SAVING PHILIPPINE REEFS

Coral Reef Monitoring Expedition
to Siquijor Province, Philippines
March 21 – 29, 2009

A project of:

The Coastal Conservation and Education Foundation, Inc.
(formerly Sulu Fund for Marine Conservation, Inc.)

With the participation and support of the

Expedition Research Volunteers

Summary Field Report:
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ABSTRACT

The annual Saving Philippine Reefs Expedition assessed the condition of the coral reefs in Siquijor Island Province and Apo Island, Negros Oriental, in March 2009. Surveys were conducted at selected sites and updated information from surveys in 2002, 2005, 2006, 2007, and 2008. In 2009, live hard coral (LHC) for all seven sites ranged from poor to good (14.1 ± 1.7% to 68.8 ± 5.8%). Comparison among sites in the 7 to 9 meter depth range gave a highly variable result. In this depth zone, Tubod Marine Sanctuary had the highest LHC, and Caticugan, the lowest. A total of 191 fish species in 48 families were observed in 2009, somewhat lower compared to the previous years. Butterflyfish species counted was 25 which is the same as in 2002.

Fish abundances for 2009, when compared between years within each site were significantly higher in two sites, namely Lower Cabancalan and Apo Island sanctuaries. The other sites showed similar fish abundance compared to the last survey.

The status of coral reefs of Siquijor Island has improved since 1980 when surveys were first conducted in the Island. Such improvement can be attributed to the implementation of MPAs, and the commencement of coastal resource management programs within each municipality and at the provincial level. The survey in 2009 indicates that the coral reefs in Siquijor are stable and improving in several sites in relation to the degree of protection and management in individual MPAs. But, fish abundances are still low by Philippine coral reef standards due to continued and in some cases increased fishing pressure near MPAs. In addition, commercial scale fishing occurs within the 15 km limits of the island which draws down the biomass of fish in nearshore waters.

A few key recommendations for improved habitat conservation and management of MPAs on Siquijor Island include the need to:

- Establish more and larger MPAs.
- Improve coastal fisheries law enforcement.
- Share monitoring and evaluation information among all stakeholders.
- Continue monitoring for sustained management.
- Increase diver, boat operator, and visitor education.
- Do more research in fisheries to be conducted for the benefit of reef management.
- Form a Siquijor MPA Network management plan and association.

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ACKNOWLEDGEMENTS

This coral reef monitoring expedition and its outcome are credited to the 14 international volunteers (see Appendix 2) from the United States, Australia and the Philippines who dedicated their time and funding to the research work. Equally important are the Coastal Conservation and Education Foundation staff, partners and volunteers (see Appendix 2) that prepared for the trip, worked long hours and have all done their part in the overall successful completion of the Expedition. They include: Agnes Sabonsolin, Data and Logistics Assistant; Sheryll Tesch, Logistics and Research Coordinator; Roxie Diaz, Researcher and Divemaster; Rafael Martinez, GIS Specialist; Dean Apistar, Research Assistant; Danilo Delizo, Research Assistant; Jane Trangia, CCEF Chief Accountant; Pablita Toyong-Huerbana, CCEF Administrative Assistant; Ethan Lucas, Divemaster; and Vangie White, Overall Project Manager and support coordinator for the trip. Special thanks goes to Aileen Maypa who, despite her busy schedule, was able to edit and guide the staff in completing the report.

The Coco Grove Beach Resort staff and management hosted our group with traditional Filipino hospitality and provided excellent service, accommodations, and food. We would like to thank Ronald Van DeVooren for providing excellent diving services and assistance through Sea Explorers Dive Shop and for making the expedition a safe and smooth trip.

The Provincial Government of Siquijor, especially Governor Orlando Fua, Jr. is thanked for his invaluable support and inspiration to the volunteers during the dive expedition. The Municipality of San Juan, specifically Mayor Edwin M. Quimno whose brief visit and support inspired volunteers in their mission to monitor reefs for the good of the local communities and MPA managers.

The final production of this report has been efficiently accomplished by Sheryll Tesch and Roxie Diaz of the CCE Foundation. Finally, any unpopular opinions or remaining errors are assumed by the authors.

Alan T. White
Principal Investigator

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CB	branching coral
CFD	flat/encrusting coral
CFO	foliose/cup coral
CM	massive coral
DC	white dead standing coral
DCA	dead coral with algae
ENSO	El Niño Southern Oscillation
FVC	fish visual census
LC	live coral
LHC	live hard coral
M/V	marine vessel
MPA	marine protected area
NL	non living
NS	not significant
PAMB	Protected Area Management Board
R	coral rubble
RCK	rock and block
SC	soft coral
SD	standard deviation
SE	standard error
SI	sand and silt
spp.	species
SPR	Saving Philippine Reefs
UVC	underwater visual census

SAVING PHILIPPINE REEFS
A coral reef monitoring expedition to
Siquijor Province, Philippines
March 21 – March 29, 2009

INTRODUCTION

The Saving Philippine Reefs (SPR) Project is a reef monitoring expedition that was initiated in the early 1980s. The primary goal of this project is to improve the quality and quantity of information available on coral reefs for use in improving management and creation of appropriate policies for protection and sustainable use of coastal resources. The SPR Project has been doing regular coral reef monitoring assessments mostly within the vicinity of marine protected areas (MPAs) located in selected sites in the provinces of Cebu, Negros Oriental, Siquijor, Bohol, Batangas and Palawan.

In March of 2009, the expedition was conducted in the Province of Siquijor where the Coastal Conservation and Education Foundation is currently implementing the Local Governance for Coastal Management Project (LGCMP). The island province consists of six municipalities, namely: Siquijor, San Juan, Enrique Villanueva, Maria, Lazi and Larena. An area that is becoming popular with dive enthusiasts and tourists, Siquijor boasts fine, white sand beaches and clear blue waters. Since 2002, Siquijor has demonstrated an interest and initiative in protecting its coral reef and mangrove habitats through municipal and province-wide efforts in coastal resource management.

The SPR Project first surveyed Siquijor in 2002 but the MPAs have since been monitored annually from 2005 and onward by the research monitoring team (REMOTE) of CCE Foundation. In this report, findings strongly recommend a more active effort for conservation and coastal law enforcement and management of the area. The MPAs in Siquijor have varying duration in management and protection which makes comparison between sites an interesting study.

Another site included in this 2009 expedition is the well-known Apo Island Marine Sanctuary. Apo Island has become a prime example of a successful community-managed marine sanctuary. With an extensive history in monitoring activities from the time Silliman University entered the island in the 1970s to educate islanders of the benefits of establishing an MPA, and later gave further assistance in the formation of the marine sanctuary in 1980. The SPR expedition also surveyed Apo Island during the 1992 and 2002 expeditions and has worked in close partnership with Silliman University, the Municipality of Dauin, and the Apo Island barangay government for logistical coordination and sharing of results.

Management of Marine Protected Areas in Siquijor Province and Apo Island, Negros Oriental

Management of Siquijor MPAs has always reflected strong support from both the local and the provincial governments. Nevertheless, with outside threats like commercial fishing, coastal law enforcement and overall MPA management still remain a challenge. Most of Siquijor's MPAs were established after the year 2000, except for the two oldest MPAs on the island, Tulapos Marine Sanctuary of the Municipality of Enrique Villanueva established in 1987, and Tubod Marine Sanctuary in 1989.

With roughly 173,000 hectares of municipal waters, five times larger than its 31,800 hectare land area, Siquijor is faced with a variety of problems ranging from socio-economic to legal and institutional in managing its coastal areas. The continued destruction of coastal habitats was one of

the most common issues that were identified upon the entry of CCE Foundation into the area in 2002, through its subcontracted project SCORE – or Siquijor Coastal Resource Enhancement Project with the Dumaguete-based Ting Matiao Foundation. Major environmental issues at that time were conversion of mangroves to other uses, illegal and destructive fishing activities, intrusion of commercial fishing into municipal waters, unregulated quarrying, and white sand extraction. Since then, most of these activities have been mitigated through the establishment and management of several MPAs (both coral and mangrove) on the island, except for commercial fishing which remains a more difficult issue to solve.

The municipal governments of Siquijor Province began coastal resource management in 2002 by collaborating closely with the provincial government and other non-government entities to effectively manage their coastal and marine ecosystems. These efforts have led to the delineation of municipal waters, coastal zoning, MPA establishment and management, coastal law enforcement, fisheries management, and policy development. Through the SCORE project, Siquijor was able to decrease illegal fishing activities as well as regulate fishing by declaring certain “off-season” times for specific species of fish. To date, thanks to their supportive incumbent Governor Fua, Jr., Siquijor had passed its first Provincial Environmental Code which provides policies and guidelines in environmental management activities in Siquijor.

Apo Island Marine Sanctuary, established in 1984 as a local government supported MPA, was declared in 1994 as a National Integrated and Protected Area System (NIPAS) site. Since the marine sanctuary was established, which covers about 10% of the island’s fishing grounds, Apo Island has experienced a significant increase in fish stock and coral growth. The strict protection by the island’s local government has provided the island with a substantial income for its residents over the years and it has become a major tourist destination for divers and snorkelers.

Increased tourism in the island has raised concerns about how much tourism capacity the sanctuary is able to manage without there being negative consequences (Reboton and Calumpong 2003). The island has experienced over a quarter century of research and monitoring which has helped it promote its management efforts and the corresponding positive effects (Abesamis et al 2005,2006, Russ and Alcala (1999, 2004), Russ et al 2003, , Maypa *et al.* (2002), Raymundo and Maypa (2002, 2003).

This EXPEDITION—2009

This 9-day expedition to Siquijor and Apo Islands (Figure 1) was participated in by a team of 13 volunteers and 8 staff members (Appendix 2). The volunteers hailed from the USA, UK, Australia and the Philippines. Most of them are seasoned Saving Philippine Reefs Expedition volunteers who have joined in one or more of the previous expeditions.

The expedition team’s home for those nine days was Coco Grove Beach Resort in the Municipality of San Juan. The expedition team’s boats were provided by Sea Explorers Dive Shop, which also had an efficient and well-trained boat crew and manager to allow the expedition research dives to run smoothly. The trip itinerary is shown in Appendix 1. The expedition team also benefited from two visits by local marine conservation champions, namely Governor Orlando Fua, Jr. and two municipal mayors**.**

The survey team monitored the condition of the coral reef and other substratum, fish diversity, abundance, indicator species and human activities affecting the MPAs. This report documents the changes in coral reef condition and reef fish abundance in the sites over time. It also aims to report

possible factors contributing to such changes and provides recommendations for improvement in MPA management and marine conservation efforts.

Data Collected and Methods

Study site

Siqujor Province is an island province in Region 7 (Central Visayas) (Figure 1). It is bounded on the northeast by Bohol Island, east by Camiguin Island, west by Negros Island, and north by Cebu Island. Each marine sanctuary is managed by a local people's organization and its corresponding municipal government. All vary in age and management. The reefs around the island are wide and shallow and are usually characterized by a gentle slope of corals and large diversity of marine life.

Apo Island Marine Sanctuary, located off the mainland of Negros Oriental, is part of the Municipality of Dauin (Figure 2). The island experiences strong currents at certain times of day which attracts schooling fish and natural protection of certain marine life around parts of the island. Currently, Apo Island has one marine sanctuary which has existed since 1984 and is the site surveyed in this expedition. In 2009, a juvenile fish marine sanctuary was proposed on the southwestern side of the island based on the research findings on the life history of *Caranx sexfasxciatus* (A.P. Maypa, unpublished data, Maypa *et. al.* 2009).

Data collection

Substrate cover. Systematic snorkeling surveys were carried out in the shallow reef flat at 2-3 m depth covering a distance of 0.5 – 1 km parallel to the reef crest. The distance covered for sampling is limited by the reef extent and may be less than 0.5 km in some sites. The substrate was evaluated within an estimated area of 1 m^2 quadrant at every 50-meter stop (or station). The following data was recorded:

1. Percent cover of living coral (hard and soft)
2. Percent cover of non-living substrate (e.g., rock, rubble, sand, dead coral)
3. Percent cover of living substrate (e.g., seagrass, algae, sponges)
4. Numbers of indicator species (e.g., butterflyfish, giant clams, lobsters, Triton shells, Crown of thorns starfish and other invertebrates)
5. Presence of large marine life (e.g., sharks, manta rays, Humphead wrasses, sea turtles, whales, dolphins and others)
6. Causes of reef damage

Distances between stations were estimated through kick cycles, wherein, volunteers calibrated their kicks along a transect tape prior to surveys. Each volunteer attempted to make at least ten or more stations on one snorkel survey, limited by the extent of the reef.

Scuba surveys were carried out in the deep area (7-9 m) parallel to the reef crest using a systematic point-intercept method. Transects were laid on sections of a reef flat, reef crest or slope. Substrate was evaluated at 25 cm intervals along a 50 m transect. Data gathered during scuba surveys were the same type as those collected during snorkel surveys. The distance between transects was approximately 5 m.

Fish estimates. Fish abundance and diversity were estimated using a 50 x 10 m visual census (UVC; n = 4 - 8) technique done by four specialists (RD Diaz, AT White, D Delizo, Jr., R Weeks and TJ Mueller). Specified substrate transects were utilized for UVC. The abundance of target species,

indicator species and numerically dominant and visually obvious were all counted. Lengths of fish counted were also estimated (Uychiaoco et al. 2001; English et al. 1997). Biomass of target species was computed using length-weight constants (www.fishbase.org).

Data Analyses

Coral and fish abundance. Substrate was categorized into total live hard coral (branching, massive, encrusting and foliose), soft coral, rubble, non-living substrate (white dead standing coral, dead coral, rock and block, sand and silt) and others (sponges, algae, and seagrass) for comparison and presented graphically. Each category was compared within site between years using a one factor analysis of variance (1-ANOVA) or Kruskal-Wallis whichever is appropriate. Similarly, each category was also compared between sites per year using 1-ANOVA. Surveys in the previous years with low replication (n<3) were excluded from statistical analyses. Thus, T-test was used in sites with only two survey points available. Data included in the statistical analyses were tested for normality (when necessary) using probability plots, log or square root transformation was made whenever appropriate; and Tukey's Test was used as post hoc. All statistical analyses used the software Minitab 14® . Regression lines are also shown for long-term trends. In describing coral condition, the following terms may have the corresponding values:

Gomez et al (1994) categories:

Live Coral Cover (%mean ±SE)			
Poor	Fair	Good	Excellent
0% – 25%	25% – 50%	50% - 75%	75 – 100

Density of fish was presented and classified according to the 19 coral reef fish families/subfamily which include target fish families (Serranidae: Epinephelinae and Anthiinae, Lutjanidae Haemulidae, Lethrinidae, Carangidae, Caesionidae, Nemipteridae, Mullidae, Balistidae, Chaetodontidae, Pomacanthidae, Labridae, Scaridae, Acanthuridae, Siganidae, Kyphosidae, Pomacentridae and Zanclidae), used as indicators in Coral Reef Monitoring for Management (Uychiaoco *et al*. 2001). Target fish families were also classified according to trophic groups: Piscivores, Planktivores, Invertebrate Feeders, Herbivores, Omnivores; and Coral Indicators for comparison and presented graphically. When applicable, species richness was expressed as mean number of species per 500m². Target fish densities were compared between years where raw data is available, using 1-ANOVA and Tukey's Test was used for post hoc. T-Test was used for sites having only 2 years of data. All data were tested for variance equality and normality using Minitab 14®. A log or square root transformation was made whenever appropriate. Classification of target fish densities followed that of Hilomen et al. (2000), where values were computed from a 1000m^2 area. Thus, our values were extrapolated from the 500m^2 sampling area to 1000m^2 to be able to use the aforementioned fish density categories.

Hilomen et al. (2000) categories:

Fish Species Diversity (no. of species/1000m^2):				
Very Poor	Poor	Moderate	High	Very High
0 - 26	27 - 47	48 - 74	76 – 100	>100
Fish Density (no. of fish/1000m^2):				
Very Poor	Poor	Moderate	High	Very High
0 - 201	202 - 676	677 – 2,267	2,268 – 7,592	>7,592

Biomass (metric tons/km^2)				
Very Poor	Poor	Moderate	High	Very High
<5.0	5.1 – 20.0	20.1 – 35.0	35.1 – 75.0	>75

Fish biomass. Fish biomass was computed using the formula: $\mathbf{a} \cdot \mathbf{L}^{\mathbf{b}}$ (Fishbase 2004), using standardized length-weight constants (www.fishbase.org). Biomass of target fish species were computed on the species level and summed up per family, based on selected target fish/commercially important food fish: Epinephilinae (Serranidae), Lethrinidae, Lutjanudae, Acanthuridae, Caesionidae, Carangidae, Haemulidae, Nemipteridae, Mullidae, Scaridae, Siganidae, Labridae (larger species, i.e., *Cheorodon* spp., *Cheilinus* spp.), including a non-reef family, Scombridae. Fish biomass data did not meet the assumptions of variance equality, thus, comparisons between families within sites used the Kruskal-Wallis. For this report, biomass computations were based on species-specific lengths (n=3-5).

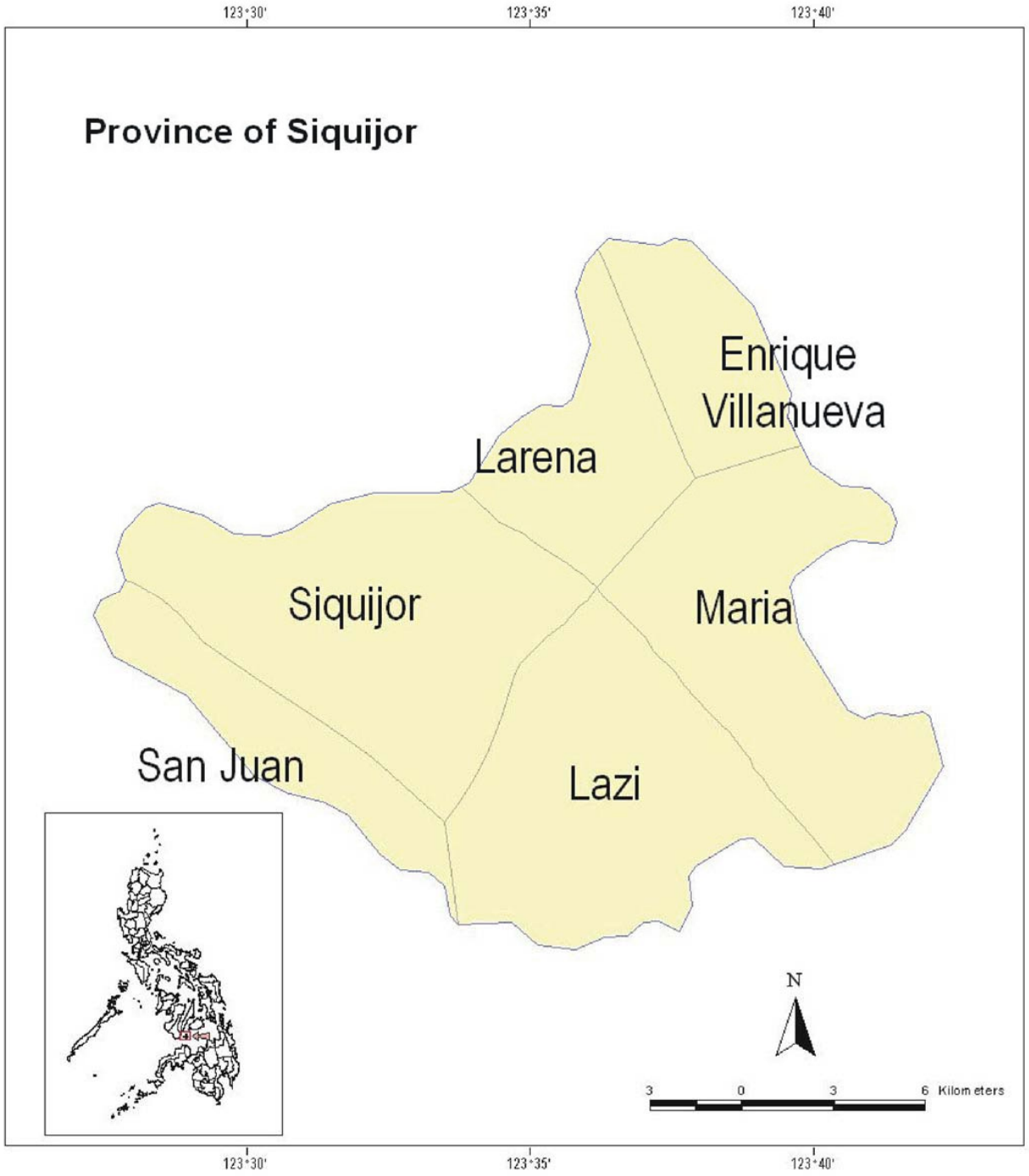


Figure 1.Siquijor Province (*Source:* CCE Foundation, Inc.).

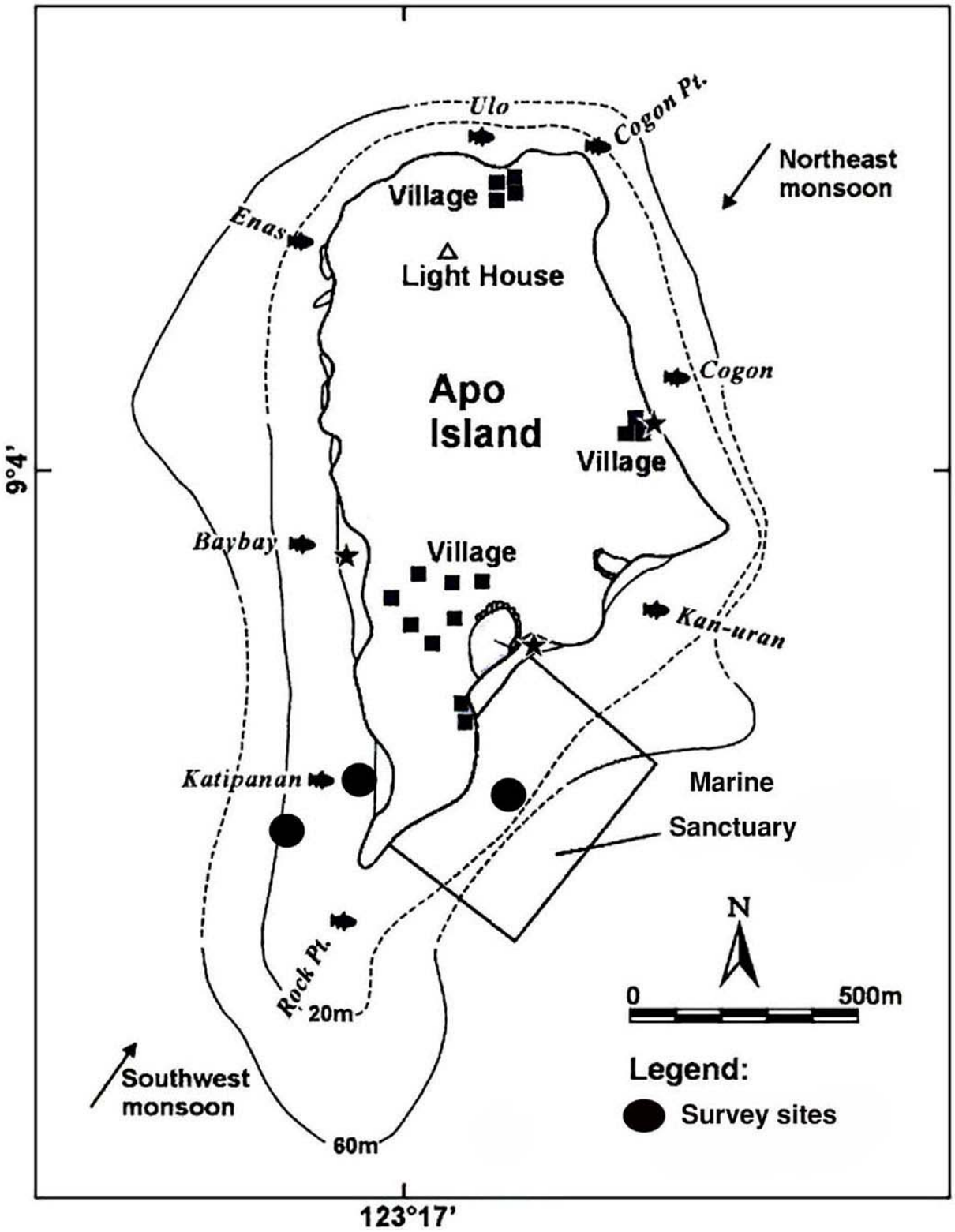


Figure 2. Apo Island Marine Sanctuary, Dauin, Negros Oriental (*Source*: Maypa et al. 2009).

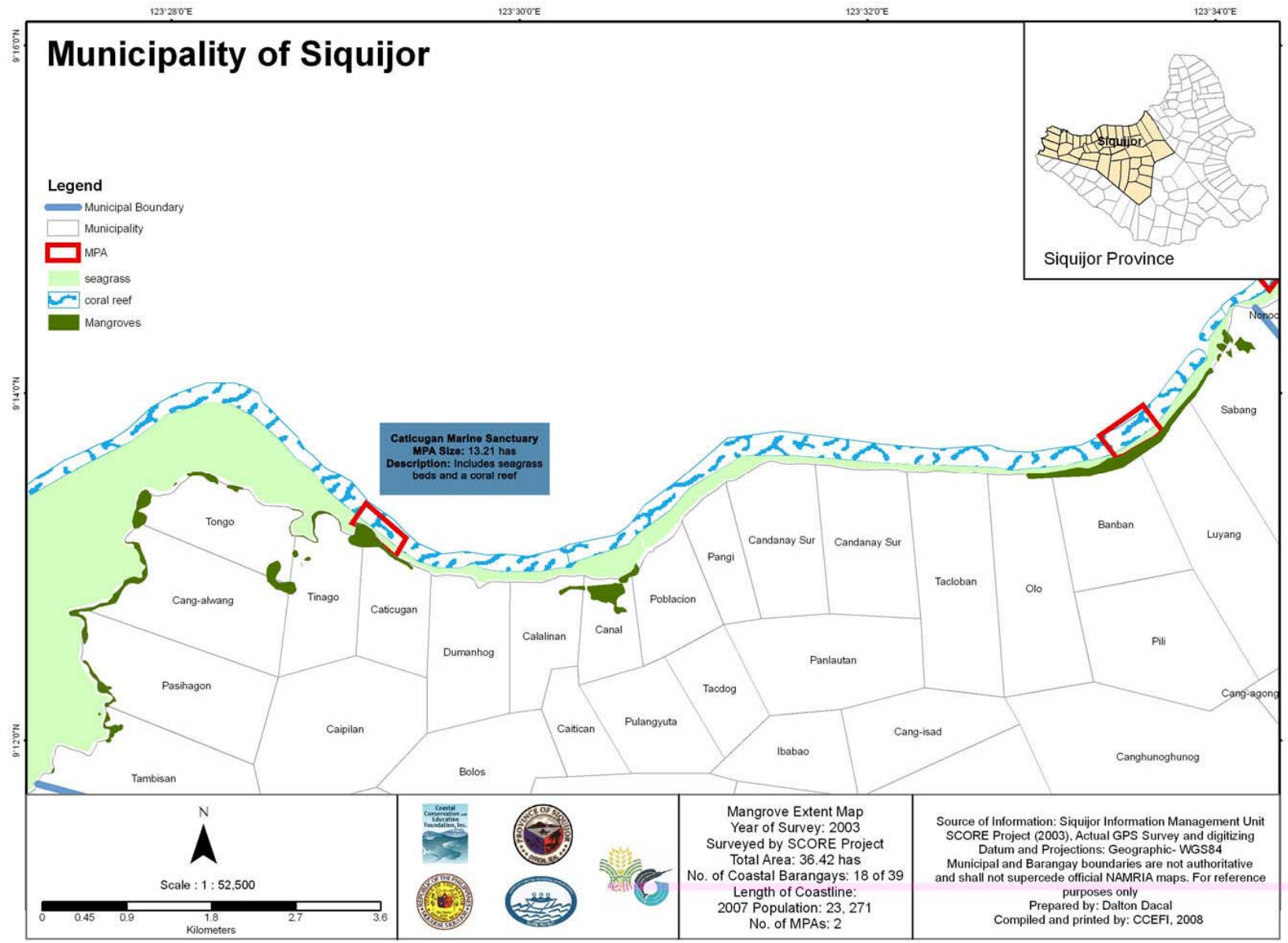


Figure 3a. Caticugan Marine Sanctuary, Siquijor, Siquijor.

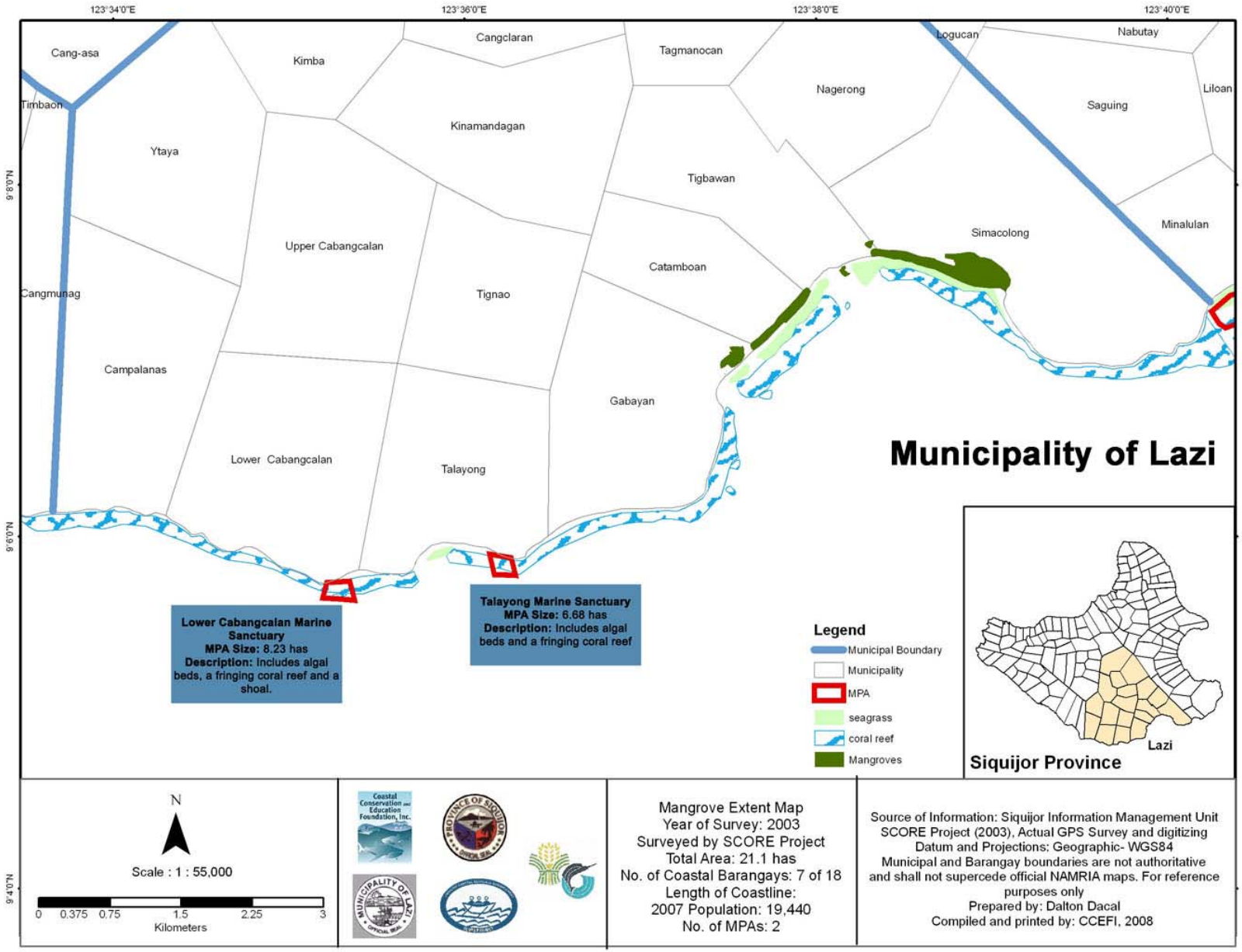


Figure 3b. Lower Cabancalan Marine Sanctuary and Talayong Marine Sanctuary, Municipality of Lazi.

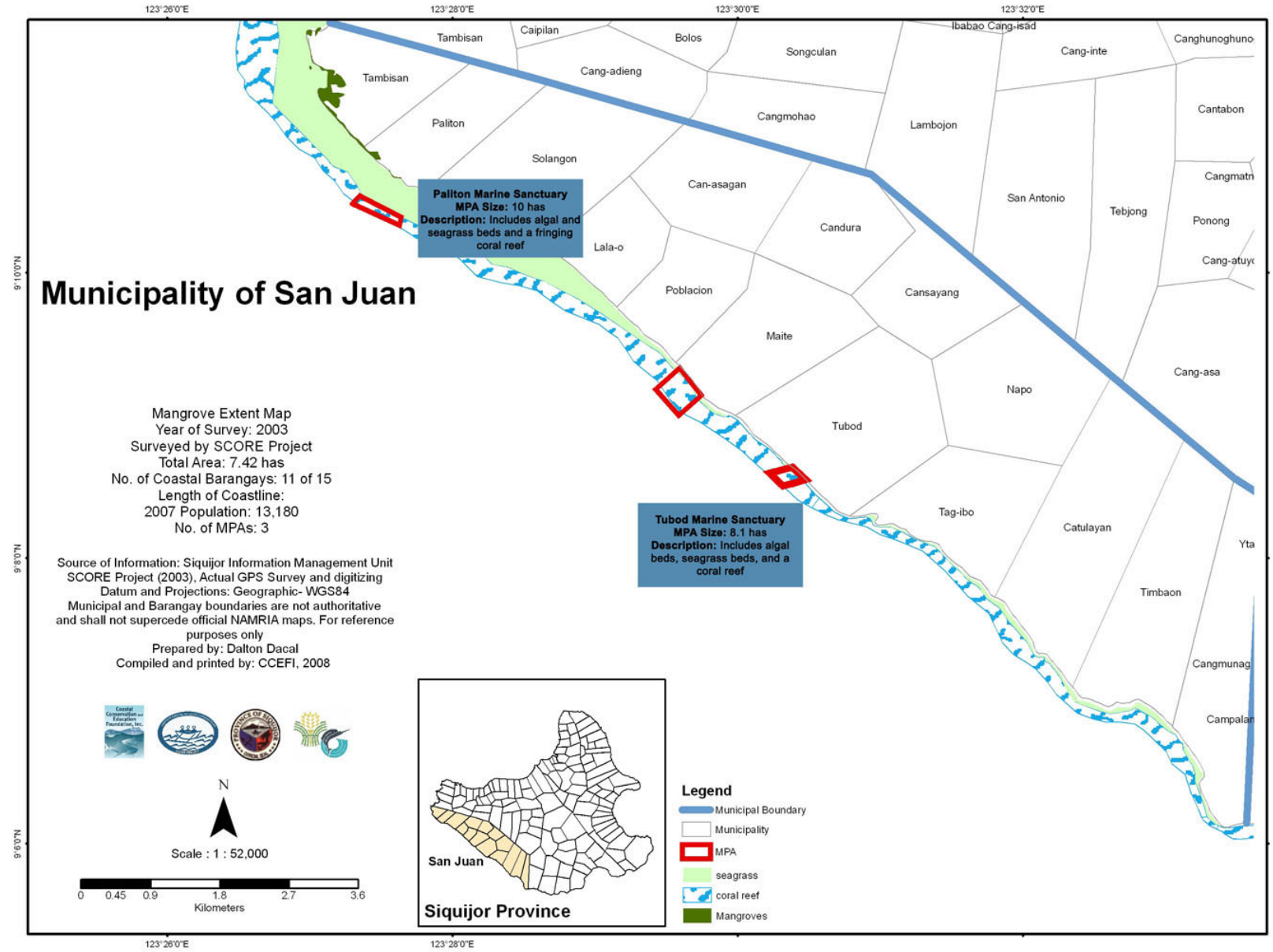


Figure 3c. Tubod Marine Sanctuary and Paliton Marine Sanctuary, Municipality of San Juan.

RESULTS

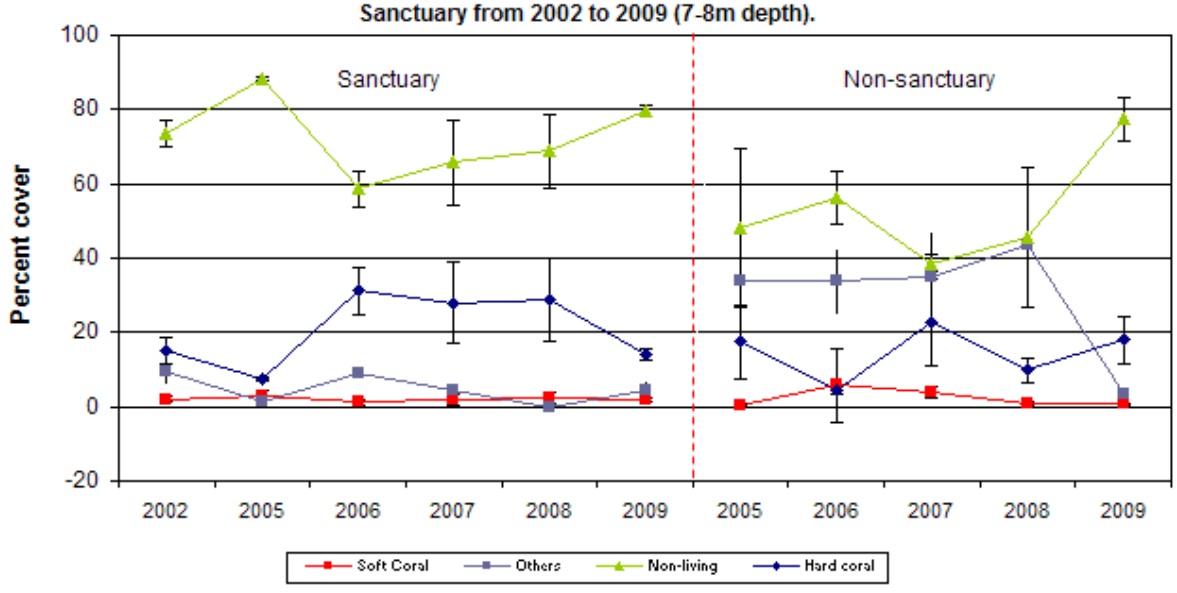
Caticugan Fish Sanctuary, Siquijor Town, Siquijor

Site overview. Located near the western tip of the island, this 13.51 ha MPA was legally established in 2003 through Municipal Ordinance 41-A-1989. The ordinance states the illegality to fish or gather all marine products within the perimeter of the fish sanctuary for the purposes of conserving and rehabilitating the marine habitat and to improve it as an income source for the fishing community. This fringing coral reef includes several habitats like rocky intertidal, sandy and soft bottom, and a wide seagrass bed (Figure 3a). This MPA is managed by the Caticugan Marine Management Council which is the peoples' organization in the barangay. The assisting groups in managing and monitoring the sanctuary are the Municipality of Siquijor, the provincial government, CCE Foundation, the Bureau of Fisheries and Aquatic Resources (BFAR), the Siquijor Integrated Management of Coastal Resources (SIMCOR), and the local fish warden task force.

The site has existing marker buoys, six of which are most evident, to delineate the boundaries. To date the only violations that have been observed and addressed are gleaning activities within the fish sanctuary in the shallow area. The MPA Management Rating that Caticugan Fish Sanctuary achieved is Level 3: MPA is enforced with 27 points. According to the surveys in the area in 2008, the priorities for improved management are: (1) the development of a sustainable financing mechanism; (2) education to increase community awareness and support; (3) supplemental and alternative livelihood options; (4) training to improve management capacity; and (5) strengthening law enforcement.

Substrate. In 2009, live hard corals in Caticugan MPA ,in both shallow(19.6±3.33%) deep(14.1±1.65 are poor. Most of the deeper area is dominated by sand and there is a wide seagrass bed in the shallows. LHC in 2005 appears lowest in percent cover compared other years but this is not statistically significant. Thus, LHC has been maintained over time (Table 1, Figure 4).

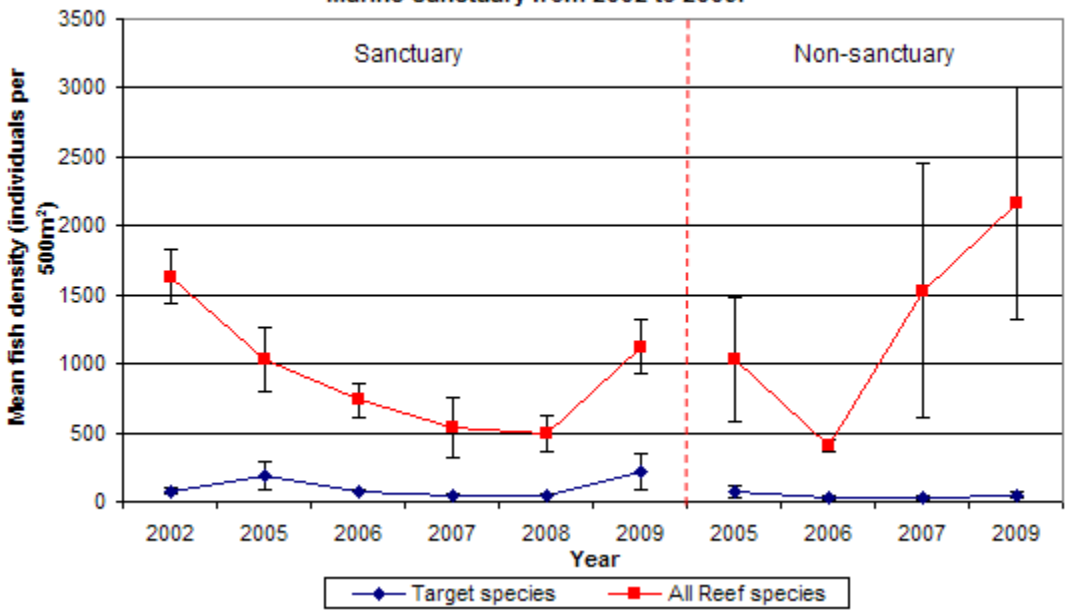
Figure 4. Changes in substrate composition (% mean ±SE) in Caticugan Marine Sanctuary from 2002 to 2009 (7-8m depth).



Fish density, species richness and biomass. Mean density for all reef species in 2009 is 1,122.0±193.3 fish/500m^2. Mean target fish density is poor with 214.3±130.7 fish/500m^2 Fig. 5).

This is mostly dominated by rabbitfish (family siganidae 122.4±20.8 fish/500m^2 (Fig. 5). No significant change was observed in target fish densities from 2005-2009. This means that density has been maintained (Table 5).

Figure 5. Changes in mean (±SE) fish density (density/500m^2) in Caticugan Marine Sanctuary from 2002 to 2009.



In 2009, mean species richness is moderately high with 29.4±4.2 spp/500m^2. The most diverse family is Pomacentridae (6.6±1.2 spp/500m^2), followed by Labridae (5.1±0.5 spp/500m^2). Mean target fish diversity is 11.4±2.8 spp/500m^2. Mean target fish biomass for 2009 is low with 8.1 kg/500m^2.

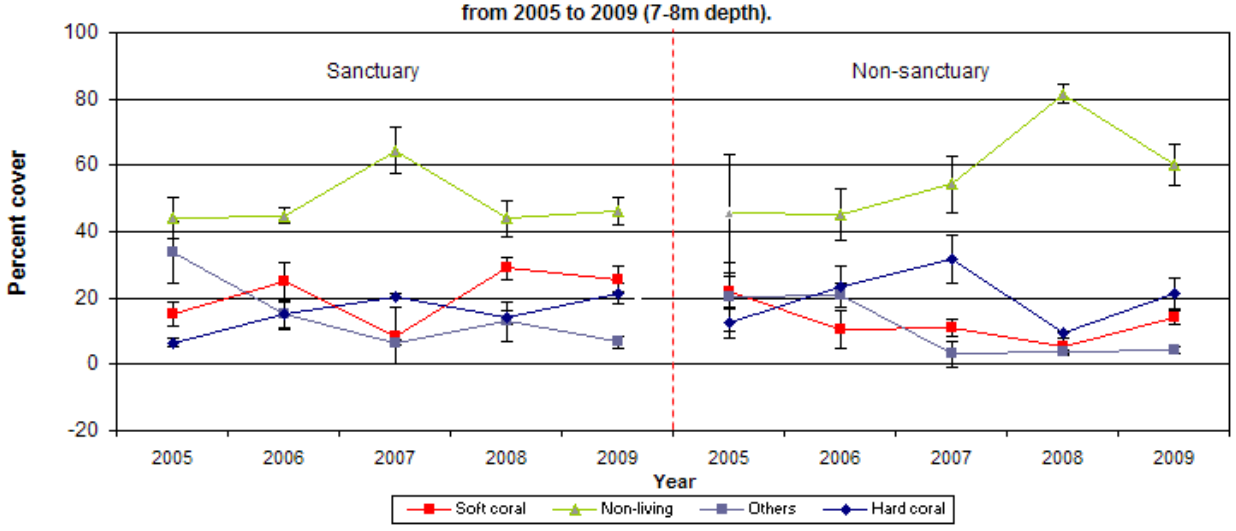
Lower Cabancalan Marine Sanctuary, Lazi, Siquijor

Site overview. Situated near the southern tip of the island facing Mindanao, this 8.23 ha MPA was legally established in 2003 through Municipal Ordinance 13-2003. It is locally known as the Lalag-Bato Marine Sanctuary. The site has an off-shore reef characterized by rock and block in the shallow area (3-4 m) and is dominated by soft corals in the deeper part (7-9 m). Coral reef and macro-algal bed are the major ecosystems (Figure 3b). This MPA is managed by the Talayong Marine Management Committee and is assisted by the Municipality of Lazi.

The MPA Management Rating for Lower Cabancalan is Level 3: MPA is enforced with 27 points. The priority concerns for improved management are: (1) developing a sustainable financing mechanism for MPA management; (2) increasing education and information campaigns to raise community awareness and support; and (3) developing options for alternative livelihoods.

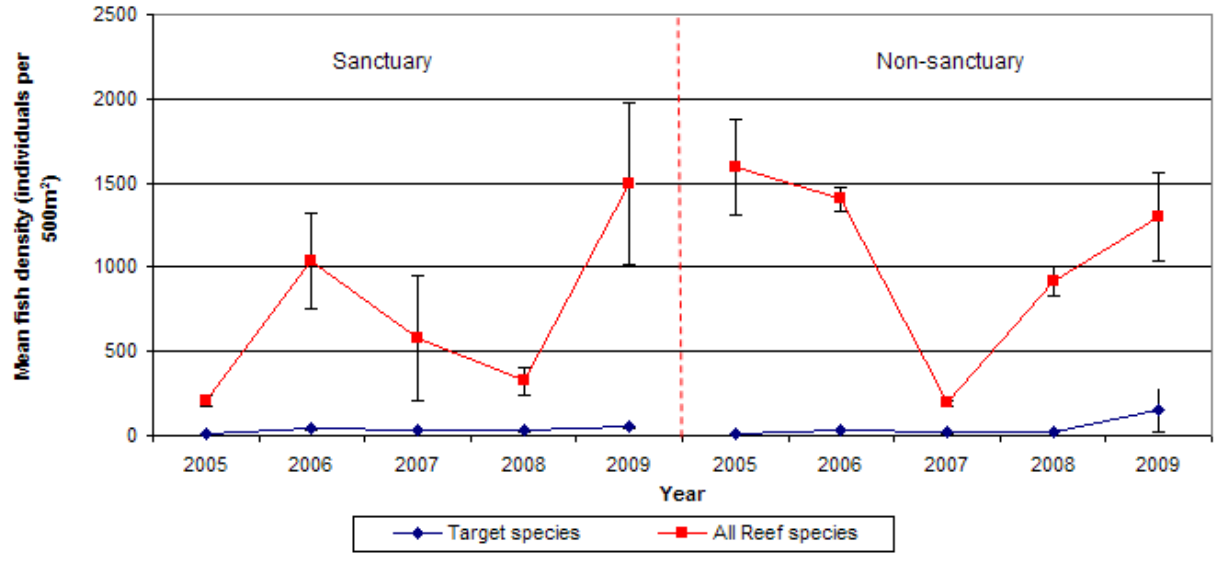
Substrate. Live hard coral cover in Lower Cabancalan MPA is poor (shallow: 21.6±3.46%, deep: 21.4±3.13%) in 2009. A significant increase was observed over time (2005-2009) in % LHC (p-=0.043, F = 3.28, df = 4). Although a significant change was detected, LHC inside the MPA still remains poor (Figure 6, Table 6).

Figure 6. Changes in substrate composition (% mean ±SE) in Lower Cabancalan Marine Sanctuary from 2005 to 2009 (7-8m depth).



Fish density, species richness and biomass. Mean density for all reef species in 2009 is recorded at 1,498.4±478 fish/500m^2. Pomacentrids and Anthids are the most abundant fish families followed by Labrids (104.1±74.6 fish/500m^2) then the Acanthurids (19.6±3.7 fish/500m^2; Table7). Mean target fish density was 50.4±9.0 fish/500m^2. In 2009, a significant change in target fish density was detected after five years of monitoring (p =0.031, F =3.66, df =4; Figure 7). Change in fish density between years is shown in Table 9.

Figure 7. Changes in mean (±SE) fish density (density/500m^2) in Lower Cabancalan Marine Sanctuary from 2005 to 2009.



In 2009, mean species richness is moderately high compared with other reefs in the Philippines with 29.0±3.8 spp/500m^2 of which 8.3±1.7 spp/500m^2 are target. The most diverse fish family following the Pomacentridae is Labridae 4.6±1.7 spp/500m^2. An average of three species of butterflyfish was recorded (Table 9). Mean target fish biomass for 2009 is low with 6.8 kg/500m^2.

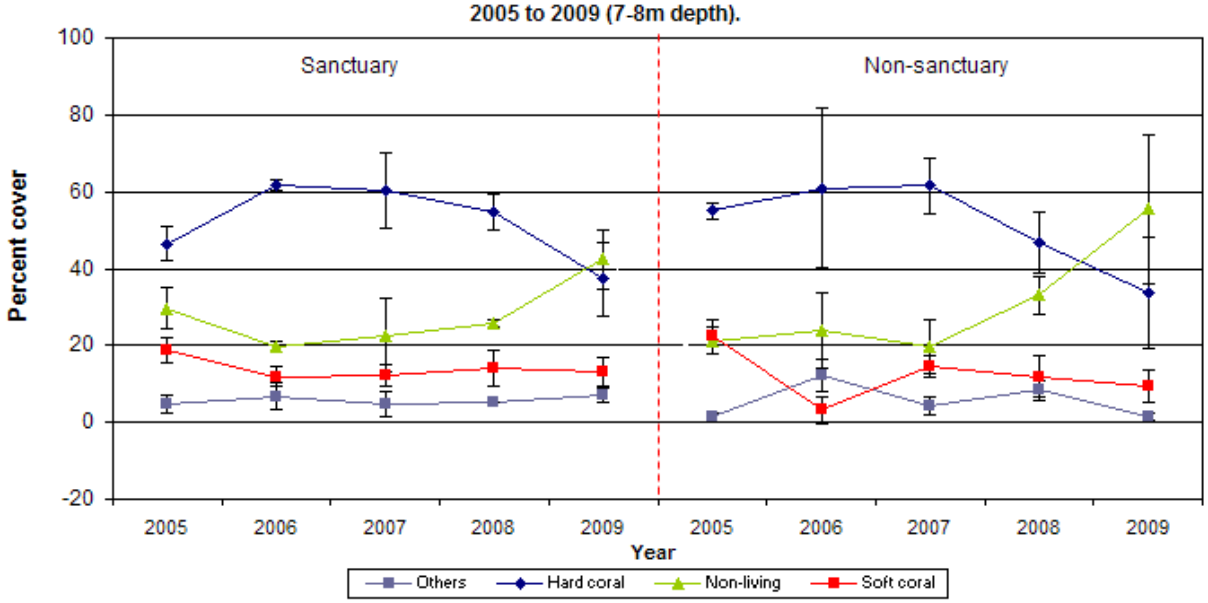
Talayong Marine Reserve, Lazi, Siquijor

Site overview. Located towards the southern tip of the island relatively near Lower Cabancalan MPA, this 6.68 ha marine reserve was legally established in 2003 through Municipal Ordinance 12-2003. The area has fringing coral reefs and is locally known as the Napayong Marine Reserve (Figure 3b). This MPA is managed by the Talayong Marine Management Committee and the Municipality of Lazi. Assisting groups include CCE Foundation for capacity training and reef monitoring activities.

The Talayong Marine Reserve has 27 points in the Rating system (Level 3: MPA is enforced). Priorities for improved management include: (1) creating a sustainable financing mechanism to support sanctuary enforcement and management; (2) increasing community awareness and support through information and education campaigns; and (3) developing a program for alternative livelihood for affected fishermen.

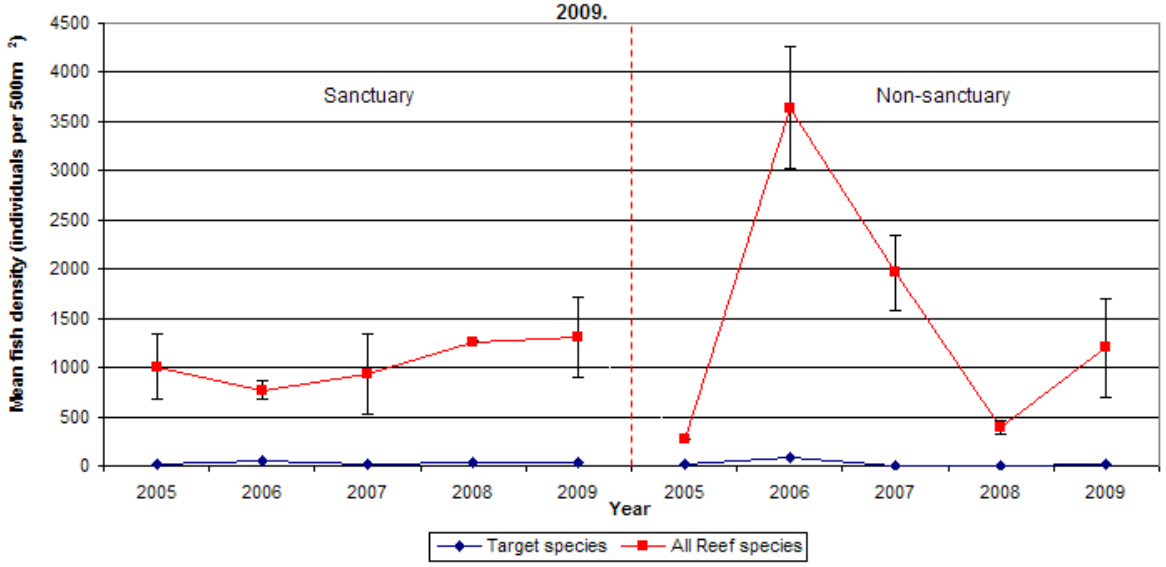
Substrate. Live hard coral in Talayong MPA was in poor to fair (shallow: 19.6±3.33%, deep: 37.3±0.39%) condition in 2009 (Figure 8). Most of the LHC is the branching growth form while the general substratum is dominated by sand. No significant change was observed from 2005-2009 in %LHC. This means LHC has been maintained since establishment (Table 10).

Figure 8. Changes in substrate composition (% mean ±SE) in Talayong Marine Sanctuary from 2005 to 2009 (7-8m depth).



Fish density, species richness and biomass. Mean density for all reef species in 2009 is high, relative to other Philippine reefs with 1,310.1±404.9 fish/500m^2 where Pomacentrids (1,018.3±368.6 fish/500m^2) numerically dominated (Figure 9). Mean target fish density is very low at only 28.9±8.1 fish/500m^2. No significant change in target fish density was observed after five years of monitoring. Fish densities over time are shown in Table 13.

Figure 9. Changes in mean (±SE) fish density (density/500m^2) in Talayong Marine Sanctuary from 2005 to 2009.



In 2009, mean species richness in Talayong MPA was low. An average of 23.7±2.9 spp/500m^2 is listed for Talayong MPA of which 5.1±0.9 spp/500m^2 are target species. Following the Pomacentrids, Labrids are the most diverse fish family with 4.6±0.5 spp/500m^2. Three species of butterflyfish were recorded (Table 11). Mean target fish biomass in 2009 was low (1.8 kg/500m^2).

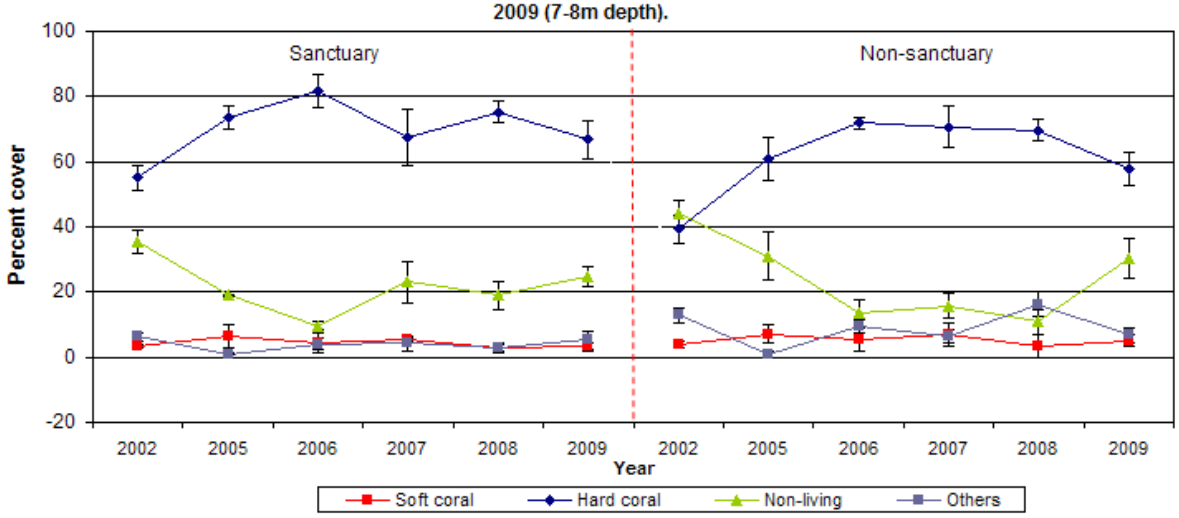
Tubod Marine Sanctuary, San Juan, Siquijor

Site overview. Situated in the southwestern side of the island, this 7.5 ha MPA was originally established in 1989 through Municipal Ordinance 07-1989. A series of amendments in the ordinance and changes in the management body re-established it as a protected area in 2003 through Municipal Ordinance 15-2003. This fringing reef is characterized by a long stretch of sandy white then a large algal and seagrass bed in the reef flat and followed by a slope dominated by branching growth forms of live hard corals. This MPA is also the house reef of Coco grove resort and Sea Explorers Dive Shop (Figure 3c).

The MPA is managed by the Tubod Fishermen's Association which is a local people's organization. It is also assisted by the Municipality of San Juan, the provincial government, the Tubod barangay local government unit, Coco Grove Beach Resort, and CCE Foundation. Based on the Management Rating, Tubod Marine Sanctuary is Level 4: MPA is sustained with 34 points. According to community surveys, priorities for improved management include: (1) developing a sustainable financing mechanism for MPA management; (2) providing supplemental and livelihood options to the affected fishing community; and (3) seeking more support from the government at the municipal and provincial level.

Substrate. Live hard coral in Tubod MPA was good in the deep (66.8±5.83%) and fair (45.1±4.42%) in the shallow in 2009 (Figure 10). Highest coral cover for Tubod MPA was in 2006 (81.7±8.16%). By 2007, it decreased (67.4±6.73%) but the decrease is not statistically significant, which means that LHC cover has been maintained from 2005 to 2009 (Table 14, Figure 10).

Figure 10. Changes in substrate composition (% mean ±SE) in Tubod Marine Sanctuary from 2002 to 2009 (7-8m depth).



Fish density, species richness and biomass. Mean density for all reef species in 2009 was 2147.2±423.1 fish/500m^2. Pomacentrids (1348.3±573.0 fish/500m^2) numerically dominate the area. Target fish density for Tubod MPA in 2009 was moderate (302±175 fish/500m^2), relative to other Philippine reefs (Figure 11). Among target fish species, Kyphosids (186.7±18.6 fish/500m^2) and Acanthurids dominate. After 5 years of monitoring, no significant change was detected in target fish density. Tubod MPA recorded the highest density for Chaetodontids (28.8±4.0 fish/500m^2; Table 15). Fish densities over the years are shown in Figure 11.

Figure 11. Changes in mean (±SE) fish density (density/500m^2) in Tubod Marine Sanctuary from 2005 to 2009.

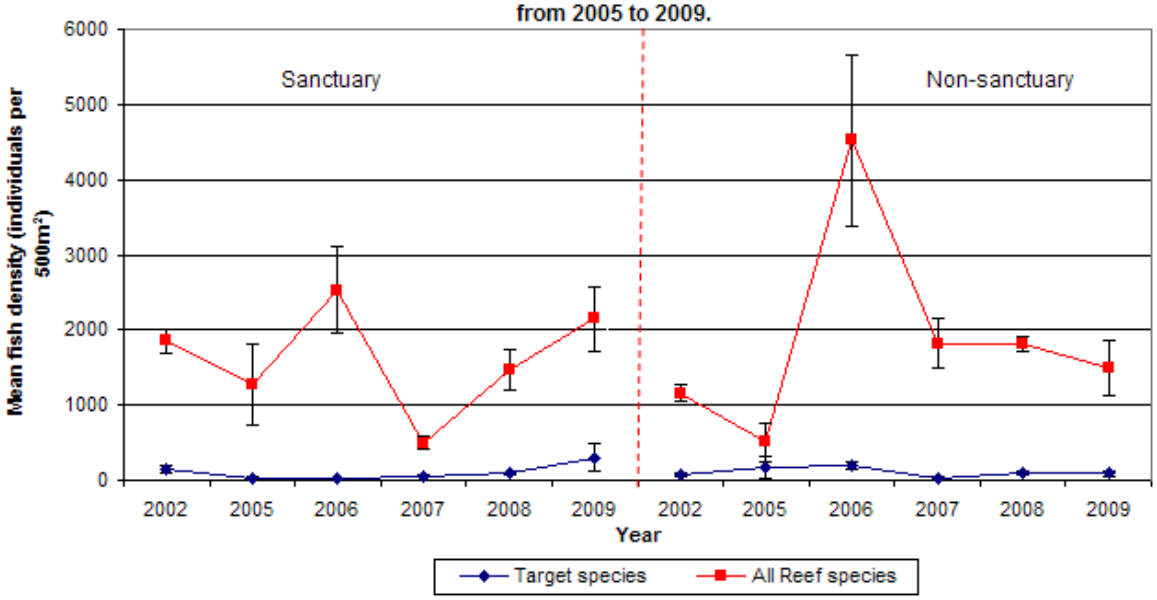
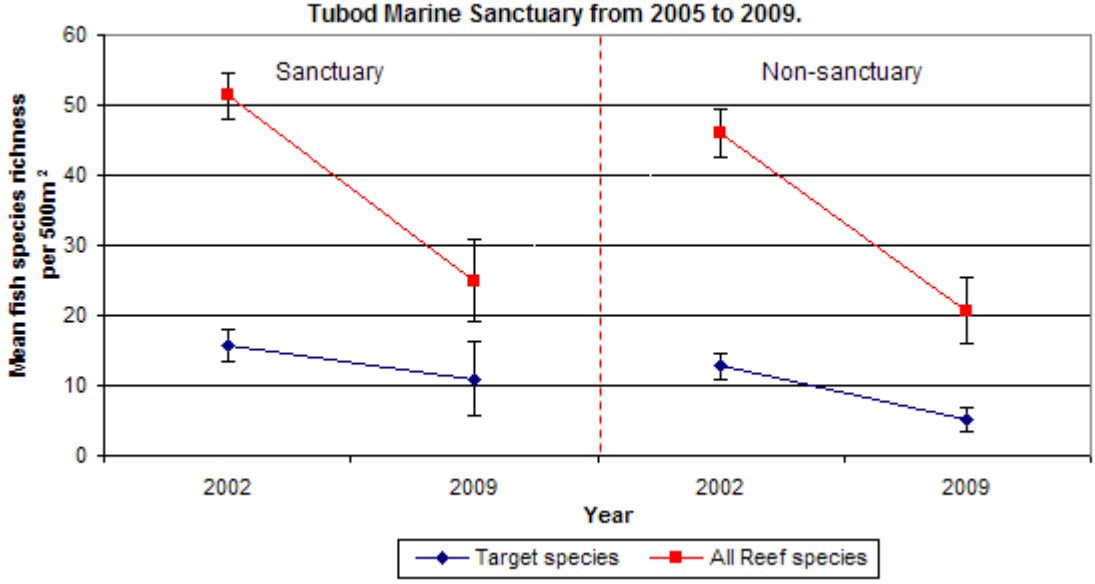


Figure 12. Changes in mean (±SE) fish species richness (species/500m^2) in Tubod Marine Sanctuary from 2005 to 2009.



For 2009, mean species richness in Tubod MPA for all reef species (25.0±5.9 spp/500m^2) was moderately high (Figure 12). An average of 11.0±5.4 spp/500m^2 target fish species was recorded (Table 15). Mean Chaetodontid diversity is noted at 7.5±2.3 spp/500m^2.

Mean target fish biomass for 2009 is very low compared to other Philippine reefs with 9.3 kg/500m^2.

Paliton Marine Sanctuary, San Juan, Siquijor

Site overview. The newest of the MPAs surveyed during this expedition was Paliton, a 12 ha MPA legally established in 2008 through Municipal Ordinance 21-2008. Located towards the northern boundary of the municipality of the San Juan in the west side of the island, this MPA is characterized by a wide intertidal and reef flat laden with rock and block. Towards the crest, branching and massive colonies of hard corals dominate the zone and are interlaced with sand patches. The crest is a 90 degrees drop-off with its walls covered with tunicates, hydroids and gorgonians. The general area is referred to as the Paliton Wall and is a known dive spot (Figure 3c). The MPA is currently managed by a multi-sector group, the Paliton Marine Management Committee, jointly with the municipal government of San Juan.

The Management Rating System was applied and Paliton Marine Sanctuary generated 12 points putting it at Level 1: MPA is initiated. The priorities identified by the surrounding community in terms of marine sanctuary management are: (1) developing a sustainable financing mechanism to cover sanctuary management costs; (2) training to improve management capacity of the managing body; and (3) improving law enforcement within the sanctuary area.

Figure 13. Changes in substrate composition (% mean ±SE) in Paliton Marine Sanctuary from 2006 to 2009 (7-8m depth).

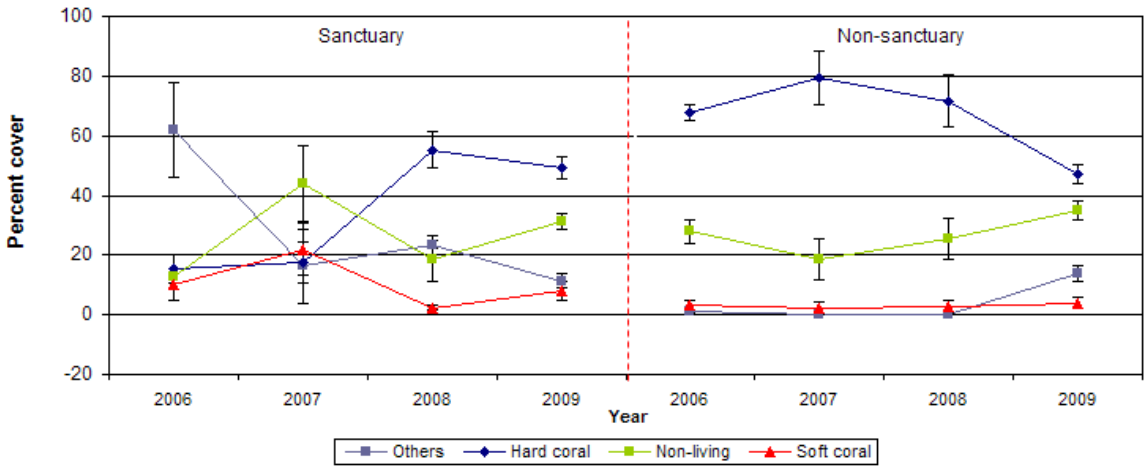
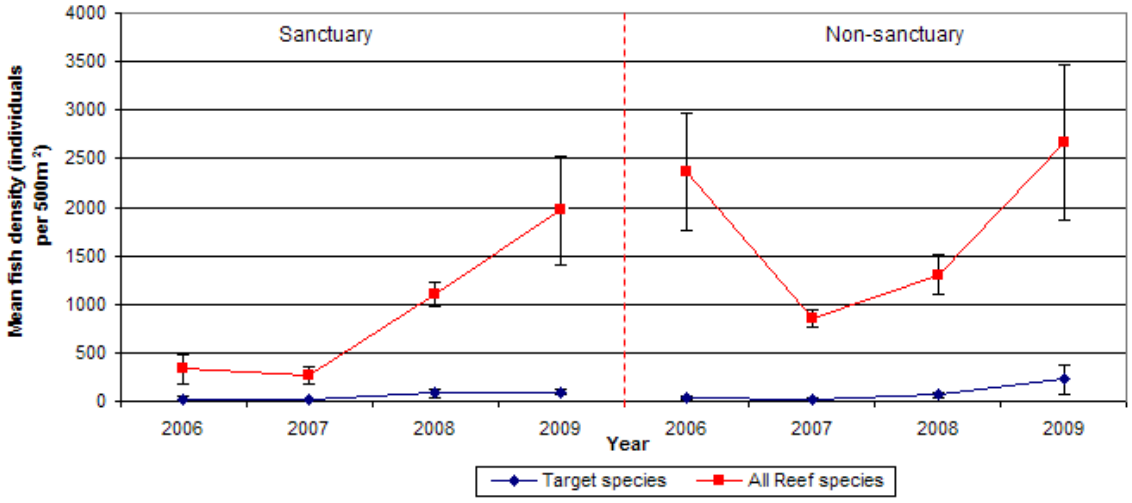


Figure 14. Changes in mean (±SE) fish density (density/500m^2) in Paliton Marine Sanctuary from 2006 to 2009.



Substrate. Live hard coral inside (49.4±3.66%) and outside (47.2±2.99%) in the deeper part of Paliton MPA were both in fair condition (Figure 13). LHC in the shallow is lower (23.8±3.77%) inside the sanctuary branching (18.4±2.52%) and massive (18.7±1.87%) colonies dominate over the other coral growth forms present.

Fish density, species richness and biomass. Mean density for all reef species in 2009 was 1,964±552.0 fish/500m^2. Target fish abundance was poor, with only 91.4±24.8 fish/500m^2 (Figure 14). Pomacentrids (1,198.0±332.8 fish/500m^2) numerically dominate the fish fauna of Paliton MPA. Fusiliers (58.6±25.4 fish/500m^2) are the most abundant target fish inside the MPA (Table 21). Chaetodontid density is also fairly high at (20.6±5.6 fish/500m^2 (Table 17). No significant difference in target fish density from 2006-2009 was observed. This means density has been maintained since establishment. Fish densities over the years are shown in Table 20.

Mean species richness for all reef species (36.7±5.4 spp/500m^2) in 2009 was moderate. Mean species richness for target fish species was 9.6±1.5 spp/500m^2 and 5.4±1.1 spp/500m^2 for Chaetodontids (Table 21).

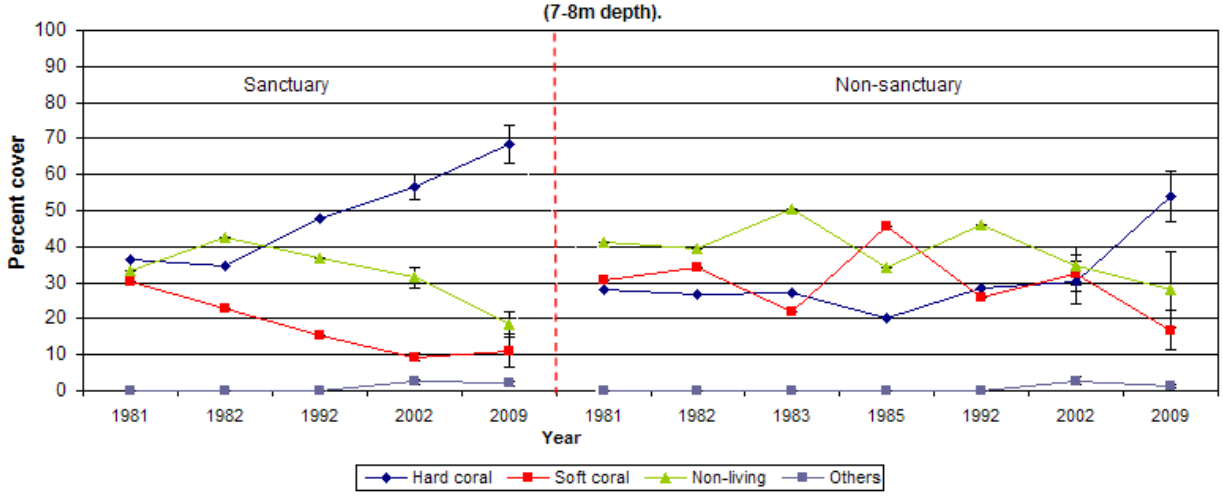
Mean target fish biomass for 2009 was very low with 8.1 kg/500m^2.

Apo Island Marine Sanctuary, Dauin, Negros Oriental

Site overview. Apo Island is a 74 ha island off the coast of Oriental Negros. Its MPA is located in the southeastern side of the island, fully enforced since its establishment in 1984 (Russ & Alcala 1999). A municipal ordinance (01-1985) was created in 1984 formalizing its protection along with a management council (Raymundo & Maypa 2002) specifying the protection of the marine reserve and fish sanctuary, and in 1997 another was passed (02-1997) regulating the activities of the visitors, scuba divers, tourists, snorkelers, pumpboats, and other resource-users in Apo Island. In 1994, Apo Island became part of the National Integrated protected Areas System (NIPAS). The 6 ha sanctuary harbors a good to excellent live hard coral cover which recovered after the severe El Niño bleaching event in 1998 (Raymundo & Maypa 2002, Raymundo & Maypa 2003, Maypa et al. 2009). This area is exposed to the northeast monsoon (*Amihan*) (Maypa *et al.* 2009).

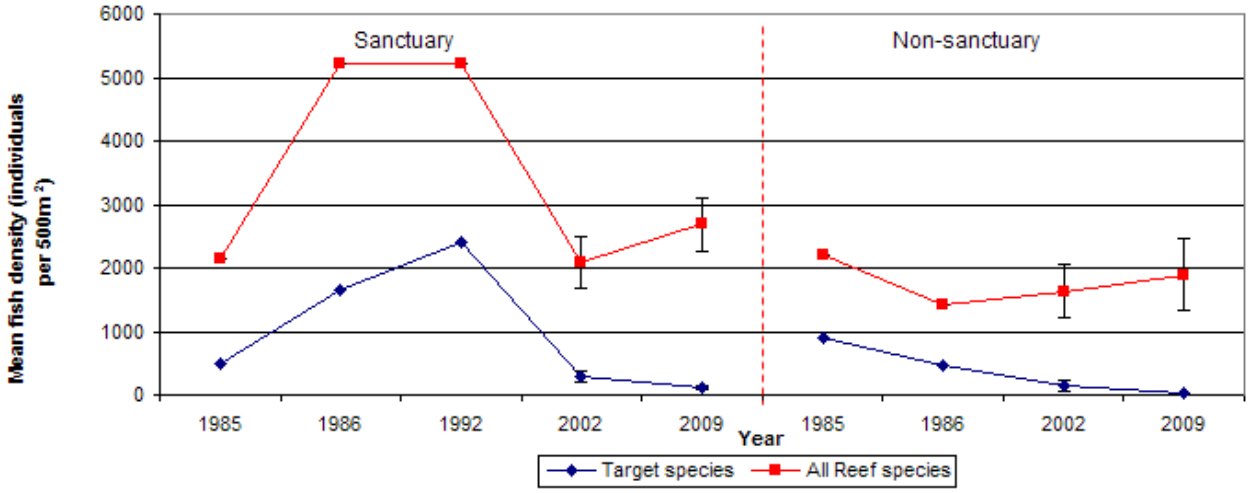
Substrate. Live hard coral in the deep zone (7-9 meters) of Apo Island MPA was good (68.5±5.21%) and poor (23.8±3.77%) in the shallow area in 2009. Branching colonies of live hard corals dominate the substrate inside Apo Island MPA, followed encrusting and massive growth forms (Table 22). Apo Island MPA records the highest percentage of LHC (68.5%) among all surveyed sites (Table 22). LHC has continually exhibited an increasing trend since 1982 and has recovered after the severe El Niño bleaching event in 1998 (Figure 15).

Figure 15. Changes in substrate composition (% mean ±SE) in Apo Island Marine Sanctuary from 1981 to 2009 (7-8m depth).



Fish density, species richness and biomass. Mean density for all reef species in 2009 was 2,684.4±420.4 fish/500m^2. Pomacentrids (2,068.1±462.2 fish/500m^2) numerically dominate the area. Target fish density for Apo Island MPA in this 2009 survey was poor with 120.6±29.6 fish/500m^2 compared to previous studies. Among the target fish, the five most dense fish families are the Labrids, Acanthurids, Balistids, and Caesionids. After years of monitoring, target fish density inside the sanctuary has shown a significant decrease since the last survey in 2002 (p-value:0.003 DF = 3.66 f = 4) (Figure 16).

Figure 16. Mean (±SE) fish density (density/500m^2) in Apo Island Marine Sanctuary from 1985 to 2009.



For 2009, mean species richness in Apo Island MPA for all reef species (50.0±8.2 spp/500m^2) was high relative to other Philippine reefs. An average of 15.0±2.5 spp/500m^2 target fish species was recorded. Mean Chaetodontid diversity is noted at 9.1±1.5 spp/500m^2. Apo Island is the most diverse for all reef, target fish and butterflyfish species among all surveyed sites for this expedition (Figure 17). Change in fish abundance between years is shown in Table 24.

Mean target fish biomass for 2009 was poor with 23.0 kg/500m^2.

Figure 17. Changes in mean (±SE) fish species richness (species/500m^2) in Apo Island Marine Sanctuary from 1985 to 2009.

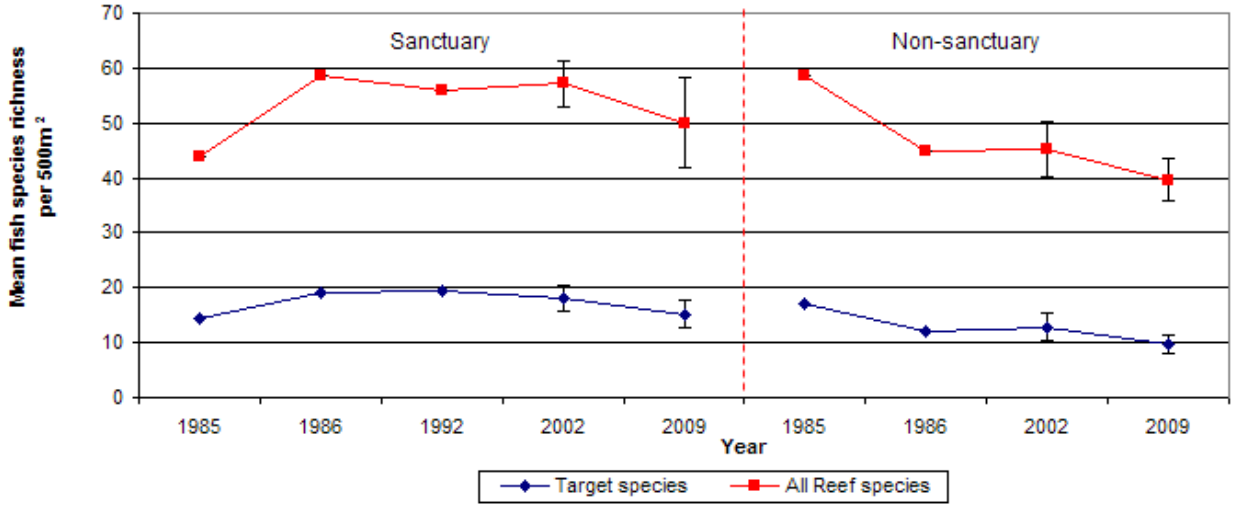


Table 1. Changes in substrate composition (% mean) in Caticugan Marine Sanctuary from 2002 to 2009.

	SANCTUARY										NON-SANCTUARY					
	SCUBA SURVEYS:							SNORKEL SURVEYS:			SCUBA SURVEYS:					
	2002	2005	2006	2007	2008	2009	% Change 2008-2009	2002	2009	% Change 2002-2009	2005	2006	2007	2008	2009	% Change 2008-2009
SUBSTRATE COVER	% cover	% cover	% cover	% cover	% cover	% cover		% cover	% cover		% cover	% cover	% cover	% cover	% cover	
Sand (s) and Silt (SI)	50.3	55.0	41.0	39.2	47.2	55.4	17.3	15.8	28.6	81.2	34.2	47.6	23.7	18.2	59.9	228.9
Coral Rubble (R)	11.3	8.0	7.0	15.1	1.7	12.9	662.7	4.3	30.4	607.9	8.8	2.1	5.8	17.4	8.4	-51.5
Rock and Block (RK)	7.3	6.0	0.7	5.4	0.0	4.6	+	27.9	1.4	-95.1	1.2	5.8	0.3	3.0	4.6	51.3
White Dead Standing Coral (DC)	0.1	0.8	5.0	0.5	0.0	1.7	+	0.0	0.3	+	2.3	0.7	0.2	3.0	0.5	-83.2
Dead Coral with Algae (DCA)	4.6	18.3	4.9	5.5	19.9	5.0	-74.9	2.8	0.9	-67.3	1.7	0.1	8.6	3.9	4.1	7.3
Subtotal Non-living Substrate	***73.6***	***88.2***	***58.6***	***65.7***	***68.8***	***79.6***	15.7	***50.8***	***61.6***	21.2	***48.1***	***56.2***	***38.7***	***45.4***	***77.5***	70.6
Branching (CB)	9	1.7	15.0	15.2	10.8	6.9	-36.0	3.8	7.6	100.1	11.2	1.2	18.8	2.0	9.7	385.6
Massive (CM)	5.2	5.7	11.6	11.0	17.2	3.9	-77.6	5.7	9.1	59.8	3.5	2.8	2.6	5.6	4.8	-15.0
Flat/Encrusting (CFD)	0.4	0.0	4.2	1.3	0.3	2.6	659.9	0.4	0.3	-30.6	0.3	0.3	0.3	2.2	2.2	0.2
Foliose Cup (CFO)	0.4	0.0	0.3	0.5	0.5	0.7	40.7	0.2	2.6	1205.6	2.3	0.0	1.0	0.0	1.4	+
Total Hard Coral	**15**	**7.3**	**31.1**	**28.0**	**28.9**	**14.1**	-51.3	**10.1**	**19.6**	94.1	**17.4**	**4.3**	**22.7**	**9.8**	**18.1**	83.6
Total Soft Coral	**2.1**	**3.1**	1.2	1.9	2.3	1.9	-17.8	26.8	17.6	-34.2	0.5	5.7	3.9	1.0	0.8	-20.6
Subtotal Coral	***17.1***	***10.5***	***32.3***	***29.9***	***31.2***	***15.9***	-48.9	***36.9***	***37.2***	0.9	***17.9***	***10.0***	***26.6***	***10.8***	***18.9***	74.1
Sponges	0.4	0.5	3.3	0.2	0.0	0.1	+	0.2	0.0	-86.1	0.0	0.2	0.3	0.0	0.4	+
Other animals	0	0.0	1.3	0.7	0.0	0.3	+	0.0	0.0	N/A	0.3	0.6	0.3	0.0	0.2	+
Algae		0.3	0.2	0.3	0.0	0.1	+		1.0	+	0.8	6.2	0.0	0.0	0.6	+
Turf algae	0.3	~	~	~	~	0.1	N/A	0.8	0.0	-100.0	~	~	~	~	0.0	N/A
Fleshy algae	0.8	~	~	~	~	0.1	N/A	8.7	1.0	-88.2	~	~	~	~	0.6	N/A
Coralline algae	0	~	~	~	~	0.0	N/A	0.7	0.0	-100.0	~	~	~	~	0.1	N/A
Seagrass	7.9	0.5	4.3	3.2	0.0	3.9	+	2.0	0.1	-94.4	32.8	26.7	34.1	43.7	2.4	-94.6
Subtotal Others	***9.4***	***1.4***	***9.1***	***4.3***	***0.0***	***4.4***	+	***12.4***	***1.2***	-90.6	***34.0***	***33.7***	***34.7***	***43.7***	***3.6***	-91.7
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**		**100**	**100**		**100**	**100**	**100**	**100**	**100**	
Environmental Paramenters																
Mean Slope (degrees)	10.4	~	~	~	~	16.0		3.8	3.2		~	~	~	~	20.8	
Mean Topography (m) *	1.4	~	~	~	~	3.3		1.0	1.5		~	~	~	~	2.6	
Mean Depth/Range (m)	7.0	7-8m	7-8m	7-8m	7-8m	7.3		3.5	3.2		7-8m	7-8m	7-8m	7-8m	7.7	
Horizontal Visibility (m)	13.9	~	~	~	~	14.0		16.7	12.8		~	~	~	~	12.8	
No. of 50 m Transects	16	3	3	3	3	7.0		-240	12		3	3	3	3	7	

~ no data available

* mean distance between lowest and highest point on the horizontal transect line

% change = $[(Yr_2/Yr_1)-1] \times 100$

(-) = decrease

(+) = increase

Table 2. Species list of butterflyfish in Province of Siquijor and Apo Island, Negros Oriental

Butterfly species	Common name	Caticugan		Lower Cabancalan	Talayong	Tubod		Paliton	Apo Island	
		2002	2009	2009	2009	2002	2009	2009	2002	2009
Chaetodon adiergastos	Philippine butterflyfish					X			X	Y
Chaetodon auriga	Threadfin butterflyfish					X			X	Y
Chaetodon baronessa	Eastern triangular butterflyfish	X	Y	Y	Y	X	Y	Y	X	Y
Chaetodon bennetti	Bluelashed butterflyfish			Y				Y		
Chaetodon citrinellus	Speckled butterflyfish					X				Y
Chaetodon ephippium	Saddle butterflyfish					X			X	Y
Chaetodon kleinii	Klein's butterflyfish	X	Y	Y	Y	X	Y	Y	X	Y
Chaetodon lineolatus	Lined butterflyfish		Y	Y		X			X	Y
Chaetodon lunula	Raccoon butterflyfish			Y		X			X	Y
Chaetodon lunulatus	Pacific redfin butterflyfish	X		Y		X	Y	Y	X	Y
Chaetodon melannotus	Blackback butterflyfish					X	Y	Y	X	Y
Chaetodon mertensii	Merten's butterflyfish								X	
Chaetodon meyeri	Meyer's butterflyfish									
Chaetodon ocellicaudus	Spottail butterflyfish					X	Y	Y	X	
Chaetodon octofasciatus	Eightband butterflyfish	X			Y	X	Y			
Chaetodon ornatissimus	Ornate butterflyfish					X	Y	Y		
Chaetodon oxycephalus	Spot-nape butterflyfish								X	
Chaetodon plebeius	Blueblotch butterflyfish					X				
Chaetodon punctatofasciatus	Spotband butterflyfish	X	Y	Y	Y	X	Y	Y	X	Y
Chaetodon rafflesi	Latticed butterflyfish	X		Y		X	Y	Y	X	Y
Chaetodon reticulatus	Mailed butterflyfish									
Chaetodon selene	Yellowdotted butterflyfish					X			X	
Chaetodon semeion	Dotted butterflyfish									
Chaetodon speculum	Mirror butterflyfish					X		Y	X	Y
Chaetodon trifascialis	Chevron butterflyfish					X			X	Y
Chaetodon ulietensis	Pacific doublesaddle butterflyfish								X	Y
Chaetodon unimaculatus	Teardrop butterflyfish				Y		Y		X	Y
Chaetodon vagabundus	Vagabond butterflyfish			Y		X		Y	X	Y
Chaetodon xanthurus	Pearscale butterflyfish					X			X	Y
Chelmon rostratus	Beaked coralfish			Y		X				
Forcipiger flavissimmus	Forcepsfish			Y		X	Y	Y	X	Y
Forcipiger longirostris	Longnose butterflyfish							Y		Y
Hemitaurichthys polylepis	Pyramid butterflyfish			Y				Y	X	Y
Heniochus acuminatus	Pennant coralfish			Y	Y				X	Y
Heniochus chrysostomus	Threeband pennantfish					X		Y	X	Y
Heniochus diphreutes	Schooling bannerfish									
Heniochus monoceros	Masked bannerfish									
Heniochus singularius	Singular bannerfish					X			X	Y
Heniochus varius	Horned bannerfish	X	Y	Y	Y	X	Y	Y	X	Y
Coradion chrysozonus	Goldengirdled coralfish							Y		
Coradion melanopus	Two-eyed coralfish				Y	X				
Parachaetodon ocellatus	Ocellate coralfish					X				
Total number of species/site		**7**	**5**	**14**	**8**	**28**	**12**	**17**	**27**	**25**

Total number of species observed in all sites surveyed in 2009:

Table 3. Mean (±SE) fish species richness (species/500m^2) in Caticugan Marine Sanctuary from 2002 to 2009.

Family	SANCTUARY		% Change 2002-2009	SANCTUARY
	2002 (N=3)	2009 (N=7)		2009 (N=7)
	Mean	Mean		Mean
Surgeonfish (Acanthurids)*	3.3±0.6	2±0.7	-39.4	1.9±0.3
Rabbitfish (Siganids)*	1±0.2	1.9±1.7	85.7	0.3±0
Groupers (Serranids)*	0.2±0.3	0.9±0.3	328.6	0.4±0.2
Barramundi cod	0±0	0±0	N/A	0±0
Snapper (Lutjanids)*	0.3±0.2	1±0.4	233.3	0.3±0.2
Sweetlips (Haemulids)*	0±0	0±0	N/A	0.1±0.1
Emperors (Lethrinids)*	0±0	0.3±0.2	+	0.1±0.1
Jacks (Carangids)*	0±0	0±0	N/A	0±0
Fusiliers (Caesionids)*	0.3±0.6	0.4±0.2	42.9	0.4±0.2
Spinecheeks (Nemipterids)*	1±0	1.3±0.2	28.6	0.7±0.2
Goatfish (Mullids)*	2±0.5	1.3±0.4	-35.7	0.9±0.3
Parrotfish (Scarids)*	2.7±1.1	2.4±0.4	-10.1	1.4±0.4
Bumphead parrotfish	0±0	0±0	N/A	0±0
Rudderfish (Kyphosids)*	0±0	0±0	N/A	0±0
Triggerfish (Balistids)	0.8±0	0.4±0.2	-46.4	0.7±0.2
Butterflyfish (Chaetodonids)	3.5±0.7	3.4±0.8	-2.0	3.1±0.5
Angelfish (Pomacanthids)	2.2±0.3	1.3±0.4	-41.6	1.6±0.3
Wrasses (Labrids)	7.7±1.5	5.1±0.5	-33.2	3.9±0.6
Humphead wrasse	0±0	0±0	N/A	0±0
Damselfish (Pomacentrids)	14.8±1.1	6.6±1.2	-55.6	6.7±1.6
Fairy Basslets (Anthids)	0.8±0.2	0.9±0.3	7.1	1±0.2
Moorish Idols (*Zanclus cornutus*)	0.3±0.2	0.3±0.2	-4.8	0.3±0.2
Total (target reef spp.):	10.8±1.7	11.4±2.8	5.8	6.6±1.4
Total (all reef spp.):	41±4.4	29.4±4.2	-28.2	23.9±4.1

* Target species/families

Table 4. Mean (±SE) fish density (density/500m^2) in Caticugan Marine Sanctuary from 2002 to 2009.

Family	SANCTUARY						% Change 2008-2009	NON-SANCTUARY				% Change 2008-2009
	2002 (N=6)	2005 (N=3)	2006 (N=3)	2007 (N=3)	2008 (N=3)	2009 (N=7)		2005 (N-3)	2006 (N=3)	2007 (N=3)	2009 (N=7)	
	Mean	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	
Surgeonfish (Acanthurids)*	25.3 ± 8.18	40.3 ± 19.5	9±1.2	1.7±1.2	8.3±4.4	15.6±4.3	86.9	19.7 ± 11.1	0±0	0±0	13.6±4.5	-66.5
Rabbitfish (Siganids)*	1.5 ± 0.671	0.3 ± 0.3	1±0.6	5±2.6	0±0	122.4±120.8	+	0 ± 0	0±0	0.3±0.3	1.3±0.8	-34.9
Groupers (Serranids)*	0.3 ± 0.211	1 ± 1	0±0	0.3±0.3	0±0	1.7±0.8	+	0 ± 0	0±0	0±0	0.9±0.5	-46.4
Barramundi cod	0 ± 0	0 ± 0	0±0	0±0	0±0	0±0	N/A	0 ± 0	0±0	0±0	0±0	N/A
Snapper (Lutjanids)*	0.3 ± 0.333	11.3 ± 5.9	1.3±0.3	0±0	0±0	5.7±3.1	+	2.7 ± 2.7	0±0	0±0	0.4±0.3	-30.6
Sweetlips (Haemulids)*	0 ± 0	1.7 ± 1.7	0.3±0.3	0±0	0±0	0±0	N/A	0.7 ± 0.3	0±0	0±0	0.1±0.1	0.0
Emperors (Lethrinids)*	0 ± 0	0 ± 0	0±0	1.3±0.7	4.3±3	1.4±0.9	-67.0	0.3 ± 0.3	0±0	0.3±0.3	0.3±0.3	0.0
Jacks (Carangids)*	0 ± 0	0.7 ± 0.7	0±0	0±0	0±0	0±0	N/A	1.3 ± 0.9	0±0	0±0	0±0	N/A
Fusiliers (Caesionids)*	7 ± 7	23.7 ± 23.7	0±0	0±0	0±0	9.1±4.9	+	0 ± 0	0±0	0±0	7±3.7	-46.5
Spinecheeks (Nemipterids)*	8.5 ± 2.473	12.3 ± 4.3	4.7±0.3	5.3±2	5.3±3.2	7.6±1.7	42.0	5.3 ± 3.8	4±2.5	2.3±1.9	2.7±0.9	-67.1
Goatfish (Mullids)*	22.2 ± 5.759	9.3 ± 3.5	6±3	3.7±0.9	3±2.5	12.6±4	319.0	8.7 ± 6.7	4.3±1.8	2.3±0.7	12.4±6.6	-47.1
Parrotfish (Scarids)*	30.3 ± 10.131	109.3 ± 76.8	57.3±9.3	34.7±6.8	33.3±12.8	42.1±22.8	26.4	40.7 ± 26.2	20.7±9.6	26.7±11.2	15.1±9	-40.5
Bumphead parrotfish	0 ± 0	0 ± 0	0.3±0.3	0±0	0±0	0±0	N/A	0 ± 0	0±0	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0 ± 0	0 ± 0	0±0	0±0	0±0	0±0	N/A	0 ± 0	0±0	0±0	0±0	N/A
Triggerfish (Balistids)	1 ± 0.258	5 ± 4.5	1.3±0.9	1.7±0.9	0.3±0.3	1.4±0.7	328.6	5.7 ± 2.6	0±0	0.7±0.3	2.4±0.8	-67.8
Butterflyfish (Chaetodonids)	13.2 ± 3.331	9.7 ± 3.2	3±1.5	3.3±0.7	1±0.6	9.6±2.2	857.1	10 ± 4	3.3±1.9	1±1	18.3±5.2	-71.4
Angelfish (Pomacanthids)	6 ± 0.856	4.7 ± 3.2	1.3±0.7	1±0.6	0±0	5.3±1	+	5 ± 3.5	1.7±0.9	2.3±1.2	6.7±1.9	-71.0
Wrasses (Labrids)	121.7 ± 30.239	44 ± 14.6	96.3±12.8	172±151.2	13±3.5	98.3±65.7	656.0	54.3 ± 30.3	32±5.6	325.3±224.7	156.6±51	-67.4
Humphead wrasse	0 ± 0	1 ± 1	0±0	0±0	0.3±0.3	0±0	-100.0	3.3 ± 1.9	0±0	0±0	0±0	N/A
Damselfish (Pomacentrids)	1363 ± 170.813	737.7 ± 292.7	496.7±82.1	310±83.2	423.3±121.6	682.9±198.4	61.3	833.3 ± 428.5	340±52.5	766.7±321.7	1419.9±549.5	-61.3
Fairy Basslets (Anthids)	27 ± 10.141	21.7 ± 14.8	56.7±36.4	0±0	0±0	105.7±44.3	+	40.3 ± 20.9	0.7±0.7	398.3±368.7	506.1±255.1	-49.6
Moorish Idols (*Zanclus cornutus*)	1.8 ± 1.47	2 ± 1	0±0	0±0	0±0	0.6±0.4	+	0 ± 0	0±0	0.3±0.3	0.6±0.4	-35.5
Total (target reef spp.):	**76.3 ± 18.1**	**189 ± 103.7**	**79.3±6.6**	**50.3±6.9**	**47.7±9.5**	**214.3±130.7**	349.6	**70.3 ± 42.7**	**29±11.5**	**32±11.2**	**48.9±17.9**	-63.4
Total (all reef spp.):	**1629.7 ± 199**	**1035.7 ± 230.3**	**735.3±119.4**	**540±220.7**	**492.3±131.6**	**1122±193.3**	127.9	**1031.3 ± 455.9**	**406.7±36.8**	**1526.7±923.1**	**2164.4±837.5**	-61.3

* Target species/families

Table 5. Mean (±SE) fish species richness (species/500m^2) and density (fish/500m^2) per family at Caticugan Marine Sanctuary in 2009.

Family	Species	Size Class				Density
	Mean	1-10 cm**	11-20 cm	21-30 cm	>30 cm	Mean
Surgeonfish (Acanthurids)*	2±0.7	4.0	7.0	4.0	0.6	15.6±4.3
Rabbitfish (Siganids)*	1.9±1.7	121.0	0.6	0.9	0.0	122.4±120.8
Groupers (Serranids)*	0.9±0.3	0.0	0.7	0.4	0.6	1.7±0.8
Barramundi cod	0±0	0.0	0.0	0.0	0.0	0±0
Snapper (Lutjanids)*	1±0.4	0.0	4.4	1.1	0.1	5.7±3.1
Sweetlips (Haemulids)*	0±0	0.0	0.0	0.0	0.0	0±0
Emperors (Lethrinids)*	0.3±0.2	0.0	1.4	0.0	0.0	1.4±0.9
Jacks (Carangids)*	0±0	0.0	0.0	0.0	0.0	0±0
Fusiliers (Caesionids)*	0.4±0.2	0.0	9.1	0.0	0.0	9.1±4.9
Spinecheeks (Nemipterids)*	1.3±0.2	2.3	4.1	1.1	0.0	7.6±1.7
Goatfish (Mullids)*	1.3±0.4	1.1	9.7	1.6	0.1	12.6±4
Parrotfish (Scarids)*	2.4±0.4	22.1	9.4	2.3	8.3	42.1±22.8
Bumphead parrotfish	0±0	0.0	0.0	0.0	0.0	0±0
Rudderfish (Kyphosids)*	0±0	0.0	0.0	0.0	0.0	0±0
Triggerfish (Balistids)	0.4±0.2	0.0	1.0	0.3	0.1	1.4±0.7
Butterflyfish (Chaetodonids)	3.4±0.8	4.3	5.3	0.0	0.0	9.6±2.2
Angelfish (Pomacanthids)	1.3±0.4	1.3	2.9	1.1	0.0	5.3±1
Wrasses (Labrids)	5.1±0.5	83.6	11.7	2.4	0.6	98.3±65.7
Humphead wrasse	0±0	0.0	0.0	0.0	0.0	0±0
Damselfish (Pomacentrids)	6.6±1.2	621.4	61.4	0.0	0.0	682.9±198.4
Fairy Basslets (Anthids)	0.9±0.3	92.9	12.9	0.0	0.0	105.7±44.3
Moorish Idols (*Zanclus cornutus*)	0.3±0.2	0.0	0.6	0.0	0.0	0.6±0.4
Total (target reef spp.):	**11.4±2.8**	**146.6**	**46.6**	**11.4**	**9.7**	**214.3±130.7**
Total (all reef spp.):	**29.4±4.2**	**954.0**	**142.3**	**15.3**	**10.4**	**1122±193.3**

* Target species/families

** Surgeonfish in this size class are not counted as targets

Fairly high density for target families

Table 6. Changes in substrate composition (% mean) in Lower Cabancalan Marine Sanctuary from 2005 to 2009.

	SANCTUARY							NON-SANCTUARY					
	SCUBA SURVEYS						SNORKEL	SCUBA SURVEYS					
	2005	2006	2007	2008	2009	% Change 2008-2009	2009	2005	2006	2007	2008	2009	% Change 2008-2009
SUBSTRATE COVER	% cover	% cover	% cover	% cover	% cover		% cover	% cover	% cover	% cover	% cover	% cover	
Sand (s) and Silt (SI)	22.6	32.0	21.4	28.7	27.5	-4.3	16.2	37.2	34.6	45.1	76.6	44.2	-42.3
Coral Rubble (R)	10.4	5.6	26.1	6.7	5.3	-20.6	1.8	1.4	0.7	2.7	0.0	8.4	+
Rock and Block (RK)	5.8	6.0	5.2	4.4	9.9	125.8	37.6	3.0	0.5	0.0	4.0	3.9	-1.0
White Dead Standing Coral (DC)	0.3	0.1	0.0	0.0	0.1	+	0.0	0.6	0.0	2.9	0.2	0.4	98.2
Dead Coral with Algae (DCA)	5.3	1.2	11.7	4.3	3.4	-21.6	1.1	3.3	9.4	3.6	0.7	3.4	385.1
Subtotal Non-living Substrate	***44.4***	***44.9***	***64.4***	***44.1***	***46.2***	4.9	***56.6***	***45.4***	***45.2***	***54.3***	***81.5***	***60.3***	-26.0
Branching (CB)	2.7	3.8	3.7	4.8	6.7	38.7	7.2	1.9	11.9	9.3	3.0	6.7	121.4
Massive (CM)	1.4	8.8	15.9	4.3	9.4	117.1	10.9	8.4	8.4	10.7	2.8	7.9	180.7
Flat/Encrusting (CFD)	0.1	0.5	0.9	0.5	4.4	752.7	2.5	0.8	1.5	11.6	1.3	5.3	319.4
Foliose Cup (CFO)	2.4	1.8	0.0	4.3	0.9	-78.5	1.1	1.3	1.7	0.0	2.5	1.4	-42.6
Total Hard Coral	**6.6**	**15.0**	**20.6**	**14.0**	**21.4**	52.8	**21.6**	**12.5**	**23.5**	**31.7**	**9.6**	**21.4**	122.4
Total Soft Coral	15.2	25.2	8.5	28.9	25.7	-11.1	16.6	21.6	10.7	10.9	5.1	14.1	175.2
Subtotal Coral	***21.8***	***40.2***	***29.1***	***42.9***	***47.1***	9.8	***38.3***	***34.1***	***34.1***	***42.6***	***14.7***	***35.5***	140.8
Sponges	2.2	1.4	5.3	2.4	1.6	-33.7	0.4	1.3	17.2	0.0	0.9	1.1	31.8
Other animals	0.3	3.5	0.8	1.8	1.4	-20.7	0.0	1.8	3.3	0.0	0.7	0.1	-80.0
Algae	31.3	10.0	0.0	8.8	3.6	-58.7	4.7	17.3	0.2	3.1	2.0	2.9	45.1
Turf algae	~	~	~	~	2.1	N/A	0.7	~	~	~	~	0.9	N/A
Fleshy algae	~	~	~	~	1.4	N/A	3.8	~	~	~	~	1.9	N/A
Coralline algae	~	~	~	~	0.2	N/A	0.2	~	~	~	~	0.1	N/A
Seagrass	0.0	0.0	0.3	0.0	0.0	N/A	0.1	0.0	0.0	0.0	0.2	0.0	-100.0
Subtotal Others	***33.8***	***14.9***	***6.5***	***13.0***	***6.6***	-48.8	**5.2**	***20.4***	***20.7***	***3.1***	***3.8***	***4.2***	11.9
TOTAL	**100**	**100**	**100**	**100**	**100**		**100**	**100**	**100**	**100**	**100**	**100**	
Environmental Paramenters													
Mean Slope (degrees)	~	~	~	~	7.1		3.3	~	~	~	~	10.8	
Mean Topography (m) *	~	~	~	~	2.2		1.5	~	~	~	~	2.4	
Mean Depth/Range (m)	7-8m	7-8m	7-8m	7-8m	7.3		3.0	7-8m	7-8m	7-8m	7-8m	7.6	
Horizontal Visibility (m)	~	~	~	~	16.2		12.5	~	~	~	~	15.3	
No. of 50 m Transects	3	3	2	3	7		12	3	3	3	3	7	

~ no data available

* mean distance between lowest and highest point on the horizontal transect line

% change = $[(Yr_2/Yr_1)-1] \times 100$

(-) = decrease

(+) = increase

Table 7. Mean (±SE) fish species richness (species/500m^2) in Lower Cabancalan Marine Sanctuary for

Family	SANCTUARY	NON-SANCTUARY
	2009 (N=7)	2009 (N=7)
	Mean	Mean
Surgeonfish (Acanthurids)*	2.6±0.6	1.4±0.5
Rabbitfish (Siganids)*	1±0.4	2.4±2.1
Groupers (Serranids)*	0.7±0.3	0.3±0.2
Barramundi cod	0±0	0±0
Snapper (Lutjanids)*	0.9±0.3	0±0
Sweetlips (Haemulids)*	0.1±0.1	0±0
Emperors (Lethrinids)*	0±0	0±0
Jacks (Carangids)*	0±0	0±0
Fusiliers (Caesionids)*	0.3±0.3	0.1±0.1
Spinecheeks (Nemipterids)*	1±0	0.7±0.2
Goatfish (Mullids)*	1.6±0.2	1.3±0.5
Parrotfish (Scarids)*	2.3±0.4	1±0.3
Bumphead parrotfish	0±0	0±0
Rudderfish (Kyphosids)*	0±0	0±0
Triggerfish (Balistids)	0.7±0.4	0.6±0.3
Butterflyfish (Chaetodonids)	3.4±0.6	2.1±0.4
Angelfish (Pomacanthids)	1.7±0.5	1.1±0.3
Wrasses (Labrids)	4.6±0.6	3.9±0.7
Humphead wrasse	0±0	0±0
Damselfish (Pomacentrids)	6.4±1.7	4.7±1.6
Fairy Basslets (Anthids)	1±0	1.1±0.1
Moorish Idols (*Zanclus cornutus*)	0.7±0.2	0.4±0.2
Total (target reef spp.):	**8.3±1.7**	**6.6±3**
Total (all reef spp.):	**29±3.8**	**21.3±4.2**

* Target species/families

Table 8. Mean (±SE) fish density (density/500m^2) in Lower Cabancalan Marine Sanctuary from 2005 to 2009.

Family	SANCTUARY					% Change 2008-2009	NON-SANCTUARY					% Change 2008-2009
	2005 (N=3)	2006 (N=3)	2007 (N=3)	2008 (N=3)	2009 (N=7)		2005 (N=3)	2006 (N=3)	2007 (N=3)	2008)N=3)	2009 (N=7)	
	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	Mean	
Surgeonfish (Acanthurids)*	4±2.1	10.3±3.2	5.7±2	14±6.1	19.6±3.7	39.8	2±2	47.7±8.7	7±2.1	5±2	8±2.3	60.0
Rabbitfish (Siganids)*	0±0	0±0	2.7±2.7	0.7±0.7	2.7±1.1	307.1	0±0	0±0	0±0	0±0	132.3±131.3	+
Groupers (Serranids)*	0±0	1.7±0.3	0.3±0.3	2±0.6	1.6±0.9	-21.4	0±0	0.3±0.3	0±0	0.7±0.7	0.7±0.5	7.1
Barramundi cod	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Snapper (Lutjanids)*	0.3±0.3	0±0	1.7±1.7	0.3±0.3	1.7±1.1	414.3	0±0	0±0	0±0	0±0	0.6±0.6	+
Sweetlips (Haemulids)*	0±0	0.7±0.7	1±0.6	0±0	0.3±0.3	+	0±0	0±0	0±0	0±0	0±0	N/A
Emperors (Lethrinids)*	0.7±0.3	0±0	0±0	0±0	0±0	N/A	0.3±0.3	0±0	0±0	0±0	0±0	N/A
Jacks (Carangids)*	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Fusiliers (Caesionids)*	0±0	0±0	3.3±3.3	0±0	3.6±3.6	+	0±0	0±0	0±0	3.7±3.7	2.9±2.9	-22.1
Spinecheeks (Nemipterids)*	2.7±0.7	4.3±0.7	13±4.7	7.7±4.8	5.9±1.7	-23.6	2±1	9.3±4.7	0±0	2.7±1.3	1.7±0.6	-35.7
Goatfish (Mullids)*	7.3±1.5	14±2.5	5.3±4.4	8±3.6	7.1±1.7	-10.7	10±5.3	12±1.2	4±1.5	9.7±3.3	5.7±1.9	-40.9
Parrotfish (Scarids)*	0±0	17.3±3.2	9.7±7.7	4.3±1.9	10±2	130.8	0±0	8±4	13±5.9	3.3±2.3	2.9±0.8	-14.3
Bumphead parrotfish	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Triggerfish (Balistids)	0.3±0.3	1.3±0.3	0±0	1.7±1.7	2±1.1	20.0	4.3±4.3	2±2	0±0	2±1.2	1.1±0.7	-42.9
Butterflyfish (Chaetodonids)	13±1.2	12.3±3.5	15±3.6	10±1.5	16.4±3.3	64.3	8.3±4.9	13±2.1	8±5.5	5±1	5.4±1.1	8.6
Angelfish (Pomacanthids)	0.7±0.3	9±2.6	1.3±1.3	3.7±2.7	6.1±1.2	67.5	0±0	12.3±0.3	0.7±0.7	4.7±0.9	3.4±1	-26.5
Wrasses (Labrids)	22±3	33.3±5.2	6.3±2.2	9.3±2.3	104.1±74.6	1015.8	348.3±332	75.7±11.5	18.7±1.8	28.3±3.9	119±84.9	320.0
Humphead wrasse	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Damselfish (Pomacentrids)	97±35.7	711±205.6	508.3±368.3	241.7±64.2	1143.3±396.8	373.1	293.7±145.6	723.7±49.2	142.3±7.2	533.3±33.3	782±240.5	46.6
Fairy Basslets (Anthids)	60.3±48	219.7±72.5	0±0	19±5.6	172.9±44.7	809.8	923.3±391.6	500.3±28.9	0±0	321.7±69.3	232.7±56.2	-27.7
Moorish Idols (*Zanclus cornutus*)	0±0	0±0	0±0	0±0	1.1±0.3	+	0±0	1±0	0±0	0±0	0.7±0.4	+
Total (target reef spp.):	**14.3±2.4**	**40.3±4.1**	**37±5.5**	**36.3±9.1**	**50.4±9**	**38.8**	**14.3±5.9**	**31.7±2.3**	**17±7.4**	**24.7±7.5**	**153.3±131.2**	**521.4**
Total (all reef spp.):	**208.3±31.3**	**1035±282.5**	**573.7±370.8**	**322.3±79.3**	**1498.4±478**	**364.9**	**1592.3±281**	**1405.3±73.3**	**193.7±14.3**	**920±86.4**	**1299.1±256.8**	**41.2**

* Target species/families

Table 9. Mean (±SE) fish species richness (species/500m^2) and density (fish/500m^2) per family inside Lower Cabancalan Marine Sanctuary in 2009.

Family	Species	Size Class				Density
	Mean	1-10 cm**	11-20 cm	21-30 cm	>30 cm	Mean
Surgeonfish (Acanthurids)*	2.6±0.6	2.0	7.4	7.9	2.3	19.6±3.7
Rabbitfish (Siganids)*	1±0.4	0.0	1.3	0.0	1.4	2.7±1.1
Groupers (Serranids)*	0.7±0.3	0.0	0.6	0.6	0.4	1.6±0.9
Barramundi cod	0±0	0.0	0.0	0.0	0.0	0±0
Snapper (Lutjanids)*	0.9±0.3	0.0	0.9	0.7	0.1	1.7±1.1
Sweetlips (Haemulids)*	0.1±0.1	0.0	0.0	0.0	0.3	0.3±0.3
Emperors (Lethrinids)*	0±0	0.0	0.0	0.0	0.0	0±0
Jacks (Carangids)*	0±0	0.0	0.0	0.0	0.0	0±0
Fusiliers (Caesionids)*	0.3±0.3	0.0	2.9	0.7	0.0	3.6±3.6
Spinecheeks (Nemipterids)*	1±0	0.0	4.1	1.1	0.6	5.9±1.7
Goatfish (Mullids)*	1.6±0.2	0.0	4.9	2.3	0.0	7.1±1.7
Parrotfish (Scarids)*	2.3±0.4	0.7	3.4	2.4	3.4	10±2
Bumphead parrotfish	0±0	0.0	0.0	0.0	0.0	0±0
Rudderfish (Kyphosids)*	0±0	0.0	0.0	0.0	0.0	0±0
Triggerfish (Balistids)	0.7±0.4	0.1	0.6	1.0	0.3	2±1.1
Butterflyfish (Chaetodonids)	3.4±0.6	5.9	9.1	1.4	0.0	16.4±3.3
Angelfish (Pomacanthids)	1.7±0.5	3.1	2.4	0.4	0.1	6.1±1.2
Wrasses (Labrids)	4.6±0.6	90.3	10.3	2.9	0.7	104.1±74.6
Humphead wrasse	0±0	0.0	0.0	0.0	0.0	0±0
Damselfish (Pomacentrids)	6.4±1.7	1064.7	71.4	7.1	0.0	1143.3±396.8
Fairy Basslets (Anthids)	1±0	155.7	14.3	2.9	0.0	172.9±44.7
Moorish Idols (*Zanclus cornutus*)	0.7±0.2	0.0	1.0	0.1	0.0	1.1±0.3
Total (target reef spp.):	**8.3±1.7**	**0.7**	**25.4**	**15.7**	**8.6**	**50.4±9**
Total (all reef spp.):	**29±3.8**	**1322.6**	**134.6**	**31.6**	**9.7**	**1498.4±478**

* Target species/families

** Surgeonfish in this size class are not counted as targets

Fairly high density for target families

Table 10. Changes in substrate composition (% mean) in Talayong Marine Sanctuary from 2005 to 2009.

	SANCTUARY							NON-SANCTUARY					
	SCUBA						SNORKEL	SCUBA					
	2005	2006	2007	2008	2009	% Change 2008-2009	2009	2005	2006	2007	2008	2009	% Change 2008-2009
SUBSTRATE COVER	% cover	% cover	% cover	% cover	% cover		% cover	% cover	% cover	% cover	% cover	% cover	
Sand (s) and Silt (SI)	14.8	9.5	8.8	15.1	29.8	96.9	18.3	9.2	8.0	4.2	14.9	46.8	214.5
Coral Rubble (R)	6.1	4.1	7.2	2.5	6.2	152.5	5.6	6.1	7.5	7.4	1.3	2.8	115.9
Rock and Block (RK)	0.1	2.6	0.8	3.5	3.4	-4.9	12.8	2.1	0.5	0.7	3.9	1.2	-69.0
White Dead Standing Coral (DC)	0.1	0.9	0.0	0.1	0.1	-10.8	0.7	0.9	0.0	0.2	0.2	0.0	-100.0
Dead Coral with Algae (DCA)	8.5	2.6	5.9	4.5	3.1	-32.5	3.6	2.9	7.7	7.0	12.8	4.7	-63.3
Subtotal Non-living Substrate	***29.7***	***19.7***	***22.7***	***25.8***	***42.6***	64.8	***40.9***	***21.3***	***23.7***	***19.5***	***33.1***	***55.5***	67.8
Branching (CB)	12.6	28.6	27.9	22.3	18.6	-16.5	10.1	9.4	22.8	20.4	17.9	10.9	-39.2
Massive (CM)	18.1	17.0	16.0	17.2	9.1	-47.2	11.0	28.5	20.2	21.2	20.7	8.2	-60.3
Flat/Encrusting (CFD)	12.5	12.4	13.7	6.7	3.8	-42.9	2.0	7.2	13.2	13.7	2.3	5.1	125.8
Foliose Cup (CFO)	3.3	3.6	2.8	8.7	5.8	-33.7	0.7	9.9	4.8	6.2	5.8	9.4	61.7
Total Hard Coral	**46.5**	**61.7**	**60.3**	**54.8**	**37.3**	-32.0	**23.8**	**55.0**	**61.0**	**61.5**	**46.7**	**33.6**	-28.0
Total Soft Coral	18.9	11.9	12.1	14.1	13.0	-8.1	4.0	22.4	3.2	14.8	11.6	9.5	-18.2
Subtotal Coral	***65.4***	***73.6***	***72.4***	***69.0***	***50.3***	-27.1	***27.9***	***77.4***	***64.1***	***76.3***	***58.3***	***43.1***	-26.1
Sponges	3.5	0.5	0.0	1.9	0.4	-80.4	1.0	0.2	6.1	0.5	0.5	0.1	-81.0
Other animals	0.0	2.4	0.1	0.6	0.8	31.0	0.5	0.0	2.6	1.0	0.4	0.3	-23.5
Algae	1.0	0.7	1.9	2.7	4.8	77.5	29.7	1.1	3.5	2.7	7.6	1.0	-86.8
Turf algae	~	~	~	~	2.4	N/A	4.5	~	~	~	~	0.9	N/A
Fleshy algae	~	~	~	~	2.1	N/A	24.5	~	~	~	~	0.0	N/A
Coralline algae	~	~	~	~	0.3	N/A	0.8	~	~	~	~	0.1	N/A
Seagrass	0.4	3.2	2.8	0.0	1.3	+	0.0	0.0	0.0	0.0	0.2	0.0	-100.0
Subtotal Others	***4.9***	***6.8***	***4.9***	***5.2***	***7.2***	37.9	**31.2**	***1.3***	***12.2***	***4.3***	***8.6***	***1.4***	-83.8
TOTAL	**100**	**100**	**100**	**100**	**100**		**100**	**100**	**100**	**100**	**100**	**100**	
Environmental Paramenters													
Mean Slope (degrees)	~	~	~	~	10.0		6.6	~	~	~	~	27.5	
Mean Topography (m) *	~	~	~	~	2.2		1.3	~	~	~	~	1.3	
Mean Depth/Range (m)	7-8m	7-8m	7-8m	7-8m	8.8		3.1	7-8m	7-8m	7-8m	7-8m	7.4	
Horizontal Visibility (m)	~	~	~	~	16.1		16.3	~	~	~	~	19.3	
No. of 50 m Transects	3	3	3	3	8		14	3	2	3	3	5	

~ no data available

* mean distance between lowest and highest point on the horizontal transect line

% change = $[(Yr_2/Yr_1)-1] \times 100$

(-) = decrease

(+) = increase

Table 11. Mean (±SE) fish species richness (species/500m²) in Talayong Marine Sanctuary for 2009.

Family	SANCTUARY	NON-SANCTUARY
	2009 (N=7)	2009 (N=7)
	Mean	Mean
Surgeonfish (Acanthurids)*	1.1±0.3	1.2±0.5
Rabbitfish (Siganids)*	0.1±0.1	0.2±0.2
Groupers (Serranids)*	0.6±0.2	0±0
Barramundi cod	0±0	0±0
Snapper (Lutjanids)*	0.4±0.2	0±0
Sweetlips (Haemulids)*	0±0	0±0
Emperors (Lethrinids)*	0±0	0.2±0.2
Jacks (Carangids)*	0±0	0±0
Fusiliers (Caesionids)*	0.3±0.2	0±0
Spinecheeks (Nemipterids)*	0.6±0.2	0.8±0.2
Goatfish (Mullids)*	1.1±0.3	0.8±0.2
Parrotfish (Scarids)*	0.9±0.3	0.6±0.4
Bumphead parrotfish	0±0	0±0
Rudderfish (Kyphosids)*	0±0	0±0
Triggerfish (Balistids)	0.6±0.2	0.8±0.2
Butterflyfish (Chaetodonids)	3.1±0.3	3.2±1.4
Angelfish (Pomacanthids)	1.6±0.2	1.4±0.6
Wrasses (Labrids)	4.6±0.5	3±0.9
Humphead wrasse	0±0	0±0
Damselfish (Pomacentrids)	7.1±1.1	6.2±2.4
Fairy Basslets (Anthids)	1±0.3	1±0.4
Moorish Idols (*Zanclus cornutus*)	0.6±0.2	0.4±0.2
Total (target reef spp.):	**5.1±0.9**	**3.8±1**
Total (all reef spp.):	**23.7±2.9**	**19.8±6.6**

* Target species/families

Table 12. Mean (±SE) fish density (density/500m^2) in Talayong Marine Sanctuary from 2005 to 2009.

Family	SANCTUARY					% Change 2008-2009	NON-SANCTUARY					% Change 2008-2009
	2005 (N=3)	2006 (N=3)	2007 (N=3)	2008 (N=3)	2009 (N=7)		2005 (N=3)	2006 (N=3)	2007 (N=3)	2008 (N=3)	2009 (N=7)	
	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	Mean	
Surgeonfish (Acanthurids)*	13.3±8.3	45.3±22	12±3.8	62.7±34.7	11.6±3.7	-81.5	18±7	46.7±24	0±0	3.3±1.7	3.4±1.7	2.0
Rabbitfish (Siganids)*	0±0	0±0	0±0	0.3±0.3	0.1±0.1	-57.1	0±0	0.3±0.3	0.3±0.3	0±0	0.2±0.2	+
Groupers (Serranids)*	1±0.6	0.3±0.3	0.3±0.3	2.7±0.9	1.9±0.8	-30.4	2.3±0.7	9±7.1	0±0	0±0	0±0	N/A
Barramundi cod	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Snapper (Lutjanids)*	0.7±0.7	1±1	0.3±0.3	2.7±0.7	3±1.8	12.5	0±0	0±0	0±0	0±0	0±0	N/A
Sweetlips (Haemulids)*	1.3±1.3	0.3±0.3	0±0	0.7±0.3	0.1±0.1	-78.6	0±0	0±0	0±0	0±0	0±0	N/A
Emperors (Lethrinids)*	0±0	0±0	0±0	0.3±0.3	0±0	-100.0	0±0	0.3±0.3	0.7±0.3	0±0	0.4±0.4	+
Jacks (Carangids)*	0±0	0±0	0±0	0.7±0.7	0±0	-100.0	5.3±2.7	0±0	0.3±0.3	0±0	0±0	N/A
Fusiliers (Caesionids)*	1±0.6	1.7±0.9	0±0	1±0.6	6.4±4.2	542.9	0±0	0±0	0±0	0±0	0±0	N/A
Spinecheeks (Nemipterids)*	2.3±0.3	0.3±0.3	0±0	0.7±0.7	2±0.8	200.0	0±0	17.3±11.5	0.7±0.3	0.3±0.3	3±1.3	800.0
Goatfish (Mullids)*	2±1.5	1.7±0.9	1.3±0.7	5.3±1.2	3.3±1.1	-38.4	4±1	18±9	0±0	0.7±0.3	2.8±1	320.0
Parrotfish (Scarids)*	4.3±1.7	5.7±2.3	6.7±2.8	7.7±4.1	3.6±1.4	-53.4	5.7±1.3	24.7±12.8	2.3±2.3	2±1	2.6±1.8	30.0
Bumphead parrotfish	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0±0	0±0	0±0	1.7±1.7	0.7±0.7	-57.1	0±0	0±0	0±0	0±0	0±0	N/A
Triggerfish (Balistids)	2.7±0.7	1.7±0.7	1.7±0.9	6.7±0.9	1±0.5	-85.0	0.7±0.7	11.3±6.6	1.3±0.3	0.7±0.3	1.8±0.7	170.0
Butterflyfish (Chaetodonids)	13.7±4.1	18.3±5.2	5.7±3.5	40±9.6	12.1±2.4	-69.6	9±1	32±2.3	9±1	5.7±0.9	9±4.1	58.8
Angelfish (Pomacanthids)	5±2.6	5.3±0.3	3±2.1	13.3±4.9	5.4±0.5	-59.3	2.7±1.3	29±1	1±1	2.3±1.3	5.6±2.3	140.0
Wrasses (Labrids)	97.7±70	23.7±2.6	5±0.6	47.3±7.7	26.9±6.9	-43.3	25.7±7.3	232.7±84.7	8.7±1.8	19.3±7.5	45.8±30.8	136.9
Humphead wrasse	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	N/A
Damselfish (Pomacentrids)	796.7±371	463.3±63.3	805±401.6	900±57.7	1018.3±368.6	13.1	176.7±6.7	1751.7±121.5	1263.3±143.8	297±44.8	966.4±377.9	225.4
Fairy Basslets (Anthids)	64.7±42.7	196.3±68.6	93.3±13.3	166.7±54.6	212.7±121.2	27.6	21.7±21.7	1466.7±404.5	676.7±258.8	58.3±26.8	158.4±135.8	171.5
Moorish Idols (*Zanclus cornutus*)	0±0	0.7±0.7	0±0	1.7±0.7	1±0.4	-40.0	2±1	0.7±0.7	0.7±0.7	0±0	2±1.8	+
Total (target reef spp.):	**12.7±2.2**	**53±22.2**	**10.7±3.8**	**40±13**	**28.9±8.1**	-27.9	**17.3±5.7**	**78±25.2**	**4.3±2.4**	**6±1.5**	**11.2±1.6**	86.7
Total (all reef spp.):	**1006.3±334.5**	**765.7±94.1**	**934.3±402.1**	**1262±7**	**1310.1±404.9**	3.8	**273.7±5.7**	**3640.3±619.8**	**1965±386.6**	**389.7±69.6**	**1201.4±499.5**	208.3

* Target species/families

Table 13. Mean (±SE) fish species richness (species/500m^2) and density (fish/500m^2) per family at Talayong Marine Sanctuary in 2009.

Family	Species	Size Class				Density
	Mean	1-10 cm**	11-20 cm	21-30 cm	>30 cm	Mean
Surgeonfish (Acanthurids)*	1.1±0.3	3.9	6.6	1.0	0.1	11.6±3.7
Rabbitfish (Siganids)*	0.1±0.1	0.0	0.1	0.0	0.0	0.1±0.1
Groupers (Serranids)*	0.6±0.2	0.0	1.0	0.0	0.9	1.9±0.8
Barramundi cod	0±0	0.0	0.0	0.0	0.0	0±0
Snapper (Lutjanids)*	0.4±0.2	0.0	1.3	1.7	0.0	3±1.8
Sweetlips (Haemulids)*	0±0	0.0	0.0	0.0	0.1	0.1±0.1
Emperors (Lethrinids)*	0±0	0.0	0.0	0.0	0.0	0±0
Jacks (Carangids)*	0±0	0.0	0.0	0.0	0.0	0±0
Fusiliers (Caesionids)*	0.3±0.2	0.0	6.4	0.0	0.0	6.4±4.2
Spinecheeks (Nemipterids)*	0.6±0.2	0.0	2.0	0.0	0.0	2±0.8
Goatfish (Mullids)*	1.1±0.3	0.0	2.4	0.9	0.0	3.3±1.1
Parrotfish (Scarids)*	0.9±0.3	0.0	2.7	0.9	0.0	3.6±1.4
Bumphead parrotfish	0±0	0.0	0.0	0.0	0.0	0±0
Rudderfish (Kyphosids)*	0±0	0.0	0.0	0.7	0.0	0.7±0.7
Triggerfish (Balistids)	0.6±0.2	0.0	0.7	0.1	0.1	1±0.5
Butterflyfish (Chaetodonids)	3.1±0.3	7.7	4.3	0.1	0.0	12.1±2.4
Angelfish (Pomacanthids)	1.6±0.2	2.3	2.7	0.1	0.3	5.4±0.5
Wrasses (Labrids)	4.6±0.5	16.7	6.1	3.7	0.3	26.9±6.9
Humphead wrasse	0±0	0.0	0.0	0.0	0.0	0±0
Damselfish (Pomacentrids)	7.1±1.1	1009.3	9.0	0.0	0.0	1018.3±368.6
Fairy Basslets (Anthids)	1±0.3	212.7	0.0	0.0	0.0	212.7±121.2
Moorish Idols (*Zanclus cornutus*)	0.6±0.2	0.0	0.9	0.0	0.1	1±0.4
Total (target reef spp.):	**5.1±0.9**	**0.0**	**22.6**	**5.1**	**1.1**	**28.9±8.1**
Total (all reef spp.):	**23.7±2.9**	**1252.6**	**46.3**	**9.3**	**2.0**	**1310.1±404.9**

* Target species/families

** Surgeonfish in this size class are not counted as targets

Fairly high density for target families

Table 14. Changes in substrate composition (% mean) in Tubod Marine Sanctuary from 2002 to 2009.

	SANCTUARY										NON-SANCTUARY							
	SCUBA SURVEYS							SNORKEL SURVEYS			SCUBA SURVEYS							SNORKEL
	2002	2005	2006	2007	2008	2009	% Change 2008-2009	2002	2009	% Change 2002-2009	2002	2005	2006	2007	2008	2009	% Change 2008-2009	2002
SUBSTRATE COVER	% cover	% cover	% cover	% cover	% cover	% cover		% cover	% cover		% cover	% cover	% cover	% cover	% cover	% cover		% cover
Sand (s) and Silt (SI)	7.8	9.4	5.4	8.2	4.3	7.8	80.1	15.7	11.6	-26.2	10.8	11.9	3.5	1.1	2.5	12.3	390.6	12.6
Coral Rubble (R)	3.4	0.3	0.7	4.4	4.4	5.1	18.0	3.0	2.7	-10.2	2.8	4.2	4.6	4.4	1.4	2.6	90.6	2.3
Rock and Block (RK)	13.3	0.7	0.9	0.3	2.0	6.9	238.5	49.1	29.3	-40.4	21.5	8.0	0.5	1.0	2.9	8.2	180.7	25.2
White Dead Standing Coral (DC)	0.5	0.1	1.9	0.8	0.0	1.4	+	0.1	1.4	1266.7	0.0	0.8	0.8	2.7	0.0	0.7	+	0.6
Dead Coral with Algae (DCA)	10.5	8.5	0.9	9.4	8.2	3.6	-56.4	4.7	2.0	-56.7	8.8	6.2	3.9	6.6	4.0	6.4	60.4	3.4
Subtotal Non-living Substrate	***35.5***	***19.1***	***9.7***	***23.0***	***18.9***	***24.8***	31.0	***72.6***	***47.0***	-35.3	***43.9***	***31.1***	***13.4***	***15.8***	***10.8***	***30.3***	179.8	***44.1***
Branching (CB)	23.8	34.8	37.9	36.1	28.2	34.4	22.2	7.2	20.9	190.4	15.2	12.3	23.5	33.5	29.2	22.3	-23.7	5.5
Massive (CM)	17.9	22.3	18.1	11.3	12.0	17.5	45.4	11.1	19.6	76.4	15.5	36.6	28.7	27.3	20.3	19.4	-4.9	5.4
Flat/Encrusting (CFD)	8.3	9.7	20.5	13.3	20.2	7.2	-64.2	3.5	2.4	-32.5	6.0	3.9	15.8	7.6	10.0	10.4	3.4	0.6
Foliose Cup (CFO)	5.1	6.9	5.2	6.7	14.8	7.6	-48.5	0.9	2.2	145.1	2.7	8.1	3.8	2.3	10.1	5.7	-43.4	0.6
Total Hard Coral	**55.1**	**73.7**	**81.7**	**67.4**	**75.2**	**66.8**	-11.2	**22.7**	**45.1**	98.5	**39.4**	**60.9**	**71.8**	**70.7**	**69.7**	**57.7**	-17.1	**12.1**
Total Soft Coral	3.3	6.3	4.5	5.4	3.0	3.1	3.6	2.1	2.2	5.8	3.9	7.2	5.4	7.0	3.4	5.1	53.5	1.3
Subtotal Coral	***58.4***	***80.0***	***86.2***	***72.8***	***78.2***	***69.9***	-10.6	***24.8***	***47.3***	90.7	***43.3***	***68.1***	***77.3***	***77.7***	***73.0***	***62.9***	-13.9	***13.4***
Sponges	1.8	0.8	1.0	0.8	0.9	1.3	42.6	0.7	0.1	-84.1	2.9	0.5	4.6	3.5	6.4	1.8	-72.2	1.8
Other animals	0.0	0.0	1.2	0.5	0.0	0.6	+	0.0	0.4	+	0.0	0.0	3.5	1.1	1.4	0.5	-63.0	0.0
Algae		0.2	1.9	2.9	1.9	3.4	72.3	2.2	4.6	110.9		0.3	1.0	2.0	8.4	4.6	-45.6	
Turf algae	3.1	~	~	~	~	0.7	N/A	1.1	2.2	97.0	3.2	~	~	~	~	2.0	N/A	3.0
Fleshy algae	0.9	~	~	~	~	1.6	N/A	0.4	1.7	316.7	5.0	~	~	~	~	1.9	N/A	35.0
Coralline algae	0.4	~	~	~	~	1.0	N/A	0.7	0.8	15.1	1.8	~	~	~	~	0.7	N/A	2.7
Seagrass	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.6	+	0.0	0.0	0.2	0.0	0.0	0.0	N/A	
Subtotal Others	***6.2***	***1.0***	***4.1***	***4.2***	***2.9***	***5.3***	85.4	**2.9**	**5.8**	98.3	***12.9***	***0.8***	***9.4***	***6.6***	***16.2***	***6.9***	-57.6	***42.5***
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**		**100**	**100**		**100**	**100**	**100**	**100**	**100**	**100**		**100**
Environmental Paramenters																		
Mean Slope (degrees)	27.2	~	~	~	~	40.0		5.4	10.0		39.0	~	~	~	~	42.0		5.5
Mean Topography (m) *	2.2	~	~	~	~	3.3		1.8	1.1		3.6	~	~	~	~	3.3		1.6
Mean Depth/Range (m)	6.5	7-8m	7-8m	7-8m	7-8m	6.5		3.3	4.0		6.5	7-8m	7-8m	7-8m	7-8m	7.6		2.9
Horizontal Visibility (m)	20.9	~	~	~	~	21.2		17.2	23.8		17.0	~	~	~	~	19.0		16.6
No. of 50 m Transects	16	3	3	3	3	7		225	12		13	3	3	3	3	7		195

~ no data available

* mean distance between lowest and highest point on the horizontal transect line

% change = $[(Yr_2/Yr_1)-1] \times 100$

(-) = decrease

(+) = increase

Table 15. Mean (±SE) fish species richness (species/500m^2) in Tubod Marine Sanctuary from 2005 to 2009.

Family	SANCTUARY		% Change 2002-2009	NON-SANCTUARY		% Change 2002-2009
	2002 (N=6)	2009 (N=6)		2002 (N=6)	2009 (N=7)	
	Mean	Mean		Mean	Mean	
Surgeonfish (Acanthurids)*	7.2±0.7	3.7±0.8	-49.1	5.3±0.5	3±0.7	-43.4
Rabbitfish (Siganids)*	0.7±0	1.3±0.4	90.5	0.7±0.2	0.4±0.3	-38.8
Groupers (Serranids)*	0.8±0	2.5±0.4	212.5	0.3±0	1.4±0.6	376.2
Barramundi cod	0±0	0±0	N/A	0±0	0±0	N/A
Snapper (Lutjanids)*	1.8±0.4	1.8±0.5	1.9	1.5±0.6	1±0.4	-33.3
Sweetlips (Haemulids)*	0.5±0	0±0	-100.0	0±0	0±0	N/A
Emperors (Lethrinids)*	0.2±0	0.8±0.5	316.7	0±0	0±0	N/A
Jacks (Carangids)*	0±0	0.2±0.2	+	0±0	0±0	N/A
Fusiliers (Caesionids)*	0.3±0	0.8±0.5	177.8	0.3±0	0.6±0.3	90.5
Spinecheeks (Nemipterids)*	0±0	1.3±0.4	+	0.7±0.2	1.3±0.4	83.7
Goatfish (Mullids)*	1.5±0.3	1.2±0.6	-22.2	1.5±0.6	0.9±0.5	-42.9
Parrotfish (Scarids)*	2.5±0.7	3.3±0.6	33.3	2.5±0.5	2.4±0.7	-2.9
Bumphead parrotfish	0±0	0±0	N/A	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0.2±0	3.2±3.2	1483.3	0±0	0±0	N/A
Triggerfish (Balistids)	2.5±0.4	2±0.7	-20.0	1.8±0.5	1.3±0.4	-28.6
Butterflyfish (Chaetodonids)	7.2±0.8	7.5±0.8	4.2	6.8±0.8	6.4±0.8	-5.5
Angelfish (Pomacanthids)	3±0.4	1.8±0.5	-38.9	1.5±0.2	1.4±0.3	-4.8
Wrasses (Labrids)	5.2±1.7	7.2±2.3	37.8	5.2±0.8	3.1±1	-39.6
Humphead wrasse	0±0	0±0	N/A	0±0	0±0	N/A
Damselfish (Pomacentrids)	16±0.7	8.5±2.6	-46.9	16±0.7	9.3±1.2	-42.0
Fairy Basslets (Anthids)	1.3±0.2	1.8±0.5	41.0	1.2±0.2	1.6±0.4	31.0
Moorish Idols (*Zanclus cornutus*)	0.5±0	1±0	100.0	0.7±0	0.7±0.2	2.0
Total (target reef spp.):	**15.7±2.2**	**11±5.4**	-29.9	**12.8±1.8**	**5.1±1.7**	-59.8
Total (all reef spp.):	**51.3±3.2**	**25±5.9**	-51.3	**46±3.3**	**20.7±4.8**	-55.0

* Target species/families

Table 16. Mean (±SE) fish density (density/500m^2) in Tubod Marine Sanctuary from 2005 to 2009.

Family	SANCTUARY						% Change 2008-2009	NON-SANCTUARY						% Change 2008-2009
	2002 (N=6)	2005 (N=3)	2006 (N=3)	2007 (N=3)	2008 (N=3)	2009 (N=6)		2002 (N=6)	2005 (N=3)	2006 (N=3)	2007 (N=3)	2006 (N=3)	2009 (N=7)	
	Mean	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	Mean	Mean	
Surgeonfish (Acanthurids)*	111.5±31.5	16±6.1	12.3±2	9±5.2	19.7±4.4	48.3±14.1	145.8	46.7±13.1	6.7±5.2	67.7±22.6	20±20	28.7±9.7	30.9±13.3	7.6
Rabbitfish (Siganids)*	2.2±1	0.3±0.3	1.3±0.7	22.3±22.3	2.7±2.7	4±1.1	50.0	3.5±2.7	2±2	4±2	3.3±2.8	5.7±1.2	2.4±1.2	-57.1
Groupers (Serranids)*	0.8±0.3	1.3±0.7	2.3±1.5	3.7±2.3	3.7±1.2	7±2	90.9	0.3±0.2	2±1.5	13±4.7	0±0	1.7±0.7	2.4±1.2	45.7
Barramundi cod	0±0	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	0±0	N/A
Snapper (Lutjanids)*	8.3±3.3	0±0	4.3±3.4	1.7±1.7	7±6.5	12.8±7.7	83.3	2.3±1.3	0±0	8.7±4.7	0.3±0.3	1.3±0.7	20.9±15.9	1464.3
Sweetlips (Haemulids)*	0.8±0.4	0±0	0±0	2.3±1.9	0±0	0.8±0.8	+	0±0	0±0	2.7±1.3	0±0	0±0	0±0	N/A
Emperors (Lethrinids)*	0.5±0.5	0.3±0.3	0±0	2±1.2	0.3±0.3	1.5±0.8	350.0	0±0	1.7±1.7	0±0	0.7±0.7	0±0	0±0	N/A
Jacks (Carangids)*	0±0	1±0.6	0±0	1.3±1.3	0±0	0.2±0.2	+	0±0	0.3±0.3	10±10	0.3±0.3	0±0	0±0	N/A
Fusiliers (Caesionids)*	7±5.4	0±0	0±0	1.7±1.7	34±33	21.7±13.8	-36.3	7±5.4	151.3±150.3	11.3±4.7	0±0	23.3±6	12.7±8.4	-45.5
Spinecheeks (Nemipterids)*	0±0	0±0	0.3±0.3	2.7±1.8	1.3±1.3	5.2±1.9	287.5	6.8±5.3	3±2.1	25±3.6	0.7±0.7	6.3±1.2	4±1.2	-36.8
Goatfish (Mullids)*	5.3±1.5	2.7±0.9	2±0.6	4.7±0.9	1±0.6	5.2±3.2	416.7	11±5	3.7±1.9	11±4.4	2±1.2	7.3±0.3	3.6±2	-51.3
Parrotfish (Scarids)*	49±18.1	12.7±7.8	11.7±3.8	17±3.5	17.7±4.4	18.7±8.8	5.7	35.3±5.2	9.7±3.4	51.3±13.3	11±6.5	33.3±6.4	16.6±6.7	-50.3
Bumphead parrotfish	0±0	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0.2±0.2	0±0	0±0	0±0	0±0	186.7±186.7	+	0±0	0±0	2.3±0.3	0±0	0±0	0±0	N/A
Triggerfish (Balistids)	7.2±1.5	7.3±2.6	3.7±0.3	5.7±3	6.7±1.3	8±3	20.0	10±4.9	10±5.5	14.3±4.1	1±0.6	3±0.6	3±0.8	0.0
Butterflyfish (Chaetodonids)	43.3±4.1	22.3±7.8	23.7±1.3	8.3±4.8	26.7±3.5	28.8±4	8.1	31.7±6.2	17±7.2	21±1.2	4.3±1.2	14±1	24.7±4.4	76.5
Angelfish (Pomacanthids)	6.8±0.7	3.7±2	7.3±2.6	4.3±0.3	5±0.6	5.2±1.3	3.3	8.8±3.7	12±9.2	18.3±5.4	0.7±0.3	5.7±1.3	5.1±1.4	-9.2
Wrasses (Labrids)	37.2±6	22.3±10.1	12.3±2.2	12.7±10.3	29±16.5	21.7±7.3	-25.3	24.3±11.2	24±8.6	101.3±4.7	24.7±7.9	88±41.3	117.7±61.3	33.8
Humphead wrasse	0±0	0±0	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	0±0	0±0	N/A
Damselfish (Pomacentrids)	1482±153.2	1136.7±482.3	2133.3±669.2	225±10.4	1206.7±171.9	1348.3±573	11.7	916.3±138.8	264.3±114.7	2206.7±482.9	1036.7±115.7	883.3±83.3	990±288.4	12.1
Fairy Basslets (Anthids)	89.5±27.4	50.3±31.9	310±115.9	177.3±47.6	103.3±67.4	420.7±133.7	307.1	48.2±17.5	0±0	1950±606.2	716.7±420.5	700±50	260±114.6	-62.9
Moorish Idols (*Zanclus cornutus*)	4.5±1.4	1.7±0.9	1.7±0.9	0±0	2.3±0.7	2.5±0.7	7.1	3.8±1.7	1.7±1.7	0.7±0.7	1±0.6	1.3±0.9	1.6±0.5	17.9
Total (target reef spp.):	**155.3±47.5**	**28.7±15.7**	**24.3±5.4**	**61±23.4**	**86±24.2**	**302.8±175**	252.1	**79.2±26.2**	**174.3±148.9**	**195.3±59.2**	**33.3±19.6**	**96.7±14.9**	**89.4±28.4**	-7.5
Total (all reef spp.):	**1856.2±161.4**	**1278.7±535.8**	**2526.3±572.3**	**501.7±75.5**	**1467±277.4**	**2147.2±423.1**	46.4	**1156.2±114.1**	**509.3±256.8**	**4519.3±1137.2**	**1823.3±336.3**	**1803±96.7**	**1495.6±359**	-17.1

* Target species/families

Table 17. Mean (±SE) fish species richness (species/500m^2) and density (fish/500m^2) per family at Tubod Marine Sanctuary in 2009.

Family	Species	Size Class				Density
	Mean	1-10 cm**	11-20 cm	21-30 cm	>30 cm	Mean
Surgeonfish (Acanthurids)*	3.7±0.8	9.2	22.2	9.2	7.8	48.3±14.1
Rabbitfish (Siganids)*	1.3±0.4	0.3	2.0	0.5	1.2	4±1.1
Groupers (Serranids)*	2.5±0.4	1.2	2.0	1.8	2.0	7±2
Barramundi cod	0±0	0.0	0.0	0.0	0.0	0±0
Snapper (Lutjanids)*	1.8±0.5	0.0	0.8	8.2	3.8	12.8±7.7
Sweetlips (Haemulids)*	0±0	0.0	0.0	0.8	0.0	0.8±0.8
Emperors (Lethrinids)*	0.8±0.5	0.0	0.8	0.2	0.5	1.5±0.8
Jacks (Carangids)*	0.2±0.2	0.0	0.0	0.0	0.2	0.2±0.2
Fusiliers (Caesionids)*	0.8±0.5	0.0	15.8	5.8	0.0	21.7±13.8
Spinecheeks (Nemipterids)*	1.3±0.4	1.7	3.3	0.0	0.2	5.2±1.9
Goatfish (Mullids)*	1.2±0.6	0.0	3.0	2.2	0.0	5.2±3.2
Parrotfish (Scarids)*	3.3±0.6	1.5	5.7	6.3	5.2	18.7±8.8
Bumphead parrotfish	0±0	0.0	0.0	0.0	0.0	0±0
Rudderfish (Kyphosids)*	3.2±3.2	186.7	0.0	0.0	0.0	186.7±186.7
Triggerfish (Balistids)	2±0.7	1.7	3.8	2.2	0.3	8±3
Butterflyfish (Chaetodonids)	7.5±0.8	11.8	16.5	0.5	0.0	28.8±4
Angelfish (Pomacanthids)	1.8±0.5	2.5	2.2	0.5	0.0	5.2±1.3
Wrasses (Labrids)	7.2±2.3	10.2	9.8	1.3	0.3	21.7±7.3
Humphead wrasse	0±0	0.0	0.0	0.0	0.0	0±0
Damselfish (Pomacentrids)	8.5±2.6	1341.7	6.7	0.0	0.0	1348.3±573
Fairy Basslets (Anthids)	1.8±0.5	333.3	86.8	0.5	0.0	420.7±133.7
Moorish Idols (*Zanclus cornutus*)	1±0	0.0	2.3	0.0	0.2	2.5±0.7
Total (target reef spp.):	**11±5.4**	**191.3**	**55.7**	**35.0**	**20.8**	**302.8±175**
Total (all reef spp.):	**25±5.9**	**1901.7**	**183.8**	**40.0**	**21.7**	**2147.2±423.1**

* Target species/families

** Surgeonfish in this size class are not counted as targets

Fairly high density for target families

Table 18. Changes in substrate composition (% mean) in Paliton Marine Sanctuary from 2006 to 2009.

	SANCTUARY					NON-SANCTUARY					
	SCUBA SURVEYS					SNORKEL	SCUBA SURVEYS				
	2006	2007	2008	2009	% Change 2008-2009	2009	2006	2007	2008	2009	% Change 2008-2009
SUBSTRATE COVER	% cover	% cover	% cover	% cover		% cover	% cover	% cover	% cover	% cover	
Sand (s) and Silt (SI)	5.1	6.3	8.0	5.4	-32.5	18.3	5.0	9.2	6.7	6.4	-3.8
Coral Rubble (R)	1.8	1.8	4.7	6.5	38.7	5.6	1.5	0.9	12.2	8.2	-32.8
Rock and Block (RK)	4.0	35.7	0.0	10.6	+	12.8	0.0	7.1	0.0	9.5	+
White Dead Standing Coral (DC)	0.2	0.0	0.0	1.6	+	0.7	1.0	0.0	1.2	1.0	-19.9
Dead Coral with Algae (DCA)	1.5	0.0	6.0	7.1	17.3	3.6	20.4	1.2	5.4	9.9	81.0
Subtotal Non-living Substrate	***12.7***	***43.9***	***18.8***	***31.2***	66.4	***40.9***	***27.9***	***18.4***	***25.6***	***35.0***	36.7
Branching (CB)	6.5	7.7	25.4	18.4	-27.9	10.1	16.3	25.9	32.0	13.8	-56.9
Massive (CM)	5.5	10.0	25.4	18.7	-26.3	11.0	18.7	52.3	32.9	18.6	-43.4
Flat/Encrusting (CFD)	3.0	0.0	1.0	9.0	801.3	2.0	9.3	0.8	5.7	11.6	104.5
Foliose Cup (CFO)	0.6	0.0	3.5	3.3	-5.5	0.7	23.4	0.3	1.1	3.2	189.3
Total Hard Coral	**15.6**	**17.7**	**55.3**	**49.4**	-10.8	**23.8**	**67.7**	**79.4**	**71.7**	**47.2**	-34.1
Total Soft Coral	10.0	22.0	2.3	8.1	248.4	4.0	3.3	2.3	2.7	3.9	40.9
Subtotal Coral	***25.5***	***39.7***	***57.6***	***57.4***	-0.4	***27.9***	***70.9***	***81.6***	***74.4***	***51.1***	-31.3
Sponges	0.2	0.0	0.7	0.9	37.9	1.0	0.5	0.0	0.0	2.9	+
Other animals	0.0	0.0	1.2	0.7	-39.1	0.5	0.4	0.0	0.0	0.9	+
Algae	61.6	0.0	21.8	9.7	-55.3	29.7	0.3	0.0	0.0	10.1	+
Turf algae	~	~	~	1.8	N/A	4.5	~	~	~	4.6	N/A
Fleshy algae	~	~	~	7.1	N/A	24.5	~	~	~	4.6	N/A
Coralline algae	~	~	~	0.9	N/A	0.8	~	~	~	0.9	N/A
Seagrass	0.4	16.4	0.0	0.0	N/A	0.0	0.0	0.0	0.0	0.0	N/A
Subtotal Others	***62.2***	***16.4***	***23.6***	***11.4***	-51.9	**31.2**	***1.2***	***0.0***	***0.0***	***13.9***	+
TOTAL	**100**	**100**	**100**	**100**		**100**	**100**	**100**	**100**	**100**	
Environmental Paramenters											
Mean Slope (degrees)	~	~	~	21.7		6.6	~	~	~	22.5	
Mean Topography (m) *	~	~	~	2.6		1.3	~	~	~	2.3	
Mean Depth/Range (m)	7-8m	7-8m	7-8m	10.9		3.1	7-8m	7-8m	7-8m	8.0	
Horizontal Visibility (m)	~	~	~	20.4		16.3	~	~	~	18.8	
No. of 50 m Transects	3	3	3	7		14	3	3	3	7	

~ no data available

* mean distance between lowest and highest point on the horizontal transect line

% change = $[(Yr_2/Yr_1)-1] \times 100$

(-) = decrease

(+) = increase

Table 19. Mean (±SE) fish species richness (species/500m^2) in Paliton Marine Sanctuary for 2009.

Family	SANCTUARY	NON-SANCTUARY
	2009 (N=7)	2009 (N=7)
	Mean	Mean
Surgeonfish (Acanthurids)*	3.3±0.7	3.1±0.8
Rabbitfish (Siganids)*	0.6±0.3	0.3±0.2
Groupers (Serranids)*	0.3±0.3	0.4±0.2
Barramundi cod	0±0	0±0
Snapper (Lutjanids)*	0.7±0.3	0.9±0.3
Sweetlips (Haemulids)*	0.1±0.1	0±0
Emperors (Lethrinids)*	0±0	0.4±0.2
Jacks (Carangids)*	0±0	0.1±0.1
Fusiliers (Caesionids)*	0.9±0.3	0.9±0.3
Spinecheeks (Nemipterids)*	0.7±0.3	0.3±0.2
Goatfish (Mullids)*	1±0.4	1.3±0.5
Parrotfish (Scarids)*	2±0.4	1.7±9.7
Bumphead parrotfish	0±0	0±0
Rudderfish (Kyphosids)*	0±0	0±0
Triggerfish (Balistids)	1.6±0.4	2.6±0.9
Butterflyfish (Chaetodonids)	5.4±1.1	4.9±0.8
Angelfish (Pomacanthids)	1.6±0.2	2.6±0.6
Wrasses (Labrids)	4.9±1	5.4±0.5
Humphead wrasse	0±0	0±0
Damselfish (Pomacentrids)	11.7±2.5	9.9±1.9
Fairy Basslets (Anthids)	1.3±0.3	1.3±0.2
Moorish Idols (*Zanclus cornutus*)	0.7±0.2	0.9±0.1
Total (target reef spp.):	**9.6±1.5**	**9.4±2.1**
Total (all reef spp.):	**36.7±5.4**	**36.9±5.9**

* Target species/families

Table 20. Mean (±SE) fish density (density/500m^2) in Paliton Marine Sanctuary from 2006 to 2009.

Family	SANCTUARY				% Change 2008-2009	NON-SANCTUARY				% Change 2008-2009
	2006 (N=3)	2007 (N=3)	2008 (N=3)	2009 (N=7)		2006 (N=3)	2007 (N=3)	2008 (N=3)	2009 (N=7)	
	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	
Surgeonfish (Acanthurids)*	0±0	0±0	109.3±103.8	20.3±5	-75.4	20±2	3±1.5	27.3±17.8	110.7±72.7	-34.3
Rabbitfish (Siganids)*	0±0	1.7±1.7	0±0	0.9±0.6	-30.6	0.7±0.7	0±0	0±0	0.6±0.4	-35.5
Groupers (Serranids)*	0±0	0±0	0±0	0.4±0.4	0.0	4.3±0.9	0±0	2.3±0.9	0.9±0.5	-46.4
Barramundi cod	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	N/A
Snapper (Lutjanids)*	0±0	0±0	0±0	2.4±1	-59.0	4.7±0.7	0±0	5±4	2.9±1.1	-60.7
Sweetlips (Haemulids)*	0±0	0.3±0.3	0±0	0±0	N/A	0±0	0.3±0.3	0±0	0±0	N/A
Emperors (Lethrinids)*	0±0	0±0	0±0	0.3±0.3	0.0	2.7±2.7	0±0	0±0	0.6±0.3	-48.0
Jacks (Carangids)*	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0.1±0.1	0.0
Fusiliers (Caesionids)*	0.3±0.3	0±0	67.3±44	58.6±25.4	-56.6	0±0	0±0	25±25	100±72.8	-27.2
Spinecheeks (Nemipterids)*	1.3±0.9	0.3±0.3	0±0	2±0.8	-59.2	0±0	0±0	0±0	0.9±0.6	-30.6
Goatfish (Mullids)*	0.7±0.7	2.3±2.3	2±1.5	3±0.8	-72.8	0±0	0±0	1.7±1.7	3.9±1.4	-64.9
Parrotfish (Scarids)*	23.7±21.7	12.3±4.3	10.7±0.3	9±1.3	-85.9	14±9.5	20.3±9.1	5±1.7	9.7±2.8	-71.4
Bumphead parrotfish	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	N/A
Triggerfish (Balistids)	0±0	0±0	3.7±2	8.7±3.2	-63.1	11.3±4.9	3±0.6	6.7±4.4	13.6±5.8	-57.0
Butterflyfish (Chaetodonids)	1.7±1.7	0.3±0.3	5±2.6	20.6±5.6	-72.7	14±5.8	6.3±0.3	12.3±5.5	32.1±7.8	-75.8
Angelfish (Pomacanthids)	0.3±0.3	1±1	0±0	11.4±3.3	-71.1	6.3±2.3	0±0	5.3±1.2	10.6±3.9	-63.1
Wrasses (Labrids)	61.7±6.4	11.3±0.9	10.7±2.3	133±73.4	-44.8	148.3±44.2	22.7±5.4	38.7±14.3	268.3±132	-50.8
Humphead wrasse	0±0	0±0	0±0	0±0	N/A	0±0	0±0	0±0	0±0	N/A
Damselfish (Pomacentrids)	226.7±108.3	240±91.7	513.3±179.1	1198±332.8	-72.2	754±153.7	800±100	632.7±98.3	1322.4±408.3	-69.1
Fairy Basslets (Anthids)	15.3±15.3	0±0	378.3±14.2	494±167.7	-66.1	1385±447.9	0±0	543.3±122.8	785.6±245.5	-68.7
Moorish Idols (*Zanclus cornutus*)	0±0	0±0	0±0	2.1±0.6	-72.2	2±1.2	2±1.2	0±0	2.9±1.2	-58.6
Total (target reef spp.):	**26±22.6**	**17±8.7**	**80.7±42.2**	**91.4±24.8**	-72.8	**37±15.6**	**20.7±9**	**66.3±25.8**	**222.7±144.6**	-35.1
Total (all reef spp.):	**331.7±150.7**	**269.7±88.2**	**1100.3±121.6**	**1964.7±552**	-71.9	**2367.3±599.1**	**857.7±90.6**	**1305.3±200.5**	**2665.6±804.4**	-69.8

* Target species/families

Table 21. Mean (±SE) fish species richness (species/500m^2) and density (fish/500m^2) per family at Paliton Marine Sanctuary in 2009.

Family	Species	Size Class				Density
	Mean	1-10 cm**	11-20 cm	21-30 cm	>30 cm	Mean
Surgeonfish (Acanthurids)*	3.3±0.7	4.7	12.1	3.3	0.1	20.3±5
Rabbitfish (Siganids)*	0.6±0.3	0.0	0.6	0.3	0.0	0.9±0.6
Groupers (Serranids)*	0.3±0.3	0.0	0.4	0.0	0.0	0.4±0.4
Barramundi cod	0±0	0.0	0.0	0.0	0.0	0±0
Snapper (Lutjanids)*	0.7±0.3	0.0	0.7	1.6	0.1	2.4±1
Sweetlips (Haemulids)*	0.1±0.1	0.0	0.0	0.0	0.0	0±0
Emperors (Lethrinids)*	0±0	0.0	0.3	0.0	0.0	0.3±0.3
Jacks (Carangids)*	0±0	0.0	0.0	0.0	0.0	0±0
Fusiliers (Caesionids)*	0.9±0.3	4.3	25.7	24.3	4.3	58.6±25.4
Spinecheeks (Nemipterids)*	0.7±0.3	0.1	1.4	0.4	0.0	2±0.8
Goatfish (Mullids)*	1±0.4	0.0	1.9	1.1	0.0	3±0.8
Parrotfish (Scarids)*	2±0.4	0.4	5.0	2.4	1.1	9±1.3
Bumphead parrotfish	0±0	0.0	0.0	0.0	0.0	0±0
Rudderfish (Kyphosids)*	0±0	0.0	0.0	0.0	0.0	0±0
Triggerfish (Balistids)	1.6±0.4	0.1	4.3	3.7	0.6	8.7±3.2
Butterflyfish (Chaetodonids)	5.4±1.1	7.0	13.3	0.3	0.0	20.6±5.6
Angelfish (Pomacanthids)	1.6±0.2	2.4	8.3	0.7	0.0	11.4±3.3
Wrasses (Labrids)	4.9±1	119.6	11.9	1.6	0.0	133±73.4
Humphead wrasse	0±0	0.0	0.0	0.0	0.0	0±0
Damselfish (Pomacentrids)	11.7±2.5	1188.3	9.7	0.0	0.0	1198±332.8
Fairy Basslets (Anthids)	1.3±0.3	282.6	211.4	0.0	0.0	494±167.7
Moorish Idols (*Zanclus cornutus*)	0.7±0.2	0.0	1.9	0.3	0.0	2.1±0.6
Total (target reef spp.):	**9.6±1.5**	**5.9**	**47.3**	**32.6**	**5.7**	**91.4±24.8**
Total (all reef spp.):	**36.7±5.4**	**1609.6**	**308.9**	**40.0**	**6.3**	**1964.7±552**

* Target species/families

** Surgeonfish in this size class are not counted as targets

Fairly high density for target families

Table 22. Changes in substrate composition (% mean) in Apo Island Marine Sanctuary from 1981 to 2009.

	SANCTUARY											NON-SANCTUARY										
	SCUBA SURVEYS						SNORKEL SURVEYS					SCUBA SURVEYS								SNORKEL SURVEYS		
	1981	1982	1992	2002	2009	% Change 2002-2009	1983	1992	2002	2009	% Change 2002-2009	1981	1982	1983	1985	1992	2002	2009	% Change 2002-2009	1992	2002	% Change 1992-2002
SUBSTRATE COVER	% cover	% cover	% cover	% cover	% cover		% cover	% cover	% cover	% cover		% cover	% cover	% cover	% cover	% cover	% cover	% cover		% cover	% cover	
Sand (s) and Silt (SI)	9.3	24.0	9.5	13.5	7.7	-43.3	8.8	11.8	11.7	18.3	56.1	18.6	19.1	16.6	15.9	11.7	14.6	15.6	7.0	6.3	1.7	-73.0
Coral Rubble (R)	10.8	8.8	13.6	4.2	4.7	12.2	9.4	6.5	4.0	5.6	39.3	2.8	2.7	9.5	10.9	17.6	7.3	3.5	-52.1	7.1	0.0	-100.0
Rock and Block (RK)	4.9	1.5	11.9	6.3	1.9	-69.4	1.9	9.3	8.5	12.8	50.4	17.2	13.4	19.1	2.7	12.9	7.2	5.3	-27.1	14.7	19.3	31.3
White Dead Standing Coral (DC)	8.2	8.3	1.9	0.2	0.0	-100.0	16.1	2.6	0.2	0.7	233.3	2.7	4.2	5.4	4.9	3.7	0.1	0.5	400.0	3.2	0.0	-100.0
Dead Coral with Algae (DCA)	0.0	0.0	0.0	7.3	4.1	-44.0	0.0	0.0	4.4	3.6	-17.7	0.0	0.0	0.0	0.0	0.0	5.4	3.1	-42.1	0.0	0.0	N/A
Subtotal Non-living Substrate	***33.2***	***42.6***	***36.9***	***31.5***	***18.4***	-41.6	***36.2***	***30.2***	***28.8***	***40.9***	42.0	***41.3***	***39.4***	***50.6***	***34.4***	***45.9***	***34.6***	***28.0***	-19.1	***31.3***	***21.0***	-32.9
Branching (CB)	13.7	16.0	13.1	22.1	24.2	9.6	18.8	15.4	22.7	10.1	-55.4	12.6	12.4	13.1	8.5	7.1	14.2	30.6	115.7	14.4	14.0	-2.8
Massive (CM)	17.7	16.6	18.8	23.8	15.5	-34.8	16.9	15.8	10.6	11.0	3.7	14.7	14.2	11.6	4.7	12.9	9.6	8.0	-16.7	13.2	1.3	-90.2
Flat/Encrusting (CFD)	2.0	2.1	13.5	6.0	18.9	214.3	0.0	3.1	1.9	2.0	6.5	0.6	0.0	1.6	2.8	4.4	4.9	11.5	134.7	5.8	0.0	-100.0
Foliose Cup (CFO)	3.0	0.0	2.5	4.7	9.9	111.2	8.1	3.8	2.3	0.7	-68.9	0.0	0.0	1.1	4.0	3.9	1.4	3.9	176.8	6.0	2.7	-55.0
Total Hard Coral	**36.4**	**34.7**	**47.9**	**56.6**	**68.5**	21.1	**43.8**	**38.1**	**37.5**	**23.8**	-36.4	**27.9**	**26.6**	**27.4**	**20.0**	**28.3**	**30.1**	**54.0**	79.4	**39.4**	**18.0**	-54.3
Total Soft Coral	30.4	22.7	15.3	9.4	11.1	17.9	20.0	31.7	31.5	4.0	-87.2	30.8	34.0	22.1	45.5	25.9	32.6	16.8	-48.6	29.3	60.0	104.8
Subtotal Coral	***66.8***	***57.4***	***63.2***	***66.0***	***79.6***	20.6	***63.8***	***69.8***	***69.0***	***27.9***	-59.6	***58.7***	***60.6***	***49.5***	***65.5***	***54.2***	***62.7***	***70.8***	12.8	***68.7***	***78.0***	13.5
Sponges	~	~	~	0.4	0.5	25.0	~	~	0.2	1.0	411.9	~	~	~	~	~	2.1	0.0	-100.0	~	0.3	N/A
Other animals	~	(0.4)	~	0.1	1.1	971.4	~	~	0.0	0.5	+	~	(1.5)	(1.2)	~	~	0.0	0.3	+	~	0.0	N/A
Algae						N/A					N/A											
Turf algae	~	~	~	0.7	0.1	-79.6	~	~	0.9	4.5	400.0	~	~	~	~	~	0.2	1.0	400.0	~	0.0	N/A
Fleshy algae	~	~	~	1.0	0.1	-85.7	~	~	0.4	24.5	6013.1	~	~	~	~	~	0.3	0.0	-100.0	~	0.7	N/A
Coralline algae	~	~	~	0.3	0.1	-52.4	~	~	0.2	0.8	281.0	~	~	(0.3)	~	~	0.2	0.0	-100.0	~	0.0	N/A
Seagrass					0.0	N/A				0.0	N/A							0.0	N/A			N/A
Subtotal Others	***0.0***	***0.0***	***0.0***	***2.5***	***2.0***	-20.0	**0.0**	**0.0**	**1.7**	**31.2**	1736.1	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***2.8***	***1.3***	-55.4	***0.0***	***1.0***	+
TOTAL	**100**	**100**	**100**	**100**	**100**		**100**	**100**	**100**	**100**		**100**	**100**	**100**	**100**	**100**	**100**	**100**		**100**	**100**	
Environmental Paramenters																						
Mean Slope (degrees)	~	~	~	11.7	35.0		~	~	3.8	6.6		~	~	~	~	~	7.7	23.8		~	30	
Mean Topography (m) *	2.2	2.0	3.0	2.1	2.5		3.3	2	1.6	1.3		1.9	1.7	2.4	2.0	2.3	1.8	2.8		2.2	~	
Mean Depth/Range (m)	.7-15	1.1-20.7	4-8	7.0	7.41429		~	4-7	3.1	3.1		.8-6	.4-6	.3-15	3-14	6-7	7.7	7.25		~	~	
Horizontal Visibility (m)	~	~	~	23.2	19.6		~	~	20.9	16.3		~	~	~	18.7	!	18.5	17.3		~	~	
No. of 50 m Transects	~	5	~	15	7		11	1	450	14		~	~	3	3	7	9	4		12	225	

~ no data available

* mean distance between lowest and highest point on the horizontal transect line

% change = $[(Yr_2/Yr_1)-1] \times 100$

(-) = decrease

(+) = increase

Table 23. Mean (±SE) fish species richness (species/500m^2) in Apo Island Marine Sanctuary from 1985 to 2009.

Family	SANCTUARY					% Change 2002-2009	NON-SANCTUARY				% Change 2002-2009
	1985 (N=4)	1986 (N=6)	1992 (N=5)	2002 (N=6)	2009 (N=7)		1985 (N=6)	1986 (N=4)	2002 (N=6)	2009 (N=7)	
	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	
Surgeonfish (Acanthurids)*	7.3	10.0	6.8	8±0.7	3.9±0.9	-51.8	10.2	7.0	6.2±0.5	3.7±0.3	-40.9
Rabbitfish (Siganids)*	0.5	0.8	1.2	1.8±0.3	0.6±0.3	-68.3	0.0	0.3	0.5±0.3	0.3±0.3	-33.3
Groupers (Serranids)*	0.3	0.3	1.0	0.3±0	1.7±0.4	471.4	0.2	0.3	0.7±0.5	0.7±0.3	-4.8
Barramundi cod	0.0	0.0	0.0	0±0	0±0	N/A	0.0	0.0	0±0	0±0	N/A
Snapper (Lutjanids)*	1.0	2.0	2.2	1.2±0.2	2±0.4	66.7	1.3	0.8	1.3±0.7	1±0.6	-23.1
Sweetlips (Haemulids)*	0.3	0.5	0.8	0±0	0.1±0.1	+	0.0	0.5	0±0	0±0	N/A
Emperors (Lethrinids)*	0.3	0.0	0.8	0.2±0	0.4±0.3	114.3	0.3	0.0	0.2±0.2	0±0	-100.0
Jacks (Carangids)*	0.8	0.7	0.6	0.7±0	0.4±0.2	-38.8	0.3	0.3	0.5±0.3	0±0	-100.0
Fusiliers (Caesionids)*	2.0	2.2	3.0	2±0.5	1±0.4	-50.0	2.2	1.0	0.7±0.3	0±0	-100.0
Spinecheeks (Nemipterids)*	0.3	0.2	0.4	0.2±0	0.6±0.4	185.7	0.5	0.0	0±0	0±0	N/A
Goatfish (Mullids)*	1.0	1.0	1.0	1.5±0.4	1.1±0.5	-23.8	1.0	1.0	1.5±0.3	2±1	33.3
Parrotfish (Scarids)*	1.0	1.0	1.0	2.2±0.7	2.9±0.9	29.9	1.0	1.0	1.3±0.6	1.7±0.3	28.2
Bumphead parrotfish	0.0	0.0	0.0	0±0	0±0	N/A	0.0	0.0	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0.0	0.5	0.6	0±0	0.4±0.2	+	0.2	0.0	0±0	0.3±0.3	+
Triggerfish (Balistids)	1.5	2.2	1.8	4±0.9	3±0.3	-25.0	2.0	1.8	2±0.9	1.7±0.3	-16.7
Butterflyfish (Chaetodonids)	8.3	12.3	8.8	10.3±1.4	9.1±1.5	-11.2	11.2	11.5	8±1.3	10.7±1.2	33.3
Angelfish (Pomacanthids)	2.0	3.0	2.0	1.8±0.5	1.9±0.6	3.2	3.0	3.0	1.8±0.4	1±0.6	-44.4
Wrasses (Labrids)	4.3	6.5	6.0	5.7±1.3	6.7±2.3	17.8	8.2	5.0	4.3±0.3	2.3±1.2	-45.7
Humphead wrasse	0.0	0.0	0.0	0±0	0±0	N/A	0.0	0.0	0±0	0±0	N/A
Damselfish (Pomacentrids)	10.5	12.2	14.8	15.3±1.3	11.7±2.2	-23.4	13.7	8.8	14.3±1.4	13±0	-9.1
Fairy Basslets (Anthids)	2.0	2.3	2.2	1±0.2	1.4±0.4	42.9	2.5	1.5	1.2±0.4	0.3±0.3	-72.2
Moorish Idols (*Zanclus cornutus*)	1.0	1.0	1.0	1±0	1±0	0.0	1.0	1.0	0.8±0.2	1±0	25.0
Total (target reef spp.):	**14.5**	**19.2**	**19.4**	**18±2.3**	**15.1±2.5**	-15.9	**17.2**	**12.2**	**12.8±2.5**	**9.7±1.7**	-24.5
Total (all reef spp.):	**44.0**	**58.7**	**56.0**	**57.2±4.2**	**50±8.2**	-12.6	**58.7**	**44.8**	**45.3±5.1**	**39.7±3.8**	-12.4

* Target species/families

Table 24. Mean (±SE) fish density (density/500m^2) in Apo Island Marine Sanctuary from 1985 to 2009.

Family	SANCTUARY					% Change 2002-2009	NON-SANCTUARY				% Change 2002-2009
	1985 (N=4)	1986 (N=6)	1992 (N=5)	2002 (N=6)	2009 (N=7)		1985 (N=6)	1986 (N=4)	2002 (N=6)	2009 (N=7)	
	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	
Surgeonfish (Acanthurids)*	187.8	487.3	640.3	113.3±13.4	42.3±15	-62.7	387.7	225.8	54.2±11.3	21.3±11.5	-60.6
Rabbitfish (Siganids)*	3.0	2.5	3.6	6.3±3.1	3±1.8	-52.4	0.0	0.3	0.8±0.7	0.7±0.7	-16.7
Groupers (Serranids)*	0.3	0.7	1.8	0.7±0.5	2.9±1	308.2	0.2	0.3	1±0.7	0.7±0.3	-33.3
Barramundi cod	0.0	0.0	0.0	0±0	0±0	N/A	0.0	0.0	0±0	0±0	N/A
Snapper (Lutjanids)*	5.5	7.7	20.2	4.3±2.7	15.4±8.7	258.8	9.0	9.3	3.2±1.8	1.7±1.2	-47.9
Sweetlips (Haemulids)*	0.8	0.8	1.6	0±0	0.4±0.4	+	0.0	0.5	0±0	0±0	N/A
Emperors (Lethrinids)*	0.8	0.0	4.8	0.2±0.2	0.9±0.6	328.6	0.3	0.0	0.2±0.2	0±0	-100.0
Jacks (Carangids)*	1.3	10.0	28.2	1±0.4	2.3±1.3	128.6	0.7	0.8	0.7±0.4	0±0	-100.0
Fusiliers (Caesionids)*	231.0	1055.5	1572.6	165.7±70	28.7±11.8	-82.7	321.5	201.0	99.8±89.8	0±0	-100.0
Spinecheeks (Nemipterids)*	0.3	0.2	0.4	0.8±0.8	1.4±0.9	78.6	0.8	0.0	0±0	0±0	N/A
Goatfish (Mullids)*	13.5	16.0	12.6	17±8.5	4.3±1.9	-74.8	44.0	19.5	10.8±4.9	7.7±5	-29.0
Parrotfish (Scarids)*	51.0	61.0	129.0	19.8±5.1	27±12.9	36.4	145.0	6.0	5.3±2.9	6.3±2.3	19.5
Bumphead parrotfish	0.0	0.0	0.0	0±0	0±0	N/A	0.0	0.0	0±0	0±0	N/A
Rudderfish (Kyphosids)*	0.0	6.5	1.0	0±0	2.6±1.3	+	0.5	0.0	0±0	1.7±1.7	+
Triggerfish (Balistids)	8.0	8.2	8.6	29.5±10.3	38±6.9	28.8	3.3	4.8	4.3±2.5	3.3±0.7	-22.5
Butterflyfish (Chaetodonids)	92.3	76.7	52.0	48.3±11.1	28.3±2.7	-41.4	143.8	70.5	26.8±2.4	26±4	-3.0
Angelfish (Pomacanthids)	4.0	14.3	20.0	5.2±1.8	5.3±2.2	1.6	19.0	14.3	7.5±2.9	1.7±1.2	-77.8
Wrasses (Labrids)	78.8	262.8	268.2	63.3±26.4	61.1±24.4	-3.4	149.2	108.5	24.7±8.2	125±113.7	406.1
Humphead wrasse	0.0	0.0	0.0	0±0	0±0	N/A	0.0	0.0	0±0	0±0	N/A
Damselfish (Pomacentrids)	935.0	2383.5	2214.6	1573.8±348.8	2068.1±462.2	31.4	548.7	717.8	1202±388.8	1685.7±455.1	40.2
Fairy Basslets (Anthids)	514.5	813.0	226.2	22.3±6.6	342.3±165	1434.9	425.5	31.5	183.7±97	3±3	-98.4
Moorish Idols (*Zanclus cornutus*)	15.0	17.0	7.8	6.5±1.3	10.1±4	56.0	9.0	6.0	3±0.8	13.3±9.8	344.4
Total (target reef spp.):	**495.0**	**1648.2**	**2416.6**	**287.8±77.9**	**120.6±29.6**	-58.1	**909.7**	**463.3**	**150±94.1**	**26±5.1**	-82.7
Total (all reef spp.):	**2142.5**	**5223.7**	**5214.0**	**2078.2±401.2**	**2684.4±420.4**	29.2	**2208.2**	**1416.5**	**1628±417.9**	**1898±552.7**	16.6

* Target species/families

Table 25. Mean (±SE) fish species richness (species/500m^2) and density (fish/500m^2) per family at Apo Island Marine Sanctuary ir

Family	Species	Size Class				Density
	Mean	1-10 cm**	11-20 cm	21-30 cm	>30 cm	Mean
Surgeonfish (Acanthurids)*	3.9±0.9	10.6	16.6	12.0	3.1	42.3±15
Rabbitfish (Siganids)*	0.6±0.3	0.0	1.7	1.3	0.0	3±1.8
Groupers (Serranids)*	1.7±0.4	0.0	0.3	0.9	1.7	2.9±1
Barramundi cod	0±0	0.0	0.0	0.0	0.0	0±0
Snapper (Lutjanids)*	2±0.4	0.0	0.0	1.4	14.0	15.4±8.7
Sweetlips (Haemulids)*	0.1±0.1	0.0	0.0	0.0	0.4	0.4±0.4
Emperors (Lethrinids)*	0.4±0.3	0.0	0.0	0.0	0.9	0.9±0.6
Jacks (Carangids)*	0.4±0.2	0.0	0.0	0.0	2.3	2.3±1.3
Fusiliers (Caesionids)*	1±0.4	0.0	6.0	22.7	0.0	28.7±11.8
Spinecheeks (Nemipterids)*	0.6±0.4	0.0	1.4	0.0	0.0	1.4±0.9
Goatfish (Mullids)*	1.1±0.5	0.0	1.6	2.1	0.6	4.3±1.9
Parrotfish (Scarids)*	2.9±0.9	0.0	11.0	9.7	6.3	27±12.9
Bumphead parrotfish	0±0	0.0	0.0	0.0	0.0	0±0
Rudderfish (Kyphosids)*	0.4±0.2	0.0	0.0	0.7	1.9	2.6±1.3
Triggerfish (Balistids)	3±0.3	2.0	4.6	15.4	16.0	38±6.9
Butterflyfish (Chaetodonids)	9.1±1.5	9.3	15.3	3.7	0.0	28.3±2.7
Angelfish (Pomacanthids)	1.9±0.6	2.1	1.7	0.9	0.6	5.3±2.2
Wrasses (Labrids)	6.7±2.3	32.3	16.0	10.9	2.0	61.1±24.4
Humphead wrasse	0±0	0.0	0.0	0.0	0.0	0±0
Damselfish (Pomacentrids)	11.7±2.2	1942.0	125.7	0.4	0.0	2068.1±462.2
Fairy Basslets (Anthids)	1.4±0.4	299.4	42.9	0.0	0.0	342.3±165
Moorish Idols (*Zanclus cornutus*)	1±0	0.0	9.1	1.0	0.0	10.1±4
Total (target reef spp.):	**15.1±2.5**	**0.0**	**38.6**	**50.9**	**31.1**	**120.6±29.6**
Total (all reef spp.):	**50±8.2**	**2297.7**	**253.9**	**83.1**	**49.7**	**2684.4±420.4**

* Target species/families

** Surgeonfish in this size class are not counted as targets

Fairly high density for target families

SUMMARY OF RESULTS AND TRENDS

Coral reef and other substrate. Two of the six sites have poor (<25%) LHC (Caticugan and Lower Cabancalan), another two of the six sites were fair (25-50%) (Talayong and Tubod) and the remaining two sites were good (50-75%) (Paliton and Apo Island) (Figure 18). Of the five Siquijor sites surveyed, four sites showed no significant changes in LHC cover (Talayong, Tubod, Paliton and Caticugan) while only Lower Cabancalan having a significant change (p=0.043, f=3.28, df=4). LHC cover in sites that showed no significant change within three to five years is comparable to MPAs in Cebu Province with similar ages (e.g., Eisma-Osorio *et al.* 2009). However, in Siquijor, improvements in areas with poor LHC where sand and/or silt dominates will less likely show significant improvement over the next few monitoring activities since this is their natural state. It appears that geographical location plays an important role in LHC cover (Maypa *et al.* 2009). Most of the MPAs in Siquijor are relatively young (3 to 4 years old) and still need time to develop and rehabilitate before more significant positive changes in substrate may be observed. This should happen along with protection and careful management of each area.

Figure 18. Changes in live coral cover (%mean ±SE) at all sites in Siquijor Province from 2002 to 2009.

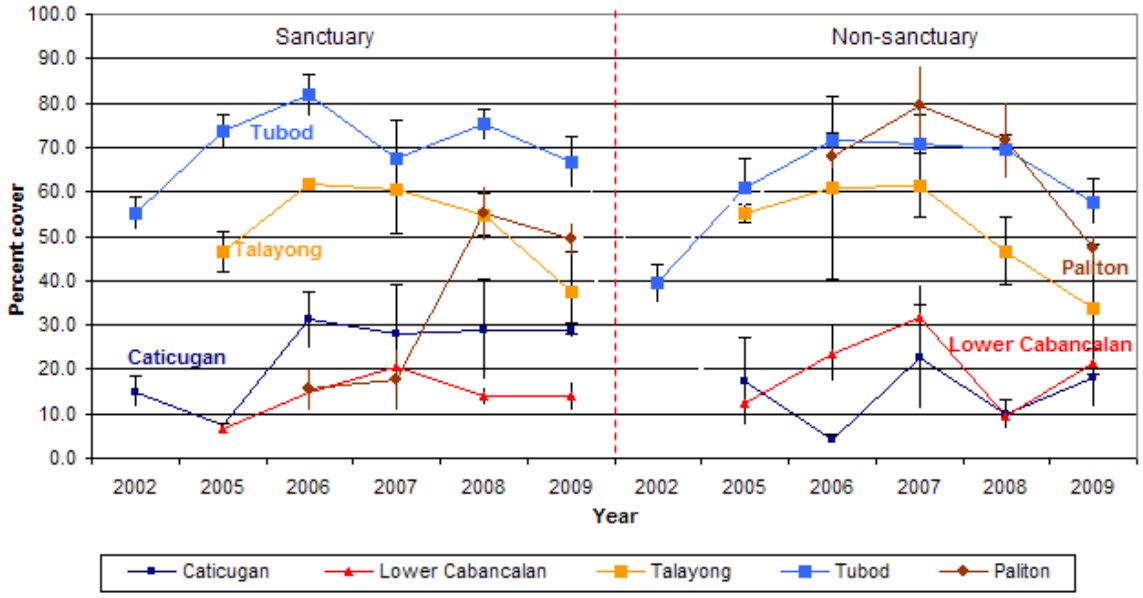
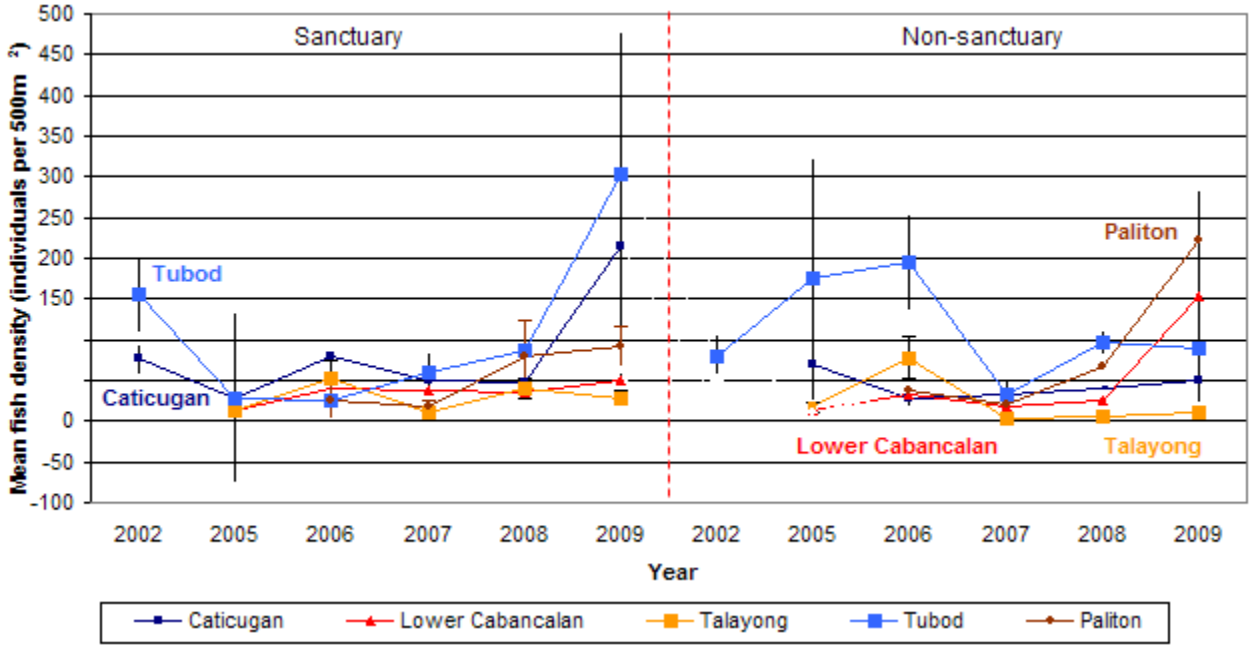


Figure 19. Changes in target fish density (fish/500m^2) at all sites in Siquijor Province from 2002 to 2009.



Fish diversity and abundance. Of the five sites surveyed in Siquijor, four sites showed no significant change, only Lower Cabancalan showed a significant change in fish abundance; p-value = 0.0311, F = 3.66, DF = 4 (Figure 19). Except for Apo Island, target fish density is generally low in the MPAs and their adjacent fishing grounds overall. Siquijor Province relies mostly on small oceanic/pelagic fish species for food (Bendijo et al. 2004). Most of these species recorded in the catch have low-mid vulnerability and high resiliency to fishing (Maypa et al. 2009). It is likely that these patterns are reflections of very high fishing pressure in the area. Establishment of and protection of MPAs in the province may not be enough to address fisheries management issues (Maypa *et a*l. 2009).The community surveys made expressed that there is a need for stronger coastal law enforcement since many of the fisheries issues spring from commercial fishing vessel intrusion into municipal waters. Because of this, much of the fish stock is depleted in the surrounding waters of Siquijor.

Comparisons among all the sites surveyed for all parameters are shown in Figure 20-23 and in Table 26. It is noted that the 5 sites on Siquijor are quite similar in species richness which is expected given the similar habitat types among the sites. Figures 22 and 23 compare fish density among the sites and while similar for most sites, the sites with higher fish densities (e.g. Tubod and Caticugan) reflect more consistent management and protection from fishing pressure. Apo Island stands out as a separate habitat type with good protection and thus much higher coral cover. But, fish density while still relative good, has declined since the last survey in 2002.

Figure 20. Mean (±SE) species richness (species/500m^2) of all reef species at five sites in the Province of Siquijor.

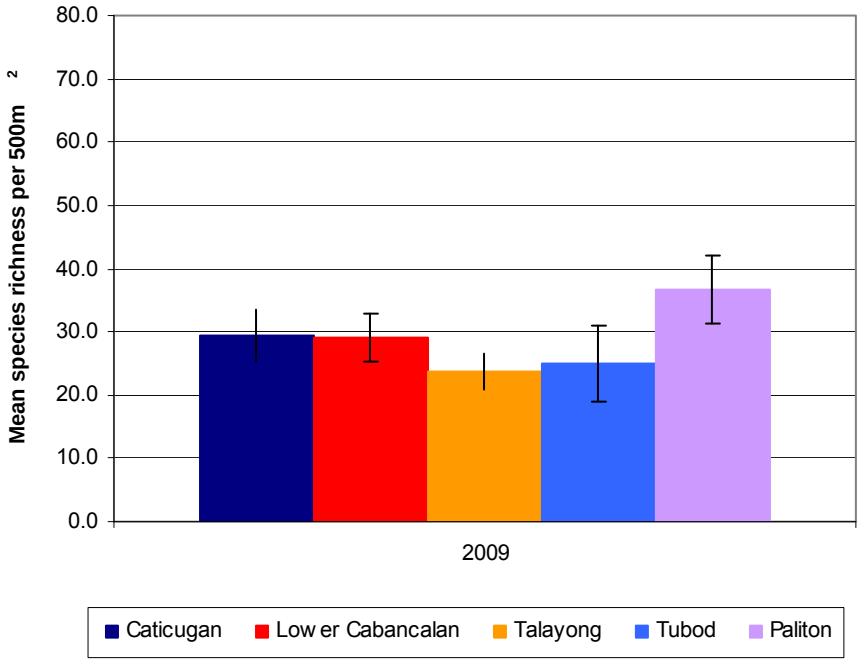


Figure 21. Mean (±SE) species richness (species/500 m^2) of target species at five sites in Province of Siquijor.

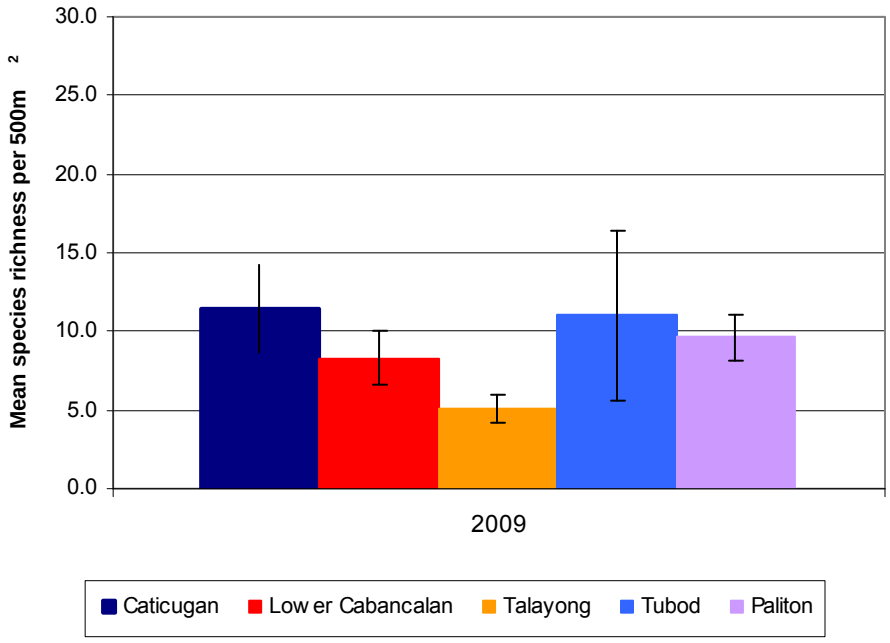


Figure 22. Mean (±SE) density (fish/500m^2) of all reef species at five sites in the Province of Siquijor.

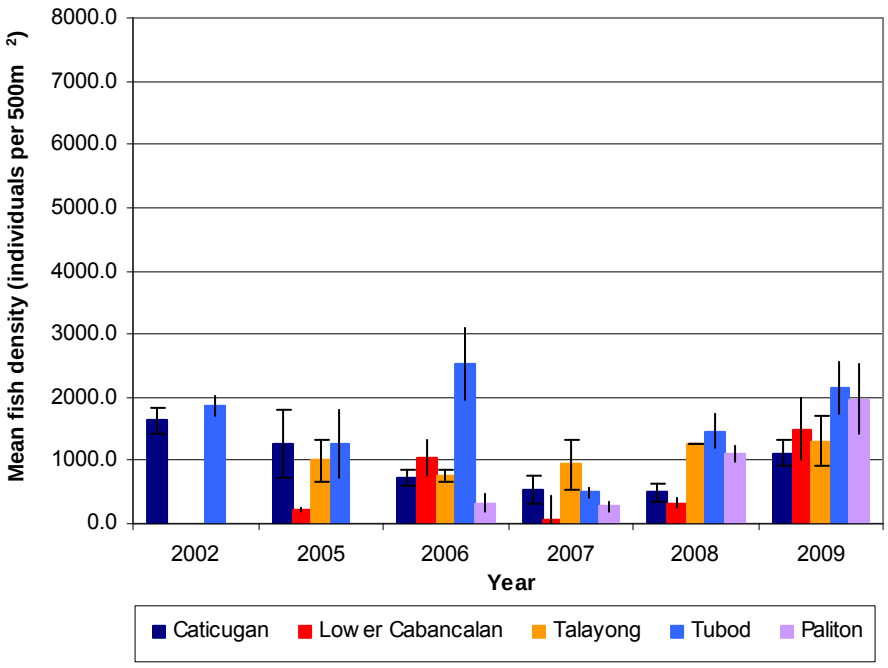


Figure 23. Mean (±SE) density (fish/500m^2) of target species at five sites in the Province of Siquijor.

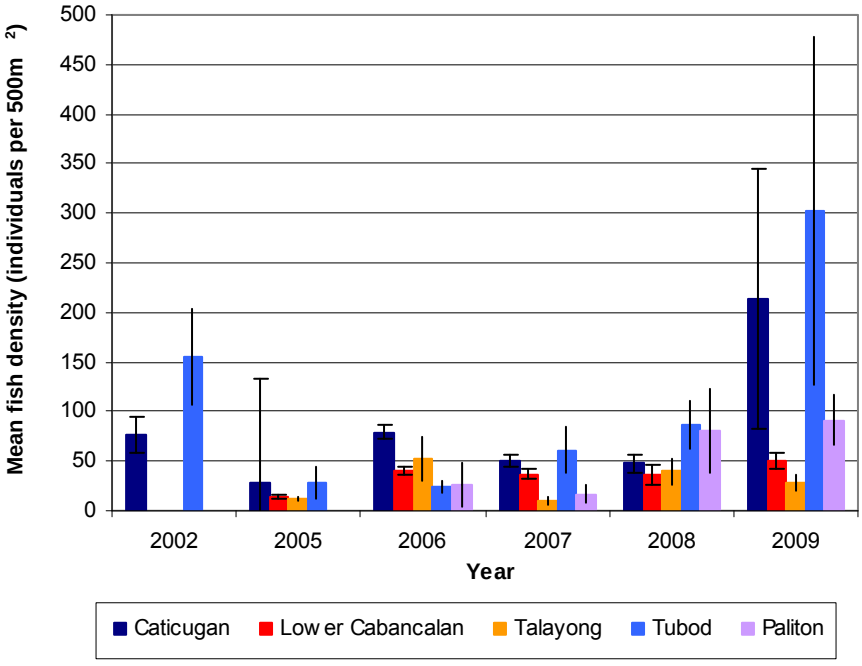


Table 26. Sites compared by LHC, fish density, species richness, and butterflyfish in 2009.

Study Site	LHC Cover (% cover)	Fish Density (fish/500m^2)	Species Richness (species/500m^2)	Butterflyfish Ranks
Caticugan	14.1	214.3 (Target)	11.4 (Target)	6 (5 species present)
		1,122 (All reef)	29.4 (All reef)	
Lower Cabancalan	21.4	50.4 (Target)	8.3 (Target)	3 (14 species present)
		1,498.4 (All Reef)	29.0 (All Reef)	
Talayong	37.3	28.9 (Target)	5.1 (Target)	5 (8 species present)
		1,310.1 (All Reef)	23.7 (All Reef)	
Tubod	66.8	302.8 (Target)	11.0 (Target)	4 (12 species present)
		2,147.2 (All Reef)	25.0 (All Reef)	
Paliton	49.4	91.4 (Target)	9.6 (Target)	2 (17 species present)
		1,964.7 (All Reef)	36.7 (All Reef)	
Apo Island	68.5	120.6 (Target)	15.1 (Target)	1 (25 species present)
		2,684.4 (All Reef)	50.0 (All Reef)	

RECOMMENDATIONS FOR IMPROVED MANAGEMENT

Siquijor Province has been very active in coastal resource management since the entry of CCE Foundation in 2002. However, there is still the challenge that lies in sustaining efforts to enforce the law against illegal and commercial fishing, strengthen MPA management bodies, and manage the growing volume of tourism. Siquijor, however, looks forward to a bright future in protected area management with the strong support that it is receiving from the six municipal mayors and the provincial government. Recommendations to further enhance conservation of Siquijor MPAs are:

1. **Need for more and larger MPAs**. Siquijor has improved its marine conservation and marine resource management regimes markedly in the 10 years since efforts started. Now, in light of continued fishing pressure in the near-shore waters surrounding Siquijor Island, more and larger no-fishing reserves are needed to ensure that fish catches are sustainable and that the coral reefs can return to a balanced ecological condition.

2. **Need to improve coastal fisheries law enforcement.** A main finding in the study was that there were very low fish densities inside and adjacent to the MPAs surveyed. This indicates that high fishing pressure exists and that it is necessary to control fishing activities inside and adjacent to marine protected areas. Such fishing pressure will negate all sustainability initiatives in the area the marine sanctuaries. Law enforcement should be primary on the agenda of managing bodies, which also includes the prevention of commercial fishing vessels from fishing within municipal waters.

3. **Need to share monitoring and evaluation information among all stakeholders.** Sharing accurate information is very important in educating others about the history of a MPA as well as the efforts being done to protect it. Findings from dive expeditions like SPR, contribute to better policy formulation and management decisions. Stakeholders that may benefit if informed includes the local government, provincial government, local tourist operations, fishing communities, and MPA managers.

4. **Continue monitoring for sustained management.** With all the information being disseminated about climate change and other factors affecting our natural coastal resources, it is important to continue reef monitoring activities to assist in sustaining MPA management. By continuous monitoring, stakeholders and managers can be kept informed of the most critical issues that they need to address and prioritize those in their planning and protection of the reef.

5. **Increase diver, boat operator, and visitor education.** With the increasing popularity of tourism in Siquijor, each dive and tourist operation needs to allocate time for diver and tourist briefings. Such briefings can highlight Siquijor MPAs and their rules and regulations. Materials that will be helpful include: flip-charts, videos and handouts that fully explain MPA regulations and the do's and don'ts of the core sanctuary areas. Information on the natural and human history and on the uniqueness of Siquijor culture should be available for newcomers. Dive operations in the area should have trained dive-masters and guides on dive trips who can make this kind of briefing to all visitors to the area.

6. **More research in fisheries to be conducted for the benefit of reef management.** Studies on fisheries and different species for management and protection should be done to support policies that the provincial government is formulating. To date, there is an environmental code that declares open and closed season to fisheries without strong back-up information on the rationalization of this move. By keeping people informed through transparent processes, the local governments will have success in convincing stakeholders of their reasons for proper reef management.

7. **Need to form a Siquijor MPA Network management plan and association.** Given the importance that Siquijor places on coastal resource management and the use of MPAs to restore its coral reefs and fisheries, a targeted MPA network plan would help to improve design and location of MPAs, provide guidance in management of MPAs and show how multiple MPAs around the island are synergistic in supporting a larger program for coral reef improvement and fisheries management. Such a network plan can be supported by all the six municipalities working with the Provincial government and other stakeholders.

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Appendix 1. Expedition Itinerary of Activities

Saving Philippine Reefs,
Siquijor Expedition
March 21-29, 2009

DAY	DATE & SITE	TIME	ACTIVITIES
1	Saturday, March 21 Dumaguete And travel to Cocogrove Resort in Siquijor	10:00 10:30 11:30 12:00 PM 1:00 2:00 7:00	Rendezvous Coco Amigos Proceed to Delta fastcraft/pier for Siquijor Welcome and Short briefing - Alan White; - Resort Manager; - Vangie White; and - Ethan Lucas, SPR Divemaster Lunch at resort Briefing on SPR project by Alan, Agnes and Roxie/Review Method Practice snorkel and scuba dive at Cocogrove Resort house reef Dinner Slide show/ Quiz and identification (Roxie and Agnes) Slides show on Butterflyfish/ discussion (Roxie and Alan)
2	Sunday, March 22 Tubod Marine Sanctuary, San Juan	7:00 AM 8:00 9:00 12:00 PM 2:00 5:00 7:00	Breakfast Briefing Conduct surveys (snorkel and scuba) Lunch Complete surveys (scuba) Compile data and submit data electronically or by forms Dinner CCE Foundation presentation (Sheryll and Alan)
3	Monday, March 23 Caticugan Marine Sanctuary, Siquijor	7:00 AM 8:00 12:00 PM 5:00 7:00	Breakfast Morning briefing Conduct surveys (snorkel and scuba) Lunch Complete surveys (snorkel and scuba) Compile and submit completed data forms Dinner Siquijor Situationer (Rey Bendijo) Training Program of CCEF (Maretes Alenton)
4	Tuesday, March 24 Talayong Marine Sanctuary, Lazi	7:00 AM 8:00 12:00 PM	Breakfast Morning briefing Conduct surveys (snorkel and scuba) Lunch

DAY	DATE & SITE	TIME	ACTIVITIES
			Complete surveys (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner
			Night dive (can be done dusk time/before dinner)
			i-Dive presentation (Ethan)
5	Wednesday, March 25 Tulapos Marine Sanctuary, Enrique Villanueva	7:00 AM	Breakfast
		8:00	Morning briefing
			Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
			Complete surveys (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner
			Tubbataha results (Alan)
			Slideshow of underwater pictures (Agnes)
6	Thursday, March 26 Apo Island Fish Sanctuary, Dauin, Negros Oriental	6:00 AM	Breakfast
		7:00	Morning briefing / Leave for Apo Island
			Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
			Complete surveys (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner
			“The power of many” presentation (Roxie)
7	Friday, March 27 Paliton Marine Sanctuary, San Juan	7:00 AM	Breakfast
		8:00	Morning briefing
			Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
			Complete surveys (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner
			Night dive
8	Saturday, March 28 Lower Cabancalan, Lazi	7:00 AM	Breakfast
		8:00	Morning briefing
			Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
			Complete surveys
		5:00	Compile and submit completed data forms
		7:00	Dinner
			Summary of Impressions and Debriefing (Alan)
9	Sunday, March 29 Travel back to Dumaguete	6:00 AM	Breakfast
			Closing Summary
		7:00-9:00 AM	Depart for Dumaguete airport or pier

Appendix 2. Expedition Staff and Volunteers

Saving Philippine Reefs Volunteers
March 21 - 29, 2009
Siquijor Province, Philippines

	Name/Address	Contact numbers/fax/email	Profession/Affiliations/Interests
1	**Denise Illing** 34 Oakland Drive Warrandyte 3113 Australia	Home: +613 9844 1583 Mobile: +61 429 146 147 denise@illing.com.au	Technical Librarian, UNICO Computer Systems. BA in Geography and Sociology. Interested in marine life, reefs, and diving. Wildlife artist. Watercolourist.
2	**Geoff Illing** 34 Oakland Drive Warrandyte, VIC 3113 Australia	Phone: 03 9865 9140 Office Phone: +613 9865 9118 Home Phone: +613 9844 1583 Mobile: +61 419307047 geoff@illing.com.au or geoff@unico.com.au	Originally a mathematician, but now director/owner of software development company. Amateur musician, playing clarinet, bass clarinet, sax and bassoon in concert bands, orchestra and small ensembles.
3	**Thomas J. Mueller** 29905 Rainbow Crest Drive Agoura Hills, CA 91301 U.S.A.	Mobile Phone: 917-592-7074 (prefered) Home Phone: 818-865-2133 tj@tjmueller.com	Self employed educational consultant to Higher Education; PhD in Biology; small boat experience, especially sail; underwater photographer; SCUBA instructor; CCE Foundation, Institutional Development Advisor – Board Member
4	**Alexander Douglas Robb** 4 Nevada Retreat, \Bulleen, Victoria 3105 Australia	Tel 61-3-92438460 Wk 61-3-9850- 5497 Hm sandy.robb@griffithhack.com.au	Civil Engineer BSC (Hons) Edinburgh MSC Melbourne – History & Philosophy of Science; Interest - History & Philosophy of Science.
5	**Alastair Pennycook** 408/1 Poplar Street, Surry Hills, NSW 2010, Australia	61 2 92680870 61 401182509 alastair.pennycook@uts.edu.au	Professor of Language in Education, University of Technology Sydney. Yachting Australia Coastal Skipper and PADI Master Diver, with an interest in underwater photography.
6	**Jill Johnson** 1545 Nehoa St. Apt# 203, Honolulu, HI 96822, U.S.A.	Tel: 808-352-2602 Cell: 808-441-3837 (work) jjohnson@midpac.edu	PADI OWSI SCUBA Instructor, Art Educator - grades 1-5
7	**John Rowland** 24 Logan Street, Canterbury VIC 3126 Australia	Tel: +61 3 9830 5695 (home); Cell: +61 417 360 025 (mobile) John.Rowland@unico.com.au	Engineer Software Engineering; Certified SSI Advanced Open water Advanced Nitrox; Advanced Decompression: Deep; Night
8	**Laurent Boillon** 27, Hardwicke Street, Balwyn VIC 3103 Australia	Tel: +61 3 98173664 (home); Cell: +61 412305038 (mobile) Laurent.Boillon@laurent.com.au	Pastry Chef Certified SSI Advanced Open water Advanced Nitrox; Advanced Decompression: Deep; Night

	Name/Address	Contact numbers/fax/email	Profession/Affiliations/Interests
9	**Mark Copley** 5 Normandy Cir, Colorado Springs, Colorado 80906 U.S.A.	Tel: 719-578-8670 (Home) Cell: 719-216-2463 (Mobile) mhc@quizdog.com	NAUI: Open Water, PADI: Advanced Open Water PADI: Rescue Diver
10	**Steve Ludemann** 35498 Road K.1 Mancos, Colorado 81328 U.S.A.	Tel: 1-970-560-3901 steveludemann@gmail.com	Retired (Aerospace Engineering) PADI Master Scuba Diver
11	**Chance Usrey** 145 Kuulei Rd. Kailua, HI 96734 U.S.A.	Tel: 808-358-7910 (Cindy-mom) 808-358-7910 (Jack-dad) jackandcindyusrey@hotmail.com	Student PADI Openwater
12	**Rebecca Weeks** 104a The Strand, North Ward QLD 4810 AUSTRALIA	+61 431312048 (Australia) +63 9216423588 (Philippines) Rebecca.weeks@jcu.edu.au	PhD Student, ARC Centre of Excellence for Coral Reef Studies James Cook University

Saving Philippine Reefs Staff
March 21 – March 29, 2009
Siquijor Province, Philippines

	Name/Address	Contact numbers/fax/email	Profession/Affiliations/Interests
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	Name/Address	Contact numbers/fax/email	Profession/Affiliations/Interests
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APPENDIX 3.

FISH SPECIES LIST

Siquijor Province and Apo Island, Negros Oriental Fish Species List as of March, 2009		Caticugan Marine Sanctuary		Lower Cababcalan Marine Sanctuary	Talayong Marine Sanctuary	Tubod Marine Sanctuary		Paliton Marine Sanctuary	Apo Island Fish Sanctuary	
		2002	2009	2009	2009	2002	2009	2009	2002	2009
I	**Acanthuridae - surgeonfishes**									
	Acanthurus dussummieri								1	
	Acanthurus japonicus				1					
	Acanthurus lineatus								1	
	Acanthurus nigricans								1	
	Acanthurus nigricauda	1			1			1	1	
	Acanthurus pyroferus					1			1	1
	Acanthurus triostegus								1	
	Ctenochaetus binotatus					1			1	1
	Ctenochaetus striatus	1	1	1	1	1	1	1		1
	Ctenochaetus tomimiensis	1				1				1
	Naso annulatus								1	
	Naso auranticavus							1		
	Naso brevirostris		1	1			1	1		1
	Naso caeruleacauda				1			1		
	Naso hexacanthus					1			1	
	Naso lituratus					1		1		1
	Naso lopezi					1				
	Naso minor	1				1		1	1	1
	Naso thynnoides									1
	Naso unicornis	1			1	1		1		1
	Naso vlamingi					1			1	
	Zebrasoma flavascens					1				
	Zebrasoma scopas	1	1	1	1	1	1	1	1	1
II	**Apogonidae - cardinalfishes**									
	Apogon aureus					1			1	
	Cheilodipterus quinquilineatus					1			1	
	Sphaeramia nematoptera	1								
III	**Aulostomidae - trumpetfishes**									
	Aulostomus chinensis	1				1			1	
IV	**Balistidae - triggerfishes**									
	Balistapus undulatus	1	1	1	1	1	1	1	1	1
	Balistoides conspicillum					1				
	Balistoides viridescens		1	1		1	1	1		1
	Melichthys niger				1			1	1	1
	Melichthys vidua					1			1	1
	Odonus niger					1		1	1	
	Rhinecanthus rectangulus					1				
	Sufflamen bursa					1			1	
	Sufflamen chrysopterus				1			1		
	Xanthichthys auromarginatus					1			1	
V	**Belonidae - needlefishes**									
	Tylosorus crocodilus								1	
	Strongylura incisa					1			1	
VI	**Blenniidae - blennies**									
	Meiacanthus atrodorsalis					1			1	
	Meiacanthus grammistes	1				1				
	Brama japonica					1				
VII	**Caesionidae - fusiliers**									
	Caesio caerulaurea	1						1	1	1
	Caesio teres							1	1	
	Pterocaesio lativittata							1		
	Pterocaesio pisang	1				1				1
	Pterocaesio tile									1
VIII	**Carangidae - jacks**									
	Carangoides bajad								1	
	Carangoides plagiotaenia					1			1	
	Caranx ignobilis		1	1			1		1	
	Caranx sexfasciatus								1	

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		2002	2009	2009	2009	2002	2009	2009	2002	2009
	Elagatis bipinnulatus									1
IX	**Centriscidae - shrimpfishes**									
	Aeoliscus strigatus	1				1			1	
X	**Chaetodontidae - butterflyfishes**									
	Chaetodon adiergastos							1	1	1
	Chaetodon auriga								1	1
	Chaetodon baronessa	1	1	1	1	1	1	1	1	1
	Chaetodon citrinellus					1				
	Chaetodon ephippium									1
	Chaetodon kleinii	1	1	1	1	1	1	1	1	1
	Chaetodon lineolatus				1	1		1		
	Chaetodon lunula					1			1	1
	Chaetodon lunulatus	1	1	1	1	1	1	1	1	1
	Chaetodon melannotus	1				1			1	1
	Chaetodon ocellicaudus	1						1		
	Chaetodon octofasciatus				1	1				
	Chaetodon oxycephalus								1	1
	Chaetodon plebeius					1				
	Chaetodon punctatofasciatus	1	1	1		1	1	1	1	1
	Chaetodon rafflesi	1				1				
	Chaetodon reticulatus							1		
	Chaetodon speculum					1				1
	Chaetodon trifascialis					1			1	
	Chaetodon ulietensis	1							1	1
	Chaetodon unimaculatus		1	1	1	1	1	1	1	1
	Chaetodon vagabundus	1			1				1	1
	Coradion chrysozonus							1		
	Coradion melanopus	1	1	1		1	1	1		
	Forcipiger flavissimus							1	1	1
	Forcipiger longirostris	1	1	1	1	1	1			1
	Hemitaurichthys polylepis					1		1	1	1
	Heniochus chrysostomus									1
	Heniochus monoceros									1
	Heniochus singularis									1
	Heniochus varius	1	1	1	1	1	1	1	1	1
XI	**Cirrhitidae - hawkfishes**									
	Cirrhitichthys falco					1			1	
	Paracirrhites arcatus					1				
XII	**Clupeidae**									
	Spratelloides gracilis					1				
XIII	**Congridae**									
	Heteroconger hassi	1							1	
XIV	**Diodontidae - Porcupinefishes**									
	Diodon holocanthus	1								
XV	**Echeneidae - Shark suckers**									
	Echeneis naucrates	1							1	
XVI	**Ephippidae - batfishes**									
	Platax pinnatus	1								
	Platax teira	1								
XVII	**Fistulariidae - cornetfishes**									
	Fistularia commersoni	1				1			1	
XVIII	**Gobiidae - gobies**									
	Amblyeleotris hectori								1	
	Amblygobius decussatus	1								
	Valenciennea strigata					1				
XIX	**Haemulidae - sweetlips**									
	Plectorynchus chaetodonoides	1				1			1	
	Plectorynchus lessoni					1				
	Plectorynchus lineatus							1		
	Hemiramphidae - halfbeaks									
	Hemiramphus far	1								
XX	**Holocentridae**									
	Myripristis murdjan	1				1			1	
	Neoniphron sammara					1				

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		2002	2009	2009	2009	2002	2009	2009	2002	2009
	Sargocentron spiniferum					1			1	
XXI	**Kyphosidae - drummers**									
	Kyphosus cinerascens								1	1
	Kyphosus vaigiensis								1	
	Kyphosus sp. 1									1
	Kyphosus sp. 2									1
XXII	**Labridae - wrasses**									
	Anampses meleagrides					1				
	Anampses twistii	1				1				
	Bodianus mesothorax	1			1	1		1	1	1
	Cheilinus chlorourus					1			1	
	Cheilinus fasciatus	1			1	1		1		1
	Cheilinus trilobatus								1	
	Cheilinus undulatus	1								
	Cheilio inermis	1							1	
	Choerodon anchorago		1	1			1			
	Choerodon sp.									1
	Cirrhilabrus cyanopleura	1	1	1	1	1	1	1	1	1
	Cirrhilabrus lubbocki	1				1			1	
	Coris batuensis	1				1			1	
	Coris gaimard	1				1			1	
	Diproctacanthus xanthurus					1				
	Epibulus insidiator	1				1			1	1
	Gomphosus varius	1			1	1			1	1
	Halichoeres argus					1				
	Halichoeres hortulanus	1				1			1	
	Halichoeres melanurus				1					
	Halichoeres prosopeion	1				1			1	
	Halichoeres scapularis	1							1	
	Hemigymnus fasciatus								1	
	Hemigymnus melapterus	1	1	1		1	1	1		
	Hologymnosus doliatus	1								
	Labrichthys unilineatus	1				1			1	1
	Labroides bicolor					1			1	
	Labroides dimidiatus	1				1			1	1
	Labropsis xanthonata					1				
	Macropharyngodon meleagris								1	
	Macropharyngodon negrosensis	1								
	Macropharyngodon ornatus					1				
	Novaculichthys taeniorus	1			1			1		
	Oxycheilinus celebicus	1				1				
	Oxycheilinus diagrammus								1	1
	Oxycheilinus unifasciatus				1					
	Pseudocheilinus evanidus					1				
	Pseudocheilinus hexataenia	1								
	Pseudocoris philippina					1				
	Stetojulis bandanensis								1	
	Stetojulis strigiventer								1	
	Stetojulis trilineata								1	
	Thalassoma hardwicke	1			1	1	1			1
	Thalassoma lunare	1			1	1		1	1	1
	Thalassoma lutescens		1	1	1			1		
	Thalassoma purpureum					1				
	Xenojulis margaritaceous					1				
XXIII	**Lethrinidae - emperors**									
	Gnathodentex aurolineatus								1	
	Gymnocranius griseus								1	
	Lethrinus erythracanthus					1				1
	Lethrinus harak	1						1		1
	Lethrinus microdon								1	
	Lethrinus ornatus	1								
	Monotaxis grandoculus					1			1	
XXIV	**Lutjanidae - snappers**									
	Lutjanus argentimaculatus	1				1				

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		2002	2009	2009	2009	2002	2009	2009	2002	2009
	Lutjanus biguttatus	1								
	Lutjanus decussatus	1	1	1	1	1	1	1		
	Lutjanus ehrenbergi	1	1	1		1	1	1	1	
	Lutjanus fulviflamma		1	1			1			1
	Lutjanus fulvus	1				1		1		1
	Lutjanus gibbus								1	1
	Lutjanus monostigma					1				
	Lutjanus rivulatus								1	
	Lutjanus russelli									1
	Macolor macularis	1				1		1	1	1
XXV	**Microdesmidae - dartfishes**									
	Ptereoletris evides					1			1	
XXVI	**Monacanthidae - leatherjackets**									
	Aluterus scriptus								1	
	Amanses scopas					1				
	Cantherhines dumerilii					1				
	Oxymonocanthus longirostris					1				
	Pervagor melanocephalus								1	
XXVII	**Mullidae - goatfishes**									
	Mulloidichthys flavolineatus	1								
	Mulloidichthys vanicolensis								1	
	Parupeneus barbarinoides				1	1		1		
	Parupeneus barberinus	1			1	1		1		1
	Parupeneus bifasciatus				1				1	1
	Parupeneus cyclostomus					1				
	Parupeneus indicus								1	
	Parupeneus multifasciatus	1			1	1		1	1	
XXVIII	**Muraenidae - moray eels**									
	Echidna nebulosa					1				
	Gymnothorax javanicus					1				
	Sideria thrysoidea					1				
XXIX	**Nemipteridae - breams**									
	Pentapodus caninus					1				
	Scolopsis bilineatus	1	1	1	1	1	1	1	1	
	Scolopsis lineatus	1								
XXX	**Ostraciidae - boxfishes**									
	Ostracion cubicus					1			1	
	Ostracion solorensis								1	
XXXI	**Pempheridae - Sweepers**									
	Pempheris oulensis								1	
XXXII	**Pinguipedidae - sandperches**									
	Parapercis clathrata	1								
	Parapercis cylindrica					1			1	
XXXIII	**Plotosidae - catfishes**									
	Plotosus lineatus	1				1			1	
XXXIV	**Pomacanthidae - angelfishes**									
	Apomelichthys trimaculatus								1	
	Centropyge bicolor					1		1	1	
	Centropyge bispinosus	1								
	Centropyge heraldi								1	
	Centropyge loriculus								1	
	Centropyge nox	1				1				
	Centropyge tibicen	1				1		1		
	Centropyge vrolicki	1	1	1	1	1	1	1	1	1
	Chaetodontoplus mesoleucus	1			1	1				
	Genicanthus lamarcki					1		1		
	Pomacanthus imperator					1				
	Pomacanthus navarchus	1			1					
	Pomacanthus semicirculatus	1				1				
	Pygoplites diacanthus	1	1	1	1	1	1	1		1
XXXV	**Pomacentridae - damselfishes**									
	Abudefduf sexfasciatus								1	1
	Abudefduf vaigiensis	1	1	1	1	1	1	1	1	1
	Amblyglyphidodon aureus	1								1

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		2002	2009	2009	2009	2002	2009	2009	2002	2009
	Amblyglyphidodon curacao	1	1	1	1	1	1	1	1	1
	Amblyglyphidodon leucogaster	1	1	1	1		1	1	1	1
	Amphiprion clarkii	1	1	1		1	1	1	1	1
	Amphiprion frenatus	1			1	1			1	1
	Amphiprion ocellaris					1				
	Amphiprion peridereion	1							1	
	Amphiprion sandaricinos					1				
	Chromis agilis									1
	Chromis amboinensis		1	1	1		1	1		1
	Chromis analis	1						1	1	1
	Chromis atripes	1				1			1	
	Chromis margaritifer								1	1
	Chromis retrofasciata	1			1			1	1	1
	Chromis ternatensis	1	1	1	1	1	1	1	1	1
	Chromis viridis	1	1	1	1	1	1	1	1	1
	Chromis weberi				1			1		
	Chromis xanthura							1		1
	Chrysiptera parasema				1			1		
	Chrysiptera rollandi	1				1			1	
	Chrysiptera springeri	1				1				
	Dascyllus aruanus	1	1	1		1	1	1	1	
	Dascyllus melanurus								1	
	Dascyllus reticulatus	1				1		1	1	1
	Dascyllus trimaculatus	1	1	1	1	1	1	1	1	
	Neoglyphidodon melas					1			1	1
	Neoglyphidodon nigroris	1				1				1
	Neoglyphidodon thoracotaeniatus		1	1	1	1	1			1
	Plectroglyphidodon lachrymatus					1			1	
	Pomacentrus alexanderae	1			1			1	1	
	Pomacentrus alleni									
	Pomacentrus amboinensis	1				1			1	1
	Pomacentrus auriventris								1	
	Pomacentrus brachialis	1	1	1	1	1	1	1	1	1
	Pomacentrus coelestis									1
	Pomacentrus lepidogenys	1				1			1	
	Pomacentrus moluccensis	1	1	1	1	1	1	1	1	1
	Pomacentrus nigromarginatus								1	
	Pomacentrus philippinus	1							1	1
	Pomacentrus stigma	1	1	1		1	1	1	1	
	Pomacentrus vaiuli					1			1	
	Pomacentrus sp.									1
XXXVI	**Priacanthidae - bigeyes**									
	Priacanthus hamrur	1							1	
XXXVII	**Scaridae - parrotfishes**									
	Cetoscarus bicolor	1				1		1		
	Hipposcarus longiceps	1				1			1	
	Scarus bleekeri	1	1	1	1	1	1	1	1	1
	Scarus bowersi					1				
	Scarus dimidiatus		1	1	1		1	1		
	Scarus forsteni	1				1			1	
	Scarus frenatus				1					
	Scarus ghobban	1								
	*Scarus globiceps**							1		1
	Scarus microrhinos								1	
	Scarus niger	1							1	
	Scarus ovifrons	1							1	
	Scarus rivulatus	1				1			1	
	Scarus schlegeli	1				1			1	
	Scarus sordidus	1	1	1		1	1		1	1
	Scarus sp. 1									1
	Scarus sp. 2									1
	Scarus sp. 3									1
	Scarus sp. 4									1
	Scarus sp. 5									1

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		2002	2009	2009	2009	2002	2009	2009	2002	2009
	Scarus spinus					1			1	
	Scarus tricolor								1	
XXXVIII	**Scombridae - tunas/ mackerels**									
	Gymnosorda unicolor								1	
XXXIX	**Scorpaenidae - scorpionfishes**									
	Dendrochirus zebra								1	
	Pterois antennata	1				1				
	Pterois volitans					1			1	
XL	**Serranidae - groupers/ basslets**									
	Aethaloperca rogaa					1				
	Cephalopolis argus	1	1	1		1	1	1	1	1
	Cephalopolis cyanostigma									1
	Cephalopolis microprion		1	1			1			
	Cephalopolis miniata								1	
	Ephinephelus fuscoguttatus								1	
	Ephinephelus merra									1
	Pseudoanthias huchtii		1	1	1	1	1	1	1	1
	Pseudoanthias tuka	1	1	1	1	1	1	1	1	1
	Variola louti	1								
XLI	**Siganidae - rabbitfishes**									
	Siganus corallinus		1	1	1		1	1		1
	Siganus chrysospoecilus								1	
	Siganus doliatus	1								
	Siganus guttatus	1				1		1		
	Siganus puellus					1			1	1
	Siganus punctatissimus									1
	Siganus spinus	1								
	Siganus virgatus				1				1	
	Siganus vulpinus	1	1	1	1	1	1			1
XLII	**Solenostomidae - ghost pipefish**									
	Solenostomus paradoxus					1				
XLIII	**Sphyraenidae - barracudas**									
	Sphyraena barracuda		1	1			1			
	Sphyraena flavicauda								1	
XLIV	**Synotodontidae - lizardfishes**									
	Saurida gracilis	1				1			1	
	Synodos variegatus								1	
XLV	**Tetraodontidae - puffers**									
	Arothron hispidus								1	
	Arothron mappa	1								
	Arothron nigropunctatus	1				1			1	
	Canthigaster compressa	1								
	Canthigaster solandri					1				
	Canthigaster valentini	1							1	
XLVI	**Zanclidae - moorish idol**									
	Zanclus cornutus	1	1	1	1	1	1	1	1	1
	TOTAL	132	48	48	62	166	48	82	166	107

APPENDIX 4. Expedition Photos

Beachfront in Cocogrove Resort at San Juan, Siquijor. (A. Pennycook)

Volunteers waiting for the fastcraft to Siquijor at Dumaguete City pier. (V. White)

A field of beautifully intact foliose corals in an expedition site. (V. White)

Dive briefing at Seaquest diveshop given by expedition divemaster Ethan Lucas. (V. White)

Lionfish on the reef during an underwater survey. (L. Boillon)

Hon. Orlando Fua, Jr., Governor of Siquijor Province, and DENR representative talk to volunteers about Siquijor's conservation efforts.(V. White)

Jacks in the shallows of the Apo Island Fish Sanctuary, taken during a snorkel. (A. Pennycook)

Active SPR expedition volunteers, Denise and Geoff Illing, enjoy their 7th SPR trip! (V. White)

Diving with jacks in Apo Island Fish Sanctuary. (A. Pennycook)

One of many beautiful coral formations during the expedition. (L. Boillon)

A turtle close-up. (D.Illing)

Al Pennycook (3rd expedition), Steve Ludemann (1st expedition), Sandy Robb (4th expedition). (V. White)

Cuttlefish during a reef survey. (D. VanRavenswaay)

The father and mother of SPR expeditions, Alan and Vangie White, pose underwater. (L. Boillon)

A lionfish and parrotfish rest together. Taken during a night dive at Tubod Marine Sanctuary. (D. VanRavenswaay)

Young volunteer, Chance Usrey, takes part in collecting reef assessment data. (V. White)

Flamboyant cuttlefish in a sandy part of Maite reef in Siquijor. (D. VanRavenswaay)

Ghost pipefish at Maite reef. (E. Lucas)

Meeting with the barangay captain of BarangayTubod in San Juan. (V. White)

THE 2009 SPR TEAM! Standing (L-R): Alastair Pennycook, Mark Copley, Laurent Boillon, John Rowland, Alan White, Geoff Illing, TJ Mueller, Steve Ludemann, Denise Illing, Sandy Robb, Ian White, Chance Usrey, Roxie Diaz, Sheryll Tesch, Ethan Lucas, Raffy Martinez, Ronald Van DeVooren. Sitting (L-R): Dan VanRavenswaay, Rebecca Weeks, Jill Johnson, Agnes Sabonsolin, Danioe Delizo. (V. White)