPAs), and alternative livelihood schemes are some of the most common tools employed. MPAs are the focus of this study considering that this has been the preferred management tool in the Philippines.

Intact coastal ecosystems provide an array of services to human populations. Coastal ecosystems are high in biodiversity and provide nursery habitats for many marine species. There are surprisingly few studies that demonstrate the impacts of ICM on coastal ecosystems. This is likely due to the challenges associated with assessing large areas over time. This is unfortunate since supporters of ICM—including donors, practitioners, and local community members—share expectations that environmental conditions will improve through ICM. Therefore, their long-term support for ICM may be tied to measurable positive improvements in environmental conditions. There are no known studies that explore whether ICM's environmental impact, either positive or negative, may have induced greater levels of stakeholder commitment to ICM, thereby influencing ICM sustainability.

Personal commitment to a social change process, including ICM, lies at the center of ICM process sustainability (Morris and Mueller, 1992). Without a constituency behind ICM, there is little reason to believe that ICM would be viable in the long term (Olsen, 1993). It is a plausible that changes in environmental condition, whether positive or negative, may motivate people to support ICM and become directly involved. Research by Pollnac et al. (2001) has demonstrated that perceived environmental problems are associated with marine protected area success.

While ICM projects impact a wide variety of coastal ecosystems in the Philippines, this study only considers whether

ICM has had a notable impact on coral reef ecosystems in two case study sites, Bais Bay, Negros Oriental and Mabini, Batangas. Coral reefs were chosen as the focus of this research considering data availability and ICM project goals. Research efforts have focused on documenting:

1. if there is an observed change in coral reef conditions and associated fish populations in the two case study sites;
2. if local stakeholders perceive trends in environmental conditions;
3. what motivates different groups of stakeholders to participate in ICM and whether this is related to ICM sustainability;
4. and whether perceived changes in the environmental conditions appear to impact stakeholder commitment and, therefore, the sustainability of ICM processes.

Sites and Methods

To investigate the possible linkage between biological impact and ICM process sustainability, both biological and social research were conducted. First, impacts of ICM on coral reef condition were documented using both direct observations and published historic accounts. As a second step, social research explored perceptions of environmental changes. Finally, the motives to support ICM were documented with an eye to determining whether environmental condition was a key variable determining long-term commitment. Since ICM involves a variety of stakeholders, including government officials, practitioners, academics, local coastal inhabitants, each of these types of people were important informants.

The two study sites for this inquiry were the Municipality of Mabini, Batangas on the island of Luzon (the area commonly referred to as "Anilao") and Bais Bay on Negros Oriental. In Mabini, the focus was on Arthur's Rock and Twin Rock MPAs, where fishing is prohibited, and nearby non-MPA areas that are open to fishing (Figure 1). Non-MPA sites are exposed to similar physical conditions (e.g., wave action, rates of sedimentation) as

the MPA sites. Longitudinal substrate data were available only for one non-MPA site, White Sand Reef. Longitudinal fish data from three non-MPA areas (White House, White Sand, and Selo Reef) were pooled and compared to MPA sites. For general information on the Mabini area, please see the introduction to the case study site.

In Bais Bay (Figure 2), Campuyo and Arboles Point were evaluated. Campuyo is at the mouth of the North Bay. Sites at Arboles Point were south of the Talabong Mangrove Reserve. Bais Bay, Negros, covers approximately 54 km^2 (5,430 has) of which an estimated 200 ha are coral reefs (or 3.7% of the two bays) (Calumpong and Luchavez, 1997). This is a conservative estimate. Campuyo is along the entrance and northern shore (Campuyo Point) of North Bais Bay which is where most studies have been conducted (Alcala, 1977; Alcala, et al., 1991; Alcala et al., 1994, Calumpong et al., 1997). The study sites were within coral reef areas that had been nominated as sanctuaries, but never enforced.

Biological research methods consisted of monitoring of fish populations and coral substrate in the two case study site areas.

Substrate Cover. Consistent with Reefcheck methods (Hodgson, 2000), scuba surveys were conducted using 50-m transect lines laid parallel to the reef drop-off (in depths ranging from 5 to 7 m) and closely along the substrate. The substrate immediately below the transect-line was classified and recorded every 0.25 m using descriptive categories such as: rubble, block, living soft coral, living hard coral, and dead standing coral. The incidence of each substrate type was translated into percent of substrate cover for each category. An average of twelve 50-m transects were conducted at each site, therefore percent substrate coverage calculations are based on an average of 2,400 observations per site. Snorkeling surveys estimating substrate coverage in shallow reef areas were not conducted.

Fish Species Richness and Density. These data were collected by recording the diversity and abundance of fish in a 500 m^2 area estimated by using a 50 m transect line as the upper boundary laid at approximately 7 m depth parallel to the reef crest. The observers swam 10 m along the line, then down the slope and 10 m parallel to the line and then back to the line in this pattern until reaching the transect end. This procedure was repeated in the opposite pattern back to the beginning of the transect line. The number of individuals per species was noted employing logarithmic categories for those species with large numbers of individuals. The families surveyed were: Surgeonfish (Acanthurids)*, Rabbitfish (Siganids)*, Groupers (Serranids)*, Snappers (Lutjanids)*, Sweetlips (Haemulids)*, Emperors (Lethrinids)*, Jacks (Carangids)*, Fusiliers (Caesionids)*, Breams (Nemipterids)*, Goatfish (Mullids)*, Parrotfish (Scarids)*, Rudderfish (Kyphosids)*, Triggerfish (Balistids), Butterflyfish (Chaetodonids), Angelfish (Pomacanthids), Wrasse (Labrids), Damselfish (Pomacentrids). Anthids (family Serranidae) and *Zanclus cornutus* were also counted. The twelve fish families marked with asterisks are commonly targeted by fishers due to higher market values and recorded as "target species."

In Mabini, fish surveys were conducted in 1993, 1995, 1997, and 2001, but were not consistently conducted during a particular month, which may result in some variability associated with seasonal fluctuations of several fish families. Replicates also varied over years, with the fewest in 1990 (n=2) and the greatest in 2001 (n=10). Fish and substrate surveys in Bais Bay were conducted in September 2001 and April 2002. Replicates for fish and substrate surveys ranged between 4 and 10 transects per site. All averages calculated from fish abundance data are reported with 95% confidence intervals. Other studies, which are cited, have estimated standard errors associated with averages.

In addition to biological assessments, in-depth, semi-structured interviews were conducted with eighteen key informants in September 2001 to investigate a possible causal relationship

between environmental condition and ICM sustainability. Informants, all of whom were involved in ICM, were hotel owners, resource users, ICM practitioners, and academics. After basic information such as position, age, and role in ICM was collected, informants were asked to discuss their perception of the condition of the coastal environment and if its condition was changing for the better or worse. Informants were then asked why they were involved in ICM. This open-ended question was asked of the initial few informants. Based on responses, the interview guide was augmented to include, in addition to this open-ended question, some probing questions that were formulated based on responses from prior informants. After recording any initial responses to the open-ended question, informants were asked if they were motivated to participate in ICM primarily a) out of concern for the condition of the environment, b) to improve their or their family's economic condition, or c) to strengthen community groups. Respondents were then categorized as belonging to a particular group motivated to participate in ICM based on environmentalist, economic, or social motives. Finally, they were directly asked whether they felt that changes in environmental condition affected their commitment to ICM.

Pseudonyms were assigned to informants and interviews were analyzed with ATLAS.ti software for emerging themes associated with: 1) perceived changes in environmental conditions and 2) motives for participating in ICM. This software allows for the coding of interview data into categories which are then analyzed with search commands and theoretical memo writing. Environmental quotes were coded as demonstrating "environmentalist motives" to participate in ICM if they expressed a desire to use ICM to protect organisms or ecosystems, maintain ecological processes, or address general environmental issues. Those quotes identifying a personal economic interest or economic benefits for others were coded into the "economic motives" category. Quotes coded as identifying "social motives" expressed a belief that ICM helped meet basic human needs such as housing or food or strengthened community groups.

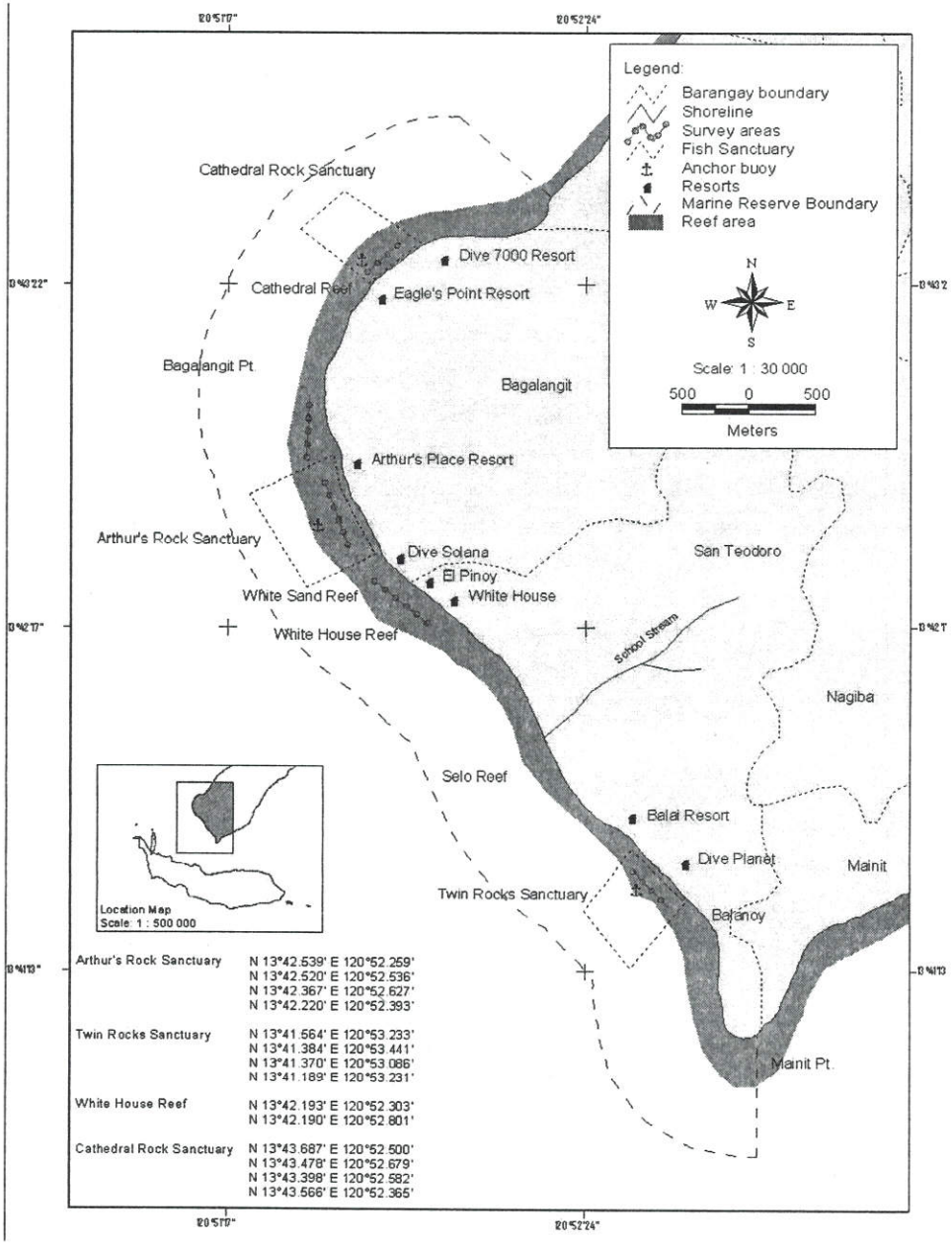


Fig. 1 Map of Mabini

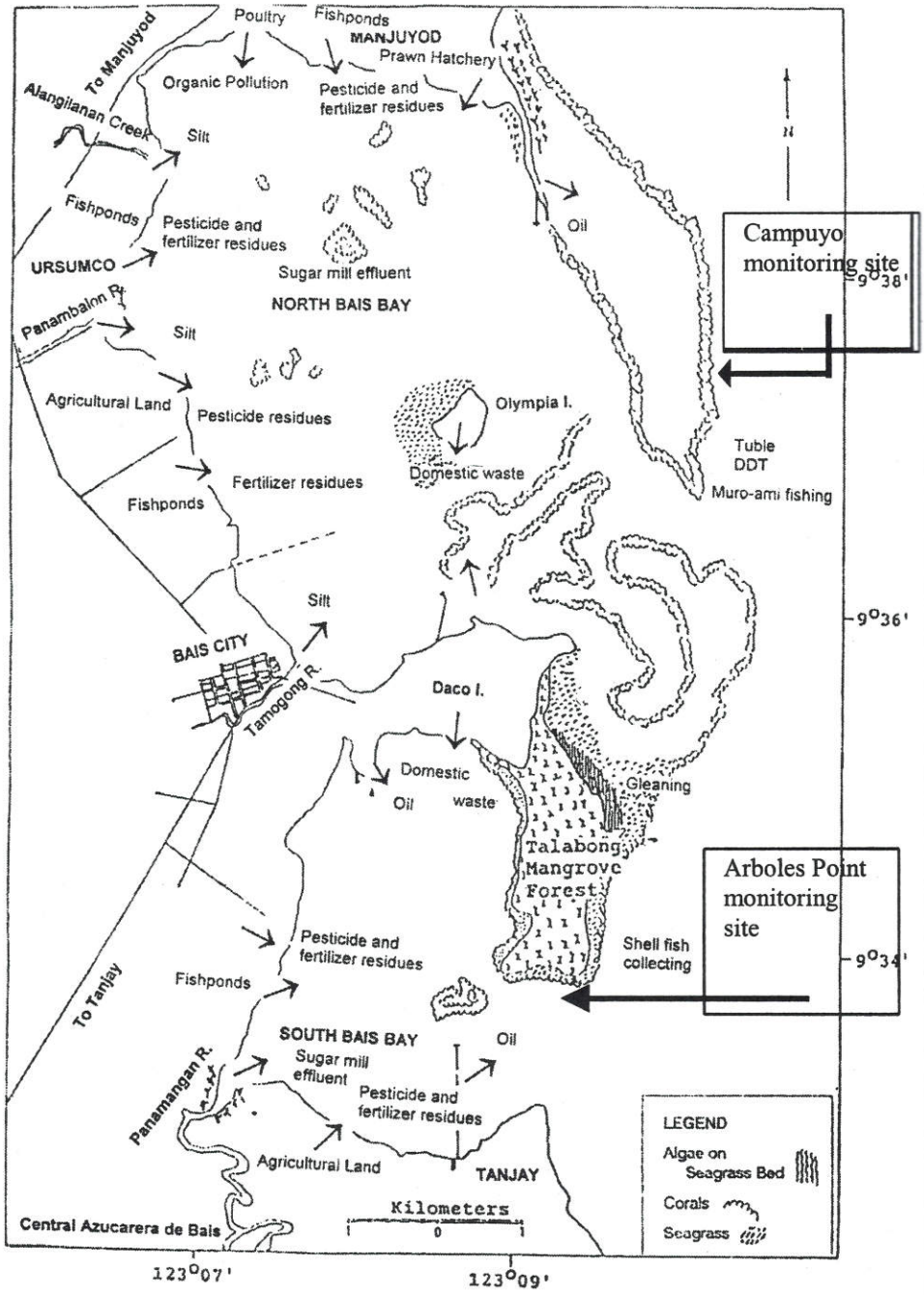


Fig. 2 Map of Bais Bay

Condition of Coral Reefs in Mabini and Bais Bay

Mabini

As highlighted in the introduction to the case study sites, the coastal area of the Municipality of Mabini is used for fishing and tourism activities (Table 1). Within the last 30 years, there has been a rapid growth in tourism, particularly dive tourism.

Coral reef substrate condition. The coral reefs in the Mabini area have either stabilized or improved since 1993 (when researchers started collecting substrate data). The following is a summary of the monitoring results.

- There has been an improvement in hard coral cover in Arthur's Rock Sanctuary, particularly in the shallow reefs (increasing from 31 % to 61%) (Figure 3).
- There has been a decline in soft coral cover in shallow and deeper areas in Arthur's Rock Sanctuary.
- Hard coral cover has increased in both shallow areas (from 39% to 58% coverage) and in deeper areas (from 13% to 31%) in the Twin Rocks Sanctuary (Figure 4).
- Soft coral cover has declined slightly in shallow and deeper areas within the Twin Rocks Sanctuary.
- Hard coral cover for White Sand Reef, a non-MPA site located just south of Arthur's Rock MPA and approximately 1.5 kilometers from Twin Rocks MPA, has remained between 20-30% in deeper areas, but has declined from 41% to 22% in shallow reefs between 1995 and 2001 (Figure 5). This area was severely affected by coral bleaching in 1998 when water temperatures were abnormally high and continues to be impacted by siltation and algae growth.
- Hard coral cover for White House Reef, a non-MPA site located approximately 500 meters south of Arthur's Rock MPA and 1.2 kilometer north of Twin Rocks MPA, declined from a peak of 37% in 1995 to 12% in 2001 (Figure 6). This area was also impacted by bleaching in 1998 and is currently impacted by siltation and algae growth.

Table 1. Information on various activities observed during survey day in Mabini area, May 1993, March 1995, June 1997 and April 2001.

SITE INFORMATION	ARTHUR'S ROCK SANCTUARY				CATHEDRAL ROCK SANCTUARY		TWIN ROCKS SANCTUARY				WHITE SAND REEF		
	1993	1995	1997	2001	1995	2001	1993	1995	1997	2001	1995	1997	2001
Type of reef	Gradual slope				Pinnacle rock		Steep slope				Flat		
Site description	Sheltered				Sheltered		Sheltered				Sheltered		
SITE CLASSIFICATION													
	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	no
	no	no	no	no	no	no	yes	yes	yes	yes	no	no	no
Nearby resort	yes	yes	yes	yes	yes	yes	no	no	no	yes	yes	yes	yes
	no	no	no	no	no	no	yes	yes	yes	yes	yes	yes	yes
FISHING ACTIVITY													
No. of fishing boats w/in 500 m during monitoring	0	2	1	2	0	0	0	0	0	0	0	0	1
No. of gleaners for food w/in 500 m during monitoring	1	0	0	2	0	0	0	0	1	0	1	1	1

TOURISM ACTIVITY													
No. of boats anchoring w/in 500 m	10	15	10 - 15	10 - 15	2	6	4	9	5	10	2	3	4
No. of anchor buoy	1	1	1	2	1	1	1	1	1	1	0	0	0
No. of divers observed w/in 500 m	20 - 30	40	20	20	10	20	20	45 - 50	30	30	6	12	5
% of nearby coast build-up w/ structures	50	60	75	75	75	75	20	20	20	30	10	15	20
OTHER STRESSES AND THREATS													
No. of large ships w/in sight	~	~	~	2	~	1	~	~	~	3	~	~	1
No. years since last typhoon (>100 kph)	5	7	9	12	7	12	5	7	9	12	7	9	12
No. years since last bleaching incident	~	~	~	3	~	3	~	~	~	3	~	~	3
% bleached coral area	~	~	~	< 5	~	< 3	~	~	~	< 10	~	~	> 20
~ No data													

Figure 3. Change in mean percent of reef substrate as observed in Arthur's Rock

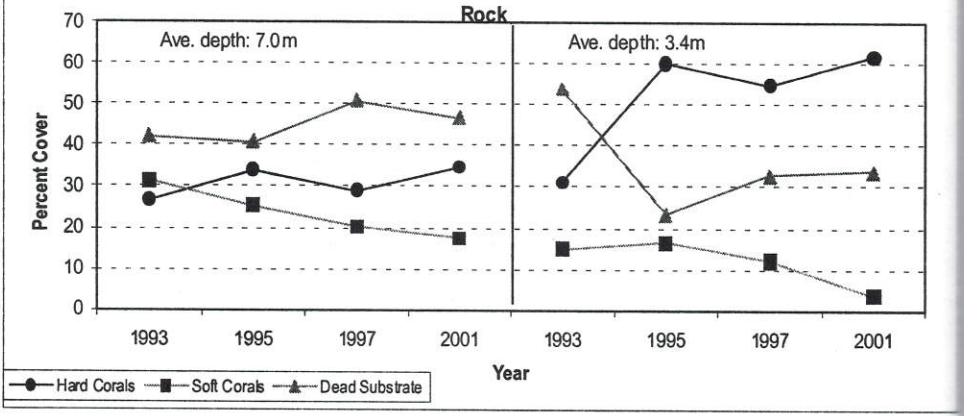


Figure 4. Change in mean percent of reef substrate as observed in Twin Rocks.

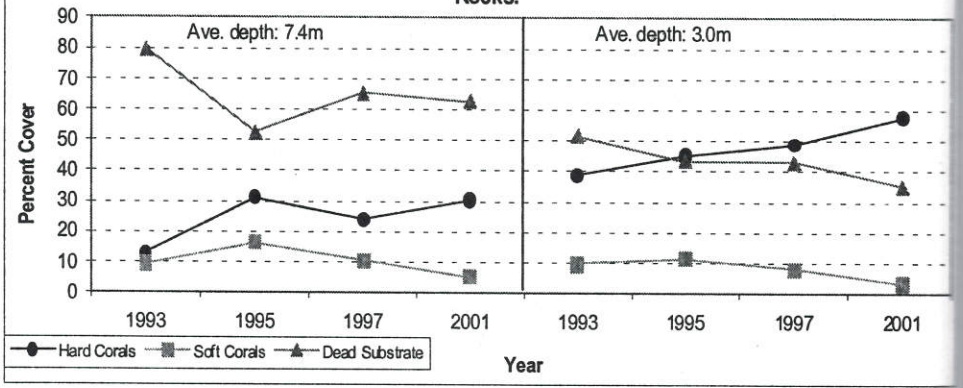
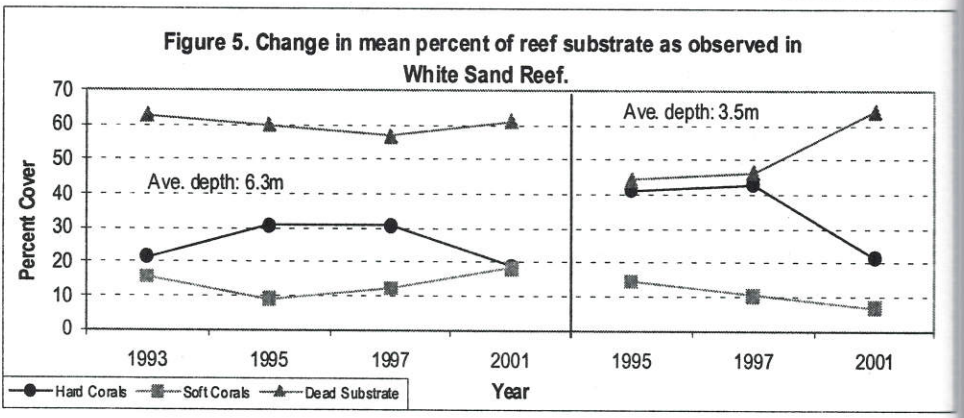
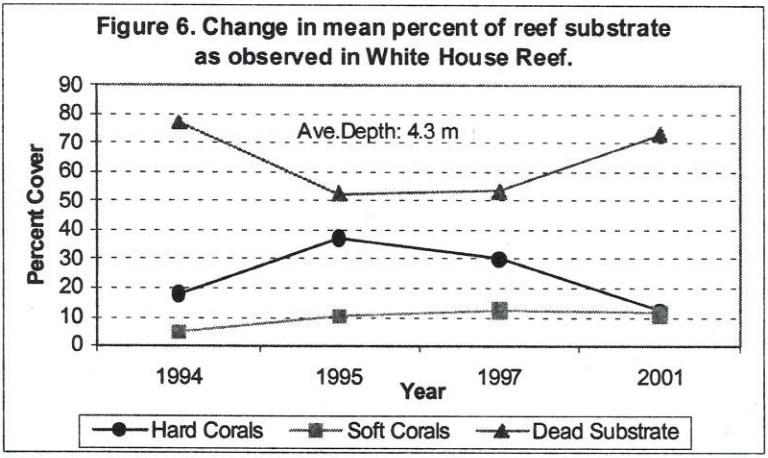


Figure 5. Change in mean percent of reef substrate as observed in White Sand Reef.





Note: No snorkeling data collected on the shallow portions of White House Reef.

As shown by research on fish diversity and abundance for Mabini, fish populations have stabilized or modestly improved in the Mabini area—at least in the areas within or nearby enforced MPAs. The general trends are the following:

- The abundance of fish outside MPAs has remained relatively constant since 1995, but target fish abundances outside the MPAs are significantly lower than abundances within enforced sanctuaries such as Twin Rocks.
- There has been a significant increase in the abundance of non-target fish in Twin Rocks.
- The abundance of fish at Arthur's Rock has varied significantly from year to year.
- Small, planktivorous species are the most numerous.
- There has been a significant increase in fish diversity inside MPAs since 1995.
- The most significant increase in fish diversity (target and non-target families) has been within Twin Rocks sanctuary (from an average of 26.5 +/- 8 fish species in 1990 to 61.8 +/- 6 species in 2001).

- The number of fish species at Arthur's Rock sanctuary has fluctuated for non-target species and target species from 1990 to 2001, with a modest increase between 1997 and 2001.

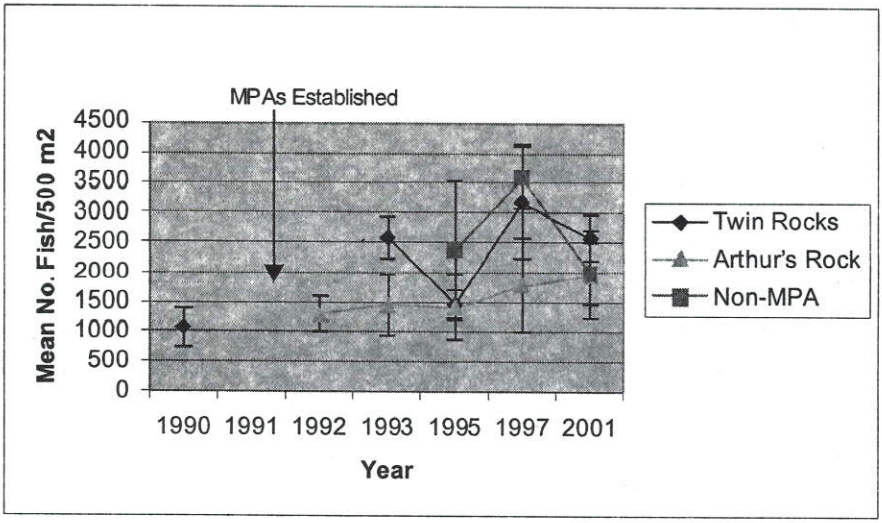
These findings are based on the following plots and two-way analysis of variance that demonstrate whether there are significant changes in abundance or diversity over time and/or significant differences between sites (George and Mallery 2001). Each plot indicates when the MPAs were legally established in the area (November 1991) and when resorts began to enforce the Twin Rocks sanctuary. The now deceased owner of Arthur's Dive Resort oversaw the Arthur's Rock MPA site. However, recent enforcement has been lax.

Figure 6 demonstrates that fish abundance for the two MPAs and the nearby non-MPA area has fluctuated over time and no discernible trend that continued until 2001. Fish abundances were significantly higher in 1997 than in previous years resulting in a significant difference in abundance over time (two-way analysis of variance: time, $p=0.02$). There is also a significant difference between sites (two-way analysis of variance: site, $p<0.01$). Interestingly, Arthur's Rock has significantly fewer fish than either Twin Rocks (Scheffe posthoc test, $p<0.01$) or non-MPA sites (Scheffe, $p=0.012$). Fish abundance is gradually increasing in Arthur's Rock.

It is notable that one of the general goals of MPAs, to increase fish abundance outside the no-take areas, has not been met. This finding agrees with others studies (Christie et al., 2001), but disagrees with other studies in Florida (Roberts et al., 2001) and in Apo Island (Russ and Alcala, 1996) where spillover has been documented. Without long-term fishing effort and yield data, it is uncertain if: 1) exported fish are being caught at a sustainable rate and therefore abundances will fluctuate between 2000 and 3000 fish per 500 m^2; 2) fishing effort is unsustainably high and possibly increasing so as to actually reduce fish stocks despite the MPAs; or 3) the MPAs are too small to have much effect outside

the no-take areas. It is plausible that without fishing effort control, many fishers will be attracted to fish near the boundaries of the no-take areas—especially if fishing resources elsewhere are in a state of decline. The general state of fish populations in the wider Anilao area has generally stabilized, however, without any consistent downward trends (White et al., 2001).

Figure 6. Fish abundance (all spp.) change over time (mean +/- 95% confidence interval). Two-way analysis of variance for 1995 to 2001: time, p=0.02; site, p<0.01; time X site, NS. N>5 per site.



There has been a marginally significant increase in target species fish abundance since 1995 (Figure 7, two-way analysis of variance: time, p=0.065). There is a significant difference between sites (two-way analysis of variance: site, p=0.033), with Twin Rocks as significantly different from non-MPA sites (Scheffe, p<0.01) but not significantly different from Arthur's Rock (Scheffe, p=0.195). Twin Rocks target fish abundance in 2001 is 280.9 (+/- 134) individuals per 500 m^2. Arthur's Rock target fish abundance is not significantly different from non-MPA sites (Scheffe

posthoc test, p=0.403). Target fish abundance has remained constant for the non-MPA sites since 1995. Again, this is an indication that local fishers are likely catching any "spill-over" from the MPAs. The greatest increase in target fish abundance for Twin Rocks took place between sampling in 1997 and 2001. In 2000, the owners of a nearby resort assumed enforcement of the Twin Rocks and have, reportedly, been very strict.

Figure 7. Target fish abundance change over time (mean +/- 95% confidence interval). Two-way analysis of variance for 1995 to 2001: time, p=0.065; site, p<0.05; time X site, NS. N>5 per site.

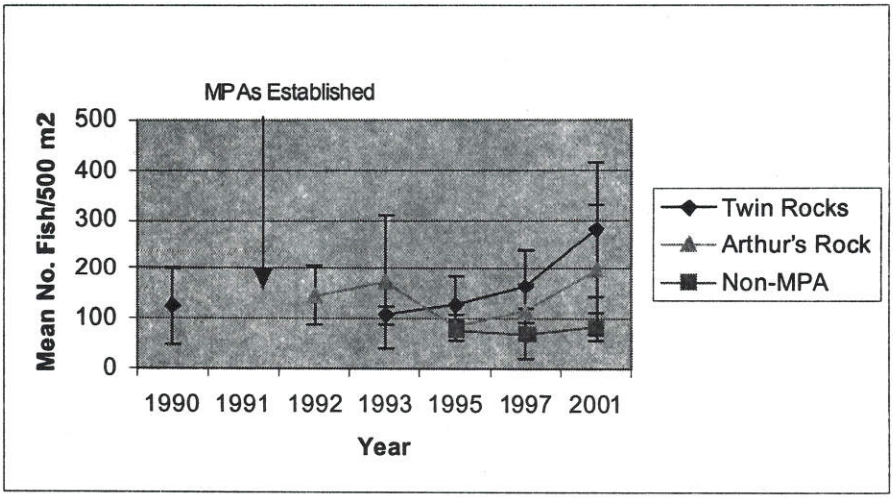
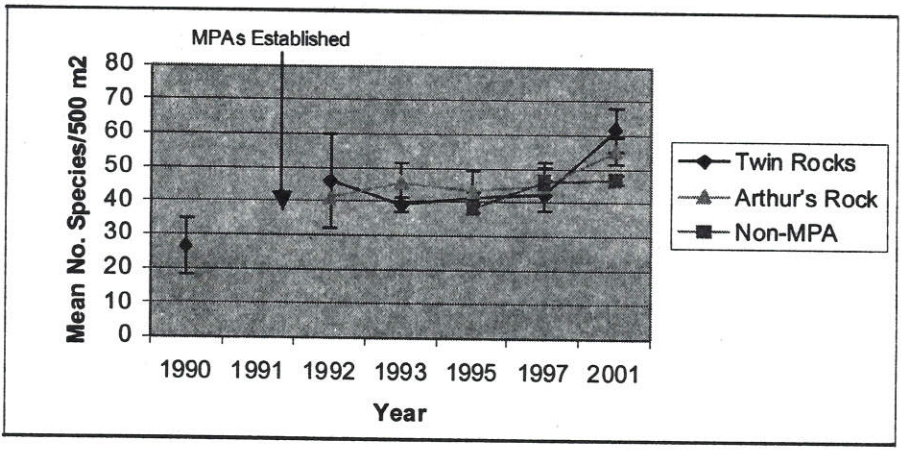


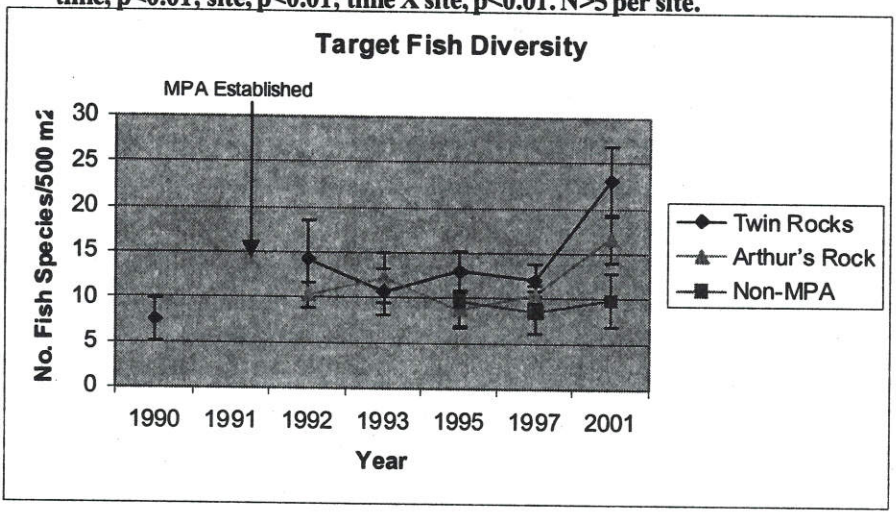
Figure 8 shows that there been a significant overall increase in the number of fish species in the area from 1995 to 2001 (two-way analysis of variance: time, p<0.01). Twin Rocks has significantly more species than non-MPA sites (LSD post hoc test, p=0.027). Fish biodiversity is clearly increasing in the area with significantly more species in 2001 than in 1997 (Scheffe, p<0.01) and 1995 (Scheffe, p<0.01).

Figure 8. Fish species diversity change over time (mean +/- 95% confidence interval). Two-way analysis of variance for 1995 to 2001: time, p<0.01; site, NS; time X site, NS. N>5 per site.



As with overall fish diversity, target fish diversity in the area has generally increased over time with a significant increase between 1997 and 2001 (Figure 9, Scheffe, p<0.01). Twin Rocks has significantly more target fish species than Arthur's Rock (Scheffe, p<0.01) and non-MPA sites (Scheffe, p<0.01). This is likely due to the strict enforcement of the Twin Rocks MPA.

Figure 9. Target fish species diversity change over time (mean +/- 95% confidence interval). Two-way analysis of variance for 1995 to 2001: time, p<0.01; site, p<0.01; time X site, p<0.01. N>5 per site.



From 1991 to 2000, local residents from fishing communities played a greater role in the management of Twin Rocks MPA. Neither fish abundance nor fish diversity increased over this period of time. From a biological perspective, as measured with these methods, conditions have improved at Twin Rocks sometime between 1997 and 2001. The most plausible explanation is the imposition of a strict enforcement regime by a local resort owner in 2000. However, fish abundance and diversity is increasing for Arthur's Rock as well, despite the fact that this MPA is not as strictly enforced as Twin Rocks. This may be due to the general decline of illegal fishing in the area. Fish diversity and abundance is generally higher in MPA areas than non-MPA areas. The only exception is the case of high level of abundance for non-target fish species in non-MPAs, possibly due to the lack of predatory fish that are targeted by fishing.

The trends in the local fishery are complex and little data exist. The establishment of the small MPAs in the area is likely improving yields and fish abundances near these MPAs do not appear to be declining. Abundances of target fish, however, are quite low with none of the 9 non-MPA sites that were surveyed in 2001 having densities higher than 100 individuals per 500 m2 (White et al., 2001). Overall, the abundance of large individuals of target fish species is low in most parts of the Philippines. The vast majority of fish in transects outside the MPAs are damselfish (Pomacentrids) or ferry basslets (Anthids), which are small planktivores. Fishing effort, in general, is not regulated, although it is plausible that fishers are being drawn into the tourism sector and away from fishing. It is equally plausible that the area is drawing fishers from elsewhere.

There is continued effort to improve coastal management in the area. Another MPA was recently established on Tingloy Island. The cessation of rampant illegal fishing, which had dramatic negative impacts in the area until the mid 1990s, has probably allowed for either a slow recovery or at least stabilization of coral reef conditions. Pre-illegal fishing longitudinal data do not exist to

determine whether this is the case. Local informants maintain that this is the case and mainly due to patrols by local *Bantay Dagat* units supported by World Wildlife Fund-Philippines and the local municipal government.

Bais Bay

Calumpong and Serate (1994) estimated the total area of coral reefs in the bay to be 200 ha or 3.68% of the bay. The main reefs areas are along the entrance and northern point (Campuyo Point) of North Bais Bay and surrounding the Talabong Mangrove Reserve. Fish and substrate surveys of the Bais Bay coral reefs indicate that the reefs are degraded by siltation and overfishing. Illegal fishing with explosives has reportedly declined, but cyanide fishing continues. Historic monitoring reports note impacts on Bais coral reefs including muro-ami and dynamite fishing in 1988 (Alcala, et al., 1991), a typhoon in 1990 (Alcala, et al., 1994), and sedimentation (Alcala, 1977; Alcala, et al., 1991; Alcala, et al., 1994; Divinagracia, et al., 1997).

Unlike Mabini, no longitudinal data set developed with consistent methods exists for Bais Bay fish abundance and diversity.

Coral reef substrate condition. Hard coral cover in Bais differed widely in the two sites that were monitored, probably as a result of both oceanographic conditions and human impacts. In Campuyo, a site with a proposed MPA that is exposed to current and clear water, living hard coral cover was "fair" (according to the rating system used by Gomez, et al., 1991) at 35.7% with soft coral coverage of 2.9% (N=13). This finding agrees with the results of the monitoring conducted in 1997 by the Coastal Resources Management Project (Table 2). The CRMP study found Bais Bay to have 91 species of hard corals with massive corals being the most abundant.

Table 2. Percent Living Coral Cover for Campuyo Reef, North Bais Bay from 1977 to 2002.

% Live Hard Coral Cover	Depth	Year	Reference
16.1	N/A	1977	Alcala, 1977
47.2	3m	1987	Alcala, et al., 1991
41.2	3m	1988	Alcala, et al., 1991
45	11m	1989	Alcala, et al., 1994
51	17m	1989	Alcala, et al., 1994
39.5	11m	1990	Alcala, et al., 1994
52.6	17m	1990	Alcala, et al., 1994
50.2	11m	1993	Alcala, et al., 1994
52.3	17m	1993	Alcala, et al., 1994
38.8	3 - 10m	1997	Calumpong, et al., 1997
35.7	7 m	2002	This study

The reefs to the southeast of Arboles Point, where another MPA has been proposed, are heavily impacted by siltation. Hard coral cover was only 17.9% and 0.05% soft coral cover (N=6) placing this site in the "poor" category. This reef is located in South Bais Bay and is protected from currents by the extensive Talabong Mangrove Reserve. It is likely exposed to seasonal runoff impacts from the nearby extensive sugar cane fields. In this area, many formally living corals were dead and covered with silt.

The dominance of massive corals in this site may be determined by siltation rather than wave action since massive corals tend to survive in silted areas better than branching corals (Alcala, et al., 1991).

Interestingly, the hard coral cover in Campuyo site (36%) was similar to that in the MPAs in Twin Rocks (31%), Arthur's Rock (35%), and slightly higher than in the non-MPA Mabini

sites. As discussed below, despite the similarly in hard coral cover in the Campuyo and Anilao sites, fish abundances and diversity were significantly lower in Campuyo sites.

Fish abundance and diversity. Average overall fish abundance at the Campuyo site (Figure 2, Table 3) was 1956 (+/ - 596) individuals per 500 m^2 with damselfish (Pomacentrids) comprising 65% of this total. Target fish abundances were low with an average of only 160 (+/-156) individuals per 500 m^2. 45 (+/- 6) species of fish per 500 m^2 were identified. Using similar transect methods, Luchavez and Divinagracia (1994) recorded lower species richness at 27.5 ± 4.3 (1 S.E.) per 500 m^2 and a higher abundance estimate of 3,992 fish ± 1,269 (1 S.E.) 500m^2 in Campuyo (Table 3). It is unclear why Luchavez et al., (1997) abundance estimates were notably higher.

Table 3. Number of fish species, species richness, and fish abundance per 500m^2 for Campuyo Reef from 1987 to 2001.

Year(s) of study	# of species / families	Mean Species Richness (+/- 1 SE)	Mean Abundance (+/- 1 SE)	Reference
1987-89	135 / 26	N/A	N/A	Luchavez & Alcala, 1992
1990-93	104 / 24	27.5 ± 4.3	3,992 ± 1,269	Luchavez & Divinagracia, 1994
1997	62 / 17	35 ± 3	18,974 ± 3,108	Luchavez, et al., 1997
2001	NA	45.1± 5.8 (95% CI)	1,955.8 ± 596.3 (95% CI)	This study

In the second southern Bais Bay site (Figure 2), locally referred to as Arboles Point, average overall fish abundance was 483 (+/- 291) individuals per 500 m^2 while average target fish abundance was only 54 (+/- 64) individuals per 500 m^2. This is significantly lower than the abundance figure reported by Luchavez et al. (1997) with 4,412 ± 2,054 (1 S.E.) fish per 500 m^2, but this

may be due to differences in methods or sampling location within this area. Species richness in this site in 2001-2002 with an average of 28 +/- 5.0 species of fish per 500 m^2 was lower than Campuyo in the same year and slightly lower than past estimates of 32 (+/- 1) species of fish per 500 m^2 by Luchavez et al. (1997).

It is notable that, in general, fish abundance and diversity were higher in no-take areas in Mabini than in Bais Bay. This could be an indication of the impacts of management or a difference in productivity of these reefs. Fish species diversity at the Bais Bay Campuyo site (45.1 +/- 5.8 per 500 m^2) is significantly lower than fish species diversity in the Twin Rocks MPA (62 +/- 6 species per 500 m^2), but similar to the Anilao non-MPA sites (47 +/- 9 species per 500 m^2) in 2001. Similarly, Campuyo target fish abundance in 2001-2202 at 160 (+/- 156) individuals per 500 m^2 was lower than Twin Rocks target fish abundance at 281 (+/- 134) individuals per 500 m^2, but higher than non-MPA sites in Mabini at 84 (+/-28). These differences are not statistically significant due to sample variance. That species diversity and target fish abundance are highest within the no-take area in Mabini and that Campuyo has comparable diversity but higher target fish abundance than non-MPA sites in Mabini suggests that differences in diversity and abundance are due to the presence or absence of a no-take MPA, rather than differences in productivity.

Lower abundance and diversity figures for Arboles Point appear to be due to differences in natural reef productivity—it is in a sheltered cover near mangroves—and increasing sediment loads that are killing the corals. The fish species diversity and target fish abundance for Arboles Point at 27.8 (+/- 5.0) species of fish per 500 m^2 and 54 (+/- 64) target fish per 500 m^2 are significantly lower than any Mabini site. During surveys, the amount of silt on the Bais Bay nearshore reef was notable and is likely exacerbated by deforestation and mono-culture sugar production in the area. The Campuyo site, if protected, would likely result in reef conditions similar to those found in Twin Rocks or nearby Apo Island.

Fisheries condition. The Bais Bay fishery is considered overexploited (Luchavez and Abrenica, 1997). No new fisheries data were collected as part of this study. However, a review of previous studies is helpful in determining if ICM activities have impacted environmental condition. Three major studies (ERMP, 1992; Alava et al., 1997; COE-CRM, 1998) on the fisheries of Bais Bay used fisher interviews, catch enumeration at landing sites, and enumeration of fish sold in the public markets. These studies demonstrate that there has been a continuous increase in fishing effort during the 1990s, but that catch per unit effort seems to be remaining stable.

Perceived condition of the environment in case study sites

In addition to field observations, this study collected information with in-depth interviews with key-informants to assess perceived trends for the environment. Results indicate that opinions of informants are distinct and are site and resources-specific.

Mabini

All five informants, with detailed knowledge of Mabini's reefs, commented that there are more fish in the area now than 10 years ago and that there are increased numbers of large, predatory fishes and threatened species such as turtles and dolphins. The following are illustrative quotes.

> *Patrick: In the past 10 years, has the condition of the coral reefs and sea changed?*
> *Local fisher: If we are going to compare it to before, in the past 10 years, there's a big change. There are new species of corals now. There's a big improvement.*
>
> *(9/7/01)*
>
> *Patrick: Could you tell me how, in your opinion, the condition of the marine environment has changed in the last 10 years?*

NGO-fieldworker: I've been here for 3 years and I think it has improved a lot. As a community organizer, I've been hearing feed back from the communities—that they are seeing big fishes like tangigue (mackerel), yellow-fin tuna. And just this year, I personally saw schools of dolphins which I haven't seen since we've started here in 1998.
(9/10/01)

There remain significant coastal environmental problems, however. There is a growing problem with trash disposal, which is frequently thrown into the sea by passenger ships and tourists. Recently, sport divers have organized large-scale annual coastal clean-up activities. During the September 2001 event, hundreds of divers participated and thousands of kilograms of trash were removed from the waters and beaches of the Mabini area.

With the explosion of tourism in the area, erosion caused by road, home, and hotel construction has become a growing concern among informants. Ongoing swidden agriculture on the steep slopes is also likely to contribute considerable silt loads to the marine systems. According to some informants, landslides are common during heavy rains . Local fishers commented on the decline of shellfish populations on beaches fronting resorts due to the construction of hotels and boat landing in some areas. Set-back regulations are either non-existent or poorly enforced. This growth is likely to continue and its impact may be compounded if proposals to extend industrial zones toward Mabini are implemented.

According to local informants, the MPAs in the area are being impacted in a number of ways and management mechanisms are weak. There are growing concerns among some community members and fishers that the three, small marine protected areas are being damaged by diving and boat anchoring. This was supported by field observations. Few anchor buoys exist. Arthur's Rock MPA is no longer strictly enforced. Twin Rocks and Cathedral Rock are protected— but mainly by vigilant resort owners rather than by local fishing community members (as was

originally the case). The case of Twin Rocks is particularly interesting since unilateral enforcement actions by one hotel owner has created considerable tensions with a nearby fishing community. Comments about diving-related damage may be linked to disapproval of hotel owner involvement in MPA enforcement. The controversy is heightened by widespread resentment caused by dive resort owners who ignore an amendment to the MPA management ordinance banning recreational diving inside the MPAs. (See report by Oracion in this issue).

In general, the consensus among informants, confirmed by direct observation, is that the environmental conditions in the Mabini area have improved through the establishment of MPAs and educational efforts. Undeniably, challenges such as impacts from building and trash remain. Also, the MPA management process is currently strained. Nonetheless, informants appreciate the improved condition of the area, especially when compared to other areas in the Philippines.

Bais Bay

Interview results give the impression that the coastal environment in Bais Bay is degraded, but stable. Serious issues, such as siltation due to upland deforestation, remain largely unsolved (Roy de Leon, pers. comm. 2001). As documented by substrate monitoring, large areas of reef are being negatively impacted by sediment loading. Sediment and nutrient loading may be linked to red tide and fish kill events in the area. Regular habitats and water chemistry monitoring with consistent methods is necessary.

The area's fishery is also reportedly stable (Calumpong, pers. comm.) mainly due to the reduction of illegal fishing. Nonetheless, fish abundance levels are greatly reduced from historic levels according to local fishers. There are no regulations in place to control fishing effort. Illegal fishing continues, although at a greatly reduced level than in previous decades. The use of poisons such as cyanide and *tubli* (derived from a plant root)

continues and was raised by a number of informants during interviews. No such activities were observed during monitoring activities.

The transition toward mariculture of seaweeds and milkfish may eventually reduce fishing effort. Seaweed mariculture (primarily Euchema) appears to be increasingly popular in certain areas of Bais Bay. Sally Alcazar (pers. comm.), formerly of the municipal government, feels that this practice is resulting in increased rabbitfish abundances as penned areas prevent fishing.

Mangrove resources appear to be improving after large-scale deforestation in the 1980s for wood and fishpond development. Historically, there were approximately 929.8 ha of mangroves in the area (Calumpong 1994) which were reduced to approximately 264 ha by 1997 (Calumpong, et al., 1997). Transition to gas for cooking, improved enforcement, and reforestation efforts seem to have had positive impacts (Calumpong and Alcazar, pers. comm.).

Motives to Participate in ICM

To investigate the plausible link between environmental condition and ICM process sustainability, information from various sources was collected—from direct observation of coral reefs, published accounts, and interviews. Interviews were used to explore the potential link between this biological information and constituency formation for ICM who are willing to commit resources, including their own time. Personal commitment is offered as a valid measure of ICM sustainability.

Those within the "environmental motives" group participated in ICM out of inspiration from what they perceived as improving environmental conditions or out of concern for declining environmental conditions. Those categorized as members of the "economic motives" group expressed desires to improve personal or family economic conditions through ICM. And those within the "social motives" group wished to use ICM as a means to meet basic human needs such as shelter and food or to strengthen

community groups. Such categorization allowed us to group informants with similar perspectives and to explore trends. People perceive multiple and differing environmental trends and they have multiple motivations and mixes of motivations to participate in ICM, therefore some informants fell into more than one group.

Nonetheless, interesting tendencies are discernible and appear to have implications for ICM process sustainability. Each set of motivations implies different goals, methods, and measures of success for ICM. Depending on an individual's motives for participation in ICM, the interpretation and valuation of tangible biological impacts is likely to differ. The matching of these goals, methods, and measures of success across different stakeholders is likely to impact ICM process sustainability. ICM is a complex process involving a variety of stakeholders that hold distinct motives and goals for ICM. Rationalizing, or at least acknowledging, these distinct motives and perspectives may be important.

Environmentalist motives. The basic texts that describe ICM (Cicin-Sain and Knecht, 1998; Kay and Alder, 1999) are clearly concerned with the state of the coastal environment and profess a sustainable development agenda that calls for rational planning that balances economic development with environmental health. The professionals of the field are influenced by an education that highlights these concerns and an internal "professional culture" that perpetuates this model (Ward and Weeks 1994).

Informants motivated primarily by "environmental motives" are Western ICM practitioners (James and Linda), local area hotel owners (Jerry and Roilo), NGO practitioners (Solita) and academics (Gloria). I categorized informants in this category if they expressed, as their principal motive for participating in ICM, the need to protect ecosystems and biodiversity and other environmental causes.

James is an example of someone informed by aesthetic and ethical concerns for reefs.

James: ... a lot of pleasure in my life comes from seeing a natural environment not being destroyed and being protected in some form for the benefit of people—but benefit in the sense that it is in a natural state...

Roilo, a dive resort owner and self-described "eco-warrior", wants immediate results. He is principally concerned with environmental problems, and tends to divorce these from social considerations.

Roilo: Well, you now the best perspective to take is the perspective of the fish in the corals. You look at, if you were the fish, what's going to be best for you... So, what is important for me is enforcement or prevention or ... reforestation of waterways, clean up. Those are still the issues. Social issues are divorced from actual impacting issues. For me those are secondary...

Solita is a committed, young NGO-worker with a prominent environmentalist NGO and has a self-professed passion for the sea.

Patrick: What is it that motivates you to be involved in this marine conservation work?
Solita: Maybe because of being an environmentalist in nature. I really love the ocean. I'm a diver, I really love seeing those live corals, big fish. Especially when I saw big schools of jacks in Dumaguete. There's this feeling that I really love the ocean. I'm looking forward to seeing it until the future.

Other people who expressed notable environmentalist tendencies expressed the need to care for the environment due to its fragile nature.

Gloria: What I see is every living thing should be taken care of. They cannot save themselves and we must do our part to help save them. It's more

of the bio-centric outlook on nature.

While most informants expressed some form of an environmentalist agenda, the above informants were clearly in favor of protecting the coastal environments for their own sake and so that they may be enjoyed recreationally. Aesthetic, ethical, and ecological reasons speak strongly to these informants and help motivate them to support and become involved in ICM.

Social motives. In a context where basic human needs frequently are not met and where inter-personal relations are fundamental—relevant characteristics of the Philippines—one might expect social motives to participate in ICM to be common. Published accounts also identify the degree to which ICM projects meet basic social needs as fundamental to their success and acceptance by community members (e.g., Olsen and Christie, 2000).

Informants who are motivated by social concerns are: local community leader (Raul), long-term ICM practitioner (James), hotel owner-former social activist (Cristi), former academic/LGU employee (Ning), environmentalist NGO field worker (Jose), academic biologist (Belinda), and Bais area Rotary Club members in Bais. Informants in this category expressed interest in participating in ICM since they perceived it as providing basic needs (e.g., food and shelter) or supporting certain social processes (e.g., conflict resolution or empowerment of communities).

One informant, who is a long-term activist and leader from a Mabini community, expressed interest in maintaining the condition of the environment to maintain fisheries.

> *Patrick: What is the number one reason why you protect the sanctuary?*
> *Raul: In my own opinion, to produce more fish and then to continue the growth of coral reefs. Not for financial reasons. Because someday money might be of little ... value, but the marine*

life is there. It will help us... Because of the abundant environment we can continue our life. Let's say our life is simple. We eat three times a day. And that comes from our environment. That is the basis for why I'm interested to continue the protection of our environment.

Some professionals are concerned about the basic needs of community members who they serve.

Ning: I am not concerned only environmentally but I'm concerned about what will happen to the environment in relation to the needs of the people in the community. Because I could see how poor the people are. They don't even have good shelter. Don't have three meals a day... Most of our lands here are owned by hacienderos (sugar plantation owners), so where will these people go?

Other Filipino ICM practitioners, who are also academics, feel that people and communities are central to the effective implementation of ICM. This informant is pragmatic in that she expresses that without support for and participation in ICM by Filipino society, the likelihood of success is slim.

Belinda: Our society is dependent on the environment. If you look at ICM, ICM actually involves people. You can manage a reef like a pristine reef. That's easy to do because nobody is living there... These resources are also dependent on people for their survival because we are the major agents of destruction and development... We know that every single thing in this world has a right to exist but we are very concerned with our survival and our survival depends on the environment.

How people choose to work with coastal communities within the framework of ICM is distinct. For example, the perception—and therefore level of interaction—is quite different for wealthy

tourists volunteering time for a beach clean-up or for activists working on a long-term basis in solidarity with communities. For example, the following quotes are from affluent members of Bais Bay society during an interview conducted at the house of a sugar plantation owner following a morning of coastal clean-up. During the morning's clean-up activities, these informants had directed, from atop a rice paddy dike, village children in the removal of trash from a fetid mangrove swamp.

> *Patrick: From your point of view, what is the purpose of the coastal clean up?*
> *Informant 1: It's helping the community become aware of preserving the environment.*
> *Informant 2: Also making the people conscious about keeping their coastal area clean. So that, maybe afterwards, they can do it on their own. Because we only come here once a year, so we can't really help them throughout the year. So, at least we set an example...*

This relationship stands in contrast to another activist field-worker (who also happens to be from a relatively affluent background).

> *Jose: I got challenged by seeing these people trying to earn an honest living and it's like you can do something with them, not for them.*

Economic motives. The published literature establishes that people participate in ICM at least partly as a consequence of economic opportunities resulting from improved environmental conditions due to ICM planning and ICM-related alternative income generation schemes (Pollnac et al., 2001; Pomeroy et al., in this issue). Informants motivated to participate in ICM out of economic interests for themselves or their communities seem to fall into three categories: the dive hotel owners who have interest in maintaining a quality experience for business reasons, the fishers who want to maintain their livelihood, and

community members who may look for employment associated with ICM project activities (e.g., as mangrove guard, tree nursery keeper, or patrol boat operator).

The least complex linkage between economic benefits and motives for participating in ICM is represented by the following quote. Many community members from the Mabini area seem to be motivated to participate in ICM related activities, such as protecting a marine sanctuary, if these help maintain a livelihood such as fishing.

> *Patrick: How were you involved in the management of the sanctuary?*
> *Raul: As I said, it is a challenge for me because this is what gives my family life and this is the source of our livelihood. Because if you're going to abuse these resources, it will destroy you.*

This is particularly the case if people are economically vulnerable and highly reliant on the resource base.

Some people also get involved in ICM-related activities such as enforcement of fisheries laws due to direct economic incentives associated with employment.

> *Presco: I was a member of the CVO (Civil Volunteer Organization) formed to ... help protect the sea in 1989. I quit after 5 months since there wasn't any salary. I couldn't support myself.*

As a poor fisherman, Presco's economic status precludes considerable volunteer work in the name of ICM. Without funds for this position, Presco's commitment to ICM ended.

Certain types of business in the Philippines, such as the recreational diving industry, are dependent on a healthy marine environment.

> *Patrick: At first, it [protecting the coral reefs] was just a business issue?*
> *Jerry: Yes, it started especially in El Pinoy [resort]. It's a scuba-diving resort so [we thought we] might as well take care of the reef—*

for our guests to see something.

Members of this industry have taken a particular interest in establishing management practices that favor a positive experience for their diving clients. In a context where fish resources are widely over exploited, marine sanctuaries are one of the few places where divers are able to view relatively pristine coral reefs. Having access to these areas is important to the business as expressed by a dive resort owner.

Patrick: If it would happen that in fact diving was stopped in the sanctuary would that hurt your business?
Cristi: Of course!

Linking Environmental Condition with Sustainability

ICM efforts had distinct impacts on the coral reefs in the two case study sites. Mabini area reefs appear to have been stabilized, and even improved in some cases. Some members of local communities and resort owners are behind the ICM concept, despite differences in motives for participation. Bais Bay coral reefs are in more highly degraded state than Mabini's reefs. MPAs have not been successfully established in Bais, nor has upland deforestation been controlled. ICM-related laws are inconsistently enforced in either location (see article by Eisma in this issue).

The link between environmental condition and personal commitment, and therefore ICM sustainability, is complex and influenced by the individual's social standing, employment, and worldview. Interviews demonstrate that some informants were motivated to participate in ICM out of a desire for improved environmental conditions that sustain their livelihoods derived from tourism or fishing. Whether people are motivated to continue participating out of concern for what the future holds or out of a sense of accomplishment and inspiration is unclear. Pollnac et al. (2001) conclude that the perception of an environmental crisis is associated with MPA success.

While informants who are ICM practitioners are motivated

to support ICM due to environmentalist perspectives, none of these particular informants (or any other informants) directly identified biological conditions or environmental trends *per se* as key factors influencing the sustainability of the ICM process. Rather, they discussed institutional, financial, and personal issues as constraints to the process and their contribution. ICM is a planning process involving institutions and people intending to have particular social and biological impacts. Therefore, the breakdown of the planning process is attributable to social dynamics, and is expressed in those turns by informants. In other words, it is not possible to make a direct causative or correlative link between environmental impact and ICM sustainability.

Nonetheless, ICM environmental impact is not unrelated to a comprehensive explanation of ICM sustainability. The impact of ICM on environment condition is noted by stakeholders with each interpreting the significance of these impacts from their point of view with their personal interests in mind. Different stakeholder groups speak uniquely of environmental impacts in a manner that calls attention to their distinct interests. The melding of these interests during a multi-stakeholder process is challenging.

The interests and motives of some ICM stakeholders are potentially complementary. For example, well managed fisheries and tourism operations can exist side by side. However, exclusive perspectives that preclude other interests have resulted in conflict in the Mabini site, and throughout the Philippines. Exclusively environmentalist motives in a context where social and economic motives are widely held are likely to result in conflict. How each of these groups of people interprets and value biological measures of ICM success is indicative of these interests and may suggest the potential for conflict.

While complementary motives may sustain a process, in the cases where interests and motives clash, the potential for conflict and, therefore, ICM process derailment arises. In the case when one stakeholder group has more political

influence or economic clout, ICM may become a process generally favoring particular elite socio-economic groups (Trist 1999). None of the ICM processes in Bais or Mabini have established formal and lasting conflict resolution mechanisms.

It would be misleading to claim that all individuals fall neatly into one motivational category. Rather, most informants are motivated to participate in ICM for complex and varied reasons that change over time. For example, a veteran ICM practitioner, who may have come to the field out of environmentalist motives, is likely to come to appreciate the importance of social and economic dynamics. As demonstrated by the above quotes, social and economic considerations are important to community members who are one of many clients served by ICM practitioners. Nonetheless, the veteran ICM practitioners did express environmentalist motives as central to their commitment to ICM. These perspectives are likely to orient ICM design and implementation efforts. These perspectives are notably distinct from those expressed by local resource users who are frequently expected to maintain a community-based ICM process after a project is phased out.

This analysis warrants further development. Nonetheless, this preliminary analysis demonstrates that, even with a relatively small sample size, discernible unique motives emerge for different stakeholder groups such as ICM practitioners, resort owners, and fishers. Educational, class, and cultural background, which are distinct among these groups, likely play a role in defining these motives. This is necessarily the subject of further research.

In short, this research supports the conclusion that stakeholder motives, and how distinct motives are managed within ICM, are linked to process sustainability. ICM project design and implemented is influenced by a particular suite of perspectives that set the range for appropriate goals for ICM. A mismatch of ICM fundamental goals is likely to

influence the chance of sustainability when multiple stakeholders are involved in a collaborative process.
An analysis of the potential links between measurable biological impacts and financial support for ICM also warrants investigation. Financial supporters of ICM projects (e.g., donors, NGOs) are likely to have particular goals that are measured in biological terms. Without meeting these benchmarks, continued financial support for ICM is unlikely.

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References

Alava, M.N.R., B.T. Abrenica, and C. A. Almaida. 1997. Fisheries Profile. In: Calumpong, H.P., J.S. Estacion, and M.V. Lepiten (eds.). Status of the coastal Resources of the Negros Learning Site (From Manjuyod to Dauin). COE-CRM and Silliman University Marine Laboratory. Manila, Philippines.

Alcala, A.C., M.S. Dy-Liacco, and L.C. Alcala. 1991. Benthic lifeform composition of two coral reef sites in the Central Visaya, Philippines. *In*: A.C. Alcala *et al.* (eds.). *Proc Reg Sympo Living Res in Coast Areas*. Manila, Philippines. pp. 69-74.

Alcala, L.C., E.E. Serate, and M.L.R. Alcala. 1994. Quantitative assessment of Campuyo Reef, North Bais Bay, Central Visayas, Philippines. *In*: Proceedings of the ASEAN-Australia Third Symposium on Living Coastal Resources, Chulalongkorn University, Bangkok, Thailand. 16-20 May, 1994. C.R. Wilkinson S. Sudara and L.M. Chon (eds.) 2:13-20.

Alcazar, S. 2001. Personal communication. Former Bais City government employee responsible for coastal monitoring.

Biña, R.T., et al., 1979. Cited by de Leon, R.O.D., J.A.U. Nuique, and R.J. Raymundo, 1991. Potential levels of primary production and community structure of the Talabong Mangrove Forest, Negros Oriental, Philippines. *In*: A.C. Alcala et al., (eds.). *Proc Reg Sympo Living Res in Coast Areas*. Manila, Philippines. pp. 453-458.

Calumpong, H.P. 2001. Personal communication. Director of Silliman University Marine Laboratory.

Calumpong, H.P. 1994. Status of Mangrove Resources in the Philippines. *In*: C.R. Wilkinson, S. Sundara, and C.L. Ming (eds.). *Proc 3rd ASEAN-Aust Sympo Living Coast Res*. Vol. 2. Chulalongkorn University, Bangkok, Thailand. pp. 219.

Calumpong, H.P. and E. Serate. 1994. Carbon Dynamics in Bais Bay, Central Philippines. *In*: C.R. Wilkinson, S. Sundara and C.L. Ming (eds.). *Proc 3rd ASEAN-Aust Sympo Living Coast Res*. Vol.2. Chulalongkorn University, Bangkok, Thailand. pp. 691-695.

Calumpong, H.P., J.S. Estacion, M.V. Lepiten, and C.E. Acedo (eds.). 1997. *Status of the Coastal Resources of the Negros Learning Site (Manjuyod to Dauin)*. Silliman University Marine Laboratory and Center of Excellence in Coastal Resources Management. Dumaguete City, Philippines, pp. 196.

Calumpong H.P. and P.L. Cadiz. 1997. Mangrove rehabilitation efforts in Bais Bay. *Silliman Journal* 37:187-203.

Center of Excellence in Coastal Resources Management (COE-CRM). *Action Research for Continuing Support 1998. Continuing support and pilot testing of management schemes and CRM activities in Apo Island, Bais Bay and Bantayan: Terminal Report*. Silliman University, Dumaguete City, Philippines.

Christie, P., A.T. White, and E. Deguit. 2002. Starting point or solution? Community-based marine protected areas in the Philippines. *Journal of Environmental Management* 66: 441-454.

Cicin-Sain, B. and R.W. Knecht. 1998. *Integrated Coastal and Ocean Management Concepts and Practices*. Washington DC: Island Press.

de Leon, R.O.D., 2001. Personal communication with professor of Biology, Silliman University, Dumaguete City, Philippines.

de Leon, R.O.D., J.A.U. Nuique, and R.J. Raymundo, 1991. Potential levels of primary production and community structure of the Talabong Mangrove Forest, Negros Oriental, Philippines. *In*: A.C. Alcala et al. (eds.). *Proc Reg Sympo Living Res in Coast Areas*. 30 January to 1 February 1989. Manila, Philippines. 453-458.

de Leon, R.O.D., P. Cadiz, and D. Baker. 1997. Mangrove Study. *In*: Calumpong, H.P., J.S. Estacion, and M.V. Lepiten (eds.). Status of the Coastal Resources of the Negros Learning Site (From Manjuyod to Dauin). Silliman University COE-CRM Project. USAID, Manila, Philippines.

Divinagracia, M.F.B., C.T. Reboton, D. Baker, R. Duran, and V.A. Duran. 1997. Coral Study. *In*: Calumpong, H.P., J.S. Estacion and M.V. Lepiten (eds.). Status of the Coastal Resources of the Negros Learning Site (From Manjuyod to Dauin). COE-CRM and Silliman University Marine Laboratory. Manila, Philippines.

Environmental and Resource Management Project (ERMP). 1992. *Bais Bay Environmental and Resource Management Project: marine component (year 1)*. Unpublished report. Silliman University, Dumaguete City, Philippines.

George, D. and P. Mallery. 2001. *SPSS for Windows Step by Step*. 3rd Edition. Allyn and Bacon. Neeham Heights.

Gomez, E.D., A.C. Alcala, and A.C. San Diego. 1981. Status of the Philippine Coral Reefs. *Proc. 4th Intl. Coral Reef Symposium*, Manila. Vol. 1. pp. 275-282.

Kay, R. and J. Alder. 1999. *Coastal Planning and Management*. E&FN Spon, New York.

Luchavez, J.A. and B. Abrenica. 1992. *Fisheries Stock Assessment of Bais Day. Bais Bay Environment and Resource Management Project, Marine Component. Silliman University, Dumaguete City, Philippines*. Terminal Report (Year 1). Unpublished.

Luchavez, J.A. and B.T. Abrenica. 1997. Fisheries Profile of Bais Bay, Negros Oriental. *Silliman Journal* 37: 93-176.

Luchavez, T.F. and L.C. Alcala. 1992. Reef fish community structure in Campuyo Bais, Negros Oriental, Philippines. *In*: L.M. Chou and C.R. Wilkinson (eds.). *Proc 3rd ASEAN Sci and Tech Week Conf*. Singapore. Dept. of Zoology, National University of Singapore and National Science and Technology Board, Singapore.6:121-138.

Luchavez, T.F. 1994. Development of Bais Bay as Marine Protected Area. *In*: Proceedings of the ASEAN-Australia Third Symposium on Living Coastal Resources, Chulalongkorn University, Bangkok, Thailand. 16-20 May, 1994. C.R. Wilkinson S. Sudara and L.M. Chon (eds.) 2:13-20.

Luchavez, T.F. and M.F. Divinagracia. 1994. Changes in the fish population of Campuyo Reef, Bais Bay Negros Oriental, Philippines. Proceedings of the ASEAN-Australia Third Symposium on Living Coastal Resources, Chulalongkorn University, Bangkok, Thailand. 16-20 May, 1994. C.R. Wilkinson S. Sudara and L.M. Chon (eds.) 2:13-20.

Luchavez, T.F., M.A. Luchavez, and D.C. Catada. 1997. Fish Visual Census. *In*: Calumpong, H.P., J.S. Estacion, and M.V. Lepeten (eds.). Status of the coastal Resources of the Negros Learning Site (From Manjuyod to Dauin). Silliman University COE-CRM Project. USAID, Manila, Philippines.

Morris, A.D. and C.M. Mueller (eds.). 1992. *Frontiers in Social Movement Theory*. Yale University Press, New Haven, CT.

Olsen, S.B. 1993. Will integrated coastal management programs be sustainable? The constituency problem. *Ocean and Coastal Management* 21:201-225.

Olsen, S.B. and P. Christie. 2000. What are we learning from tropical coastal management experiences? *Coastal Management* 28:5-18.

Pollnac, R.B., B.R., Crawford, and M.L.G. Gorospe. 2001. Discovering factors that influence the success of community-based marine protected areas in the Visayas, Philippines. *Ocean and Coastal Management* 44: 683-710.

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.C. Alcala. (1996). Do marine reserves export adult fish biomass? Evidence from Apo Island, central Philippines. *Marine Ecology Progress Series* 132:1-9.

Trist, C. 1999. Recreating ocean space: recreational consumption and representation of the Caribbean marine environment. *Professional Geographer* 51: 376-387.

Ward, W. and P. Weeks. 1994. Resource managers and resource users: field biologists and stewardship. In *Folk Management in the World's Fisheries, Lessons for Modern Fisheries Management*, ed. C.L. Dyer and J.R. McGoodwin, 91-113. University Press of Colorado, Niwot, CO.

White, A.T., P. Christie, J. Apurado, A.T. Meneses, E.E. White, and S. Tesch. 2001. *Coral Reed Monitoring for Conservation in Mabini and Tingloy, Batangas, Philippines*. Unpublished Earthwatch Institute Report. 95 pp.