Reef Rehabilitation Project of the Central Philippines

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UNIVERSITY OF GUAM MARINE LABORATORY
Technical Report #120
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Final Report

Submitted by:

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Submitted to:

Conservation, Food and Health Foundation, Inc. , Coastal Conservation and Education Foundation, Inc., CFARMC-Dumaguete City, Banilad *Bantay Dagat* Association, Ayungon Municipality, and Calagcalag *Bakhawan* Fishers' Association

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31 July, 2006

Table of Contents

List of Figures

I. Introduction

Rationale

The main objective of this project was to develop and test a low-cost method of stabilizing previously-dynamited coral reef substrate, to initiate natural recruitment processes. Dynamite-blasted substrates are problematic throughout Indo-Pacific coastal reef systems, as they do not recover naturally, and persist as areas of low productivity and fish community diversity and biomass. Existing rehabilitation methods, such as coral transplantation, are unsuitable for unconsolidated rubble substrates, so we wished to develop a method which specifically targeted such substrates which would make use of locally-available materials, promote natural recovery processes, and require little maintenance, once established. A further goal was to select a Marine Protected Area as a recipient site for this pilot study, and to enhance management of the MPA through capacity-building and involvement of the stakeholders in the mitigation treatment and monitoring.

Project Background

This project began in 2003, with an initial assessment of the Calagcalag, Ayungon Marine Protected Area. The Calagcalag MPA met the requirements of a recipient site that we had identified: it contained a significant amount of rubble (39%, with 40% hard coral cover), it was managed by an active and committed community of fishers (the Calagcalag Bakhawan Fishers' Association; CABAFA), the CABAFA was having difficulties managing the MPA, due to a lack of capacity and support, but were supportive of our involvement. Dynamite fishing was common until the mid-1980s, after which it was banned.

The first year of the project focused on deploying six mesh plots within the rubble field, anchoring them in place, and weighting them down with cemented rock piles (see Figure 1). The rock piles were constructed on land by volunteer CABAFA members, and served to create a more complex topography for coral settlement and fish habitat. Monitoring began immediately after plot deployment. The second year focused on monitoring coral and fish recruitment, identifying specific management issues of the fishers, and planning strategies to address these issues. Funding was provided a Pew Foundation grant to Dr. Edgardo Gomez of the University of the Philippines, and the Silliman University Research Center. However, without additional funding, these issues could not be addressed.

Figure 1. A fish habitat rock pile.

A proposal was submitted to the Conservation, Food and Health Foundation, Inc. (CFH), for additional funding for 2004-05. The proposal was submitted and in 2004, several activities took place: 1) monitoring continued for a second year to determine the effects of our mitigation

on the reef community; 2) management capacity issues were addressed with the purchase of a patrol boat and patrolling equipment; 3) a meeting was held with the community to present initial results and identify further management concerns, such as tension between CABAFA and the local mayor, and the need for training of CABAFA members in policing and enforcing skills, and basic monitoring skills; and 4) an additional site was added for rehabilitation: the Banilad Marine Protected Area, Dumaguete City. This site was then surveyed, a strategy for mitigation was formulated, a community dialog took place to request support for the work, and rehabilitation was initiated. In the case of Banilad, rubble substrate was not a problem; rather, seasonally-abundant macroalgae had become a dominant feature of the shallow reef, and appeared to be replacing coral. We instituted an algal weeding activity, and trained fishers to assist us. We hypothesized that this low-technology approach could be implemented by the fishers in subsequent years after the project terminated, but would eventually be unnecessary as the herbivorous fish population recovered as a result of protection.

In the project's fourth year, CFH, Inc. agreed to provide additional funding. This report details the accomplishments of this fourth year, and summarizes results of the project as a whole. The fourth year's activities were devoted largely to continuing monitoring of the effects of mitigation of rubble substrate in the Calagcalag MPA and algal weeding in the Banilad MPA, and improving management in both sites. Details are provided below.

II. Study sites

Calagcalag Marine Protected Area, Ayungon, Negros Oriental

The Calagcalag Marine Protected Area was established in 1988 by local government resolution, and is currently managed by the Calagcalag *Bakhawan* Fisher's Association (CABAFA). The MPA covers 10.4 ha of former fishing grounds containing a 3.3-ha platform reef 1 km offshore (Figure 2). The reef flat rises to 8 m depth and is dominated by a 2,400 m^2 rubble field (Figure 3). Fishers initially reported little improvement in their catch since MPA establishment, a breakdown of management efforts, and regular poaching within the reserve. Replicate line intercept transects on the platform reef within the MPA in February 2003 bisected both healthy reef and the

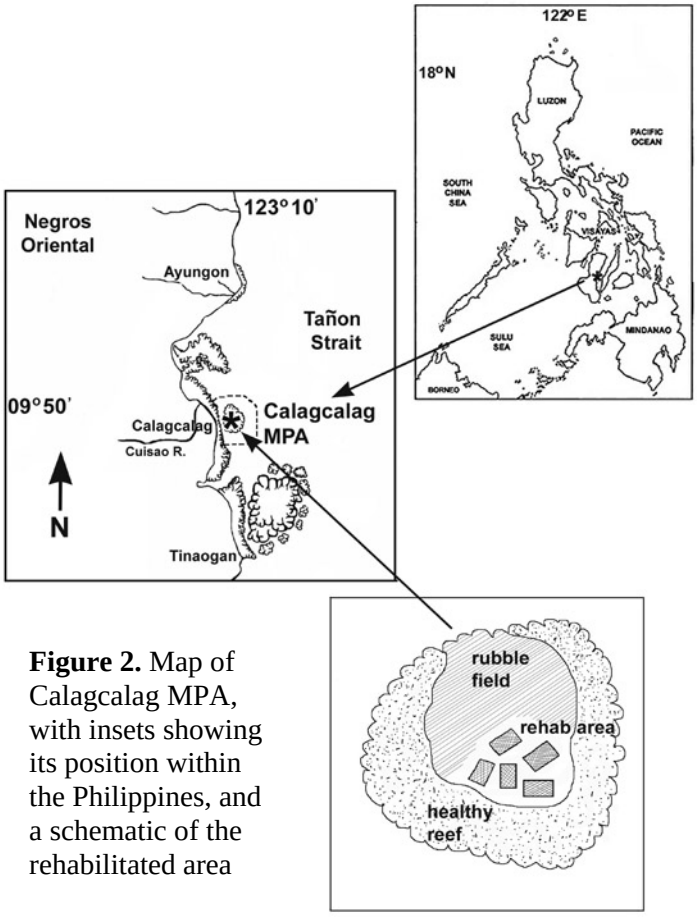


Figure 2. Map of Calagcalag MPA, with insets showing its position within the Philippines, and a schematic of the rehabilitated area

rubble field, and revealed similar amounts of live coral cover (40.9%) and rubble (39.6%). The fish community was characterized by low biomass and small body sizes, particularly of species targeted by fishers *(Lutjanus decussatus, Naso* spp., *Hemigymnus* spp. large Scaridae, Serranidae). At the beginning of this project, the CABAFA received no support for management of the MPA from the local mayor's office, and tension existed between the two. CABAFA members immediately identified this as being a major obstruction to their management efforts, and we began to formulate a strategy for addressing this issue.

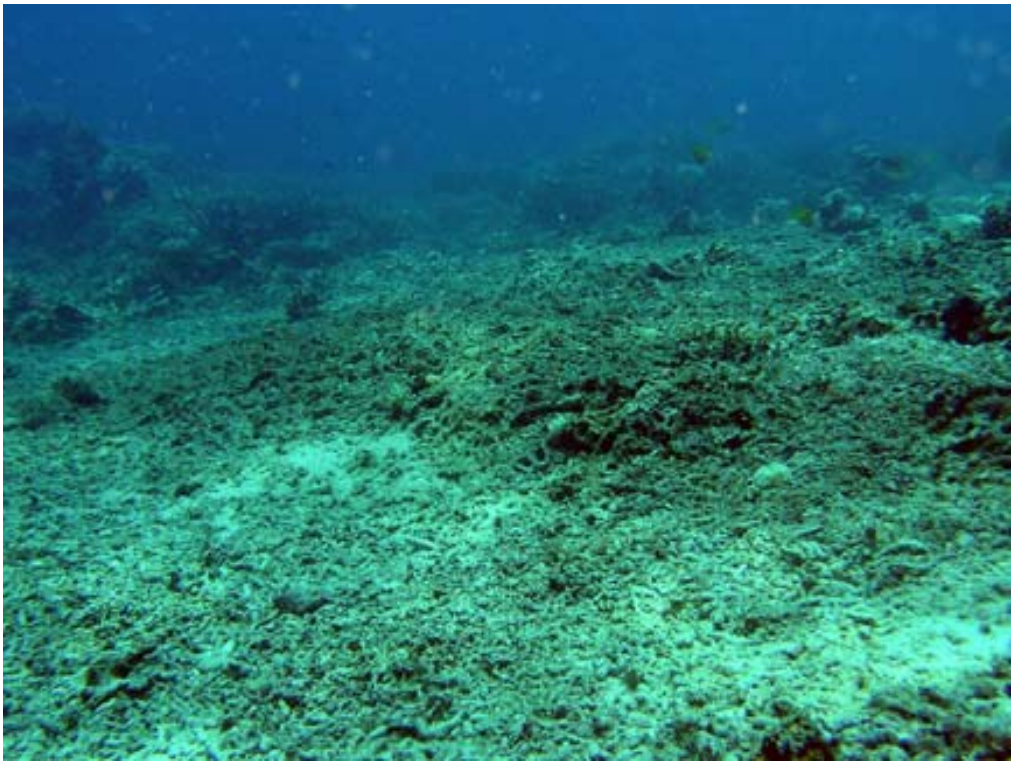


Figure 3. Photograph of the central rubble field resulting from dynamite fishing in the 1980s, within the Calagcalag Marine Protected Area.

Banilad Marine Protected Area, Dumaguete, Negros Oriental

The Banilad MPA (Figure 4) has been protected by municipal ordinance since 2003, and is managed by the Banilad *Bantay Dagat* fishers' organization. (*Bantay Dagat* means "Watchers of the Sea"; a nationwide network of local fisher-stakeholder volunteer groups set up to patrol and enforce no-take laws in MPAs). Due to intense fishing pressure, as it is located close to a major population center (Dumaguete City; population ~100,000), this reef was heavily, though not destructively, fished prior to protection. With the loss of major herbivores, and a possible effect of high nutrient input from nearby agricultural land and rivers, a seasonally-abundant macroalgal population had developed within the nearshore reef, dominated by *Sargassum* spp. and *Turbinaria* spp. (Figure 5). A preliminary survey revealed algal assemblages covered 45% of the reef substrate; in contrast, hard coral cover comprised only 19.5%. Fishers noted that coral had disappeared, and that fish were small and target species rare. Pomacentrids were the dominant fish family present. Local government support for the MPA and its management was strong, though technical advice and expertise was lacking. We identified this as an area for which we could provide assistance.

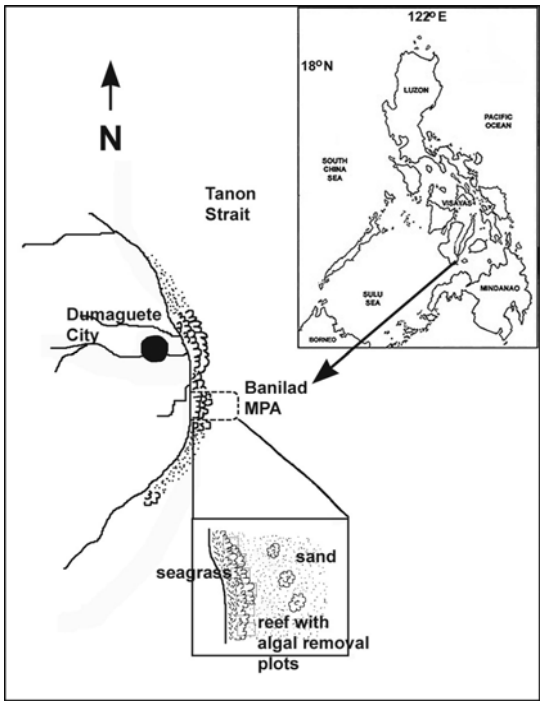


Figure 4. Map of Banilad Marine Protected Area, showing its proximity to Dumaguete City and the position of the replicated algal weeding plots.

Figure 5. Close-up view of the benthic reef community within the Banilad MPA. The acroporid coral (left) is being overtopped by the alga *Sargassum* sp. This type of overgrowth often results in tissue abrasion and death.

III. Project Achievements

Research on Reef Rehabilitation Protocols

Calagcalag Marine Protected Area

We initially subdivided the platform reef into three regions: 1) the central rubble field, 2) the rehabilitation treatment area (the southern end of the rubble field), and 3) the healthy reef (fringing the central rubble field) (Figure 2). Coral recruitment to our rehabilitation plots was visible within three months (i.e., September 2003), and recruitment has steadily increased over time. Recruit survival was significantly higher on the mesh plots (60%) than on unconsolidated rubble (6%), and recruits have begun to consolidate underlying rubble to the mesh plots (Figure 6). Hard coral cover has not yet increased significantly (Figure 7), but this is to be expected given the rate at

Figure 6. Hard coral recruit consolidating rubble. The coral settled on rubble and grew through the mesh.

which corals grow. Data on the final fish census, June 2006, are still being analyzed, but previous analyses revealed significant changes in the fish community for all three zones. The fish community within the rehabilitation area was, of course, identical to that of the rubble field initially; characterized by low diversity, small body sizes, and few target fish species, while the healthy reef showed higher diversity and more target fish, though they were of small body size. The rehabilitated area continues to shift over time, more closely resembling that of the healthy reef and less like the rubble field community. This indicates that our treatment has stimulated fish recruitment. However, positive changes in all three communities (Figure 8) indicate that management strategies instituted in 2004 have been successful in improving enforcement and reducing poaching within the MPA. Thus, both rehabilitation and improved management have resulted in positive changes in fish community diversity and biomass. To date, our plots have remained intact over three storm seasons.

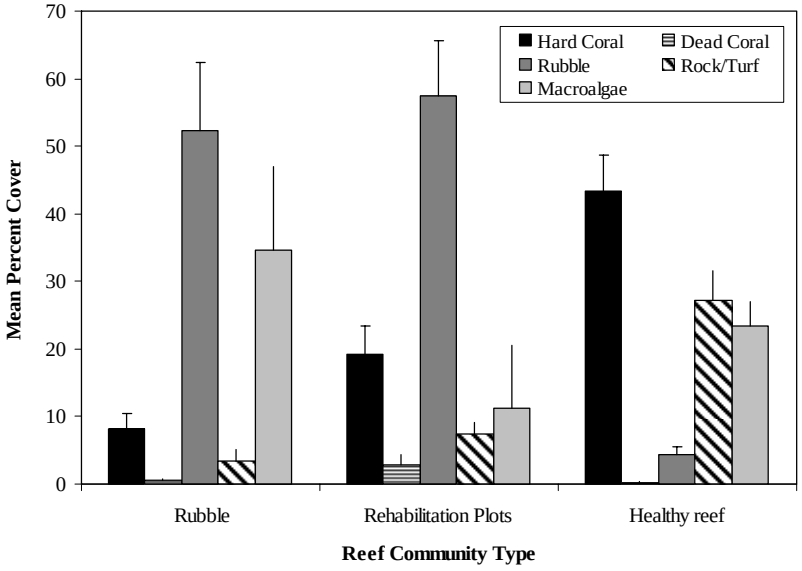


Figure 7. 2005 survey data from Calagcalag Marine Protected Area reef. Note the increase in hard coral cover within the rehabilitation plots, and reduced seasonal algae. Percent hard coral cover is intermediate between that of the rubble field and of the healthy reef. The mesh plots appeared to control the abundance of the seasonal macroalgae.

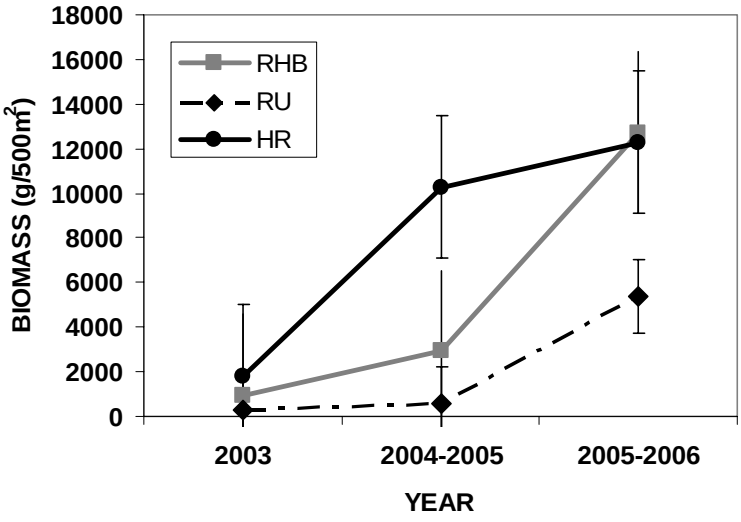


Figure 8. Changes in fish biomass within the three reef areas: RHB=rehabilitated area; RU=rubble field; HR=healthy reef. We speculate that the notable increase in 2004-2005 is due to improved management and enforcement, which resulted in reduced poaching.

Banilad Marine Protected Area

We initially established six 25m^2 quadrats which bisected the MPA and encompassed the majority of the nearshore reef cover. Three of these were assigned as unweeded control plots, and three were designated to be weeded of macroalgae. This design allowed us to compare changes in fish and benthic communities as a result of the weeding treatment. Volunteers from the Banilad *Bantay Dagat* group were trained in cropping methods, and the experimental design was explained to them prior to weeding. Weeding took place in October 2004, after an initial assessment of benthic composition the fish community. Unfortunately, after the weeding activity took place, fishers began weeding the control plots without our knowledge, so our original experimental design could not be analyzed as planned. Nonetheless, this demonstrated the enthusiasm of the fishers for our mitigation treatment. Surveys on benthic cover 18 months post-weeding showed visible changes in benthos; live hard coral cover has increased, with a corresponding decrease in macroalgae (Figure 9). The rock/turf algae category has increased in abundance, which should provide additional recruitment substrate for coral in subsequent years; new coral recruits are already being reported by fishers (Figure 10). Algal populations have not recovered to their former density so additional weeding has not been necessary.

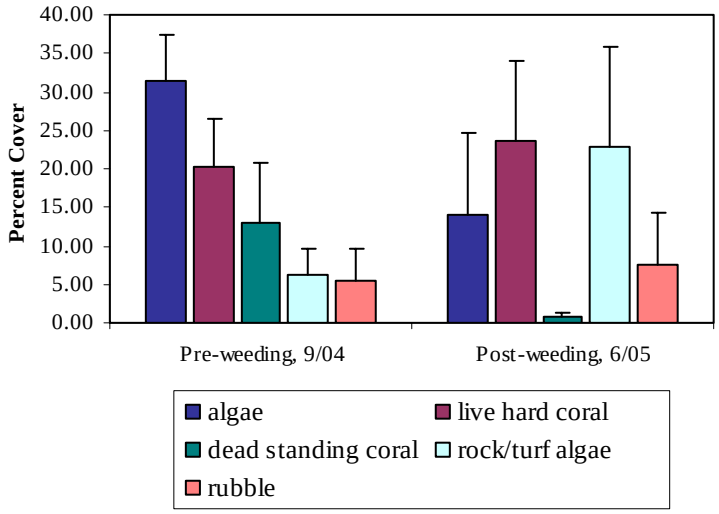


Figure 9. Changes in benthic composition as a result of algal removal within the Banilad MPA.

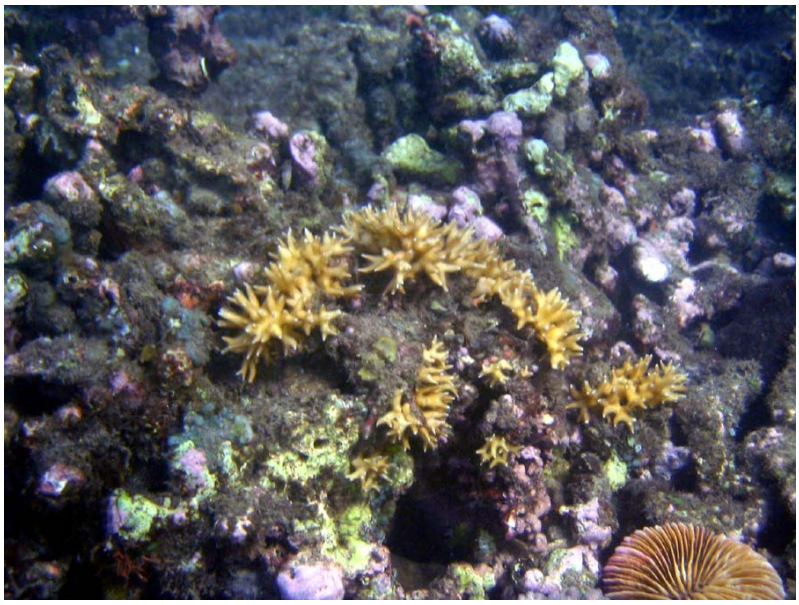


Figure 10. Visible coral recruits on substrate from which macroalgae has been removed, within the Banilad Marine Protected Area.

Because the Banilad MPA has been protected for only a short time, and our monitoring has covered only a single year, changes in the fish community are only beginning to appear. A significant increase has occurred in small Acanthurid grazers, which may be partially responsible for the failure of macroalgae to become reestablished. We predict that with strengthened management and increasing coral cover over time, fish community responses will include an increase in body size of target species, and an overall increase in diversity.

At present there are two publications in preparation, for submission to international peer-reviewed journals. Each publication will report on the successes and challenges of these mitigation procedures.

Management via Capacity Building

Specific achievements in strengthening management are listed and described, below, for each of the two sites. Much of the work of this final year involved empowering members of the managing organizations, assisting them in defining their needs, and providing technical advice and training which allowed them more active participation in managing and monitoring.

Calagcalag *Bakhawan* Fishers' Association (CABAFA)

1. A community organizer (CO) was hired to attend CABAFA and M-FARMC (Municipal Fisheries and Aquatic Resources Management Council) meetings; the CO guided and facilitated discussion to identify needs of the stakeholders and establish an effective dialogue between CABAFA and the local municipality elected leaders. This CO, Ms. Joanne Binondo, also coordinated activities for the Banilad MPA group (see below). In addition, she organized cross-visits between Calagcalag and Banilad, so leaders and stakeholders of the two communities could exchange experiences and expertise.

2. An Action Plan was formulated by CABAFA members, assisted by the CO for 2006-2007 (see Appendix 1). In addition, the municipality is finalizing a coastal resource management resolution which will provide future support for enforcement activities for the MPA.

Figure 11. CABAFA members during the Coastal Law Enforcement training.

3. A Coastal Law Enforcement Workshop (CLE; Figure 11) was held to educate members of CABAFA and other stakeholders regarding environmental laws relating to coastal resources, the enforcing of these laws, and the rights and responsibilities of deputized CABAFA members who are involved in patrolling and policing the MPA. This had an immediate and direct effect on patrolling efforts; a systematic rotation-based schedule was set up by members, to share responsibilities of patrolling the MPA.

4. Two CABAFA members were certified as Open Water Divers (PADI) last March 2006, so that they would be able to participate in future MPA monitoring. These CABAFA members were trained in Dauin, a town to the south of Calagcalag, which contains four well-managed MPAs. During their training, they interacted with the Dauin *Bantay Dagat*, which is known for its strict enforcement.

Banilad *Bantay Dagat* Fishers' Organization

1. The local government of Dumaguete City is much more supportive of the Banilad MPA and its stakeholders; the major identified challenges were the lack of technical expertise and organizational strengthening. Local *Bantay Dagat* groups, including that of Banilad, formed a Dumaguete *Bantay Dagat* Federation in 2006. This umbrella group is responsible for patrolling the entire city coastline, and they include patrolling for encroaching commercial vessels. This is an initiative of the C-FARMC (City Fisheries and Aquatic Resources Management Council) and its Chair, the City Agriculturist, Engr. de los Santos. The Banilad *Bantay Dagat* has taken the lead role, and a small honorarium has been budgeted for their financial support.

2. An information and education drive on coastal resources management was coordinated by the CO. This drive focused on the roles and objectives of Marine Protected Areas and the Coral Reef Rehabilitation Project (i.e., the algal weeding experiment and its objectives and preliminary results).

Figure 12. Participatory training in reef monitoring and data processing by Banilad *Bantay Dagat* members.

3. A training session was held on Participatory Monitoring, wherein 12 *Bantay Dagat* members were trained in the point-intercept method for substrate composition and in fish visual census (Figure 12). These methods were adapted from Uychiaoco et al. (2002) and the CCCE Foundation (2005).

4. A cross-visit was arranged whereby the Banilad *Bantay Dagat* visited the CABAFA group in Calag-calag. The two groups discussed their shared experiences and challenges. This meeting led to a strengthening of participant empowerment and commitment to conservation.

5. At the request of the local government and the Banilad *Bantay Dagat*, the project undertook an analysis of nutrient inputs into the nearshore waters of Banilad. A small stream drains into the area directly adjacent to the MPA; this stream flows through agricultural land, and receives input from fertilizer and insecticide treatment. In addition, the stream is the site of laundry activities, with accompanying phosphate-based detergents. Government officials desired to know if inputs

from this stream may be linked with the seasonal algal abundance. Our analysis suggested that nutrient inputs (nitrate and phosphate) were seasonally linked with rainfall, but concentrations did not appear to be at problematic concentrations, at present (see Appendix 2).

IV. Recommendations

For the Calag-calag Marine Protected Area

• At present, participation in management and policing of the MPA is voluntary and no support is available for equipment maintenance. This puts an enormous strain on impoverished fishers with very limited financial resources and time. A firm commitment from the Ayungon local government unit is needed, in the form of monetary support. Such support is mandated by the Local Government Code. It should encompass the purchase and maintenance of equipment (marker buoys, signboards, boat maintenance, flashlights/searchlight batteries, etc.) and a small monthly honorarium for patrolling fishers. This support will prove the government's commitment to conservation and management, and make significant progress toward cementing a productive relationship between the fishers' organizations and local government.

• To adequately assess management and rehabilitation efforts, regular (at least yearly) monitoring should continue within the MPA. Monitoring should include benthic composition (i.e., changes in coral cover) and target fish biomass and diversity. As members of the CABAFA have been trained in SCUBA and monitoring, they may be accompanied by personnel from the Department of Environment and Natural Resources (DENR), Silliman University, or CCE Foundation. Data should be kept on file by both CABAFA and the agency assisting them, and summarized yearly. The local government of Ayungon should provide funding for this.

• Tourism diving is an income-generating venture in Negros Oriental. The Calagcalag MPA could be opened to tourism diving after an additional two years of protection, should stakeholders decide to undertake this. If they do, then they should adopt a payment scheme similar to that developed by the Dauin municipality and work this plan into their long-term management action plan. However, it should be noted that in order for such a venture to succeed, the site would need to be known to the Negros Oriental Tourism Board, have visible patrolling, personnel on hand to receive payment, and improved infrastructure (i.e., an improved road, rental boats, a rest house for diver use). Given the distance of Ayungon town from Dumaguete, it is unlikely that tourist diving will ever reach problematic proportions, but it could conceivably generate some income for support of the MPA and selected community projects.

For the Banilad Marine Protected Area

At present, the Banilad MPA is closed for tourist snorkeling and diving. The nearest resort, Sta. Monica, is keen to bring visitors inside this MPA. Most resorts in Negros Oriental have what is known as "house reefs", i.e., good diving reefs near the resorts which the resort tacitly manages and controls access to. However, because the Banilad MPA is the only marine reserve within the Dumaguete City area, population pressure is high (from both tourists and fishers), and the MPA is still very young (2 years old, to date), we recommend that it be protected from heavy use for at least one more year. We recommend the following specific guidelines:

• A firm tourism development plan should be in place prior to opening the reef for tourism. Policies should be established by the management groups involved, clearly visible to visitors, and disseminated to the local dive operations and resorts. Ample experience from the Dauin municipalities, Silliman University, and CCE Foundation is available to assist the stakeholders in developing such a plan. The plan should include: a user fee system, determination of a maximum number of divers and snorkelers allowed per day, and placement of anchor buoys at strategic locations to prevent anchor usage within the reserve.

• A user fee system be constructed based on that currently used by the Dauin municipality. Personnel from the Banilad *Bantay Dagat* should be assigned to handling user fees, in addition to those members involved in policing. A plan for accounting for and spending the money should also be in place (i.e., will the money be used for identified community projects, as it is on Apo Island?)

• Diving should only be allowed on the deep reef; the shallow reef should be closed to diving for the time being, to allow for coral recruitment and growth. Snorkelling should only be allowed during high tide. Physical contact of any kind should be banned for both divers and snorkellers. In addition, a local dive guide, such as a trained member of the Banilad *Bantay Dagat*, should accompany tourist divers to ensure diver behavior is non-destructive.

• Although macroalgal populations have not returned to their former density, monitoring is required to determine if additional weeding will be necessary. We recommend monitoring at least twice a year, for benthic composition and target fish biomass and diversity. Trained members of the Banilad *Bantay Dagat* can assist in this, accompanied by personnel from the DENR, Silliman University or CCE Foundation. Data should be kept on file and summarized yearly, for presentation in annual stakeholder meetings. Monitoring should reveal recovery of the coral and fish populations and response of the macroalgae population to weeding. Monitoring should be funded by the Dumaguete local government, until tourism revenue is sufficient to cover this cost.

• Although our nutrient analyses did not indicate a severe nutrient input problem from the nearby stream, the Banilad MPA is undoubtedly impacted from downstream transport of untreated sewage, etc. from Dumaguete City. Therefore, it is important to minimize any additional inputs, particularly from additional agricultural activities, tourism activities, and population expansion from the city. Garbage and waste disposal options are minimal for this coastal community; this issue should be addressed in the overall management and development of the Banilad MPA.

• The Banilad MPA management and enforcement activities will benefit from continued and enhanced support from Dumaguete local government. It is well-established that the most successful MPAs in the country are those whose management and conservation activities extend beyond the MPA itself, and address issues affecting the coastal communities: education, population control, waste management. In other words: by creating and sustaining healthier fishing communities, coastal ecosystems become healthier and better conserved.

Appendix 1. Calagcalag Action Plan, 2006-2007

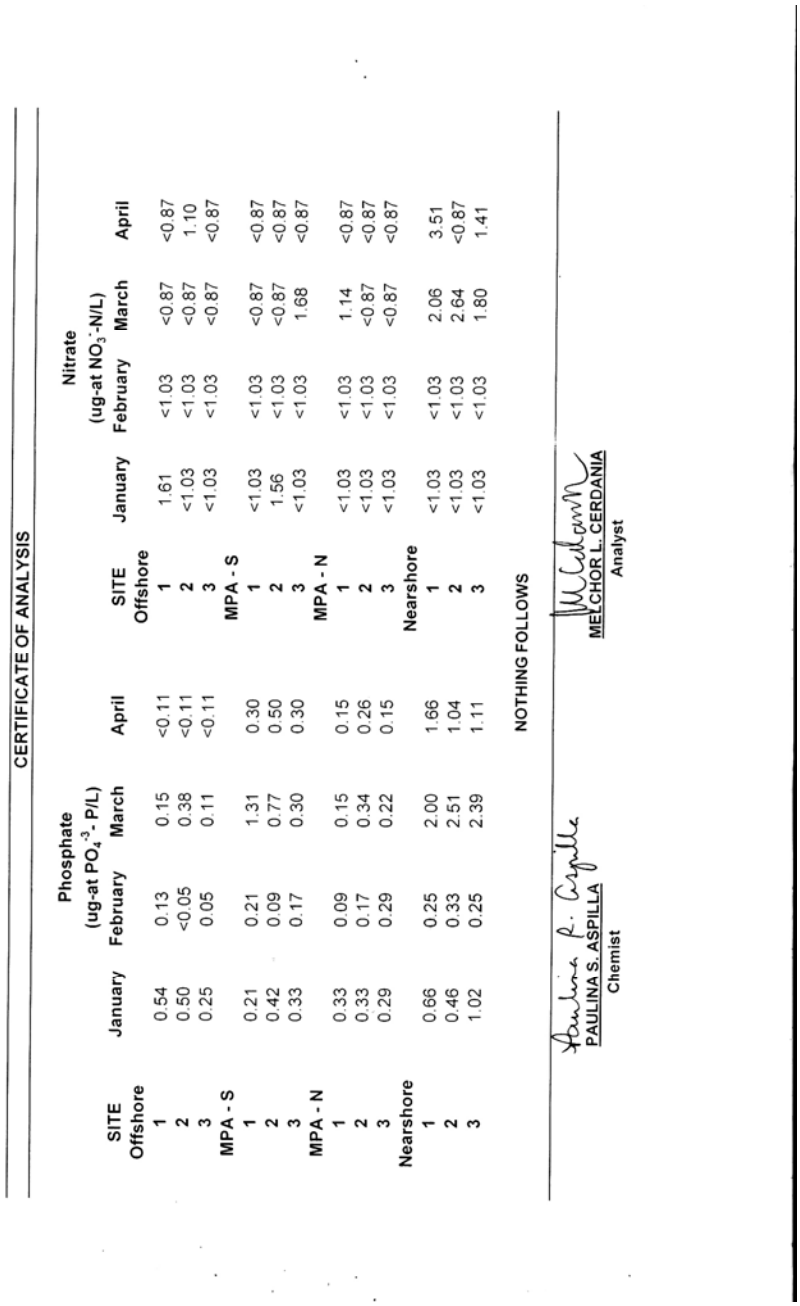
CABAFA BANTAY DAGAT

1 Year Action Plan

May 2006-May 2007

Activities	Strategies	Materials / Logistics Needed	Budget		Time Frame	Responsible Person/Agency	Remarks
			LGU	CABAFA			
Regular Meetings	ScheduleMonthly Meetings	Record book, Ballpens, markers and papers		P1,000.00	Every month	BantayDagat Members	Every last Saturday @ 9:00 AM before BOD Meeting
Regular Patrolling	Schedule Daily Patrolling by turns. Access financial support from LGU, NGO's and NGA's	-Fuel, maintenance and repair for the patrol boat - Logbooks and ballpens - equipments (Binocs, life jackets, raincoats, handheld radios, botas)	P25,000.00	P500.00 To be access to NGO/ NGA	Everyday	Bantay Dagat Members CABAFA BOD CCEF, ENRD, MAO	2 Bantay Dagat Members will be on duty everyday. - Pass a letter of request for the equipment
Fund Sourcing	Lobby for Budget Allocation from LGU for the Bantay Dagat Honorarium & Insurances	Logistics and transportation expenses for the lobbying and networking		P500.00	May- September	CABAFA BOD, Bantay Dagat Members, SB, MFARMC and Mayor	-Submit BOD Resolution to MFARMC

Appendix 2: Nitrate and Phosphate Analysis, 2006



DEPARTMENT OF CHEMISTRY - ANALYTICAL LABORATORY

May 16, 2006

CERTIFICATE OF ANALYSIS

SITE	Phosphate (ug-at PO_4^{-3} - P/L) January	February	March	April	SITE	Nitrate (ug-at NO_3^--N/L) January	February	March	April
Offshore					Offshore				
1	0.54	0.13	0.15	<0.11	1	1.61	<1.03	<0.87	<0.87
2	0.50	<0.05	0.38	<0.11	2	<1.03	<1.03	<0.87	1.10
3	0.25	0.05	0.11	<0.11	3	<1.03	<1.03	<0.87	<0.87
MPA - S					MPA - S				
1	0.21	0.21	1.31	0.30	1	<1.03	<1.03	<0.87	<0.87
2	0.42	0.09	0.77	0.50	2	1.56	<1.03	<0.87	<0.87
3	0.33	0.17	0.30	0.30	3	<1.03	<1.03	1.68	<0.87
MPA - N					MPA - N				
1	0.33	0.09	0.15	0.15	1	<1.03	<1.03	1.14	<0.87
2	0.33	0.17	0.34	0.26	2	<1.03	<1.03	<0.87	<0.87
3	0.29	0.29	0.22	0.15	3	<1.03	<1.03	<0.87	<0.87
Nearshore					Nearshore				
1	0.66	0.25	2.00	1.66	1	<1.03	<1.03	2.06	3.51
2	0.46	0.33	2.51	1.04	2	<1.03	<1.03	2.64	<0.87
3	1.02	0.25	2.39	1.11	3	<1.03	<1.03	1.80	1.41

NOTHING FOLLOWS

PAULINA S. ASPILLA
Chemist

MELCHOR L. CERDANIA
Analyst

Note: January and February correspond to the rainy season, while March and April correspond to the dry season.