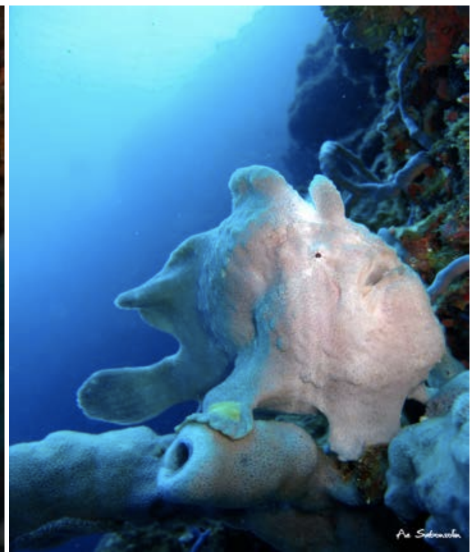
SAVING PHILIPPINE REEFS

Coral Reef Monitoring Expedition
to Moalboal and Badian, Cebu, Philippines
April 14-21, 2013


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 Researchers

Summary Field Report:
"Saving Philippine Reefs"
Coral Reef Monitoring Expedition to
Moalboal and Badian, Cebu, Philippines
April 14-21, 2013

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 Researchers:

Laurent Boillon, Australia
Julia Cichowski, USA
Mark Copley, USA
Denise Illing, Australia
Geoff Illing, Australia
Sheree Marris, Australia
Thomas J. Mueller, USA
Alastair Pennycook, Australia
Alexander Robb, Australia
Vittoria Thornley, UK
Oliver Thornley, UK

Principal investigators and CCEF Staff:

Alan T. White, Ph.D.
Senior Scientist, The Nature Conservancy, Honolulu, Hawaii, USA

Aileen Maypa, Ph.D.
Co-Principal Investigator

Dean Apistar
Michelle Baird
Dalton Dacal
Danilo Delizo, Jr.
Roxie Diaz
Rafael Martinez
Agnes Sabonsolin
Porpetcho Wenifel
Evangeline White

Summary Field Report: “Saving Philippine Reefs”
Coral Reef Monitoring Expedition to Moalboal and Badian, Cebu, Philippines, April 14-21, 2013.

Produced by the Coastal Conservation and Education Foundation, Inc.

Cebu City, Philippines

Citation:
White, A.T., A. Maypa, D. Apistar, R. Martinez and E. White. 2013. Summary Field Report: Coral Reef Monitoring Expedition to Moalboal and Badian, Province of Cebu, Philippines, April 14-21, 2013. The Coastal Conservation and Education Foundation, Inc., Cebu City, 47p.

This report was made possible through the support provided by the Expedition Researchers listed in the cover and organized through the Coastal Conservation and Education Foundation, Inc.

Coastal Conservation and Education Foundation, Inc (CCE Foundation) is a non-profit organization concerned with coral reef and coastal conservation in the Philippines.

Cover photos by Julia Cichowski, Agnes Sabonsolin and Michelle Baird

All communications to:

The Coastal Conservation and Education Foundation, Inc.
3rd Floor, PDI Condominium, Archbishop Reyes Avenue, Banilad,
Cebu City, Philippines

Phone: 6332-233-6909 or 6332-233-6947
Fax: 6332-233-6891
Email: info@coast.ph or alan_white@tnc.org
Website: www.coast.ph

ABSTRACT

The coral reefs in Moalboal and Badian appear stable with living coral cover ranging from poor (<25%) to good (>50%). Live hard coral (LHC) cover in the deep zones of Moalboal and Badian MPAs range from fair (35.71±10% in Zaragosa Island) to good (64.92±35% in Saavedra) while it is poor (16.46±16% in Lambog) to fair (33.67±21% in Basdiot) in the shallow zones in 2013. The 2013 survey results show that LHC in the majority of the MPAs decreased in 2013, of which, several declines were significant. The same decreasing pattern was also observed in the shallow areas. Anecdotal survey evidence suggests that some of the observed decrease in LHC in most of the sites may have been due to the magnitude 6.7 earthquake on February 6, 2012 wherein the Epicenter was between Moalboal and Guihulungan, Negros Oriental. This earthquake caused the sea level to recede and come back with strong waves crushing through the reef walls and damaging corals. Moreover, reef conditions were worsened by the typhoons that traversed through the Visayas at the end of 2012. Considering these factors, the decline in LHC in most sites surveyed is modest and the reefs monitored show a good level of resilience over time.

All reef fish density was highest in Pescador Island at 7387±2732 fish/500m^2 followed by Basdiot (6102±3531 fish/500m^2) and Saavedra (2928±1059 fish/500m^2) while target fish density was highest in Basdiot (2142±2743 fish/500m^2) followed by Saavedra (417±446 fish/500m^2). Target fish density within MPAs where strict enforcement is present, appears to be improving overtime as compared to outside where heavy fishing pressure is evident. This is also illustrated by the higher species richness inside MPAs compared to the adjacent areas where little or no enforcement is being implemented. Target fish biomass has increased overtime inside the MPAs. A clear picture is presented of the benefits of well protected no-fishing areas as represented by the small MPAs in Moalboal and Badian by the increasing biomass of fish.

Moalboal and Badian Municipalities have been very active in coastal resource management since the establishment of Saavedra Marine Sanctuary and Zaragosa Island Fish Sanctuary in 1987 wherein they are two examples of the well managed small marine protected areas in the Philippines. However, there are still the challenges of sustaining the efforts to enforce the law against illegal activities, strengthen MPA management bodies in other MPAs and the ever growing volume of tourism. Recommendations to further enhance conservation of the area are made herein.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

This coral reef monitoring expedition and its outcome are credited to the 11 international volunteers from Australia, England, the United States 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 that prepared for the trip and have all done their part in the overall successful completion of the Expedition. They include: Agnes Sabonsolin, Data and Logistics Assistant; Michelle Baird, Logistics and Research Coordinator; Roxie Diaz, Researcher and Divemaster; Rafael Martinez, GIS Specialist; Dean Apistar, Research Assistant and Divemaster; Danilo Delizo and Wenefel Porpetcho, Research Assistants for fish counting; Dalton Dacal, assistant researcher, Jane Trangia, CCEF Chief Accountant; Pablita Toyong-Huerbana, CCEF Administrative Assistant; and Vangie White, Overall Project Manager and support coordinator for the trip. Special thanks go to Aileen Maypa who, despite her busy schedule, was able to join and assist with the expedition.

The Kasai Village Resort staff and management hosted our group with traditional Filipino hospitality. We would like to thank the Kasai Village team for providing excellent diving services and assistance throughout our trip, excellent food and accommodations and a very entertaining farewell dinner and show!

The Municipal Government of Moalboal is thanked for its attention to marine conservation within its jurisdiction and its continued vigilance to improve the status of its coral reefs and the enforcement of its marine protected areas. The Municipality of Badian has an equally good record and is commended for guarding its MPAs.

The final production of this report has been efficiently accomplished by Dean Apistar, Danilo Delizo and Vangie White.

Alan T. White
Principal Investigator

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CB	branching coral
CCEF	Coastal Conservation and Education Foundation
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
MPA	marine protected area
NIPAS	National Integrated Protected Areas System
NL	nonliving
NS	not significant
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

INTRODUCTION to the 22nd SAVING PHILIPPINE REEFS EXPEDITION IN MOALBOAL and BADIAN, CEBU ISLAND

THE PLACE

Moalboal is a premiere dive tourism site in the province of Cebu and attracting domestic and international divers to enjoy its underwater life. Located about 90 kilometers from Cebu City, it can be reached in two and a half hours by road transportation. Moalboal lies in the waters of the Tañon Strait, which is a National Integrated Protected Areas System (NIPAS) declared protected area. Moalboal has four locally-declared and managed marine sanctuaries which implement a user-fee system that generates income for the local communities and the municipality.

THE EXPEDITION PURPOSE

This reef monitoring expedition determined the coral reef condition within the marine sanctuaries in Moalboal and several marine protected areas in the neighboring town of Badian. This data can be used in the comparison to monitoring data collected by CCEF and the local community in past years using similar methods. The expedition results support the current management of Moalboal and Badian marine sanctuaries and indicate effectiveness of protection from illegal fishing and improper tourism activities in the area.

DIVING VOLUNTEERS – WHAT DID THEY DO?

The expedition volunteers were all experienced scuba divers and most had participated in one of the “Saving Philippine Reefs Expeditions”. The volunteers made reef surveys using prescribed methods during morning and afternoon dives and snorkels. The first day was mostly dedicated to practice dives to help the divers with their survey skills. Optional recreational dives were also done after survey dives were completed on most days.

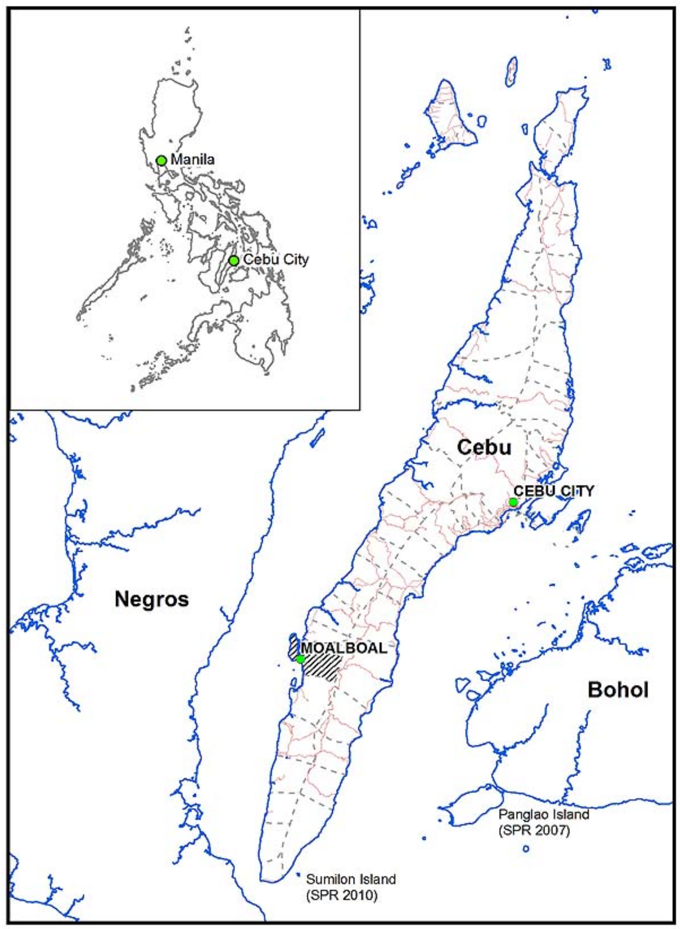
ACCOMMODATIONS

The Kasai Village Dive and Spa Resort is situated near a fishing village in the town of Moalboal, and is surrounded by white beaches and a shoreline that features excellent dive sites. Under Swedish management, Kasai Village was established in 2006 and is run by Mr. Michael Peterson and his wife Lydia. Employing local boatmen and residents, Kasai Village has grown into an establishment that aims to protect nature through sustainable practices such as good garbage disposal and management and responsible diving. Kasai Village is also known to support local artists, the local handicraft industry, and encourages in building the spirit of partnership and goodwill in all its operations.

WHO ARE THE ORGANIZERS?

The Coastal Conservation and Education Foundation, Inc. is a non-profit organization in the Philippines working to conserve coral reefs and to support the implementation of effective marine protected areas. The CCE Foundation has continued to support monitoring in the Municipalities of Moalboal and Badian, CCEF has been present in assisting and guiding the local government of the town in the management of marine protected areas since 2002.

The main objectives of the Foundation are to improve coral reef conservation in the Philippines and to support the implementation of marine protected areas. The CCE Foundation has supported monitoring in different parts of the Philippines since the early 1990s through the Principal Investigator and his associates. The CCE Foundation has supported conservation work throughout the Philippines through project design, community level training and implementation of the marine protected areas rating and management systems initiated through the Foundation.



WHO JOINED?

Eleven volunteers and eleven staff comprised the survey team. Almost all of them have joined a similar reef expedition survey to the Philippines in the past (see Appendix).

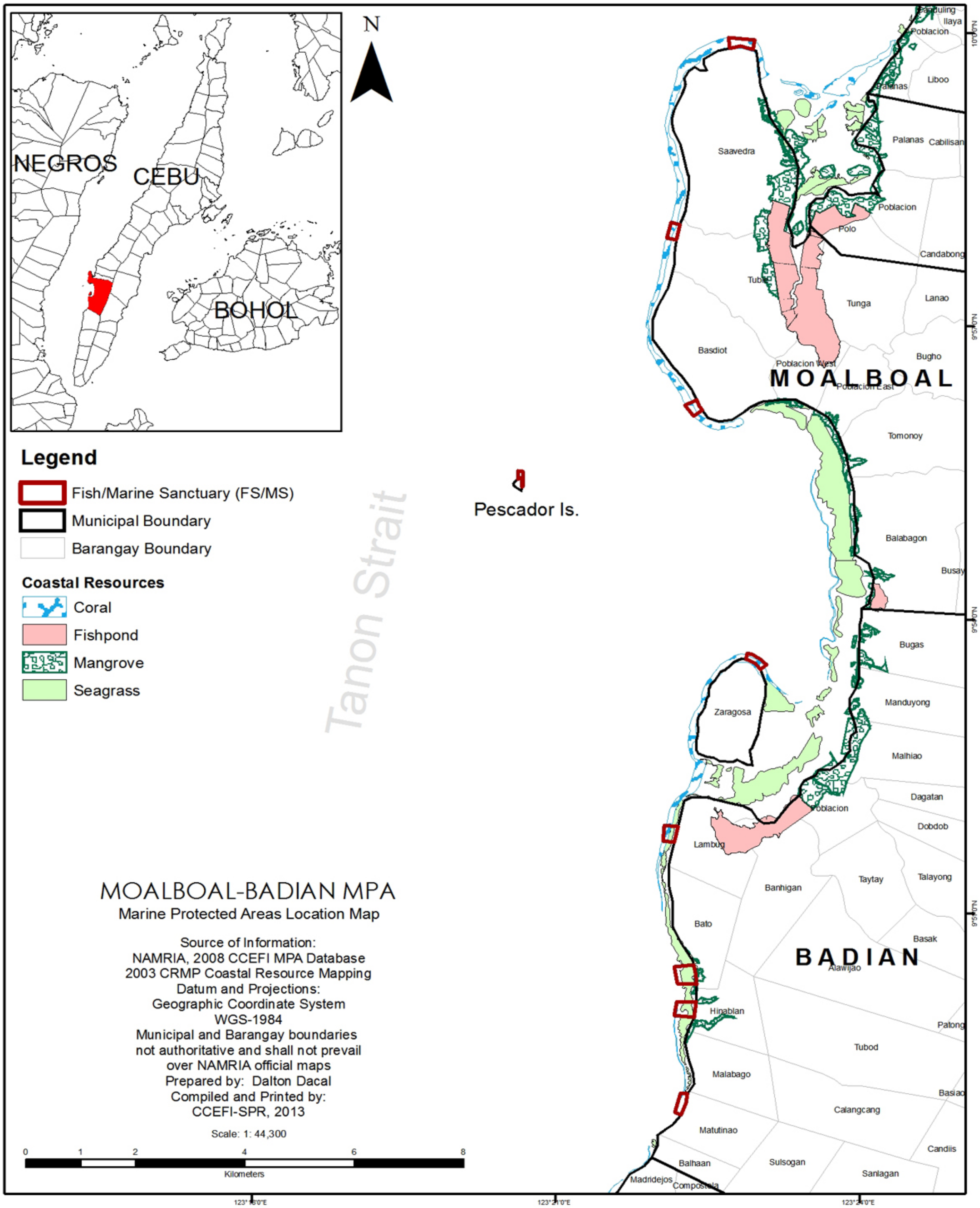
WHAT DATA WAS COLLECTED?

The dive volunteers and staff made surveys to document the status of the coral reefs in Moalboal and Badian by collecting the following information:

a. Percent bottom cover of living coral
b. Percent bottom cover of non-living reef substrates (e.g. rock, rubble, sand, dead coral)
c. Percent bottom cover of other living substrates (e.g. seagrass, algae, sponges)
d. Fish species diversity per unit area
e. Total number of fish individuals per unit area
f. Total number of fish species on the reef
g. Number of indicator species per unit area (e.g. butterflyfish, giant clams, lobsters, Triton shells, Crown-of-thorns seastars and others)
h. Presence of large marine life (e.g. sharks, manta rays, bumphead wrasses, sea turtles, whales and dolphins, and others)
i. Causes of coral damage
j. Presence of visitors of intruders in the area, and,
k. Effectiveness of management protection in the area.

Introduction and Maps

All the data collected are summarized in this report and disseminated to all interested parties in the Philippines. The survey sites, both inside and outside of marine protected areas in Moalboal and Badian, Cebu, Philippines are shown on the maps below.



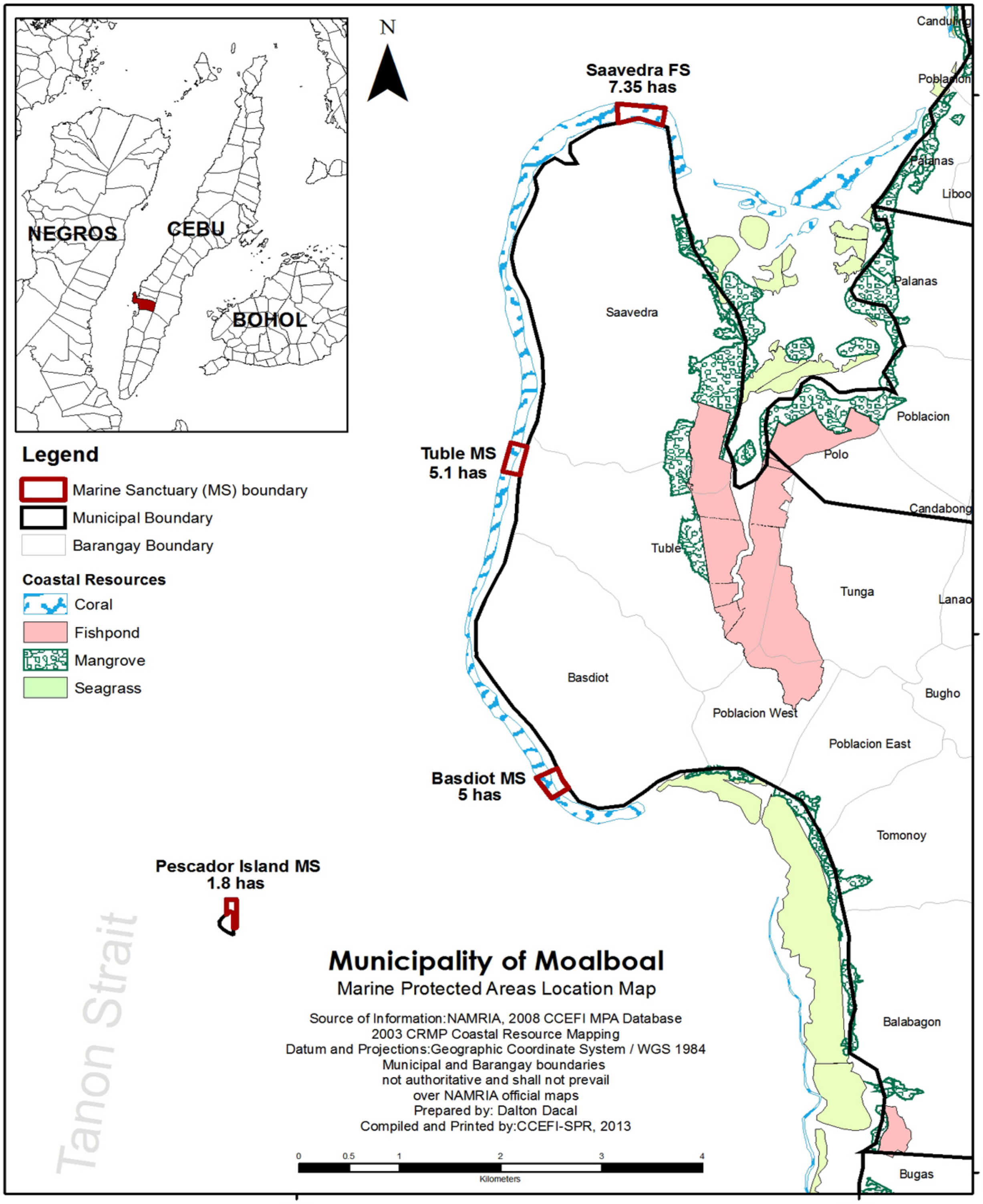


Figure 1. Map with locations of MPAs in Moalboal Municipality

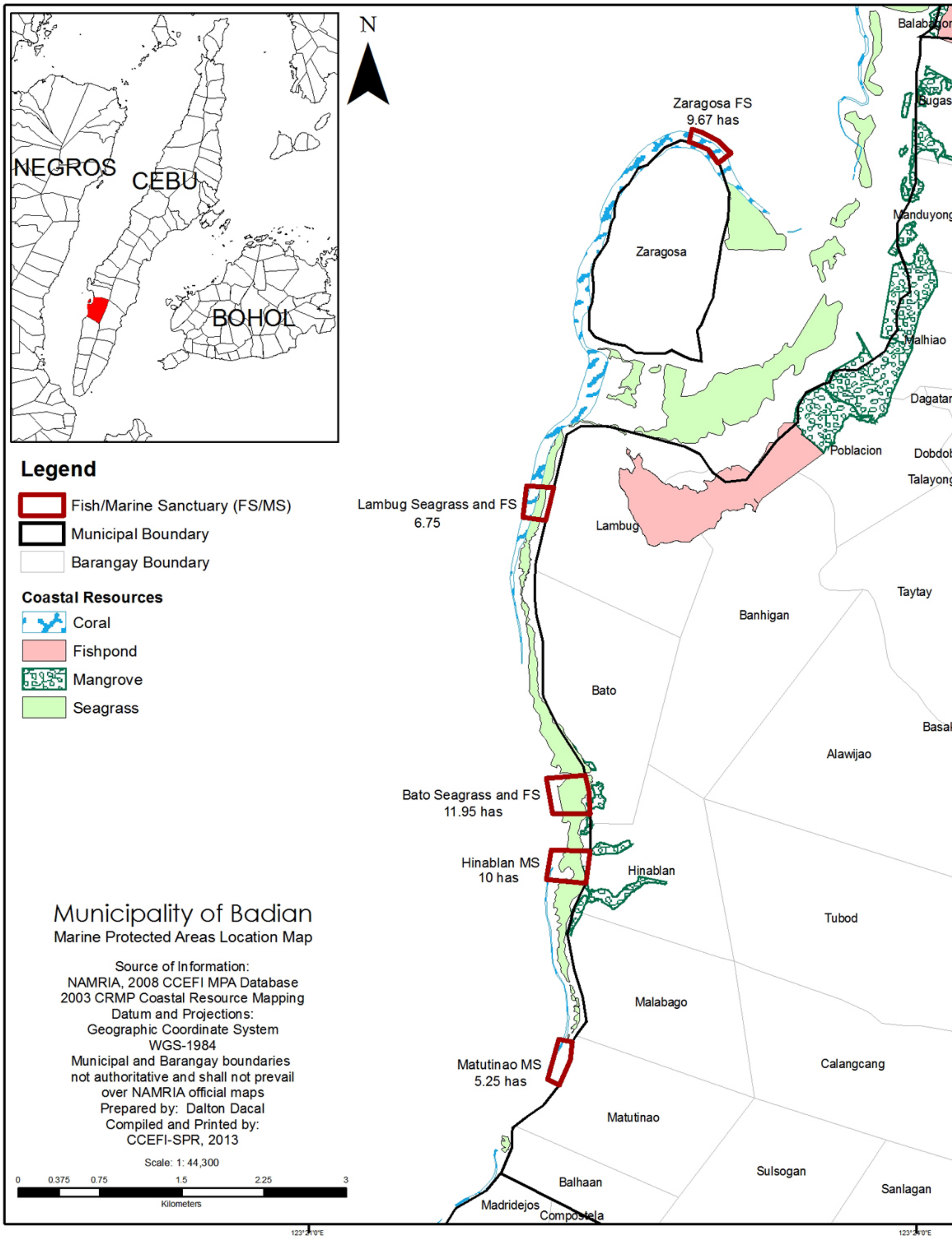


Figure 1. Map with locations of MPAs in Badian Municipality

METHODS AND 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 (6-8 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 underwater visual census (UVC; n = 4 - 8) technique done by four specialists (AT White, TJ Mueller, W Porpetcho, D Delizo Jr and D Dacal). Specified substrate transects were utilized as guides for the UVC. The abundance of target species, indicator species and numerically dominant and visually obvious were all counted. Length of fish counted is 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), Kruskal-Wallis or T-test whichever is appropriate. Survey sites with few replications (n>2) were excluded from statistical analyses. Similarly, each category was also compared between sites per year and per site using 1-ANOVA,Kruskal-Wallis or T-test whichever is appropriate. Only those years with available raw data were included in the analysis. 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®. In describing coral condition, the following terms may have the corresponding values:

Overview and Results

Gomez et al. (1994) categories:

Live Coral Cover (%mean ±SE)			
Poor	Fair	Good	Excellent
0 – 24.9	25 – 49.9	50 - 74.9	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). When applicable, species richness was expressed as mean number of species per $500m^2$. Target fish densities were compared between years where raw data is available, using 1-ANOVA and Tukey's Test was used for post hoc. All data were tested for variance equality and normality using Minitab 14®. A log or square root transformation was made whenever appropriate. Classification of 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/1000m²):				
Very Poor	Poor	Moderate	High	Very High
0 – 26	27 – 47	48 - 74	76 – 100	>100
Fish Density (no. of fish/1000m²):				
Very Poor	Poor	Moderate	High	Very High
0 – 201	202 – 676	677 – 2,267	2,268 – 7,592	>7,592
Biomass (metric tons/km²)				
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: $\mathbf{a \cdot L^b}$(Fishbase 2004), using the 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. Comparisons between families within sites used 1-ANOVA or Kruskal-Wallis whichever is appropriate. For this report, biomass computations were based on species-specific lengths (n=3-5).

RESULTS

Saavedra Marine Sanctuary

Substrate. Live hard coral (LHC) cover in Saavedra was fair to good (shallow and deep respectively) in 2013 based on the index category of Gomez et al. (1994). LHC was recorded at 43.3±10% in the shallow and 65.91±35% in the deep (Fig. 3 and 4 respectively). 1-ANOVA suggests no significant changes in LHC over the years in the deep. Nonetheless, an increasing pattern is observed from 2007 (42.67±9%) to 2013 (Fig.4). The observed increasing pattern of LHC was also coupled with the decrease in non-living substrate (2007: 50.33±8%, 2013: 29.31±10%). Outside, no significant changes were observed (Fig. 4).

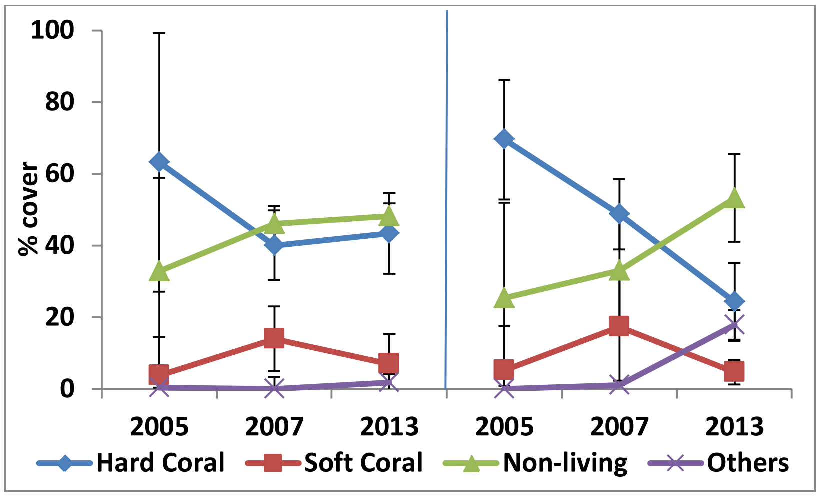


Figure 3. Changes in substrate composition (% mean ±SD) in Saavedra from 2005 to 2013, 2-3m depth.

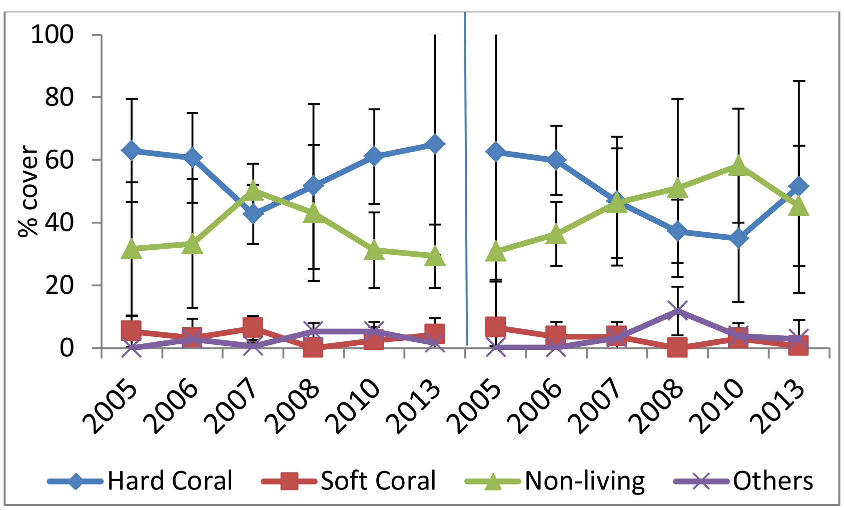


Figure 4. Changes in substrate composition (% mean ±SD) in Saavedra from 2005 to 2013, 7-8m depth.

Overview and Results

Fish density, species abundance and biomass. All reef fish density in Saavedra was high in 2013 (Hilomen et al. 2000) wherein it was recorded at 2928.43±446 fish/500m^2 (Fig. 5). 417.0±446 are considered target reef fishes. No significant changes where seen for target fish densities overtime. Nonetheless, an increasing pattern is observed as shown by the regression line (Fig.5). Outside, target fish density was significantly higher in 2008 (1-ANOVA: P=0.014, DF=5) at 396±330 fish/500m^2 which were mainly composed of Fusiliers (309.67±282 fish/500m^2). Species abundance in 2013 was very high at 110.80±38 species/500m^2. Statistical analyses also revealed that species abundance is significantly higher inside (T-test: p=0.004, DF=4) compared to the adjacent area (outside: 67.50±10 species/500m^2, Fig. 34). Conversely, target biomass was higher outside (117.51±167 kg/500m^2) compared to inside (80.36±39 kg/500m^2, Fig. 35). Nonetheless, the observed differences were insignificant. The bulk of the target biomass outside was mainly composed of *Fusiliers* (64.83±68 kg/500m^2).

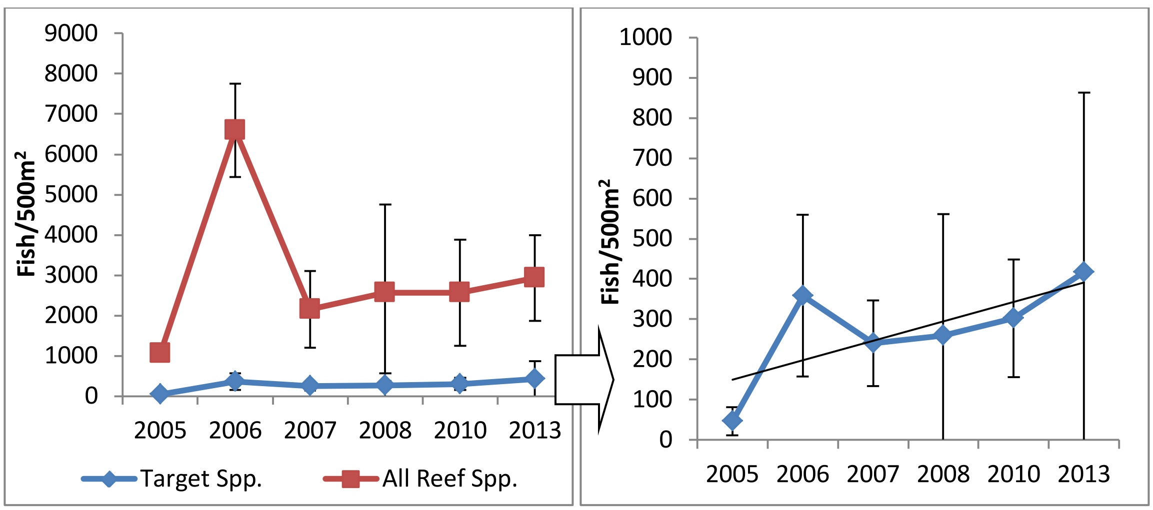


Figure 5. Mean (±SD) number of fish/500 m^2 inside Saavedra from 2005 to 2013, 7-8m depth.

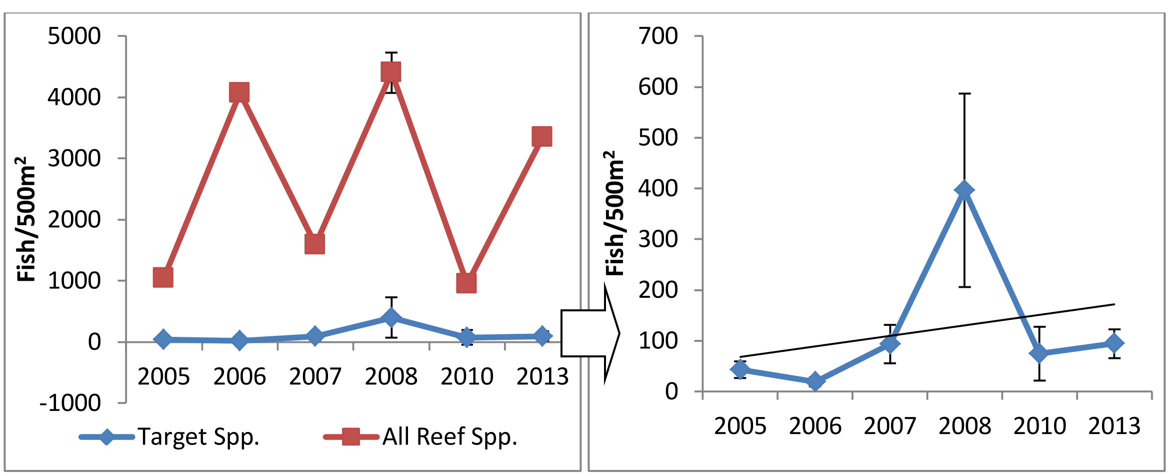


Figure 6. Mean (±SD) number of fish/500 m^2 outside Saavedra from 2005 to 2013, 7-8m depth.

Overview and Results

Tuble Marine Sanctuary

Substrate. LHC was fair in Tuble marine sanctuary both in the shallow and deep area in 2013. LHC was recorded at 30.8±18% and45.93±11% respectively. Moreover, LHC appears to decrease overtime both in the shallow and the deep area. Statistical tests show that the observed decrease in LHC cover in the deep is significant (inside: Kruskal-Wallis, P=0.008; outside: 1-ANOVA, P=0.001). The decrease in LHC was coupled with an increase in non-living substrate in 2013 (inside: 40.29±24%, outside: 54.0±18% Fig. 8).

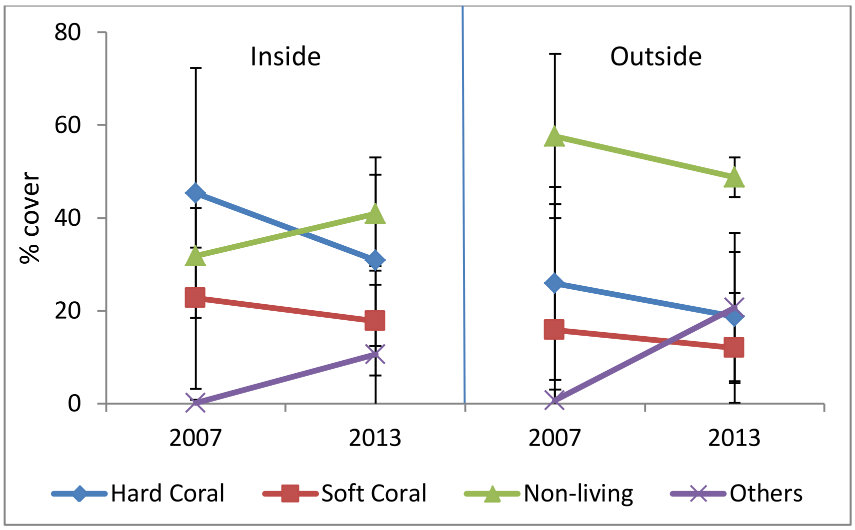


Figure 7.Changes in substrate composition (% mean ±SD) in Tuble from 2005 to 2013, 2-3 depth.

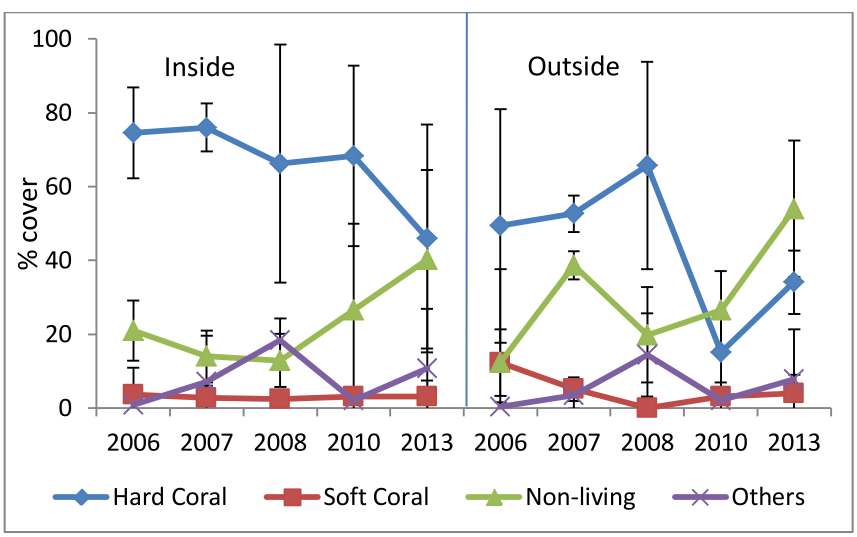


Figure 8.Changes in substrate composition (% mean ±SD) in Tuble from 2005 to 2013, 7-8m depth.

Overview and Results

Fish density, species richness and biomass. All reef fish density in Tuble was high in 2013. All reef fish density was recorded at 2380.17±1014 fish/500m^2 wherein 406.17±268 fish/500m^{2}are target reef fishes (Fig. 9). Data overtime suggests a decreasing pattern for target fish density inside from 2006 (702.33±422 fish/500m^2) to 2013. Outside, target fish density significantly increased from 28.67±25fish/500m^2 in 2006 to 601.33±463fish/500m^2 in 2007 wherein it was status quo to 2013 (Fig. 10). Species abundance in 2013 was very high both inside and outside the sanctuary (73.67±22 species/500m^2 and 63.5±41 species/500m^2 respectively, Fig. 34). Similar with the previous site, target fish biomass in 2013 was also higher than in 2010 (2013: 153.34±248 kg/500m^2, 2010: 23.57±16 kg/500m^2, Fig 35). A majority of the target fish biomass were composed of *Fusiliers* (130.96±364 kg/500m^2).

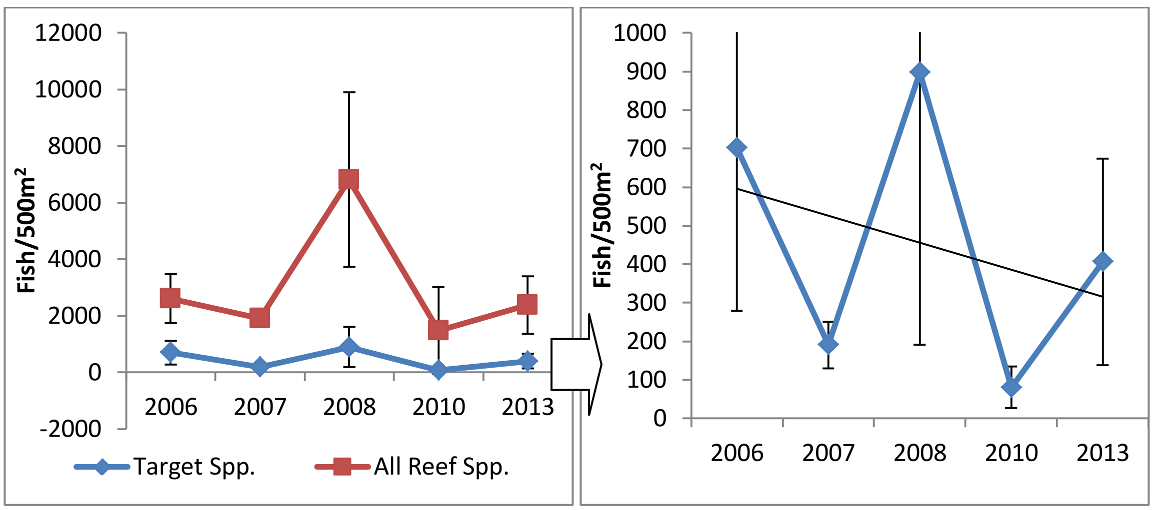


Figure 9. Mean (±SD) number of fish/500 m^2 inside Tuble from 2006 to 2013, 7-8m depth.

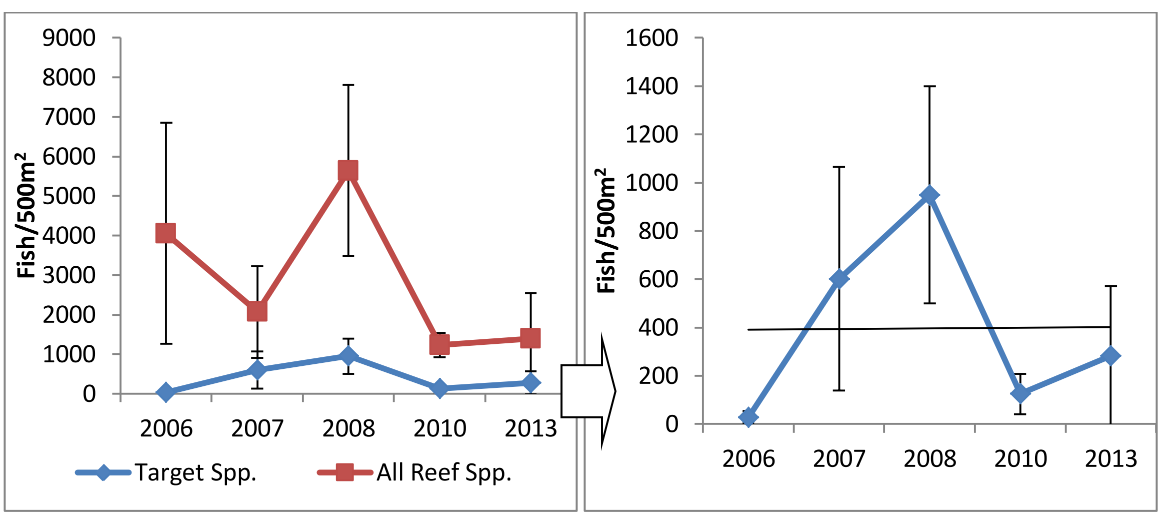


Figure 10. Mean (±SD) number of fish/500 m^2 outside Tuble from 2006 to 2013, 7-8m depth.

Overview and Results

Basdiot Marine Sanctuary

Substrate. LHC in Basdiot was fair in the shallow (Fig. 11) and good in the deep in 2013 (Fig. 12). LHC was recorded at 38.3±8% and 50.63±33% (shallow and deep respectively, Figs. 11 and 12). Data overtime showed that LHC in the deep was in status quo from 2006 (75.33±16%) to 2010 (71.5±14%) and decreased by 2013. The decrease was then coupled with an increase in non-living substrate in 2013 (45.5±34%). The same observation was also true outside the sanctuary wherein LHC decreased from 82.83±13% in 2007 to 49.50±24% in 2013. 1-ANOVA tests revealed that the observed decreases were significant (inside: P=0.011, outside: P=0.001)

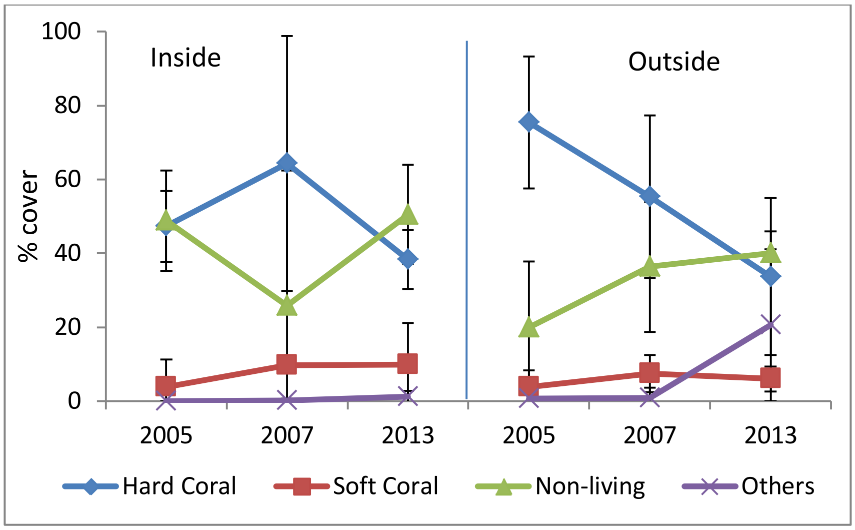


Figure 11.Changes in substrate composition (% mean ±SD) in Basdiot from 2005 to 2013, 2-3m depth.

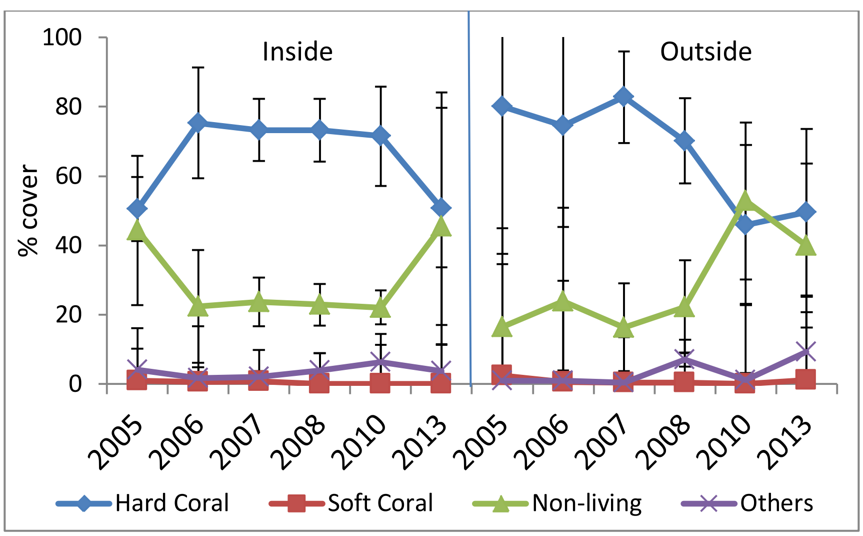


Figure 12.Changes in substrate composition (% mean ±SD) in Basdiot from 2005 to 2013, 7-8m depth.

Overview and Results

Fish density, species richness and biomass. All reef fish density in Basdiot is also very high in 2013 wherein it was at 6102.75±3531 fish/500m^2. Of the entire reef fish density recorded, 2142.0±2743 fish/500m^{2}are considered target fish density (Fig. 12). Moreover, target reef fish density was recorded highest in 2008 at 5073.33±3114 fish/500m2 and significantly lower in 2010 at 130.75±185 fish/500m^2. Nonetheless, data overtime suggests an increasing pattern as shown by the regression line (Fig.13). All species abundance is very high 2013 (75.75±31 species/500m^2). Similar with the previous sites, species abundance was also higher inside compared to outside (35.17±15 species/500m^2, Fig. 34). Target biomass in 2013 was recorded at 84.43±50 kg/500m^2, which was 42% less compared to that of 2010 (147.74±210 kg/500m^2, Fig. 35). Nonetheless, the observed decline was statistically insignificant.

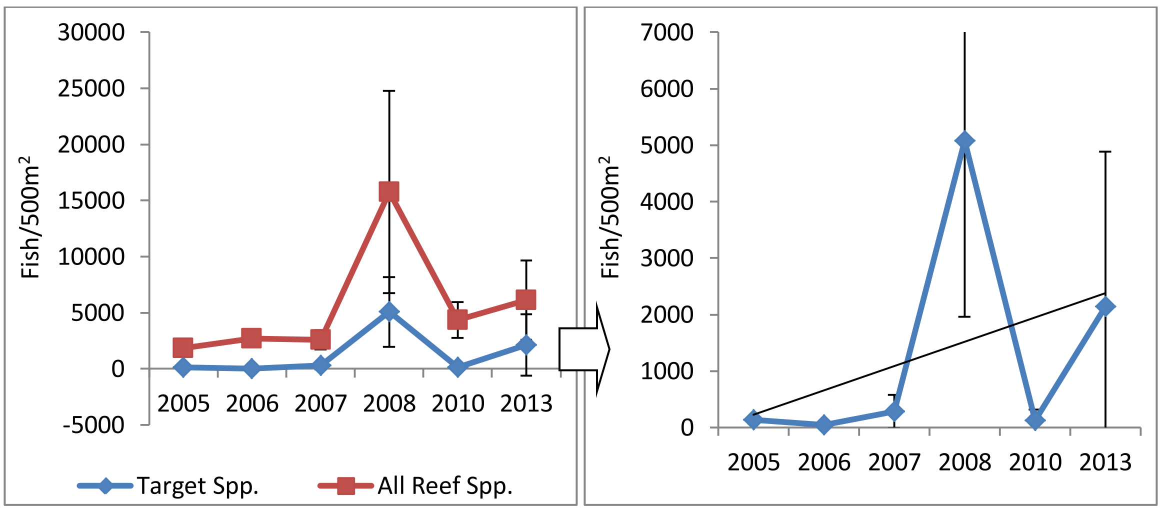


Figure 12. Mean (±SD) number of fish/500 m^{2}inside Basdiot from 2006 to 2013, 7-8m depth.

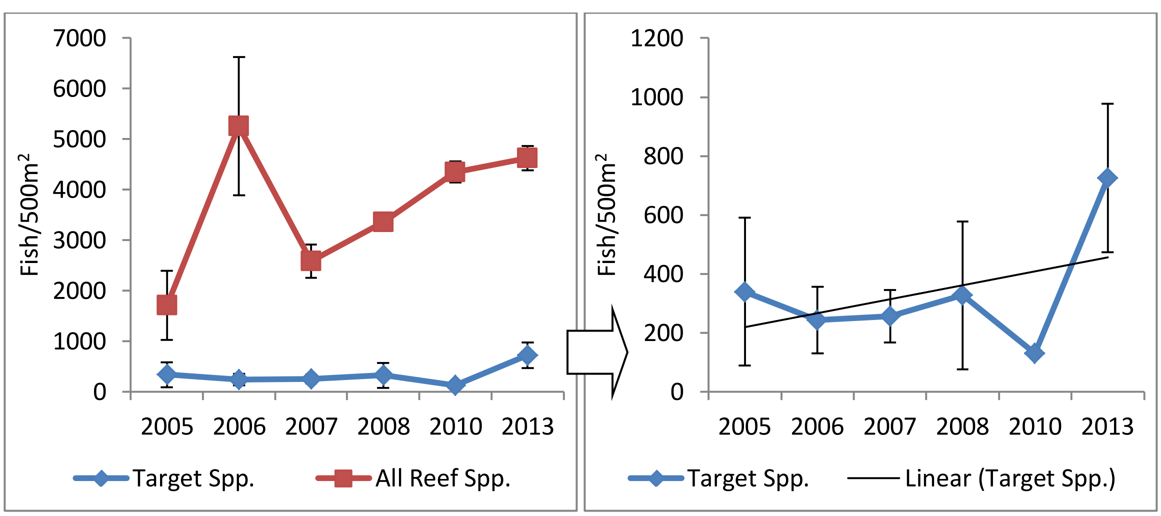


Figure 13. Mean (±SD) number of fish/500 m^2 outside Basdiot from 2006 to 2013, 7-8m depth.

Pescador Island Marine Sanctuary

Substrate. LHC in Pescador Island was recorded at 47.17±19% and 40.7±25% (inside and outside respectively, Fig. 14) in 2013 wherein it is in fair condition (Gomez et al 1994). LHC overtime appears to decrease in 2013 at a significant level (1-ANOVA: P=0.023, DF=3). The same pattern was also observed outside wherein LHC decreased from 71.0±13% in 2007 to 40.7±25% in 2013. The decrease was then coupled with the increase in nonliving substrate by 2013 (inside: 42.83±28%, outside: 49.3±42%).

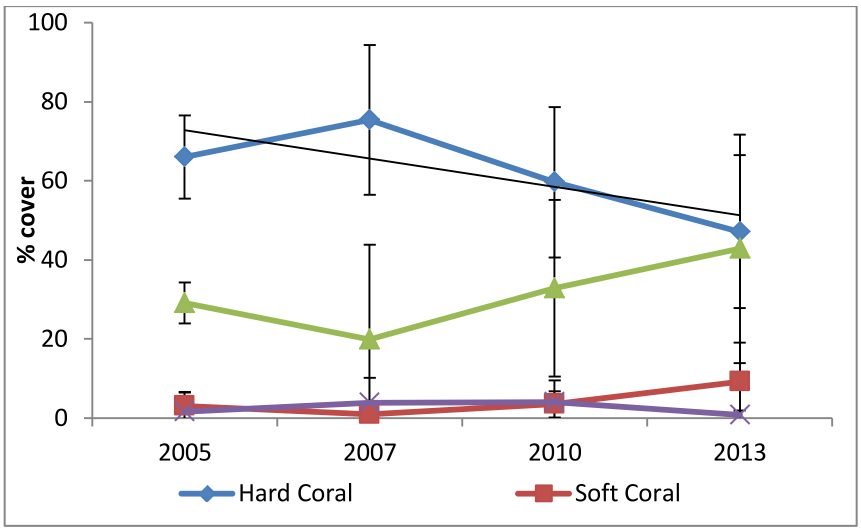


Figure 14.Changes in substrate composition (% mean ±SD) inside Pescador from 2005 to 2013, 7-8m depth.

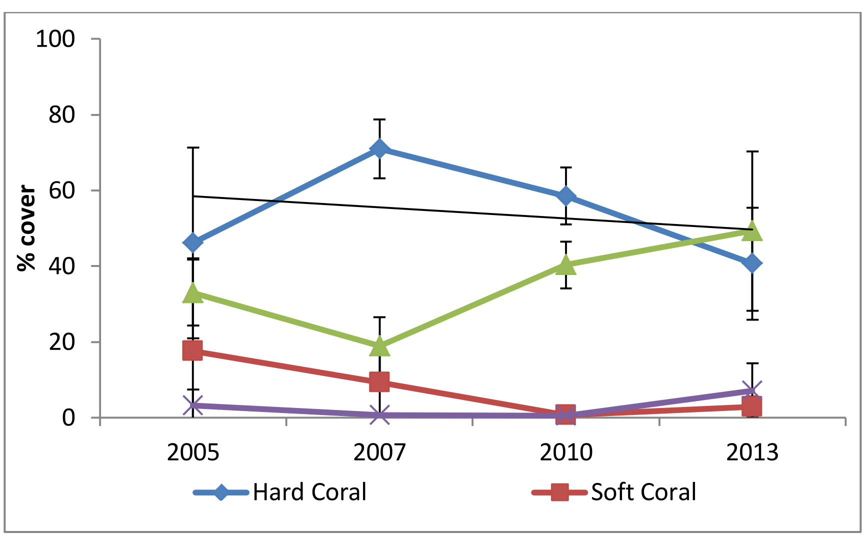


Figure 15.Changes in substrate composition (% mean ±SD) outside Pescador from 2005 to 2013, 7-8m depth.

Overview and Results

Fish density, species abundance and biomass. All reef fish density in Pescador is very high at 7383.33±2732 fish/500m^2.Target reef fish density was recorded at 417.67±515 fish/500m^2 in 2013 (Fig. 16). Moreover, Target fish density appears to decrease overtime. Statistical tests show that the observed decline is significant (1-ANOVA: P=0.023, DF=3). Moreover, *Clupidaes* (sardines) which were recorded in 2010 (4000±1452 fish/500m^2) where not present in 2013. Nonetheless, a regression line suggests an increasing pattern from 2006 to 2013. Species abundance was also very high in 2013 at 82.33±38.42 species/500m^2 (Fig. 34). Target fish biomass was at 25.77±14 kg/500m^2 which was higher compared to 2010 (17.73±17 kg/500m^2, Fig. 35).

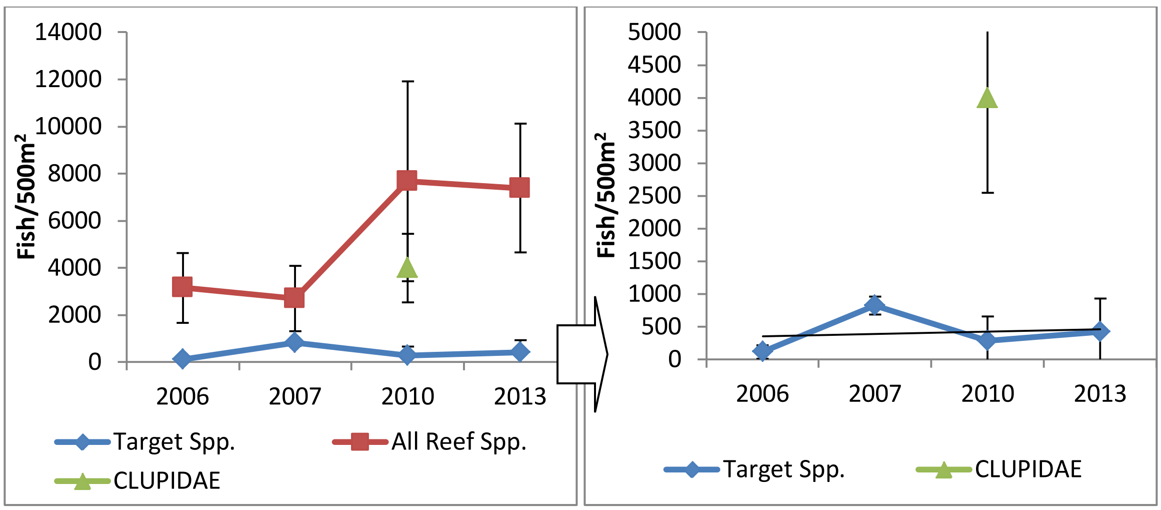


Figure 16. Mean (±SD) number of fish/500 m^2 inside Pescador Sanctuary from 2006 to 2013, 7-8m depth.

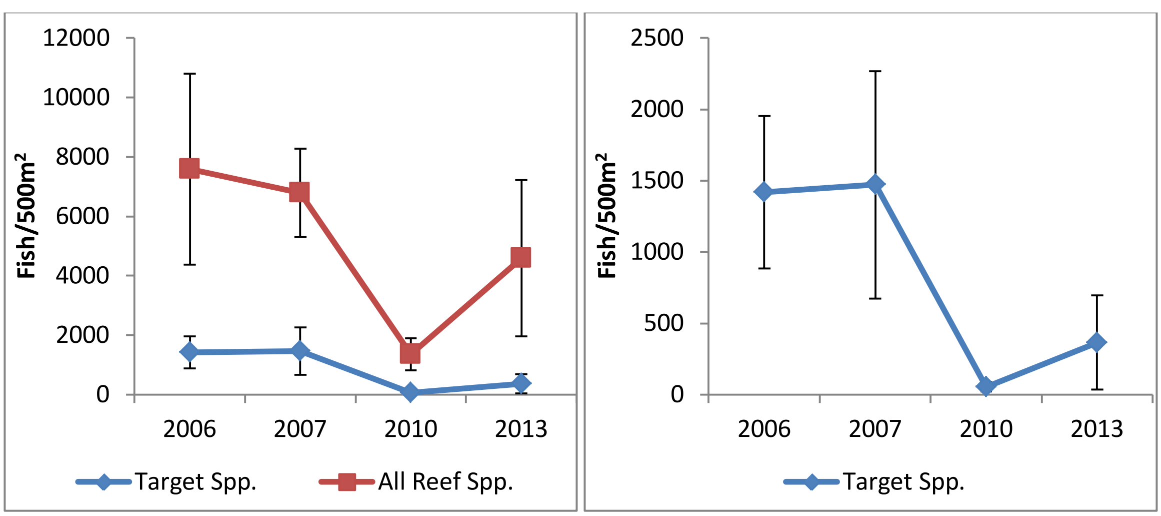


Figure 17.Mean (±SD) number of fish/500 m^2 outside Pescador Sanctuary from 2006 to 2013, 7-8m depth.

Municipality of Badian

Zaragosa Island Marine Sanctuary

Substrate. LHC in Zaragosa was fair both in the shallow and deep areas in 2014. LHC was recorded at 47.96±14% and 28.46±15% in the shallow and 35.71±10% and 42.29±22% in the deep (inside and outside respectively, Figs. 18 and 19). Data overtime suggests that LHC in the deep was significantly higher in 2007 inside (1-ANOVA: p=0.000) at 71.5±9% and decreased by 2010 (44.0±7%) and 2013. The observed decrease was then coupled with the increase in nonliving substrate form 26.2±11% in 2007 to 57.2±16% in 2013. The same pattern was also observed in the shallow and adjacent areas (outside) of the sanctuary (Fig. 18).

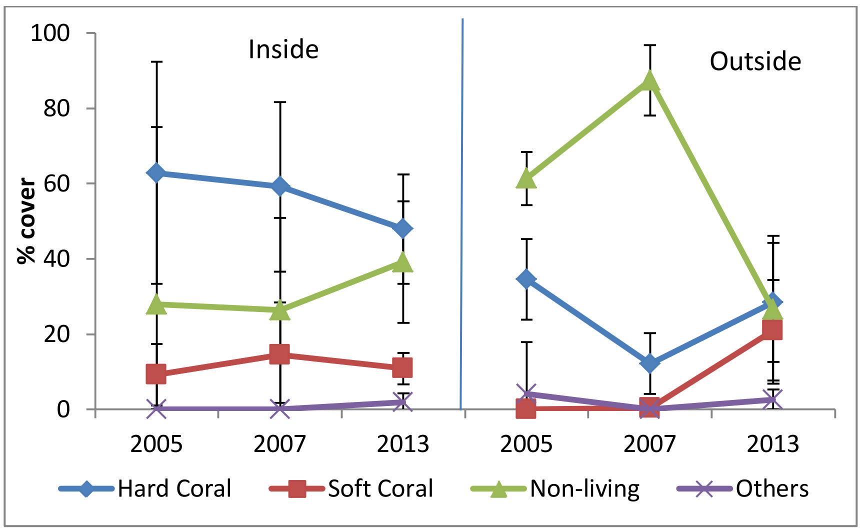


Figure 18.Changes in substrate composition (% mean ±SD) in Zaragosa Island from 2005 to 2013, 2-3m depth.

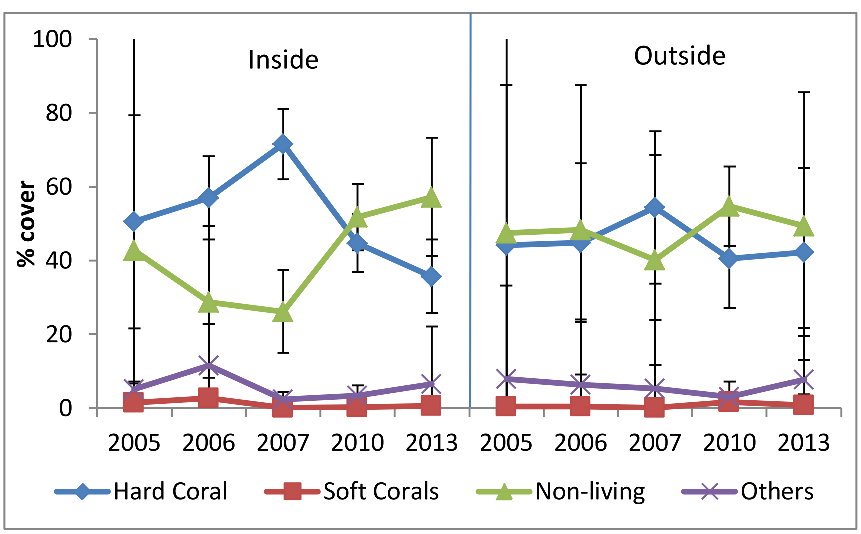


Figure 19.Changes in substrate composition (% mean ±SD) in Zaragosa Island from 2005 to 2013, 7-8m depth.

Overview and Results

Fish density, species abundance and biomass. All reef fish density in 2013 was high (2132±1985 fish/500m^2). Of the total reef fish density recorded, 137.17±92 fish/500m^2 are target fishes (Fig. 20. All reef and target fish density was highest in 2008 (all reef: 4126.67±805 fish/500m^2, target: 104±22 fish/500m^2) and appears to decrease by 2013. However, statistical tests revealed no significant change overtime. Outside, the same pattern was observed wherein target fish density decreased significantly (1-ANOVA, DF=4, P=0.006) from 2008 (607.3±151 fish/500m^2) to 2013 (87.4±45 fish/500m^2, Fig. 21). Similar with previous sites, species abundance was also high in 2013 (67.71±28 species/500m2) wherein it was higher compared to the adjacent area (outside: 48.29±17 species/500m^2, Fig. 34). Target biomass was recorded at 31.76±39 kg/500m^2 in 2013 (Fig. 35).

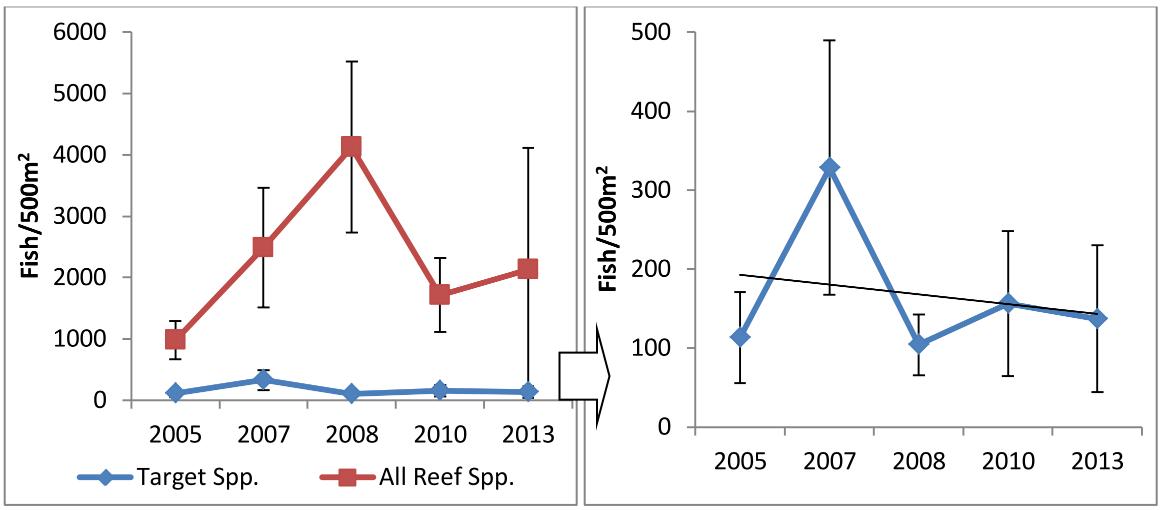


Figure 20.Mean (±SD) number of fish/500 m^2 inside Zaragosa Island from 2006 to 2013, 7-8m depth.

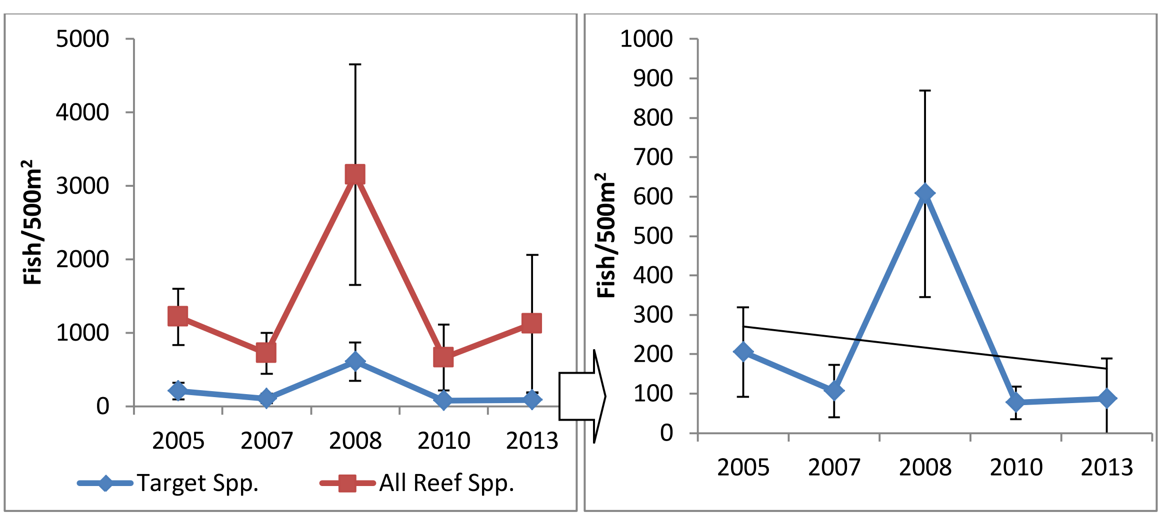


Figure 21.Mean (±SD) number of fish/500 m^2 outside Zaragosa Island from 2006 to 2013, 7-8m depth.

Overview and Results

Lambog Fish and Seagrass Sanctuary

Substrate. LHC in Lambog was also fair both in the shallow and deep area in 2013 (Figs. 22 and 23). LHC was recorded at 45.71±24% and 50.3±12% (shallow and deep respectively). Overtime, LHC in the deep appears to decrease wherein it was significantly lower in 2008 both inside (1-ANOVA: P=0.001) and outside (1-ANOVA: P=0.001) the sanctuary (Fig. 23). A decreasing pattern was also observed for LHC on the shallow area (Fig. 22).

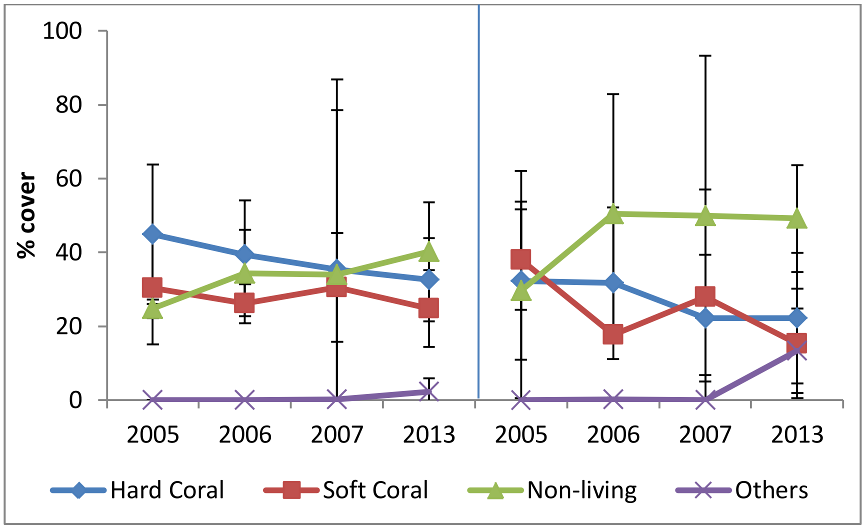


Figure 22.Changes in substrate composition (% mean ±SD) in Lambog from 2005 to 2013, 2-3m depth.

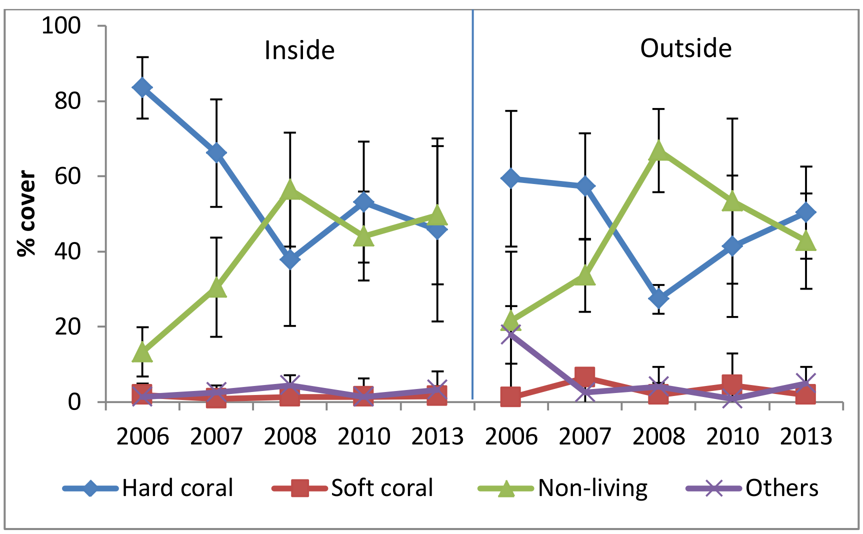


Figure 23.Changes in substrate composition (% mean ±SD) in Lambog from 2005 to 2013, 7-8m depth.

Overview and Results

Fish density, species abundance and biomass. All reef fish and target fish density was recorded at 1666.86±864 fish/500m^2 and 205.29±188 fish/500m^2 in 2013 (Fig. 24). Based from the index category of Hilomen et al. (2000) reef fish density in Lambog is high. Conversely, all reef fish and target fish density inside and outside appears to decrease overtime. 1-ANOVA test revealed that the decrease inside is significant (all reef: DF=5, P=0.000, target: DF=4, P=0.0001) as shown by the regression line (Figs. 24 and 25). Species abundance was recorded at 57.43±21.2 species/500m^2 and 54.43±13 species/500m^2 (inside and outside respectively, Fig. 34) while target fish biomass was at 23.12±32 kg/500m^2 in 2013 (Fig. 35).

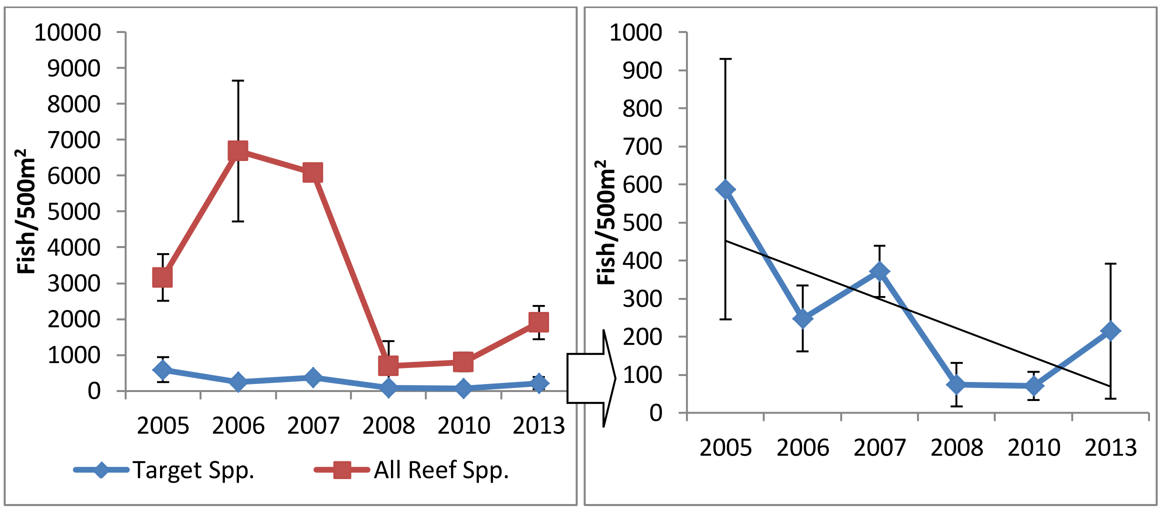


Figure 24.Mean (±SD) number of fish/500 m^2 inside Lambog from 2006 to 2013, 7-8m depth.

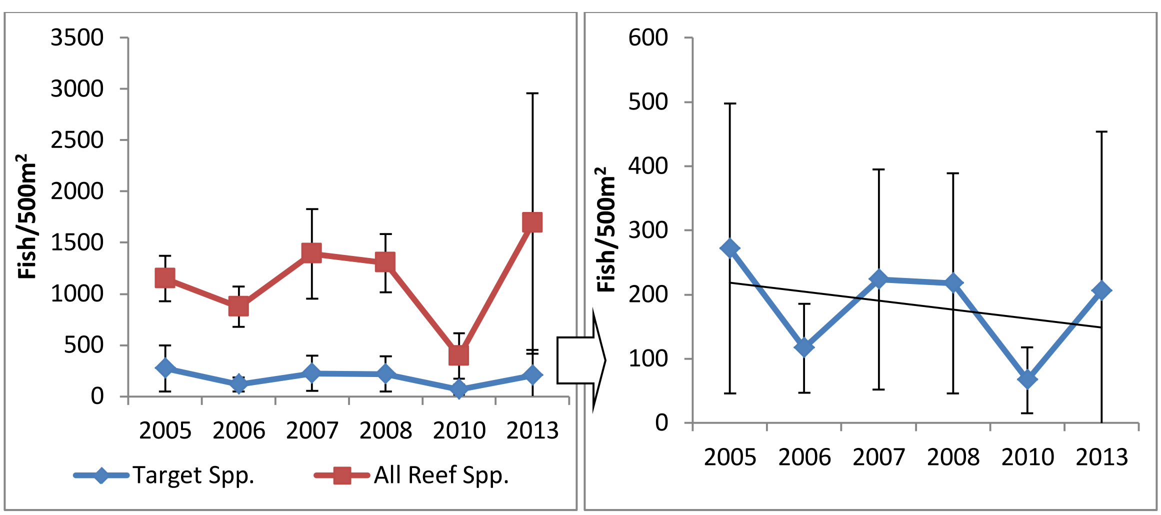


Figure 25.Mean (±SD) number of fish/500 m^2 outside Lambog from 2006 to 2013, 7-8m depth.

INVERTEBRATE SURVEY RESULTS

Indicator invertebrates were surveyed along most 6-8m substrate transects to determine the density of these organisms. It can be noted in the Table below that invertebrate densities are low and that those of particular interest (e.g. Crown of thorns seastar and Giant clams) are not abundant. It is good that few Crown of thorns have occurred in the area while it would be preferable if the density of Giant clams were higher than it is given the efforts to restock reefs with these species in recent years.

Table 1. Selected indicator invertebrate densities (no./100m^2) inside and outside of Moalboal MPAs

Organism	Saavedra								Pescador Is.		Basdiot		Tuble				
	INSIDE						OUTSIDE		INSIDE		INSIDE		INSIDE		OUTSIDE		
	2001	2003	2005	2006	2007	2013	2005	2007	2001	2003	2003	2013	2006	2013	2006	2007	2013
	n=9	n=4	n=2	n=2	n=2	n=10	n=2	n=2	n=10	n=4	n=4	n=8	n=2	n=10	n=2	n=2	n=10
Diadema urchin	0	0	0	0	0	0	0.5	0	15.3	0	0	0	0	0.1	0	5	0.3
Pencil urchin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0
Crown-of-thorns Seastar	0	0	0	0	2	0	1.5	0.5	0.3	0	0.5	0	0	0	0	0	0
Giant clam	0.3	0.3	0.5	0.5	0	0	0.5	0.5	0.5	1.5	1	0.1	0	0	0	0	0
Triton Shell	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
Lobster	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea cucumber	0.8	1.8	0	0.5	0	0.4	0	0	0.3	0	0.8	0	0.5	0	0.5	0	0.1
Banded coral shrimp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Species list of butterflyfish in municipality of Moalboal from 2001 to 2013.

Butterfly species	Common name	Basdiot FS			Pescador Is. MS			Saavedra FS				Tuble MS		
		2008	2010	2013	2001	2010	2013	2001	2008	2010	2013	2008	2010	2013
Chaetodon adiergastos	Philippine butterflyfish			Z			Z	O	Y	X	Z			
Chaetodon auriga	Threadfin butterflyfish					X		O		X				
Chaetodon baronessa	Eastern triangular butterflyfish	Y	X	Z	O	X	Z	O	Y	X	Z	Y	X	Z
Chaetodon bennetti	Bluelashed butterflyfish													
Chaetodon citrinellus	Speckled butterflyfish						Z							
Chaetodon ephippium	Saddle butterflyfish									X				
Chaetodon kleinii	Klein's butterflyfish				O		Z	O						
Chaetodon lineolatus	Lined butterflyfish						Z				Z			
Chaetodon lunula	Raccoon butterflyfish	Y	X	Z	O		Z		Y	X	Z	Y		Z
Chaetodon lunulatus	Pacific redfin butterflyfish							O	Y	X	Z			Z
Chaetodon melannotus	Blackback butterflyfish													
Chaetodon mertensii	Merten's butterflyfish													
Chaetodon meyeri	Meyer's butterflyfish													
Chaetodon ocellicaudus	Spottail butterflyfish				O		Z				Z			Z
Chaetodon octofasciatus	Eightband butterflyfish		X					O	Y	X				
Chaetodon ornatissimus	Ornate butterflyfish							O			Z			
Chaetodon oxycephalus	Spot-nape butterflyfish				O		Z				Z			Z
Chaetodon plebeius	Blueblotch butterflyfish													
Chaetodon punctatofascia	Spotband butterflyfish													
Chaetodon rafflesi	Latticed butterflyfish	Y	X		O		Z	O	Y		Z	Y		Z
Chaetodon reticulatus	Mailed butterflyfish						Z		Y	X				
Chaetodon selene	Yellowdotted butterflyfish													
Chaetodon semeion	Dotted butterflyfish													
Chaetodon speculum	Mirror butterflyfish			Z	O		Z	O	Y	X	Z	Y		Z
Chaetodon trifascialis	Chevron butterflyfish							O						
Chaetodon ulietensis	Pacific doublesaddle butterflyfish													
Chaetodon unimaculatus	Teardrop butterflyfish													
Chaetodon vagabundus	Vagabond butterflyfish						Z	O						
Chaetodon xanthurus	Pearscale butterflyfish						Z							
Chelmon rostratus	Beaked coralfish		X				Z							
Forcipiger flavissimmus	Forcepsfish											Y		
Forcipiger longirostris	Longnose butterflyfish											Y		
Hemitaurichthys polylepis	Pyramid butterflyfish	Y		Z	O		Z							
Heniochus acuminatus	Pennant coralfish						Z							
Heniochus chrysostomus	Threeband pennantfish													
Heniochus diphreutes	Schooling bannerfish						Z							
Heniochus monoceros	Masked bannerfish													Z
Heniochus singularius	Singular bannerfish	Y		Z			Z	O	Y		Z			Z
Heniochus varius	Horned bannerfish	Y	X	Z	O	X	Z	O	Y	X	Z	Y	X	Z
Coradion chrysozonus	Goldengirdled coralfish			Z			Z		Y	X	Z			
Coradion melanopus										X				
Total number of species/site		**6**	**6**	**8**	**9**	**3**	**20**	**13**	**11**	**12**	**13**	**7**	**2**	**10**

SUMMARY OF FINDINGS AND TRENDS

Substrate

Live hard coral (LHC) cover in the deep zones of Moalboal and Badian MPAs range from fair (35.71±10% in Zaragosa Island) to good (64.92±35% in Saavedra) while it is poor (16.46±16% in Lambog) to fair (33.67±21% in Basdiot) in the shallow zones in 2013. The recent survey results show that LHC in the majority of the MPAs decreased in 2013, of which, some were significant (Figs. 26 and 27). Moreover, the same decreasing pattern was also observed in the shallow areas (Figs. 28 and 29). The decrease in LHC was also paired with the increase in non-living substrates such as rubble and rock in 2013 (i.e. Tuble, Basdiot and Zaragosa). Anecdotal survey evidence suggests that some of the observed decrease in LHC in most of the sites may have been due to the magnitude 6.7 earthquake on February 6, 2012 wherein the Epicenter was between Moalboal and Guihulungan, Oriental Negros. This earthquake caused the sea level to recede and come back with strong waves crushing through the reef walls and damaging corals and pumpboats along the coast. Moreover, reef conditions were worsened by the typhoons that traversed thru the Visayas at the end of 2012. Considering these factors, the decline in LHC in most sites surveyed is modest and the reefs monitored show a good level of resilience.

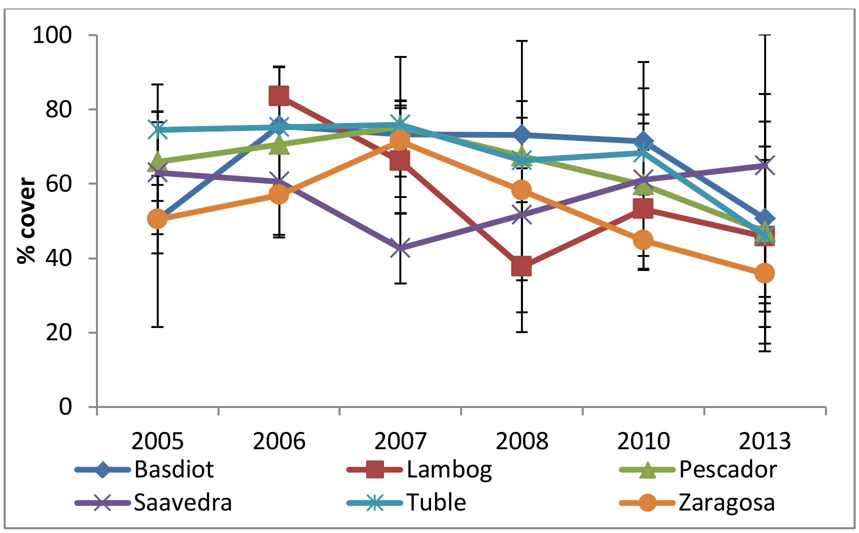


Figure 26.Changes in substrate composition (% mean ±SD) in 6 MPAs in Moalboal and Badian, Cebu from 2005 to 2013, 7-8m depth.

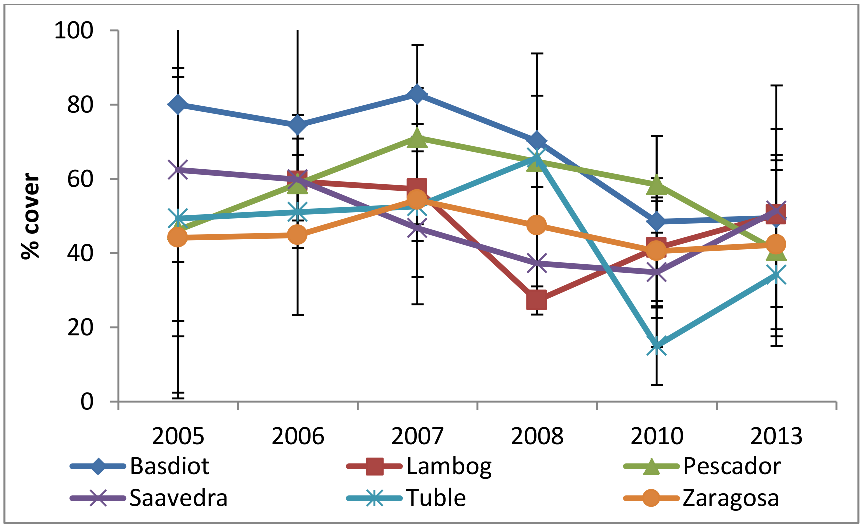


Figure 27.Changes in substrate composition (% mean ±SD) outside 6 MPAs in Moalboal and Badian, Cebu from 2005 to 2013, 7-8m depth.

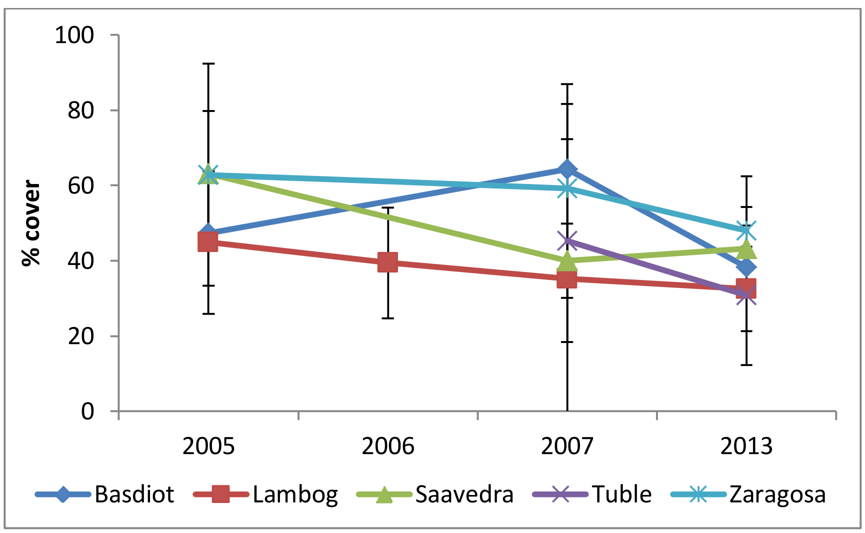


Figure 28. Changes in substrate composition (% mean ±SD) in MPAs in Moalboal and Badian, Cebu from 2005 to 2013, 2-3m depth

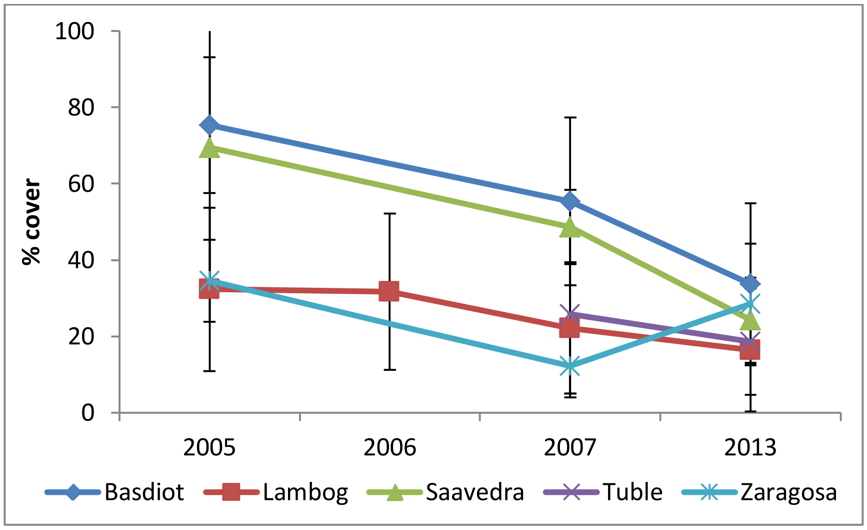


Figure 29.Changes in substrate composition (% mean ±SD) outside 6 MPAs in Moalboal and Badian, Cebu from 2005 to 2013, 2-3m depth.

Fish density, species abundance and biomass.

All reef fish density was highest in Pescador Island at 7387.33±2732 fish/500m^2 followed by Basdiot (6102.75±3531 fish/500m^2) and Saavedra (2928.4±1059 fish/500m^2) while target fish density was highest in Basdiot (2142±2743 fish/500m^2) followed by Saavedra (417±446 fish/500m^2) (Figs. 30-31). Moreover, target fish density within MPAs where strict enforcement is present, appears to improve overtime as compared to outside where heavy fishing pressure is evident (Figs. 32 and 33). This is also illustrated by the higher species abundance inside MPAs compared to the adjacent areas where little or no enforcement is being implemented (Fig. 34). Target fish biomass also appears to increase overtime inside the MPAs (Fig. 35). A clear picture is presented of the benefits of well protected no-fishing areas as represented by the small MPAs in Moalboal and Badian.

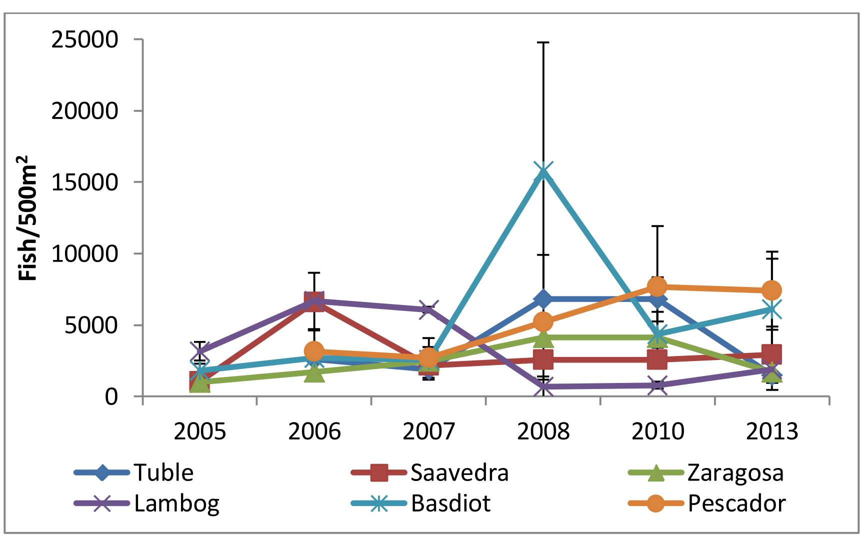


Figure 30.Mean (±SD) fish density(fish/500m^2) of all reef fish species in six MPAs in Moalboal and Badian, Cebu.

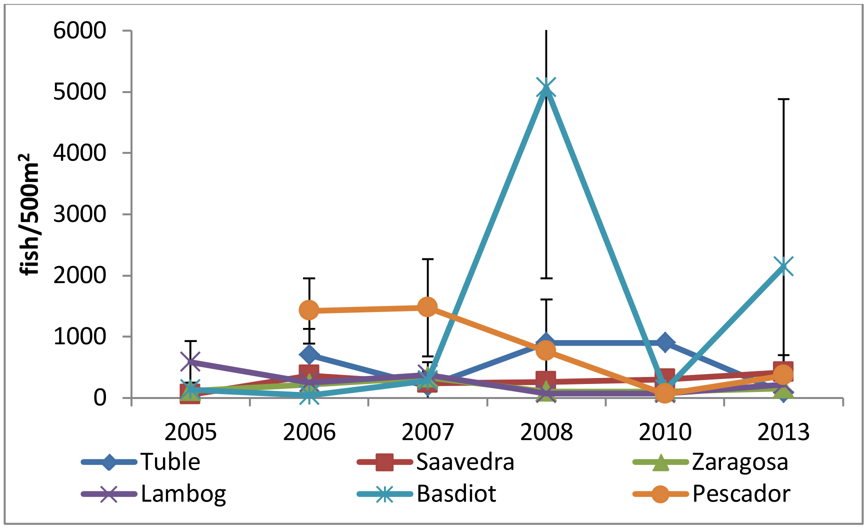


Figure 31.Mean (±SD) fish density (fish/500m^2) of target reef fish species in six MPAs sites in Moalboal and Badian, Cebu.

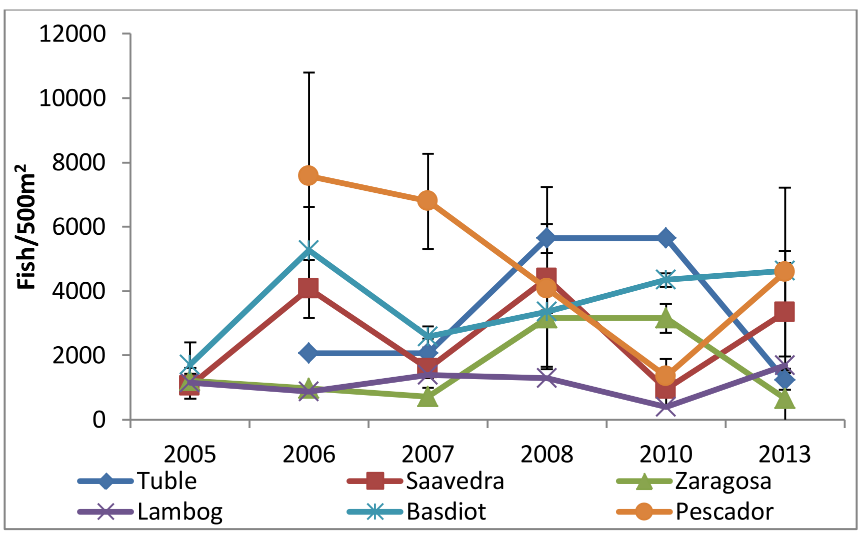


Figure 32.Mean (±SD) fish density (fish/500m^2) of all fish species outside six MPAs in Moalboal and Badian, Cebu.

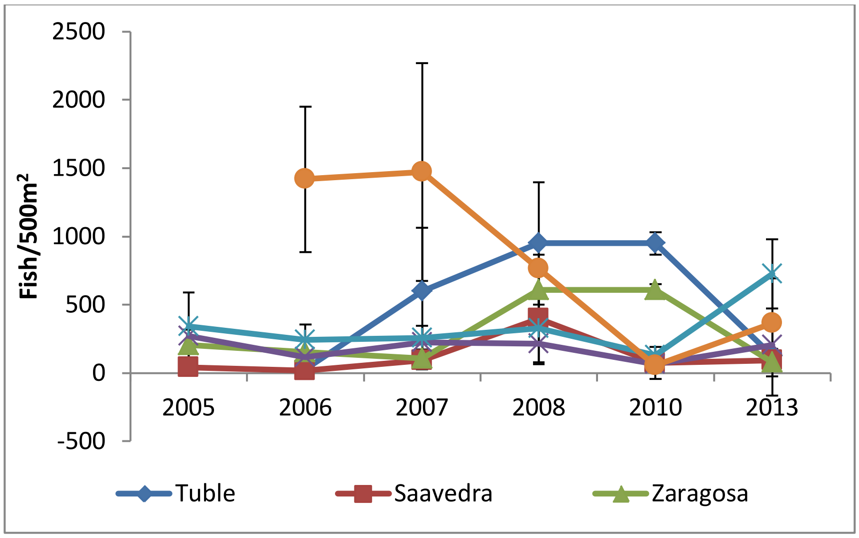


Figure 33.Mean (±SD) fish density (fish/500m^2) of target fish species outside six MPAs in Moalboal and Badian, Cebu.

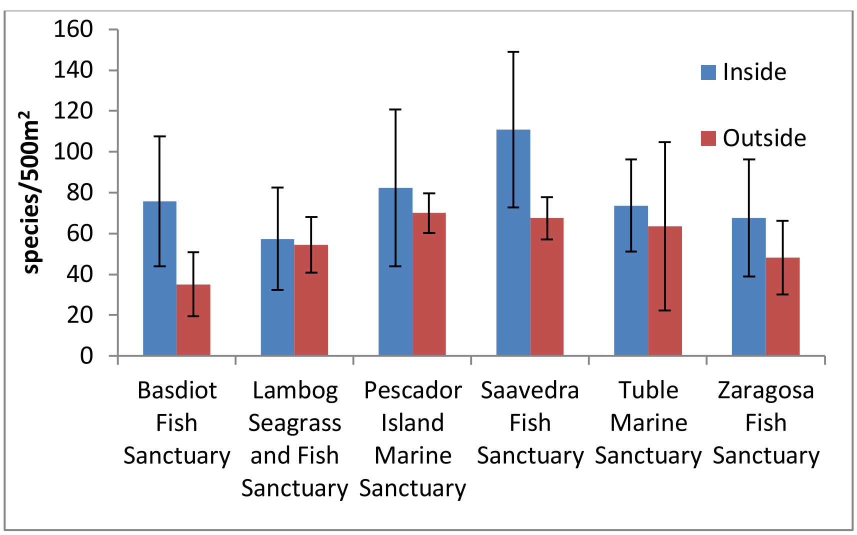


Figure 34.Mean (±SD) fish species abundance (species/500m^2) of target reef fish species in six MPAs in Moalboal and Badian, Cebu.

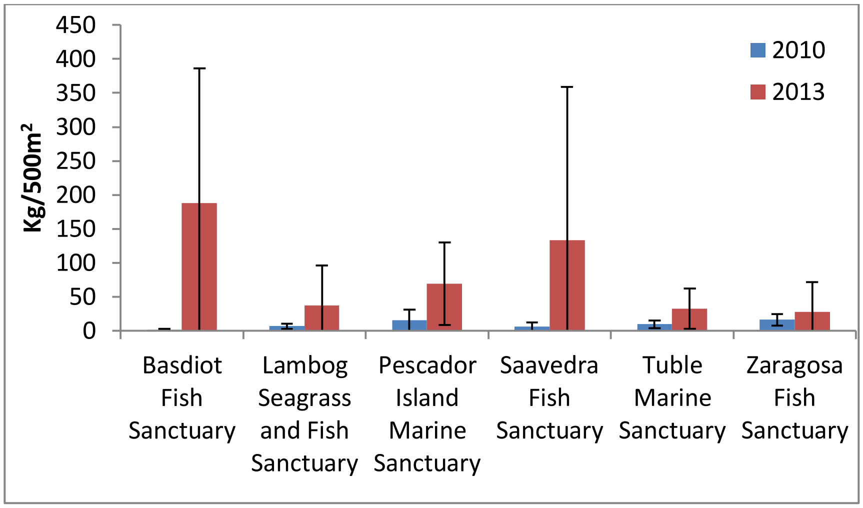


Figure 35.Mean (±SD) fish biomass (kg/500m^2) of target reef fish species in six MPAs in Moalboal and Badian, Cebu from 2010 to 2013.

RECOMMENATIONS FOR IMPROVED MANAGEMENT

Moalboal and Badian Municipalities have been very active in coastal resource management since the establishment of Saavedra Marine sanctuary and Zaragosa Island Fish Sanctuary in 1987 wherein they are two examples of the best managed small marine protected areas in the Philippines. However, there are still the challenges of sustaining the efforts to enforce the law against illegal activities, strengthen MPA management bodies in other MPAs and the ever growing volume of tourism. Recommendations to further enhance conservation of Moalboal and Badian MPAs follow:

1. **Continue monitoring for sustained management.** Since Moalboal and Badian already have long term data, it is important to continue reef monitoring activities because this data is very useful in understanding current environmental issues such as tourism, shoreline development, impacts of illegal fishing as well as long term impacts of sea level rise and ocean warming. With continuous monitoring, stakeholders and managers can be kept informed of the most critical issues that they need to address so that they can prioritize them in planning for and protection of the reef and its environs. They can also see the fruits of their protection efforts.

2. **Need for more and larger MPAs**. Moalboal and Badian have improved their marine conservation and marine resource management regimes markedly in the 27 years since the establishment of their sanctuaries. Now, in the midst of continued fishing pressure in the near-shore waters surrounding Cebu and the changing climate, more and larger no-fishing reserves

are needed to ensure that fish catches are sustainable, representation of ecosystems are achieved, and connectivity between reefs can return the local ecosystems to a balanced ecological condition. This will increase the fish biomass and resilience of the reefs and improve fish catch outside the marine reserves.

3. **Need to improve and sustain coastal fisheries law enforcement.** A main finding in the study is that there are low fish densities adjacent to most of the MPAs surveyed. This indicates that high fishing pressure exists and that it is necessary to control fishing activities inside and adjacent to MPAs. Such fishing pressure negates the contribution of the marine sanctuaries. Law enforcement of the no-take zones should be a primary concern of managing bodies. This also includes the prevention of commercial fishing vessels from fishing within municipal waters.

4. **Increase diver, boat operator, and visitor education**. With the ever increasing tourism in Moalboal and Badian, each dive and tourist operation needs to allocate time for diver and tourist education. This can highlight Cebu MPAs and their rules and regulations. Useful materials include: flip-charts, videos, handouts that explain MPA regulations and the do's and don'ts of the core sanctuary areas. Dive operations should have trained dive-masters and guides on dive trips who can brief visitors. Information on the natural and human history and on the uniqueness of Cebuano culture should be available for all.

ITINERARY OF EVENTS

Saving Philippine Reefs
Cebu Expedition April 14-21, 2013

DAY	DATE & SITE	TIME	ACTIVITIES
1	Sunday, April 14 Kasai Village Resort Moalboal, Cebu	8:00 AM	Rendezvous point at Montebello Garden Hotel, Cebu City to take bus to Kasai Village Resort, Moalboal
		12:00 PM	Arrival at Kasai Village and lunch
		1:00	Welcome and Briefing: Alan White, SPR Principal Investigator Aileen Maypa, SPR Co-Principal Investigator
		1:30	Dive Safety, SPR Dive Master
		2:00	Review of SPR research methods: Dean Apistar, Danilo Delizo, Nip-nip Porpetcho, Agnes Sabonsolin
		3:00	Checking of dive gear
		3:30	Snorkel calibration
		7:00	Dinner Slide show/Quiz and Identification
2	Monday, April 15 Tuble Marine Sanctuary	7:00 AM	Breakfast Morning briefing
		9:00	Practice scuba survey at Kasai Village House Reef
		12:00 PM	Lunch
		1:30	Conduct survey (scuba and snorkel)
		5:00	Compile and submit completed data e-forms
		7:00	Dinner CCEF General Presentation (Sheryll Tesch) CCEF in Moalboal (Rommel Kirit)
3	Tuesday, April 16 Saavedra Marine Sanctuary	7:00 AM	Breakfast/Morning briefing
		8:30	Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
		1:30	Conduct survey (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner Research/Project Presentation
4	Wednesday, April 17 Basdiot Marine Sanctuary	7:00 AM	Breakfast/Morning briefing
		8:30	Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
		1:30	Fun Dive (Sunken Island/"Airport")
		5:00	Compile and submit completed data forms
		7:00	Dinner

Appendix 1, Itinerary of Events

DAY	DATE & SITE	TIME	ACTIVITIES
			Night Dive (optional)
5	Thursday, April 18 Lambog Island Marine Sanctuary	7:00 AM	Breakfast/Morning briefing
		8:30	Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
		1:30	Conduct surveys (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner Research Presentation Slide show of volunteer pictures
6	Friday, April 19 Zaragoza Island Marine Sanctuary	5:00 AM	Morning Fun Dive
		7:00	Breakfast/Morning briefing
		8:30	Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
		1:30	Conduct surveys (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner Research/Project Presentation Slide show of volunteer pictures
7	Saturday, April 20 Pescador Island Marine Sanctuary	7:00 AM	Breakfast/Morning briefing
		8:30	Conduct surveys (snorkel and scuba)
		12:00 PM	Lunch
		1:30	Conduct surveys (scuba)
		5:00	Compile and submit completed data forms
		7:00	Dinner Summary: Impressions and Debriefing (Alan)
8	Sunday, April 21 Cebu City	7:00 AM	Breakfast Closing/Summary
		11:00	Depart by bus to Cebu City

Expedition Staff and Volunteers

Saving Philippine Reefs Volunteers
April 14-21, 2013
Moalboal and Badian, Cebu, Philippines

	Name/Address	Profession/Affiliations/Interests
1	**Denise Illing** Australia	Part of UNICO Computer Systems Finance dept. BA in Geography and Sociology. Interested in marine life, reefs, and diving. Wildlife artist. Water-colorist. Amateur photographer. 11th Saving Philippine Reefs Expedition.
2	**Geoff Illing** Australia	Technical Director UNICO Computer Systems. Interests: Amateur musician, playing clarinet, bass clarinet, sax and bassoon in concert bands, orchestra and small ensembles. 11th Saving Philippine Reefs Expedition.
3	**Thomas J. Mueller** U.S.A.	Retired college professor (Biology), educational consultant to Higher Education, enjoy diving, sailing & travel. CCE Foundation Board member. 14th Saving Philippine Reefs Expedition.
4	**Alexander Douglas Robb** Australia	IP Researcher, Civil Engineer BSC (Hons) Edinburgh MSC Melbourne – History & Philosophy of Science; Interest - History & Philosophy of Science. 8th Saving Philippine Reefs Expedition.
5	**Alastair Pennycook** Australia	Professor of Language Studies, University of Technology Sydney. Yachting Australia Coastal Skipper and PADI Master Diver, underwater photography. 6th Saving Philippine Reefs Expedition.
6	**Vittoria Thornley** United Kingdom	Office Manager, Thornley Kelham Ltd. Conservation volunteer; interest in gardens, nature conservation, travel writing and yoga. 11th Saving Philippine Reefs Expedition.
7	**Julia Cichowski** USA	V.P.User Experience Design, Fidelity Investments; Board of Direcor, Oceanic Research Group; Production team for Jonathan Bird's Blue World, an educational underwater adventure series on Public Television in the U.S.; Formal education in Computer Science and Economics and; Amateur underwater photographer; Divemaster 11th Saving Philippine Reefs Expedition.
8	**Laurent Boillon** Australia	Pastry Chef. Certified SSI Advanced Open water, Advanced Nitrox; Advanced Decompression: Deep; Night. 5th Saving Philippine Reefs Expedition.
9	**Mark Copley** U.S.A.	Engineer. 4th Saving Philippine Reefs Expedition.
10	**Sherry Marris** Australia	Aquatic Scientist/Environmental Comunication; 2nd Saving Philippine Reefs Expedition.
11	**Oliver Thornley** United Kingdom	Student. Snorkeler. Interested in all sports especially cricket. 2nd Saving Philippine Reefs Expedition.

Appendix 2, Expedition Staff and Research Volunteers

Saving Philippine Reefs Staff
April 14-21, 2013
Moalboal and Badian, Cebu, Philippines

	Name/Address	Profession/Affiliations/Interests
1	**Dr. Alan T. White** Principal Investigator U.S.A.	Senior Scientist and Coral Triangle Program Manager, The Asia-Pacific Program, The Nature Conservancy President Coastal Conservation and Education Foundation, Inc.
2	**Dr. Aileen P. Maypa** Co-Principal Investigator Philippines	Research Director, CCEF
3	**Evangeline White** SPR Project Manager USA	SPR Expedition Project Manager YWCA of Oahu Membership and Wellness Program Manager
4	**Agnes Sabonsolin** Logistics Assistant Philippines	Marine Biologist – Substrate Research Monitoring Team CCE Foundation, Inc
5	**Dean Apistar** Research and Data Coordinator Philippines	Marine Biologist Team Leader – Research Monitoring Team, CCEF
6	**Rafael Martinez** GIS Specialist Philippines	GIS Specialist and Database Programmer CCEF
7	**Michelle Baird** Substrate/Invertebrate Specialist Philippines	Project Coordinator CCEF
8	**Roxie Diaz** Divemaster Philippines	Marine Biologist Research Monitoring Team CCE Foundation, Inc.
9	**Wenifel Porpetcho** Fish Visual Census Specialist Philippines	Marine Biologist Research Monitoring Team CCE Foundation, Inc.
10	**Danilo Delizo, Jr.,** Fish Visual Census Specialist Philippines	Marine Biologist Research Monitoring Team CCE Foundation, Inc.
11	**Dalton Dacal** Substrate/GIS Specialist Philippines	Marine Biologist Research Monitoring Team CCEF

Appendix 3, Expedition photos

Arrival of the Team at Kasai Village Resort. (first row, R to L) Michelle, Dalton, Danilo, Agnes, Aileen, Laurent, Roxy, Denise, Geoff, Sheree, Vangie, Vittoria (second row, R to L) Oliver, Sandy, Alastair, Alan, TJ, Mark, Julia, Raffy and Dean.

Alan counting fish (left) and Oliver enjoying his snorkeling (photos by Vangie White).

Ghost-goby on gorgonian corals.

Appendix 3, Expedition photos

Philippine (panda) butterflyfish (photo by Alastair Pennycook).

Well-camouflaged stonefish (photo by Sheree Marris).

Photo by: Laurent Boillon

Photo by: Laurent Boillon

Ornate Ghost Pipefishes

Photo winner for the SPR T-shirt, 2013! Photo by:Michelle Baird

Appendix 3, Expedition photos

Photo by: Vangie White

Photo by: Agnes Sabonsolon

Sea turtles were seen on most dives in Moalboal and Badian—a sign that their population numbers are increasing!

.

Photo by: Laurent Boillon

Close photos of Shrimp on anemone.

Photos by: Laurent Boillon

Appendix 3, Expedition photos

Vangie admiring the diverse reefs, with the presence of giant clam (top) and a seahorse posing for a snapshot! Photos by Laurent Boillon

<u>Appendix 3, Expedition photos</u>

The team enjoyed the healthy reefs in Moalboal (top photo by Vittoria Thornley; bottom photo by a guest at Kasai).