



LRCP

Southern Leyte Coral Reef Conservation Project

Coral Cay Conservation Proposed Marine Protected Area Report: Barangay Punta 2015

Report Date: July 2016

**CORAL CAY
CONSERVATION**



Expeditions

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In partnership with the Southern Leyte
Provincial Government, Philippines



Coral Cay Conservation
Marine Protected Area Assessment Report
Barangay Punta – 2015 Proposed MPA Assessment
Liloan, Southern Leyte, the Philippines

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Edinger, Evan N., and Michael J. Risk. "Reef classification by coral morphology predicts coral reef conservation value." *Biological Conservation* 92.1 (2000): 1-13.

Russ, G. R., and A. C. Alcala. "Marine reserves: long-term protection is required for full recovery of predatory fish populations." *Oecologia* 138 (2004): 622-627.

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EXECUTIVE SUMMARY

- Coral Cay Conservation (CCC) conducted an assessment of the reef fishes, invertebrates, substrates and anthropogenic impacts at the Barangay Punta MPA in the Municipality of San Francisco.
- An enhanced Reef Check methodology was used to complete biophysical surveys of eight 100m transects, each containing four 20m replicates. Transects were equally divided between depths of 6m and 12m, with 3 conducted inside and 5 conducted outside the MPA.
- There was no significant difference in the abundance or diversity of fishes between the sites inside or outside the MPA.
- Commercially important species of Parrotfish, Groupers and Snappers were recorded in medium to low abundance across the site, with no individuals greater than 30cm in length. Most were small with 45.45% falling in the 0-10cm category and 42.21% within the 11-20cm category.
- Invertebrate abundance and diversity was not significantly different inside compared to outside the MPA. Invertebrate abundance was found to be significantly higher at outside transect 5 compared to all other transects except inside transect 3.
- Silt was the dominant substrate inside the MPA, followed by hard coral. Hard coral was the dominant substrate outside the MPA, followed by silt.
- Anthropogenic impacts were observed to be low. Fishing trash was seen in low abundance inside and outside the MPA as well as during the visual assessment. Fish traps were also spotted during the visual assessment. White banded coral disease was recorded outside the MPA.
- The lack of significant differences in abundance of fishes, invertebrate and substrate suggests that the MPA is not currently effective at protecting the area due to multiple factors including the small size of the MPA, illegal activities occurring within the MPA, and low levels of enforcement.
- Based on the results of this survey, CCC recommends the Punta MPA be extended to include the full survey area. This would increase the size and effectiveness of the MPA, giving the coral reef community the best chance to recover and thrive.
- It is recommended that consultation be started between the local community, municipal and provincial government as well as CCC on the possible extension.

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We would also like to thank the Barangay Council of Punta and the Municipality of San Francisco for facilitating the MPA assessment. In particular we would like to acknowledge the cooperation of Servando Tio Jr (Bandyoy), SB secretary of San Francisco and the honourable Captain Bennie Deloso, Barangay Captain of Punta. We would also like to thank our trained volunteers, staff and scholars who collected vital data during this proposed MPA assessment.

LIST OF ACRONYMS AND ABBREVIATIONS

CCC	: Coral Cay Conservation
CoTs	: Crown of Thorns Seastars (<i>Acanthaster planci</i>)
HC	: Hard Coral
IUCN	: International Union for the Conservation of Nature
LGU	: Local Government Unit
MR	: Marine Reserve
MPA	: Marine Protected Area
MPA MEAT	: MPA Management Effectiveness Assessment Tool
NIA	: Nutrient Indicator Algae
NIPAS	: National Integrated Protected Area System
NTA	: No-Take Areas
PENRMO	: Provincial Environmental and Natural Resource Management Office
PGSL	: Provincial Government of Southern Leyte
PRRCFI	: Philippines Reef and Rainforest Conservation Foundation Inc.
PRRP	: Philippines Reef and Rainforest Project
RB	: Rubble
RC	: Rock
RKC	: Recently Killed Coral
SC	: Soft Coral
SD	: Sand
SE	: Standard Error
SI	: Silt
LRCP	: Southern Leyte Reef Conservation Project
SP	: Sponge
UVC	: Underwater Visual Census

CORAL CAY CONSERVATION

Initially founded in 1986, CCC is an internationally renowned organisation which provides host countries with appropriate resources for the protection and sustainable use of tropical ecosystems. This protection is established to enable future generations the continued use of local ecosystem resources. These goals are outlined in CCC's mission statement:

"Providing resources to help sustain livelihoods & alleviate poverty through the protection, restoration & management of coral reefs & tropical forests."

CCC achieves its mission via the formation of long-term programmes of collaborative research with local institutions and governments. Such research programmes require technical support from CCC, in the form of scientific data collection, data analysis and the production of reports and integrated coastal zone management plans. CCC also provides communities with education, training and alternative livelihood opportunities to strengthen local human resources to the point where research can be continued independently by the host country.

CCC has carried out conservation projects all over the world, including the Philippines, the Caribbean, Belize, Honduras, Malaysia, Cambodia and Fiji. CCC has successfully set up numerous Marine Protected Areas (MPAs) throughout these regions and provided essential scientific data for the management of their local marine resources. Successfully established areas in the Philippines are a result of the Philippines Reef and Rainforest Project (PRRP). CCC established PRRP in collaboration with the Philippine Reef and Rainforest Conservation Foundation Inc. (PRRCFI) and the World Land Trust in 1995. Such protected areas include the coastal regions of the Southern Negros Occidental, Anilao, Palawan, Danjungan Island, the forests of North Negros and Padre Burgos.

In 2002, the PGSI invited CCC and the PRRCFI to conduct research in Sogod Bay. This resulted in the formation of the Southern Leyte Reef Conservation Project (LRCP). The LRCP utilises trained volunteers to survey the region's coral reefs and provide training and conservation education opportunities for project counterparts. The aim of this is to develop local capacity and ensure the long-term protection and sustainable use of marine resources throughout Southern Leyte. Between 2002 and 2013, CCC focused on implementing baseline surveys throughout Sogod Bay to obtain information on the distribution of fish and invertebrate populations, benthic cover and reef health. In 2013, having surveyed much of the accessible area in the Bay, CCC shifted its focus to concentrate on MPA monitoring surveys. Under this new protocol surveys are implemented inside and outside of existing MPAs to evaluate their efficacy and in unprotected areas to assess their potential for MPA installation.

1. INTRODUCTION

1.1 Marine Protected Areas (MPAs) and Marine Reserves (MRs)

Marine resources are under increasing pressure from an ever growing global population (Jackson *et al.*, 2001). Strong declines in catch from worldwide fisheries, such as the North Atlantic Cod (Myers 1997) and Caribbean reef fisheries (Hardt 2009), have illustrated that biological marine resources are limited and highly vulnerable to overfishing (Jackson *et al.*, 2001; Pauly *et al.*, 2002). Additional pressures such as pollution, coastal development and climate change exacerbate this vulnerability. As a result, there is an increased drive for conservation efforts and resource management in the marine environment (Wood *et al.* 2008; CBD 2010). The protection of marine areas can achieve conservation and resource management targets simultaneously and are therefore considered instrumental to sustainable ocean utilisation (Pauly *et al.* 2002). The International Union for the Conservation of Nature (IUCN) defines an MPA as:

“A clearly defined geographical space, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with the associated ecosystem services and cultural values.”

MPAs have become vital tools in protective management for the conservation of marine resources. MPAs in the Philippines encompass “no take” areas (NTAs) (min. 5 hectares), within which no form of extraction is permitted. These NTAs surrounded by 50m “buffer zones” where only non-destructive fishing methods, such as hook and line fishing, are permitted. These large areas of no extraction combat resource exploitation by providing local communities with a sustainable supply of goods; such as fish and invertebrates; and services, such as shoreline protection and tourism (World Bank, 2005).

Generally, the most desired benefit of an MPA is increased fish production. This occurs as a result of overspill and larval export from the “no take” area into surrounding waters (Fig. 1). Over time, the displacement of fishing effort from the MPA results in an increase in adult fish biomass and fecundity. This results in adult fish and larvae being exported to the buffer zone and its surrounding waters. Local fishery yields subsequently increase because they have a continual and sustainable supply of stock (Maliao *et al.* 2004). In areas where there is the potential for increased tourism and anthropogenic pressure on the marine environment for food, recreation and other resources, the benefits and necessities of having a network of functioning MPAs are increased.

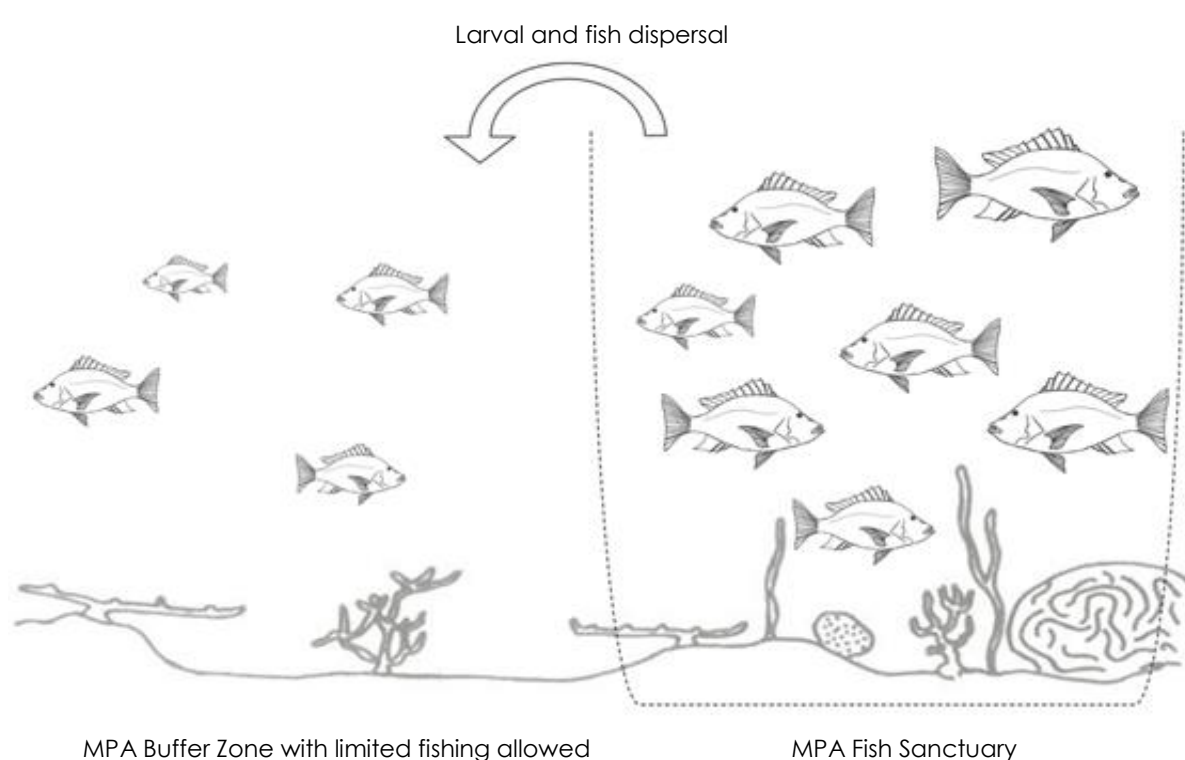


Figure 1. Schematic diagram of MPA functioning. Protected fish within the MPA fish sanctuary grow and produce offspring. This leads to 'overspill', increasing fish numbers inside and outside of the MPA. In addition, the corals inside the MPA are not disturbed by destructive fishing methods.

Marine Reserves (MRs) are areas of the marine environment where fishing is restricted to non-destructive methods, such as hook and line fishing. This reduces habitat damage often caused by destructive fishing methods, such as dynamite fishing, net fishing or trawling. MRs are preferable to areas of no protection but are not as effective as MPAs because fishing pressure remains present and is unselective. All sizes, ages and species of fish and invertebrates within an MR can still be extracted. Juveniles are often removed before they can reach reproductive age or size, causing populations to decline. Environmentally important species, such as algae-grazing parrotfish, are also removed, potentially allowing algae to proliferate and smother vital coral habitat often resulting in a transition from coral dominated reefs to those dominated by macro-algae. This transition is exasperated with the addition of excess nutrients into the water column through pollution and land run-off.

The success of a protected area is entirely dependent upon the cooperation of local stakeholders. Research has shown that the involvement of resource users in the planning, implementation and management of their own MPA increases their sense of ownership and pride. Only when local stakeholders feel they are adequately considered and regularly consulted on their MPA's management, will it be possible for the full potential of the MPA to be attained (Green *et al.* 2009, Human and Davies 2010). It is, therefore, essential that the local community is involved with the entire process of protected area establishment. Stakeholders must be consulted about key aspects of the MPA establishment process, such as size and location and directly involved in their management e.g. via community Bantay Dagats (marine guards).

1.2 Coral Reefs & Marine Conservation in the Philippines

The Philippines lies within a region known as the Coral Triangle, which also includes Indonesia, Malaysia, Papua New Guinea, Timor-Leste and the Solomon Islands. It is recognised as the global epicentre of marine biodiversity as it is home to the oldest coral reefs and the largest expanses of mangrove forest in the world (Roberts *et al.*, 2002). More than 75% of the world's known coral species and over 30% of the world's coral reefs are found in the Coral Triangle (Veron *et al.*, 2009). The same extraordinary diversity is also found in other types of marine organisms; with over 3,000 species of fish recorded, even higher figures for molluscs and new species still being discovered regularly (Allen, 2008).

The waters of the Philippines contain roughly 25,000 km² of coral reefs. An estimated 60% of the country's 92 million citizens live in coastal regions within close proximity to coral reefs and over half of the consumed animal protein comes from marine sources (CTI, 2012). This heavy reliance on marine resources has caused large areas of coral reef ecosystems to become threatened. In 1980, 33% of coral reefs were characterised as being in poor condition, in 2008 this figure had increased to 40% (Wilkinson, 2008). These figures make a strong case for increased marine conservation efforts within the Philippines. Jacinto *et al.* (2000) stated that legislation concerning marine conservation in the Philippines is some of the most advanced within the Coral Triangle. Important laws currently instigated in the Philippines include:

- 1998 Fisheries Code (Republic Act 8550): 15% of municipal waters should be within an MPA.
- Marine and Coastal Resource Protection Act 2011: Each municipality should have at least one MPA that is bigger than 10 hectares (if the total municipal waters are larger than 15 hectares).
- The Philippine Marine Sanctuary Strategy (2002): By 2020, 10% of all the Philippine marine waters will be fully protected.

Currently there are roughly 1,640 MPAs in the Philippines. Of these MPAs, 33 have been declared at national level as National Integrated Protected Area System (NIPAS) sites and the remainder are managed by Local Government Units (LGUs). Box 1 highlights two case studies of successful MPAs in the Philippines (Fig. 2).

Case Study: The success of MPAs within the Philippines – Apo Island and Sumilon Island

The MPAs at Apo Island and Sumilon Island are some of the best known examples of successful tropical marine conservation efforts in the world. Years of monitoring have provided accurate data that shows what can be achieved if the coral reef inside an MPA is given chance to recover (Fig. 1). Results also show that although an increase of biomass was observed in the first years of reserve protection, the biggest increase in biomass took several years to become evident (5-10 years). Unequivocal evidence of overspill from these MPAs remains elusive but the increased number and size of fish within the fish sanctuary make it likely the MPA is a source for net larval export that aids recovery of fish stocks in the area. Indirect positive effects of the effective management of these MPAs include increased tourism income and the elimination of unsustainable fishing practices such as dynamite fishing (Russ and Alcala, 2004)

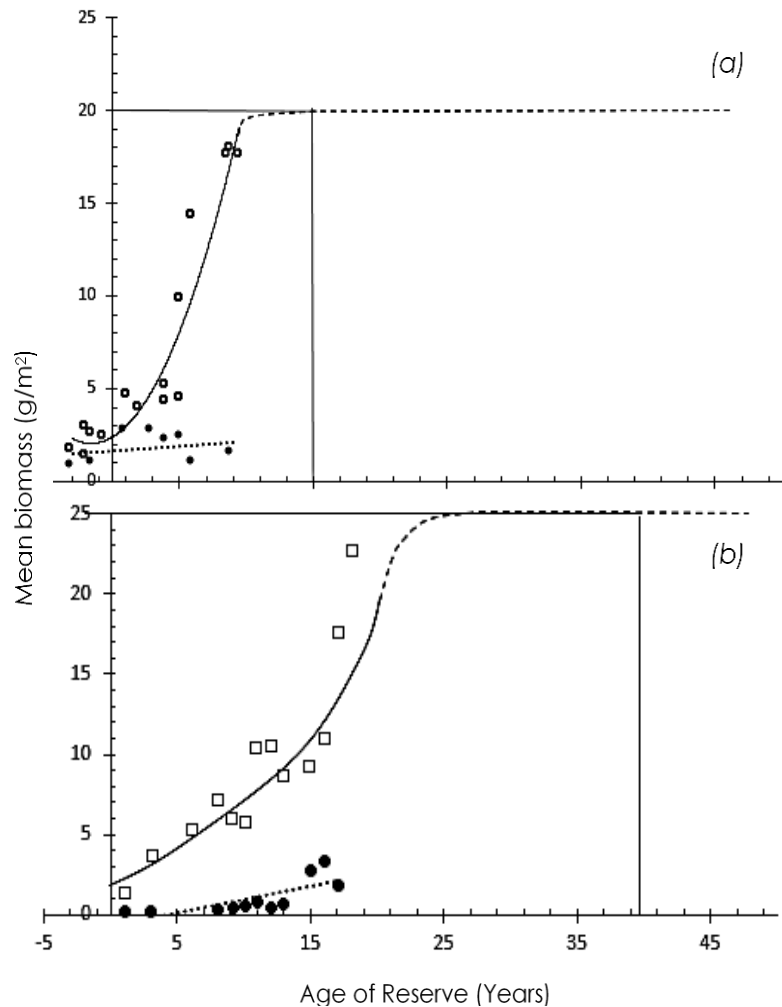


Figure 2. Observed (no-fill markers), control (filled markers) and projected (dashed line) increases in mean biomass (g/m^2) of commercially important fish species inside Apo Island (a) and Sumilon Island (b) MPAs. Data and figures adapted from Russ and Alcala (2004).



1.3 Characterisation of Study Region

1.3.1 Southern Leyte and Sogod Bay

The coral reefs of Southern Leyte remain some of the least disturbed habitats in the Philippines. The coastal regions that include Canigao Channel in the west, Sogod Bay, Cabalian Bay, the northeastern Pacific coast and the Surigao Strait are rich in marine life and are important fishing grounds for local communities. The area is rich in tuna, flying fish, herrings, anchovies, shellfish and Spanish mackerel. Sogod bay has been targeted by the Fisheries Sector Program of the Department of Agriculture as one of the country's ten largest bays in need of assessment and management (Calumpong *et al.*, 1994). The region is also a feeding ground for charismatic megafauna such as pilot whales, melon-headed whales, dolphins, manta rays and whale sharks. The coast is characterised by naturally limited mangrove areas, narrow fringing coral reefs, limited seagrass beds and narrow intertidal areas and beaches (Calumpong *et al.*, 1994).

Currently there are ~30 established MPAs within Sogod Bay covering an estimated 292 hectares. These figures will increase in the coming years as more MPAs are set up. Sizes of MPAs range from 3.5 hectares (Maujon/Juargon Fish Sanctuary) to 55 hectares (Limasawa Fish Sanctuary), with a mean average size of 11.7 hectares (± 2.2 SE) and a median average of 7.9 hectares (Galviola, 2014). The sizes for several MPAs are not known, as accurate GPS coordinates are not available.

1.3.2 Barangay Punta and MPA assessment

A Marine Reserve (MR) was established in Punta in 1997 by the previous Barangay Captain Carlito Paug Sr. This was managed with an open and closed season for fishing. Sadly, in 2003 a devastating landslide occurred, which destroyed the barangay of Punta and covered much of the Marine Reserve with silt. Thus the reserve was abandoned and the village relocated. In 2009 it was decided to establish an MPA on the site of the old Marine Reserve. Coral Cay Conservation conducted preliminary surveys in order to establish a suitable location for the MPA. With the help of the Local Government Unit of San Francisco, Barangay officials and Coral Cay Conservation, Punta MPA was established in June 2009 (Fig. 3).

The MPA is 6.9 Ha, including a buffer zone. Fishing and gleaning are not allowed within the MPA and buffer zone area. The MPA is supported by Municipal Ordinance 128, s2009. The overall management of all of the MPAs in San Francisco is overseen by a Technical Working Group which is made up of members of San Francisco LGU and Barangay Captains. The day-to-day management of Punta MPA is overseen by a Management Committee which is comprised of Barangay Officials. Currently the main management issues are lack of enforcement of the MPA rules and lack of infrastructure. The MPA does not have a guardhouse or a full time warding system and thus fishing occurs inside the MPA on a regular basis.

2. METHODS

2.1 Survey Site

CCC's assessment of the MPA site for Punta (Fig. 3) was conducted between 10th November and 1st December 2015 by trained volunteer survey teams. Weather throughout the survey period was cloudy, with no major weather systems moving through the region. Mean air temperature during surveys was 27.5°C. Mean water temperature was 27.9°C on the surface, 27.0°C at a depth of 3m and 26.9°C at 10m. The mean estimated horizontal visibility throughout the survey was 8.88m.

Through discussions with Punta's Barangay captain, it was determined that the levels of direct anthropogenic stressors currently experienced by the coral reef and surrounding areas are minimal. This is due to superstition surrounding the area held by the local Punta community, that, in turn, reduces the amount of traffic the protected site experiences. Despite no apparent direct anthropogenic stressors, the area currently experiences historic detrimental impacts from the landslide that occurred. It is thought that as the landslide swept silt and mud into the reef, a large quantity of pollutants composed the landslide matter. These pollutants are currently residing below the sediment, however are re-suspended into the water column through disturbances, releasing the pollutants at the detriment to the local coral reef, its fauna and flora.

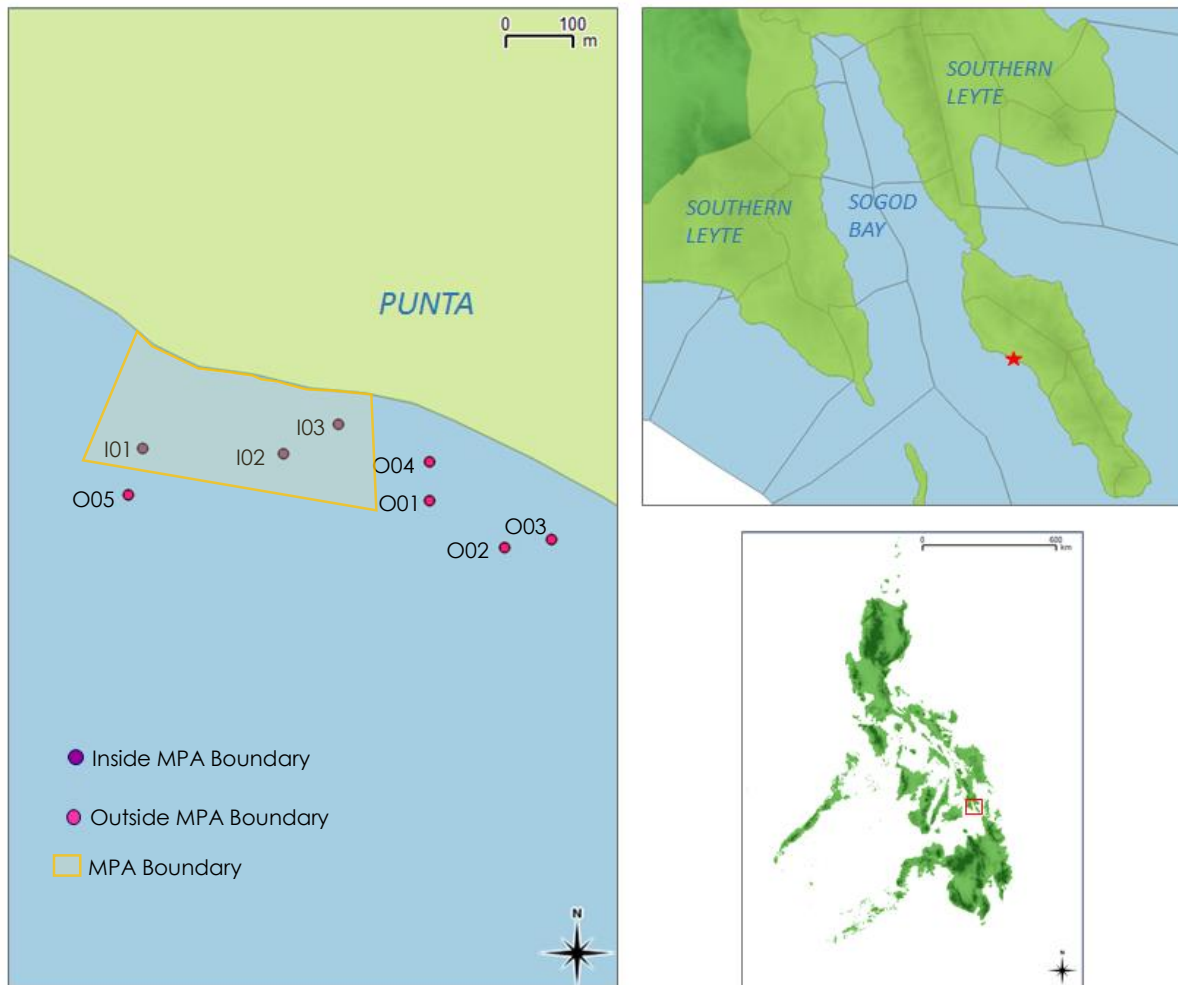


Figure 3. Map of survey locations within the waters of the Barangay Punta, Municipality San Francisco, Southern Leyte(a) and the respective wider geographic region with regards to the municipality boundaries (b) and the Philippines (c). Marine Protected Area coordinates: North west point (Latitude 10° 2'50.38"N, Longitude 125°10'3.56"E), South west point (Latitude 10° 2'49.36"N, Longitude 125°10'8.89"E), South east point (Latitude 10° 2'50.64"N, Longitude 125°10'11.56"E), North east point (Latitude 10° 2'57.16"N, Longitude 125°10'11.18"E). Maps created through ArcGIS.

2.2 Biophysical Survey

The assessment of the proposed MPA site was conducted using an enhanced Reef Check methodology, a widely recognised methodology that is used to survey coral reefs around the world. It was developed in the 1990s with the aim of gathering as much data as possible about the global status of coral reefs (Hodgson, 1999). Data from around the world is analysed on a yearly basis to enable the production of global coral reef status updates. Reef Check surveys produce a representation of the ecological status of a reef and its human impacts. CCC has augmented the methodology in order to reflect the high biodiversity of the area with the addition of extra target species of fish, coral and invertebrates (see Appendix).

Transects were laid along the reef, parallel to the shore, on a South-East, North-West bearing at 6m and 12m depths (+/- 1 meter depending on tides). One 12m inside survey site was conducted outside the MPA boundaries due to inaccurate GPS coordinates. This site was included in the analysis as outside transect 5. As such, two

transects were situated at a depth of 6m and one transect was situated at a depth of 12m inside. Outside the MPA two transects were situated at a 6m depth and three at 12m (including outside transect 5), giving a total of 8 transects in the area (Table 1). Each 100m transect was divided up into four 20m replicates, separated by 5m gaps in which no data was collected. This produced a total surveyed length of 80m. A distance of approximately 100m was left between each whole transect. This survey design allows for robust statistical analysis of the collected data.

Table 1. Depths and coordinates for the eight transects surveyed along the coast of Barangay Punta, southern Leyte, the Philippines.

Transect	Depth (m)	Easting (UTM)	Northing (UTM)
Inside 1	12	737482	1111519
Inside 2	6	737693	1111510
Inside 3	6	737774	1111555
Outside 1	12	737909	1111441
Outside 2	12	738021	1111371
Outside 3	6	737909	1111498
Outside 4	6	738090	1111382
Outside 5	12	737465	1111450

2.1.1 Coral Reef Associated Fishes

Fish diversity and abundance data was collected using Underwater Visual Census (UVC) methodologies. Selected fish families and species that are recognised as biological indicators on coral reefs for a range of anthropogenic perturbations such as fishing pressure, Live Reef Food Fish Trade (LRFFT) and the ecological status of the reef are recorded. In addition, butterflyfish species are recorded as they provide an accepted method of indicating the status of the coral reef: *The Butterflyfish Indicator Method* (Crosby and Reese, 1996). The size classes of three commercially important fish families are also recorded; Grouper (*Lapu Lapu*, Serranidae), Parrotfish (*Mulmul*, Scaridae) and Snapper (*Maya Maya*, Lutjanidae).

Fish data are recorded along a 100m 'belt' transect, where the abundance of fish is recorded within an imaginary 5x5m box along four 20m replicates. Between each 20m replicate, the divers will wait, and not record any fish for a 5m interval, this separates the total 100m transect into four 20m independent replicates (Fig. 4). Each replicate sums to a total of 500m³ with total transect area surveyed of 2,000m³.

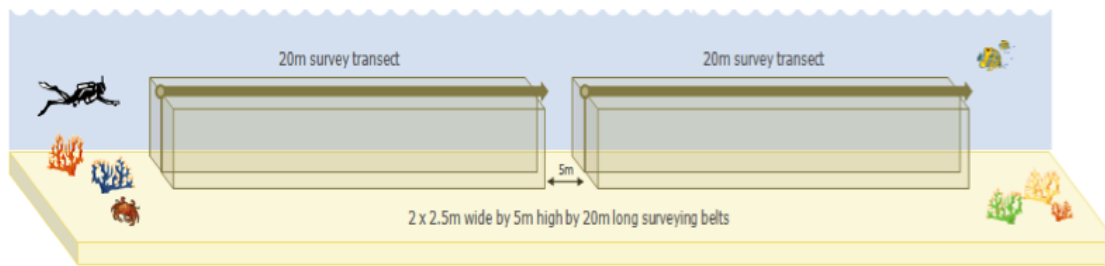


Figure 4. An augmented method that Coral Cay Conservation utilises to carry out MPA assessments that is adapted from a standardised Reef Check method. This schematic demonstrates two of the normal four replicates, of which, are separated by a 5m replicate interval. As the divers swim along the transect tape for the first 20m, they will record the specified target species within an imaginary 5x5m box, sizing those that are commercially important. Once located within the 5m replicate interval, no fish are recorded, this is as to produce independent replicates.

2.1.2 Coral Reef Associated Invertebrates

The location of the transect used for the fish UVC was also used to assess the invertebrate abundance and diversity within the area. The invertebrates recorded are target invertebrates that are typically targeted by local stakeholders as food species, collected as curios or important to the ecological balance of the reef. Due to the sessile and/or benthic nature of the targeted invertebrates, i.e. non-locomotive species, divers record their abundance 2.5m either side of the central transect tape (Fig. 5). Special care is taken to assess and explore each geo and biomorphic structure contributing to the rugosity of the transect area for cryptic species and those seeking refuge such as lobsters, *Diadema* sp. and *Holothuridae* sp.. Each replicate equates to 100m² summing to a total area of 400m² surveyed for invertebrate surveys.

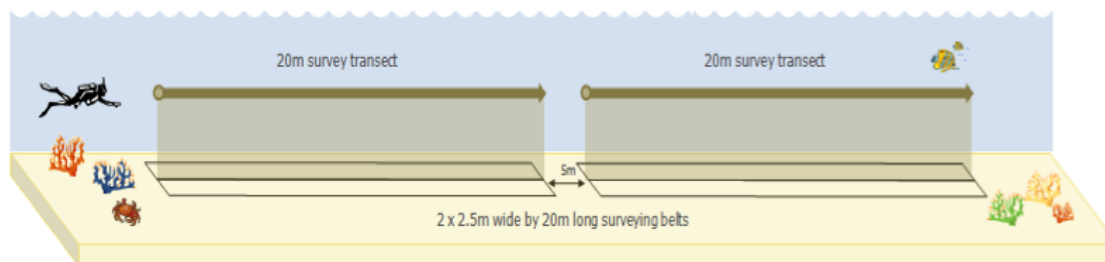


Figure 5. An augmented method that Coral Cay Conservation utilises to carry out MPA assessments that is adapted from a standardised Reef Check method. This schematic demonstrates two of the normal four replicates, of which, are separated by a 5m replicate interval. As the divers swim along the transect tape for the first 20m, they will record the specified target species within 2.5m of the central transect line. Once located within the 5m replicate interval, no invertebrates are recorded, this is as to produce independent replicates.

2.1.3 Coral Reef Benthic Substrate

Benthic diversity is measured by recording biotic and abiotic benthic categories along a point-intercept transect. Along the transect line, benthic organisms and substrate types are recorded at 50cm intervals (Fig. 6). To reduce bias, a plumb-line is dropped at each designated 50cm point and the substrate that comes into contact with the plumb-line is recorded (Table 2). Every 20m replicate contains 40 benthic points. Further categories are given in Appendix A.

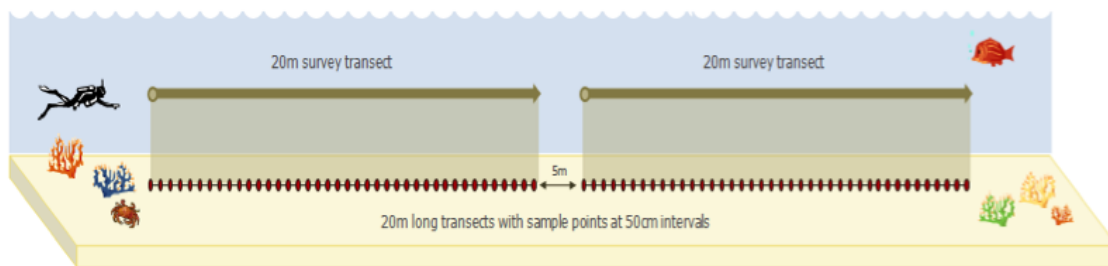


Figure 6. An augmented method that Coral Cay Conservation utilises to carry out MPA assessments that is adapted from a standardised Reef Check method. This schematic demonstrates two of the normal four replicates, of which, are separated by a 5m replicate interval. As the divers swim along the transect tape for the first 20m, they will record the specified target abiotic substrates and biotic benthic organisms using a plumb-line every 50cm. Once located within the 5m replicate interval, no data are recorded, this is as to produce independent replicates.

Table 2. Table consisting of the specific codes used by divers undertaking an MPA survey under the augmented Reef Check methodologies by Coral Cay Conservation (CCC). Each substrate type, whether biotic or abiotic is recorded every 50cm along a 20m replicate that accumulate over a total transect length of 100m. Every 50cm a diver will lower a plumb-line, and record whichever substrate category that plumb-line comes into contact with. *HC (Hard Coral) is further sub-divided into a range of categories based on the lifeform. ** OT (Other) is further sub-divided into categories based on their biological identification, these codes are specified.

Biotic Benthic Organisms	Code	Abiotic Substratum	Code
Nutrient Indicator Algae	NIA	Rock	RC
Sponge	S	Silt/Mud	SI
Recently Killed Coral	RKC	Rubble	RB
Soft Coral	SC	Sand	SD
Hard Coral*	HC*		
Other**	OT**		
Anemone	OT ANE		
Corallimorph	OT COM		
Halimeda	OT HA		
Tunicates	OT TU		
Zoanthids	OT ZO		
Gorgonian	OT GO		
Hydroid	OT HY		

2.1.4 Impacts to the Local Area

Within the same area assessed for invertebrates, divers record a number of impacts on the reef. The total percentage (%) of the coral population effected by bleaching is recorded, as well as the estimated percentage (%) of each individual coral colony that is bleached. Coral diseases were recorded as a percentage (%) of the population infected and where possible, the disease is identified. Damage is recorded in three categories: 'boat/anchor', 'dynamite' and 'other', on a categorical scale from 0 to 3 (0 = none, 1 = low, 2 = medium, 3 = high). Impact on the site from trash is recorded on the same scale and separated into 'general' and 'fishing nets/traps'.

2.2 Analysis of Data

Each 20m belt transect was treated as an independent replicate. This produced $n=8$ at 6 metres and $n=8$ at 12 metres both inside and outside of the MPA ($n=16$). Shapiro-Wilks tests, typically used on small data sets to check for normality, showed much of the data was non-parametric (Shapiro & Wilk, 1965; Thode, 2002). Square-root transformations of the non-parametric data did not sufficiently alter the data to warrant using a parametric test (O'Hara & Kotze, 2010; Morris, 2014). Thus, non-parametric Wilcoxon-Mann-Whitney U tests were used to test for statistically significant differences with 95% confidence limits ($p < 0.05$) in the abundance of fishes, commercially important fishes, target butterflyfishes, invertebrates, and substrates between all transects, both inside and outside the MPA. Wilcoxon-Mann-Whitney U tests were also utilised to test for significant differences in biomass (kg) between commercially important fishes as well as invertebrate, total fish, and fish diversity (Fishers α).

Hard corals were also grouped and analysed for abundance in three conservation classes: disturbance adapted fast growing corals (i.e. *Acropora* sp., Fire coral (*Millepora* sp.), Blue coral (*Heliopora* sp.); competitor corals (i.e. branching, foliose, encrusting, mushroom Non-*Acropora* sp.); and stress tolerant corals (i.e. massive, submassive, organ pipe (*Tubipora* sp.)), as defined by Edinger and Risk (2000).

3. RESULTS

3.1. Coral Reef Associated Fishes

Mean fish abundance inside the MPA was 50.75 ± 17.73 and 108.45 ± 60.35 outside (Fig. 7). The high level of standard error outside is due to high numbers of Cardinal fish (*Apogonidae* sp.) observed at this site (290.25 ± 270.02). Fish abundance on outside transect 5 was significantly higher than inside 1 and inside 2 ($p < 0.05$) (Fig. 8). Inside transect 3 also had a significantly higher fish abundance than inside 1 and outside transect 1 fish abundance was significantly higher than inside transect 3 ($p < 0.05$) (Fig. 8). No other significant differences were found concerning fish abundance.

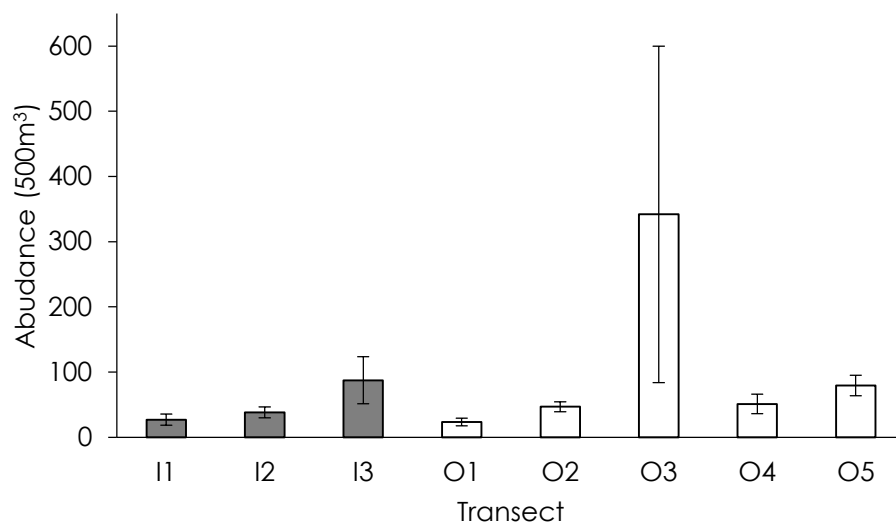


Figure 7. Average total fish abundance observed on each transect surveyed within the Barangay Punta MPA located within the Municipality San Francisco, Southern Leyte. Data are the mean number of individuals per transect (500m³), error bars denote standard error from the mean.

	I1	I2	I3	O1	O2	O3	O4	O5
I1			-					-
I2								-
I3	+			-				
O1			+					
O2								
O3								
O4								
O5	+	+						

Figure 8. Matrix showing significant differences in fish Abundance per 500m³ across all the survey sites. Matrix variables categorised with an 'I' are transect surveys conducted inside the MPA boundaries with 'O' represented those outside of the respective boundaries. A green '+' indicates abundance was significantly higher at the surveyed transect on the left compared to transect at the top ($p < 0.05$). A blue '-' indicates that abundance was significantly lower at transect on the left compared to transect at the top ($p < 0.05$). Blank cells indicate no significant difference.

Similarly, to fish abundance, the diversity of fish species (Fisher's α) was not significantly higher inside the MPA compared to outside the MPA ($p = < 0.05$) (Fig. 9). However, diversity of fishes was significantly different on outside transect 5 compared to outside 3, and on outside transect 2 compared to outside transect 3 ($p = < 0.05$).

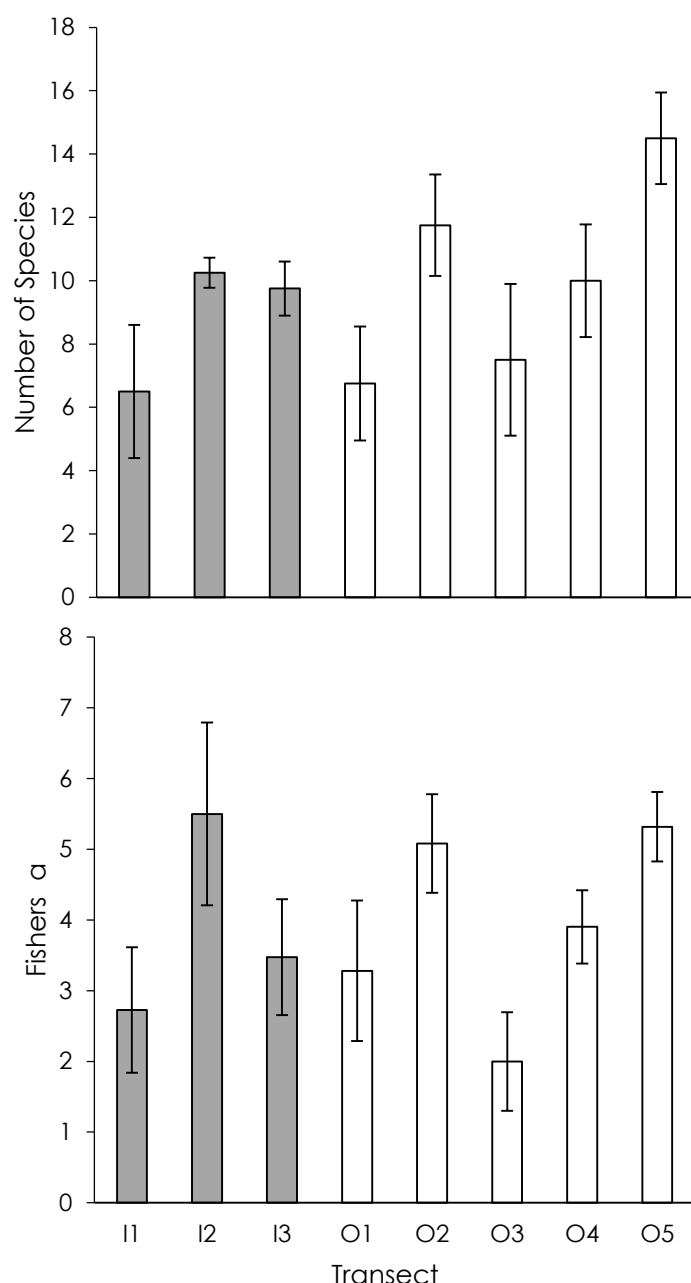


Figure 9. Total fish Species Richness (S), and diversity (Fishers α) per transect at Barangay Punta, southern Leyte, the Philippines.

Commercially important fish species were found in very low numbers on each transect. Parrotfish abundance averaged 2.24 ± 1.07 inside the MPA and 2.95 ± 2.77 outside per 500m^3 . Grouper averaged 0.5 ± 0.17 inside and 0.6 ± 0.27 ; and Snapper averaged 0.25 ± 0.16 inside and 0.25 ± 0.15 outside (Fig. 10). Outside transect 5 yielded the highest number of commercially important fish species with commercially important fish being spotted in lower numbers on all other transect (Fig. 10). The overall accumulated abundance of commercially important fish species did not vary significantly inside and outside the MPA ($p = <0.05$). However, Groupers were significantly more abundant on inside transect 2 compared to outside transect 3, and on outside transect 5 compared to inside transect 1 ($p = <0.05$).

Of the Parrotfish, Grouper and Snapper observed in Punta, all were relatively small in size. The length of each fish was recorded to the nearest 10 centimetres with 45.45% falling in to the 0-10cm category, 42.21% within 11-20cm, 12.34% within 21-30cm in length. No commercially important fish were observed to be greater than 30cm in length. Grouper biomass was significantly higher on outside transect 5 compared to inside transect 1, and outside transects 1, 2, 3, and 4 ($p = <0.05$) (Fig. 11). Grouper biomass was also significantly higher on inside transect 2 compared to inside transect 1, and outside transects 1, 2, 3, and 4 ($p = <0.05$) (Fig. 11). Biomass was not significantly different for any other commercial fish species.

Other commercially important fish species including Bumphead Parrotfish (*Bolbometopon muricatum*), Humphead Wrasse (*Cheilinus undulates*) and Sweetlips (*Plectorhinchus* sp.) were completely absent from the survey area. However, during the surveying period, three Whale Sharks (*Rhincodon typus*) were sighted off transect 1.

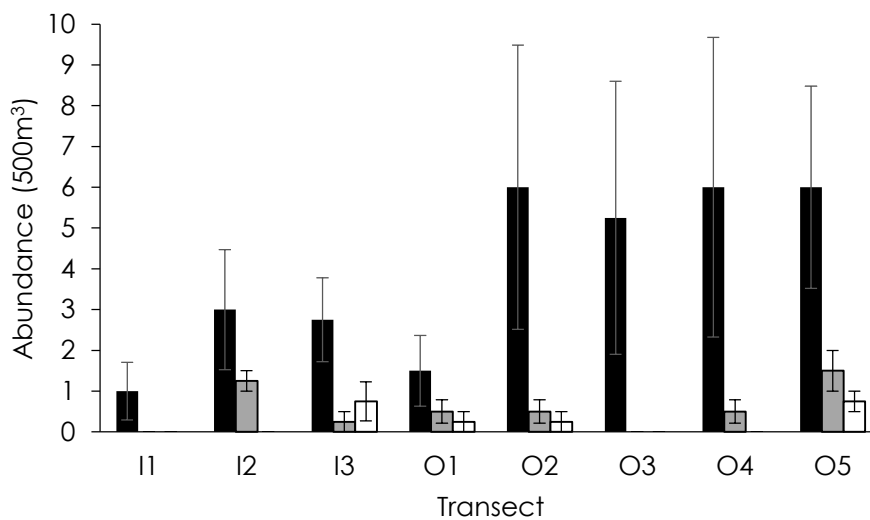


Figure 10. Average abundance of Parrotfish (*Scarridae*) (black), Grouper (*Serranidae*) (grey) and Snapper (*Lutjanidae*) (white) observed on each transect surveyed within the Brangay Punta MPA located within the Municipality San Francisco, Southern Leyte. Data are the mean number of individuals per transect (500m³), error bars denote standard error from the mean.

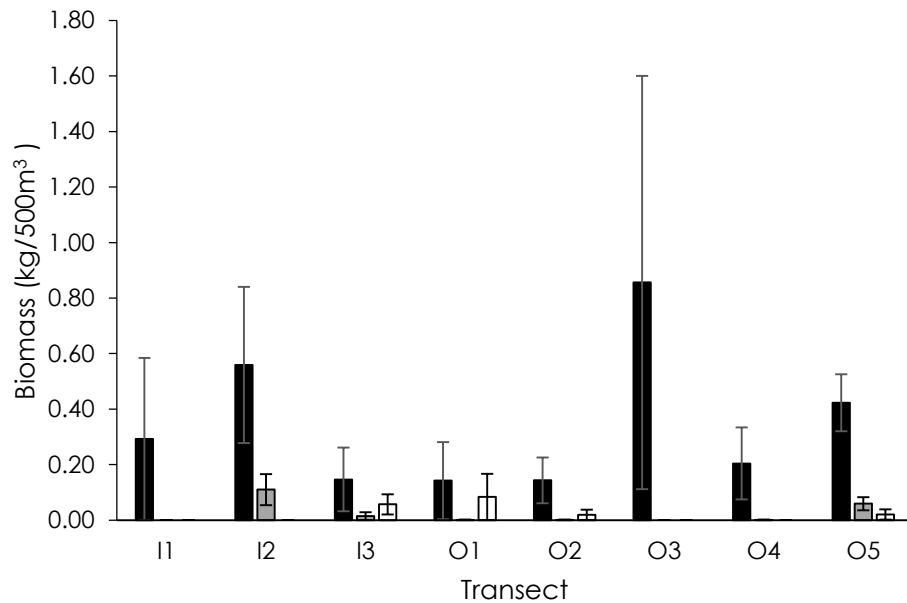


Figure 11. Average biomass of Parrotfish (*Scaridae*) (Black), Grouper (*Serranidae*) (Grey), and Snapper (*Lutjanidae*) (White), recorded at each surveyed transect within the Barangay Punta MPA located within the Municipality San Francisco, Southern Leyte.

Butterflyfish abundance averaged 5.42 ± 1.83 inside and 8.2 ± 3.15 outside the MPA (Fig. 12). Most transects did not show significant differences in abundance, excluding inside transect 1, which had significantly lower abundance ($p < 0.05$) than all but two other transects, both inside and outside (Fig. 13). Butterflyfish species richness and diversity did not vary significantly inside and outside the MPA (Fig. 14).

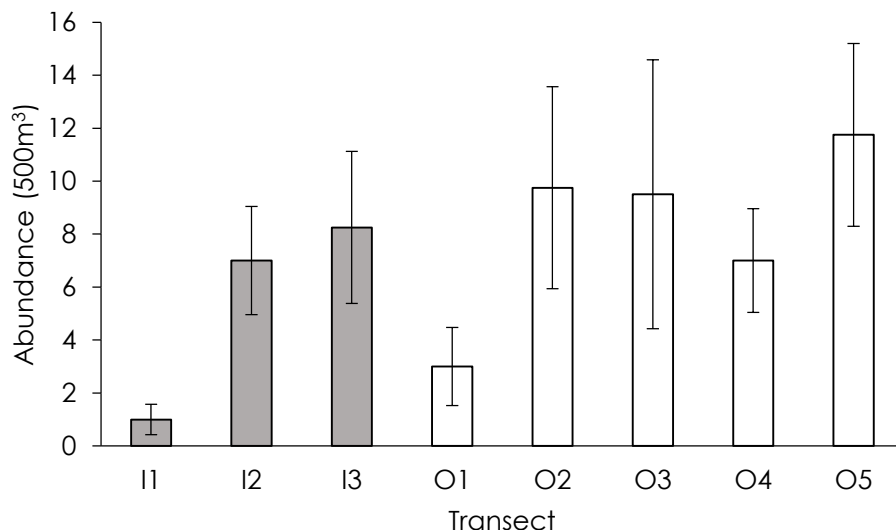


Figure 12. Average abundance of Butterflyfish observed on each transect surveyed within the Barangay Punta MPA located within the Municipality San Francisco, Southern Leyte. Data are the mean number of individuals per transect (500m³), error bars denote standard error from the mean.

A)	I1	I2	I3	O1	O2	O3	O4	O5
I1		-	-		-		-	-
I2	+							
I3	+							
O1								
O2	+							
O3								
O4	+							
O5	+							

Figure 13. Matrix showing significant differences in Butterflyfish abundance between sites surveyed within the Barangay Punta marine protected area (MPA). A green '+' indicates percentage cover was significantly higher at transect on the left compared to transect at the top ($p < 0.05$). A blue '-' indicates that percentage cover was significantly lower at transect on the left compared to transect at the top ($p < 0.05$). Blank cells indicate no significant difference

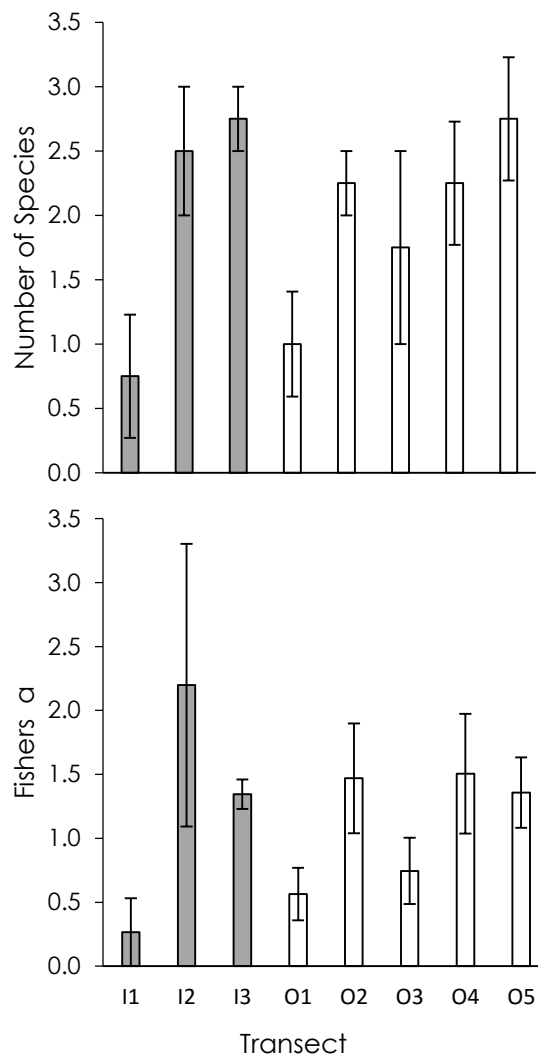


Figure 14. Total Butterflyfish Species Richness (S), and diversity (Fishers α) per transect (500m^3) at Barangay Punta, southern Leyte, the Philippines.

3.2 Invertebrates

Mean invertebrate abundance throughout the survey was 46.5 ± 14.28 inside the MPA and 52.6 ± 8.28 outside the MPA (Fig. 15). Significant differences ($p < 0.05$) were found between single transects (Fig. 16). Inside transect 2 and outside transect 5 both displayed significantly higher invertebrate abundance than most transects, while inside transect 3 and outside 1 displayed significantly lower abundance than most transects. There was no significant difference in invertebrate diversity inside vs. outside the MPA ($p < 0.05$). Commercially important invertebrate species including lobster (*Nephropidae*), abalone (*Haliotidae*), triton's trumpet (*Charonia tritonis*), squid (*Teuthida*), prickly redfish sea cucumber (*Thelenota ananas*), greenfish sea cucumber (*Stichopus chloronotus*) and pinkfish sea cucumber (*Holothuria edulis*) were entirely absent from the survey.

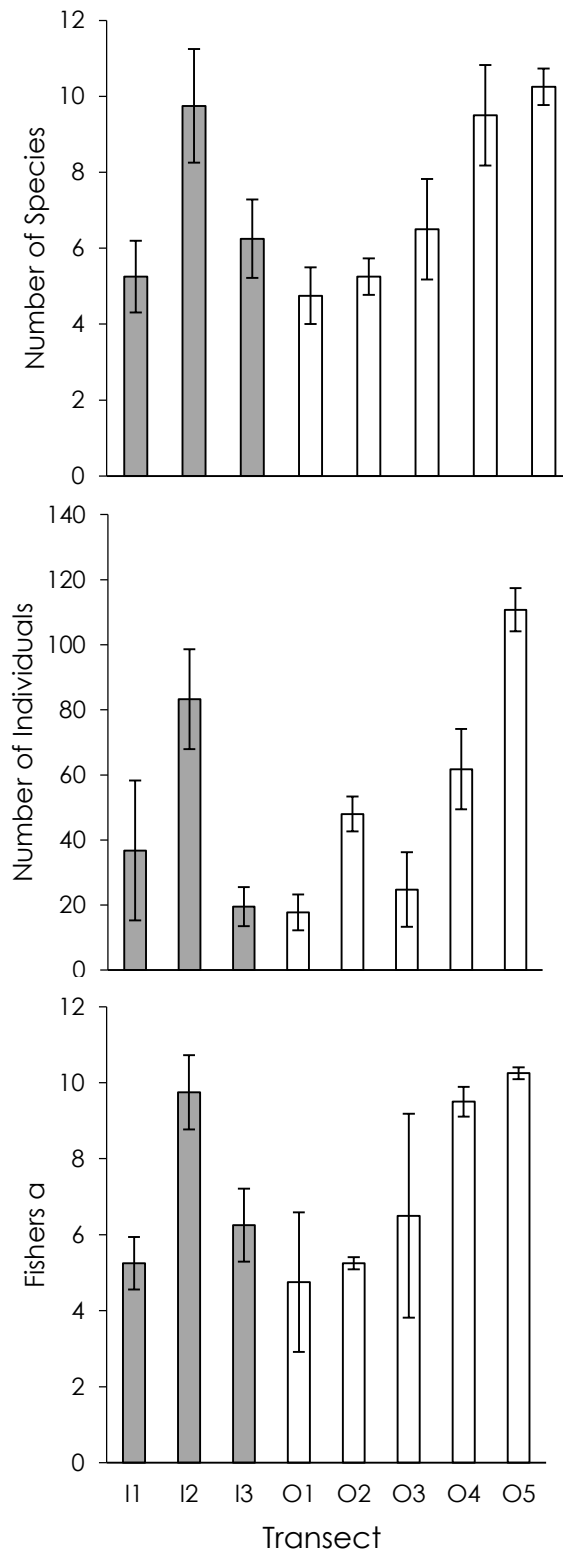


Figure 15. Total invertebrate Species Richness (S), abundance, and diversity (Fishers α) per transect (500m³) at Barangay Punta, southern Leyte, the Philippines.

	I1	I2	I3	O1	O2	O3	O4	O5
I1								-
I2			+	+		+		
I3		-			-		-	-
O1		-			-		-	-
O2			+	+				-
O3		-						-
O4			+	+				-
O5	+		+	+	+	+	+	

Figure 16. Matrix showing significant differences of Invertebrate abundance between sites. A green '+' indicates abundance was significantly higher at transect on the left compared to transect at the top ($p < 0.05$). A blue '-' indicates that abundance was significantly lower at transect on the left compared to transect at the top ($p < 0.05$). Blank cells indicate no significant difference.

3.3 Substrates

Inside the MPA, silt (SI) was the most common substrate ($41.67\% \pm 5.36\%$), followed by hard coral (HC) ($25.63\% \pm 7.82\%$) (Fig. 14). Outside the MPA the most prevalent substrate was hard coral (HC) ($32.00\% \pm 9.04\%$). This was followed by silt (SI) ($27.38\% \pm 8.85\%$) and sand (SD) ($14.25\% \pm 3.87\%$) (Fig. 17). Hard coral was significantly more abundant on outside transect 2, 4, and 5 compared to inside transect 1 ($p < 0.05$) (Fig. 18). Silt was also significantly more abundant on inside transect 1 compared to most other transects (Fig. 18). Furthermore, rock abundance was significantly lower on inside transect 1 compared to most other transects, both inside and outside (Fig. 18).

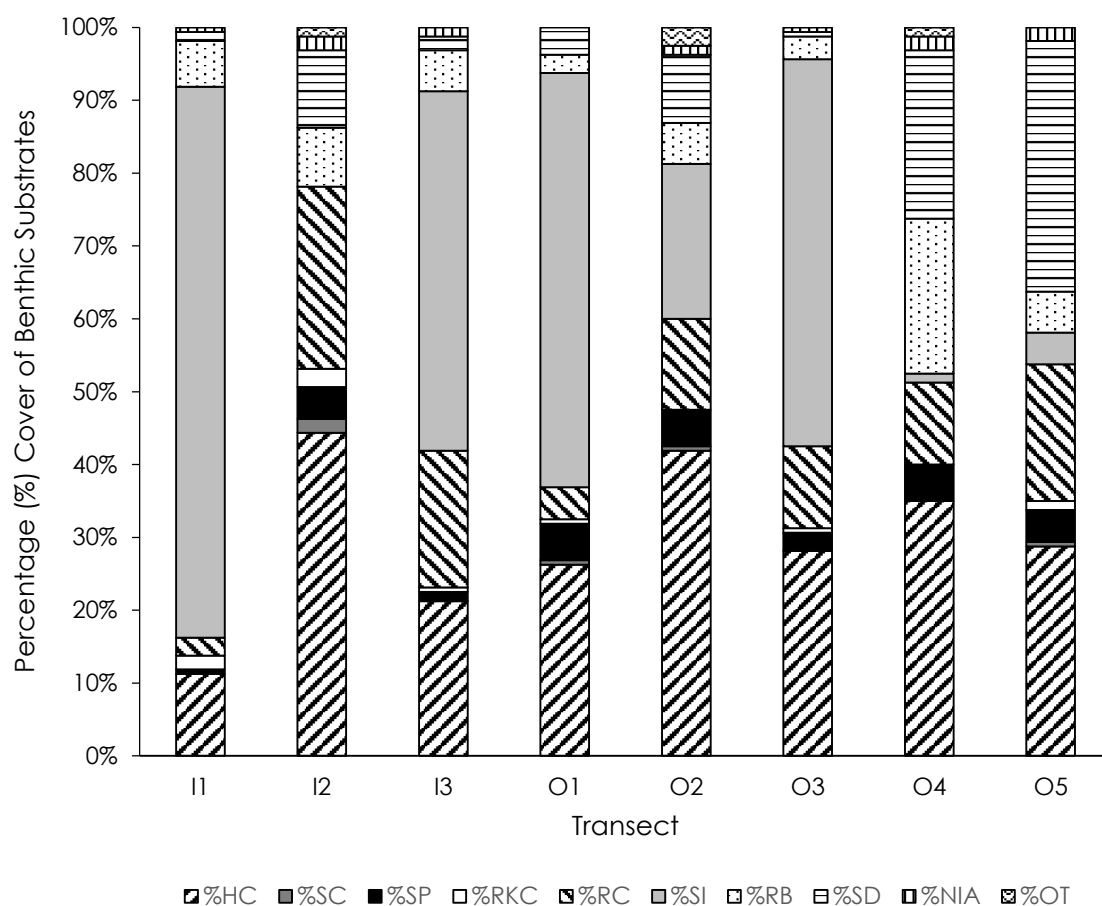


Figure 17. Mean substrate percentage cover at each transect surveyed within the Barangay Punta's marine protected area (MPA) boundaries. Due to the high variable number, refer to the in-figure legend for colour coding. The abbreviations and their respective substrate are as follows: HC – Hard coral; SC – Soft coral; SP – Sponge; RKC – Recently killed coral; RC – Rock; RB – Rubble; SD – Sand; SI – Silt; NIA – Nutrient indicator algae; OT – Other living organisms.

A)

	I1	I2	I3	O1	O2	O3	O4	O5
I1		-			-		-	-
I2	+							
I3								
O1								
O2	+							
O3								
O4	+							
O5	+							

B)	I1	I2	I3	O1	O2	O3	O4	O5
I1		+	+		+		+	
I2	-		-	-		-		
I3	-	+					+	+
O1		+					+	+
O2	-							
O3		+					+	+
O4	-		-	-		-		
O5			-	-		-		

C)	I1	I2	I3	O1	O2	O3	O4	O5
I1		-	-		-		-	-
I2	+			+	+		+	
I3	+							
O1		-			-			-
O2	+	-		+				
O3								
O4	+	-						
O5	+			+				

Figure 18 - Matrix showing significant differences in percentage cover of hard coral (A), silt cover (B) and rock (C) between sites surveyed within the Barangay Punta marine protected area (MPA). A green '+' indicates percentage cover was significantly higher at transect on the left compared to transect at the top ($p < 0.05$). A blue '-' indicates that percentage cover was significantly lower at transect on the left compared to transect at the top ($p < 0.05$). Blank cells indicate no significant difference.

A relatively high amount of variety was found at Punta when focusing on coral types and morphologies. Most transects displayed a high diversity in coral lifeforms (Fig. 19). On average, *Acropora* branching coral was most abundant inside the MPA ($34.93\% \pm 6.78\%$), followed by Non *Acropora* submassive coral ($18.32\% \pm 9.45\%$) (Fig. 16). Outside the MPA, Non *Acropora* branching ($19.87\% \pm 10.95\%$) and Non *Acropora* encrusting coral ($19.27\% \pm 8.91\%$) were most abundant.

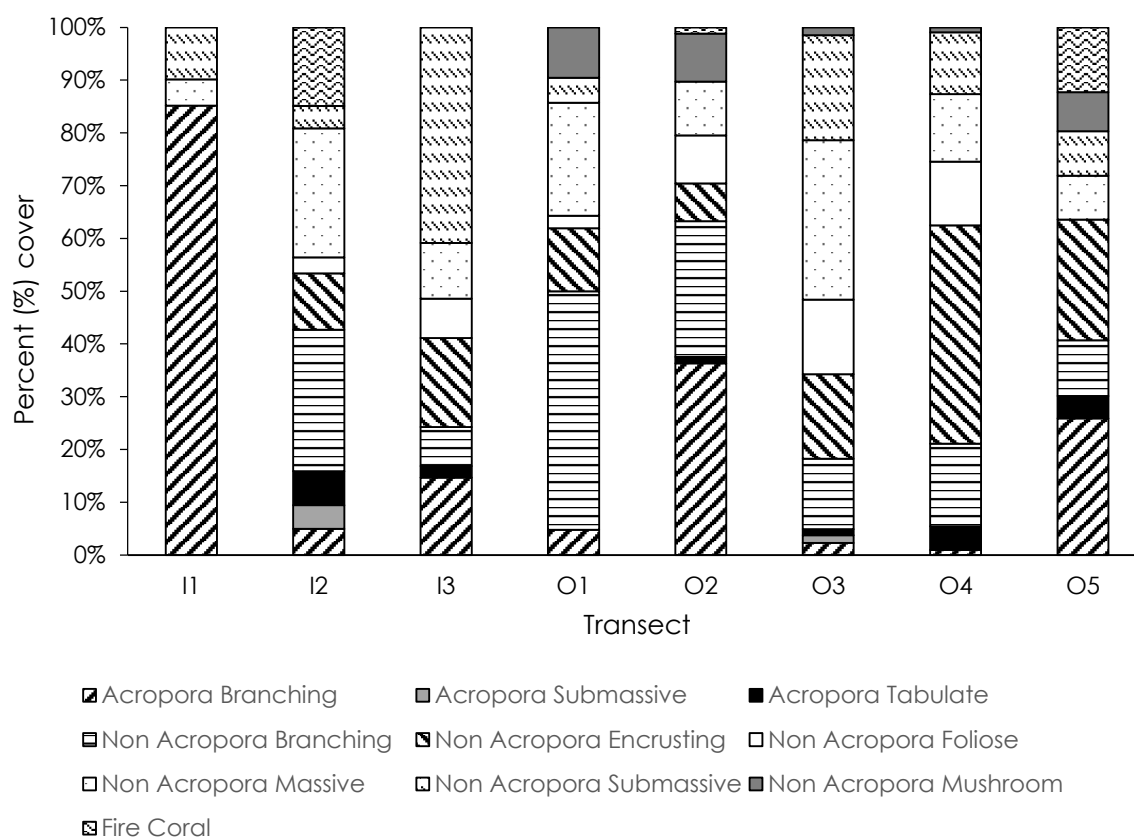


Figure 19. Average percent cover of hard coral lifeform per transect within the Barangay Punta marine protected area (MPA), Municipality San Francisco, Southern Leyte. Four hard corals (*Acropora* encrusting, *Acropora* digitate, Blue coral, and Fire coral) were not found on any transect and are exclude from the figure.

In terms of coral morphology and life strategy (Edinger and Risk, 2000), there was high diversity across transects, both inside and outside. On average, disturbance adapted fast growing corals dominated inside the MPA ($44.25\% \pm 20.85\%$) followed by stress tolerant corals ($31.68\% \pm 10.67\%$) (Fig. 20). Outside the MPA the reef was dominated by competitor corals ($51.76\% \pm 4.99\%$),

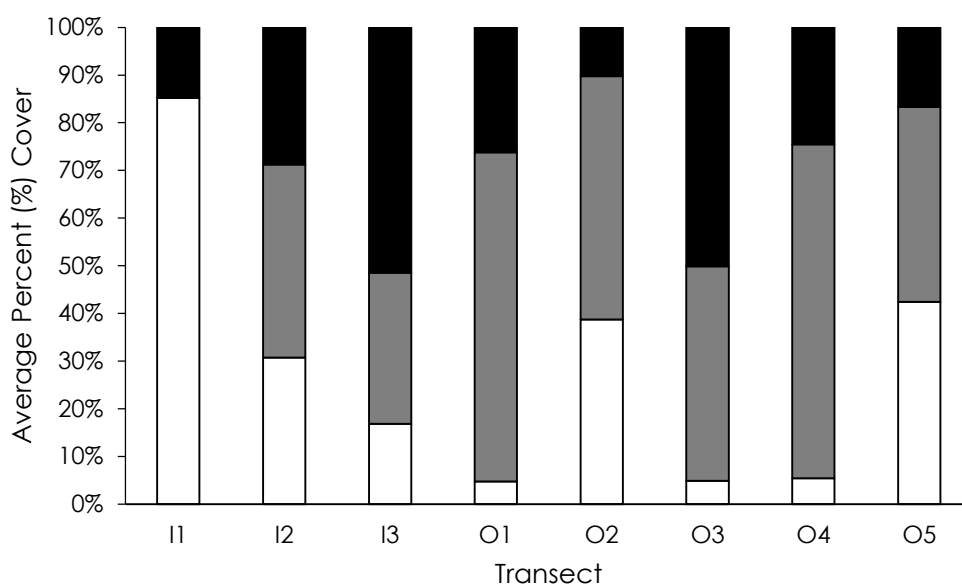


Figure 20. Average percentage (%) composition of hard coral lifeforms categorised based on their life history characteristics and resilience to abiotic factors at each transect surveyed within the Barangay Punta marine protected area (MPA, Municipality San Francisco, Southern Leyte. Corals were categorised into three categories: Disturbance adapted fast growing corals (black); Competitor corals (grey); Stress tolerant corals (white).

3.4 Anthropogenic Impacts

During the survey period the reefs of Barangay Punta showed evidence of low to moderate levels of anthropogenic impact. General trash was recorded on each transect except on inside 1. Transects outside 3 and outside 4 displayed the highest amount of anthropogenic impact. Low evidence of fishing was discovered on transect inside 3 and outside 3, suggesting that fishing does still occur in the region both inside and outside the MPA. Furthermore, during the visual assessment of the area, multiple ghost lines and nets were seen as well as the use of fish traps. There were no obvious signs of boat or anchor damage, however low levels of undetermined coral damage were observed on all transects.

Low levels of coral bleaching were recorded both inside and outside the MPA on three out of eight transects. Less than 1% of the population were affected with an average of 19% bleaching on individual colonies. Several coral colonies on transects O1, O3 and O5 were seen to be affected by white band disease.

4. VISUAL ASSESSMENT



Figure 21. Schooling reef fish at Barangay Punta MPA.



Figure 22. Top shell snail (*Tectus pyramis*) at barangay Punta MPA.



Figure 23. Discarded fishing net caught on corals at Barangay Punta MPA.



Figure 24. Tabulate Acropora sp. on top of a coral patch.



Figure 25. Deep gap between coral structures at Barangay Punta MPA.



Figure 26. Nudibranch (*Chromodoris elisabethina*) at Barangay Punta MPA.



Figure 27. Massive coral (*Favia* sp.) at Barangay Punta MPA.



Figure 28. Bubble coral (*Plerogyra* sp.) at Barangay Punta MPA.



Figure 29. Hard coral (*Goniopora* sp.) and Hydroids at Barangay Punta MPA.

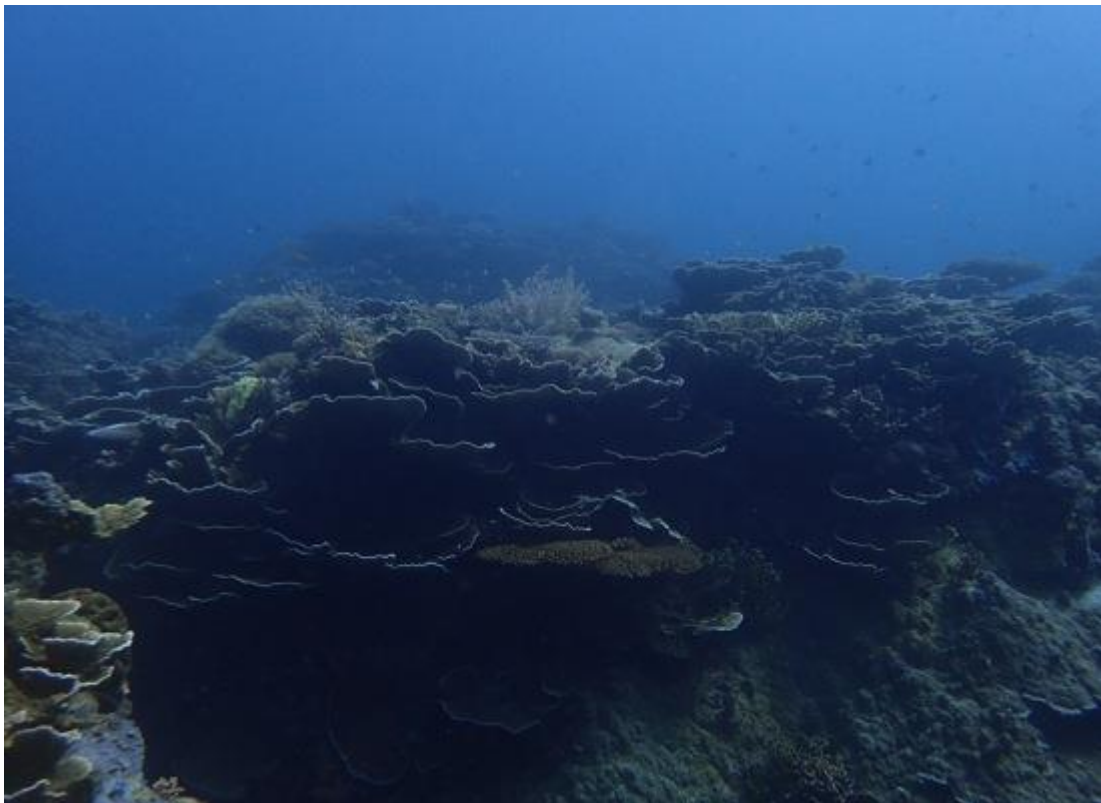


Figure 30. Foliose coral (*M* sp.) outcropping at Barangay Punta MPA.



Figure 31. Crown of Thorns starfish (*Acanthaster Plancii*) at Barangay Punta MPA.

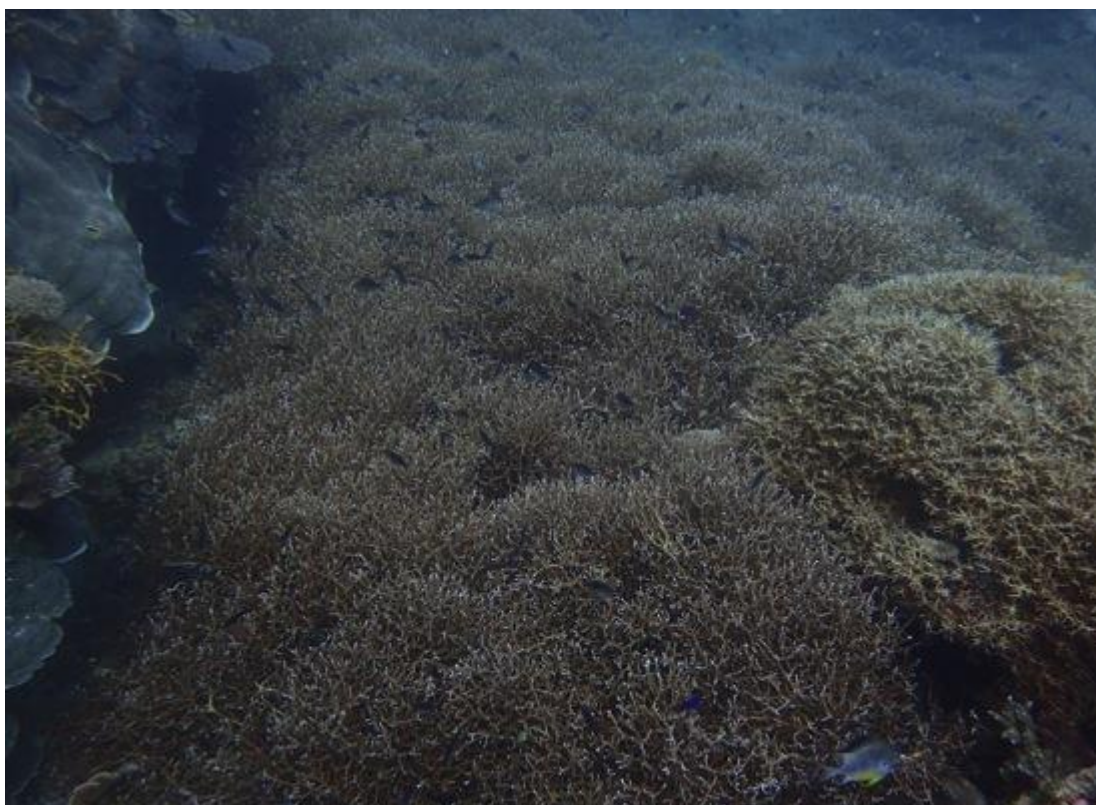


Figure 32. Bed of branching coral (*Acropora* sp) at Barangay Punta MPA.



Figure 33. Soft coral at Barangay Punta MPA.



Figure 34. Hard coral (*Anacropora* sp.) at Barangay Punta MPA.



Figure 35. Anemone and clown fish at Barangay Punta MPA.

5. DISCUSSION

Following CCC's assessment of Barangay Punta's coral reefs, the results indicate the coral reef and its respective communities, are not receiving the full benefit of the MPA's protection. The results suggest that there are minimal differences between the abundance and diversity of fauna including benthic percentage composition of substrates. However, differences can be noted in comparisons regarding individual transect sites.

The reef in its entirety is suggestive of one that is in moderate condition with large hard coral (Scleractinian) patches inter-dispersed amongst patches of silt and sand. The coral patches display low levels of anthropogenic impacts. Conversely, the abundance of invertebrates, fish and HC confers a reef with an improved ecological status.

5.1 The Current Ecological Status of Punta's Fish Community and Commercially Important Taxa

Overall, the abundance of fish inside and outside the MPA was not significantly different. This could be due to a large spill-over effect from the MPA or it may suggest high levels of illegal fishing within its boundaries (Russ & Alcala 2004).

The low abundance of small-sized Parrotfish, Grouper and Snapper across all transects indicate that these commercially important families are still being fished out in the area, thus greatly affecting reproduction rates. Individuals larger than 30cm were completely absent from the survey. Large individuals of these families are highly

valued as a food fish and easily targeted by spear fishing, hook and line fishing and net fishing when they aggregate in large numbers to spawn (Hodgson and Liebeler, 2002).

Snappers, Groupers and Parrotfish take many years to increase in size and reach sexual maturity; Snappers have been shown not to mature until they are approximately 54.6 cm in length. This suggests that a population with no individuals larger than 30cm will not be able to replenish itself (Froese and Pauly, 2001). The fecundity (or reproductive output) of these families also exponentially increases with size. One 12.5 kg female Snapper can produce the same number of eggs as 212 1.1kg snappers (Bohnsack, 1990). Overfishing of large individuals from a reef will, therefore, remove the most reproductively active individuals and create a population with a highly skewed sex ratio, which will inhibit future growth of the population. As well as having economic value, Parrotfish are an ecologically important species because they are the largest herbivorous fish found on coral reefs. They graze on large quantities of algae, which would otherwise compete with coral for space.

There were no observations of other commercially important species including Bumphead Parrotfish, Humphead Wrasse, Barramundi Cod or Sweetlips. This supports the suggestion that these desirable food-fish species have been overfished in the area. The Humphead Wrasse is the most sought after and highly priced fish in the live fish trade, with one large individual capable of selling for as much as \$10,000 (Lau and Parry-Jones, 1999). The presence of fish traps and nets inside and outside the MPA confirms that fishing is still occurring in the Punta region.

5.2 The Current Ecological Status of Punta's Coral Reef Invertebrate Community

Similar to fish abundances there was no significant difference found inside versus outside the MPA regarding invertebrate abundance or diversity. The absence of commercially important invertebrates, including lobster, squid, triton's trumpet and prickly redfish, greenfish and pinkfish sea cucumbers both inside and outside the MPA indicates high levels of overfishing in the area. Each of these species is highly sought after for food.

Lobsters are a highly prized food item throughout the world. They can be quickly removed from areas as they are easily caught in traps and nets. As with many fish species, larger lobsters sell for a higher price in the live food trade. The targeting of large individuals removes the most fecund (reproductively successful) females from the community, resulting in population decline.

Prickly redfish, greenfish and pinkfish are all edible species of sea cucumber (Holothuroidea). Their presence on the reef is ecologically significant due to the functional role they occupy; filtering and digesting sand, producing pellets that aid in reef formation. However, they are easily extracted from the reef by free divers or fishers at low tide and, as such, are regularly targeted by humans as a food substance (Hodgson and Liebeler, 2002).

5.3 The Benthic Substrate Composition of Punta's MPA and Respective Coral Reef

The most dominant substrate within the MPA surveyed area was silt. While silt is a good habitat for some species, its low complexity makes it a poor host for most reef species, which prefer substrates like hard coral. It is promising however, that the second most abundant substrate inside the MPA was hard coral (>25%). This is

indicative of a reef in a good ecological status, however, research implemented by Reef Check between 1997 and 2001 showed that healthy coral reef systems throughout the Indo-Pacific averaged around 40% hard coral cover (Hodgson and Liebeler, 2002). Compared with this relatively low 40% average, the reefs of Barangay Punta, both inside the MPA and outside are indicative of decreasing hard coral cover throughout indo-pacific coral reefs.

Although percentage of hard coral cover is low, the substrates inside and outside the MPA also had relatively high rock cover. In a coral reef ecosystem, the presence of hard coral is essential because it provides the main habitat utilised by fish and invertebrates for shelter, spawning and food. Rocky surfaces, unlike sand/silt-dominated areas, provide a suitable area for attachment of new coral colonies and create opportunities for the hard coral community in Punta to increase. In order to increase coral growth (recruitment), the reefs should be protected against destructive fishing practices including dynamite, cyanide and trawling.

The complexity of the reef structure plays a large role on associated species abundance, therefore a high diversity of hard coral lifeforms is preferable for optimum fish and invertebrates' abundance. A low amount of coral lifeforms or species can be an indicator of an unhealthy reef system or a high disturbance environment. Hard corals can be classified based on their morphology indicating specific life strategies (Edinger and Risk, 2000). For example, some corals are more adapted to high energy environments and disturbances and therefore have a faster growth rate. Others grow more slowly but are better competitors. Some coral species may tolerate stress, sedimentation or pollution better. For example, a reef dominated by stress tolerant corals such as boulder or massive corals may indicate a polluted or sedimented environment. For optimum reef health, a balance between stress tolerant, competitor and disturbance adapted corals is key, without any one category dominating the other two (Edinger and Risk, 2000). Punta MPA has a good balance between the three life strategies of coral. While there was a higher abundance of competitor corals, this did not exceed 50% of all the hard coral found. When choosing which areas should receive the greatest degree of protection within MPA zonation, it is best to select sites or transects with the best hard coral morphology balance.

5.4 Anthropogenic Impacts

It is a positive sign that the coral reef at Barangay Punta shows very low levels of coral bleaching. Coral damage including household and fishing related trash were recorded across the transects. Multiple sightings of white band coral disease were seen both inside and outside the MPA. While current sightings were low in numbers, coral diseases can be highly damaging to coral reefs and be cause for concern. Furthermore, while fishing trash was low during surveys, fish traps were commonly spotted during our visual assessment.

As mentioned in previous sections, several species of fish and invertebrates targeted for human consumption were observed in low numbers or completely absent. The most concerning aspect of these findings is that several of these species are known keystone species. This means that these organisms play a vital role in the reef system and if removed could seriously affect the stability of the entire ecosystem. This can happen in two ways: (1) direct effects or (2) indirect effects.

Direct effects occur when predators are removed from an ecosystem and facilitate the ecological release of prey species. For example, the removal of predators such as humphead wrasse (*Chelinus undulatus*), which are known to feed on CoTs can result in an increase in CoTs numbers through a lack of predation pressure. Indirect effects are more complex as they often involve many species of families and cascade down through trophic levels. In severe cases this can lead to phase shifts and alter ecosystem dynamics.

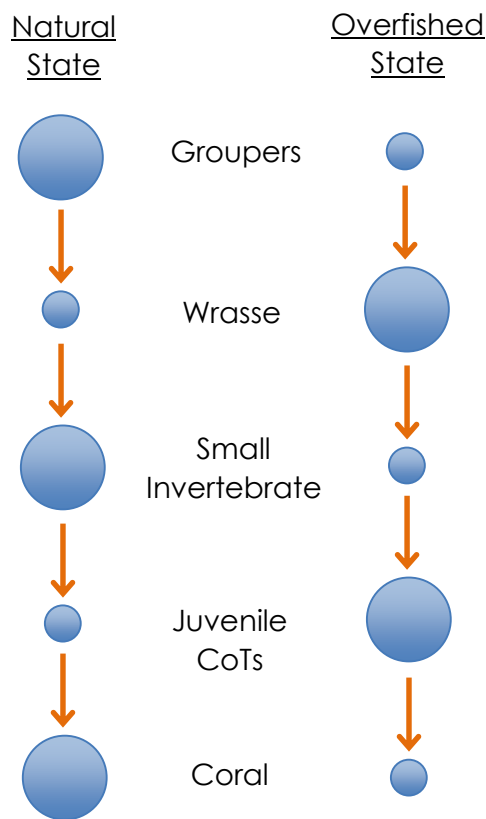


Figure 36. Representation of the indirect effects that overfishing of predatory fish, in this example Groupers can have on the entire coral ecosystem. The size of the circle represents the relative abundance of that organism or trophic level.

The removal of apex predators such as groupers causes a decrease in the predation of species such as wrasse, allowing prey populations to increase. Many wrasse species feed on benthic invertebrates that in turn predate juvenile settlement stage CoTs. With an increase in wrasse numbers there is a corresponding decline in these invertebrates and thus an increase in juvenile CoT survivorship (Fig. 36). Indirect top-down effects from depletion of apex predators have been shown to have wide spread impacts on ecosystems around the world (Myers *et al.*, 2007).

The reefs of Barangay Punta support small populations of economically, ecologically and culturally important species and exhibit excellent potential to increase in hard coral cover and fish abundance. However, the inside of the MPA does not show significant difference to the outside of the MPA. This demonstrates that the MPA is not working effectively as a fish sanctuary due to either the size of the MPA being too small to have a significant effect or that rules within the MPA are not being enforced within the local community.

6. RECOMMENDATIONS

CCC strongly recommends for the MPA in Barangay of Punta to be expanded. Increasing the size of the MPA could positively impact the effectiveness of the MPA. Partial no-take areas (complete fishing bans) are a recommended course of action. Hook and line only fishing in outside, buffer zones is also recommended. The no-take zone created by an MPA would provide a sanctuary for economically important fish species to begin to repopulate the area. By allowing fish and invertebrates to grow to larger sizes within the MPA they would produce more offspring and replenish fish stocks more quickly than an MR.

A recent study by Edgar *et al.* (2014) argues that the effectiveness of MPAs relies on five criteria: that they should be no-take zones and well enforced, that they should be both large and old (>10 years), and that they should be isolated by deep water or sand.

The major problem with Punta's MPA is its small size (6.9ha). Small MPAs take a longer time to increase fish stocks and many very small MPAs are simply ineffective. MPAs throughout the Philippines are generally small and this size restriction will dictate the length of time it takes stocks to recover. However, local fishers must still be considered and it is unreasonable to suggest creating large MPAs that restrict all fishing in a Barangay zone. Instead, MPAs should be designed to maximize size and still allow some fishing activities in outside, buffer zones and surrounding areas. In this way local fishers can continue to benefit from subsistence fishing whilst allowing their reef to recover for future generations.

MPAs should also be old (Edgar *et al.*, 2014) to see some form of success. In comparison, Punta's MPA is only 6 years old. Typically, significant differences cannot be seen in an MPA unless they have been in place for at least 10 years. In reality, it will likely take even longer to see an impact in Punta due to the small size of the current MPA. Response times can be slow and it may be a number of years before fishers see the benefits of a no-take zone. To ensure this is understood and realistic expectations are set, a consultation and presentation of data is recommended to inform the local barangay of the health of their reef and expected timeframe of results.

Perhaps the most important criteria ensuring the success of an MPA is that it is well enforced. Currently the MPA in Punta is a no-take zone and while it is not well enforced it is believed that fishing in the area is extremely low due to the belief that ghosts are present in the region from the landslide several years ago. But evidence of fishing practices within the MPA have been observed showing that a higher level of enforcement is needed. If an MPA is designated without anyone taking notice, the process becomes inadequate and further degradation will occur. For this reason, CCC advises the creation of a management committee to oversee the effective running of the MPA. The committee would coordinate the collection of MPA fees for possible dive and snorkel sites, provide training and support to Bantay Dagats, oversee the enforcement of the MPA and be a link to the Municipal Government for matters concerning the MPA. It will be important for the management committee to establish goals and objectives for the MPA based on the criteria of species protection, fisheries and tourism. Reviewing these objectives will help inform management decisions. CCC can offer support throughout this process, and can assist in training local Bantay Dagats, at the request of Punta.

6.1 Recommended Scenarios for Punta's Marine Protected Area

In the area outside the current MPA that was formerly surveyed, Outside 2, 4 and 5 had the greatest potential for coral recruitment. It is critical that these areas are included in the protected area in order to allow all other elements of the ecosystem to recover. These areas also included the highest abundance of invertebrates and commercially important fish outside the MPA. This justifies the need for this area to be included in the protected no-take zone. It would also be beneficial to include Outside transect 3 in the MPA due to its very high abundance of fish. While the majority of fish

recorded in this transect were Cardinal fish, our visual assessment suggested that the area is preferred by some fish species.

Taking these factors and the current MPA into consideration, the final MPA site for Punta must be decided in consultation with the local Barangay, the local fishers and the Municipal government of San Francisco. Outlined below are Coral Cay Conservations preliminary recommendations for a possible extension of Punta's MPA.

CCC recommends that the current MPA boundaries be extended to include the entire survey area (Fig. 37, Table 3). This recommendation would have the highest ecological benefit to the area. Allowing an increase in the size of the current MPA will greatly increase its effectiveness and will also include a larger area of hard coral cover which will give the area the best chance to recover and thrive.

All recommendations are flexible and the final designation will be the result of collaboration between CCC, the Municipality of San Francisco and the local community of Barangay Punta, in particularly with the local fisher folk. CCC provides ecologically beneficial solutions while also understanding that there are other factors to consider during the decision making process. As such, the scenarios outlined here should be used as the initial step in opening a dialogue between all relevant aforementioned stakeholders in order to come to the best possible conclusion for all parties.

Extensive consultation will be essential within the local community to enable compliance with the MPA. The livelihoods of many local fishers may be affected by the designation of an MPA so their agreement is essential to its success. Many studies (e.g. Pollnac *et al.*, 2001) from existing MPAs have shown that without the involvement of the local community the effectiveness of a MPA is greatly reduced. If individuals from the community are involved in the planning processes they will have a vested interest in the effective running and management of the MPA. If an MPA is declared, an awareness campaign is essential to ensure that everyone is aware of the new MPA, its extent and the rules that they will be expected to follow. CCC can help at all levels of this process by providing educational support to the community with information on how and why MPA can be successful.

Support for the establishment of an MPA is available from both Municipal and Provincial government levels. It will be important to secure funding from the outset to aid in the establishment of the MPA. Demarcation buoys, and signage are essential tools for raising awareness and promoting enforcement. Securing sustainable financing will help to secure the long-term future and success of an MPA.

If, after detailed consultation and evaluation, an MPA is designated in Punta, it will be important to ensure that monitoring of the MPA is conducted on a regular basis. Assessing temporal trends in abundance and diversity is crucial in determining how effectively the MPA is achieving its goals. The MPA Management Effectiveness Assessment Tool (MPA MEAT) is a national government programme designed to enable MPA manager to assess the effectiveness of their MPA. It uses detailed questionnaires and documentation to highlight limitations of MPA management and also suggests ways to improve it.

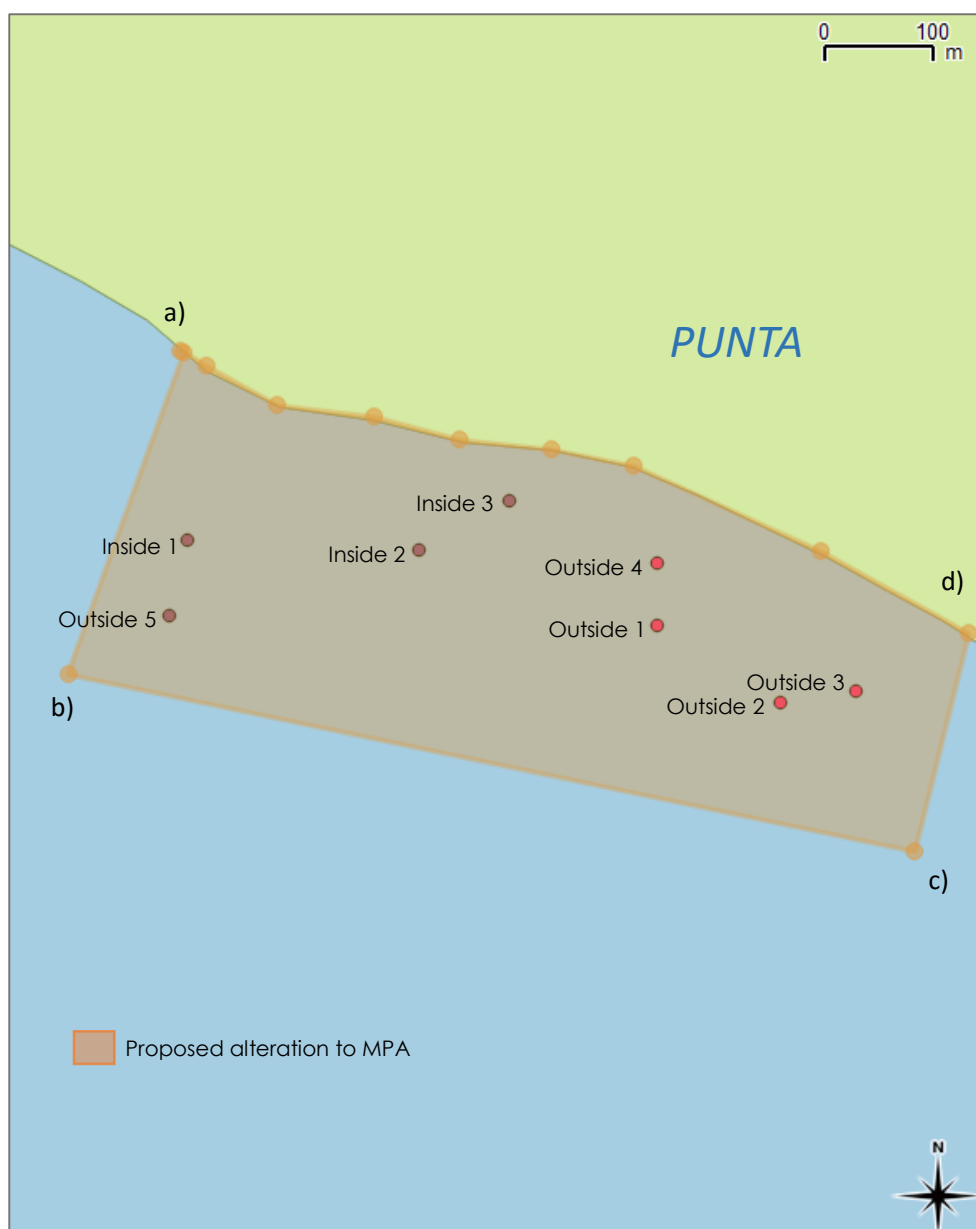


Figure 37. A visual representation of the recommended scenario for a marine protected area (MPA) of the already established MPA extension in the Barangay Punta, Municipality San Francisco, Southern Leyte.

Table 3. Recommended coordinates of the proposed 2015 Punta MPA boundaries, southern Leyte, the Philippines.

MPA Boundary	Northing (UTM)	Easting (UTM)
1) Eastern point on land	1111689	737477
2) Eastern point at sea	1111398	737373
3) Western point at sea	1111237	738142
4) Western point on land	1111434	738194

CCC can provide further support by conducting MPA assessments to provide the biophysical data required by the MPA MEAT. CCC can also provide training to allow the barangay to develop their own MPA monitoring team.

Overall the future of a protected area in Barangay Punta should be reviewed with consultation between all stakeholders involved. The site is in need of protection but this should only be established with the support of the local community and with management and monitoring coming from both Barangay and Municipal levels.

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APPENDIX: TARGET SPECIES LISTS

SUBSTRATES

Soft Coral	Sponge	Recently killed coral
Rock	Silt/mud	Rubble
Sand	Nutrient indicator algae	Other*
Hard Coral Lifeforms**:		
<i>Acropora</i> branching	<i>Acropora</i> encrusting	<i>Acropora</i> submassive
<i>Acropora</i> digitate	<i>Acropora</i> tabulate	Non- <i>Acropora</i> branching
Non- <i>Acropora</i> encrusting	Non- <i>Acropora</i> foliose	Non- <i>Acropora</i> submassive
Non- <i>Acropora</i> mushroom	<i>Heliopora</i> (blue coral)	<i>Millepora</i> (fire coral)
<i>Tubipora</i> (organ-pipe coral)		
*Other:		
Anemone	Corallimorph	Halimeda
Tunicate	Zoanthid	Gorgonian
Hydroids		

Target Invertebrates

Feather duster worms	Christmas tree worms	Flatworms
Crabs	Shrimps	Banded coral shrimp
Lobsters	Nudibranch	Abalone
Conch	Cowrie	Triton's trumpet
Cone shell	Drupella	Top shell
Other gastropod	Giant clam	Octopus
Cuttlefish	Squid	<i>Acanthaster planci</i>
<i>Linkia laevigata</i>	<i>Culcita novaeguineae</i>	<i>Protoreaster nodosus</i>
<i>Choriaster granulatus</i>	Feather star	Brittle star
Long spine sea urchin	Pencil urchin	Collector urchin
Prickly redfish	Pinkfish	Greenfish
Other sea cucumber	Giant Clam	

Target Fish

Common Name	Latin Name	Visayan Name
Angelfish	Pomacanthidae	Adlo
Barracuda	Sphyrnaeidae	
(Butterflyfish)	Chaetodontidae	Alibangbang
(Big) Longnose Butterflyfish	Forcipiger flavissimus	
Eastern Triangle Butterflyfish	Chaetodon baronessa	
Humphead Bannerfish	Heniochus varius	
Kleins Butterflyfish	Chaetodon	
Raccoon Butterflyfish	Chaetodon lunula	
Redfin Butterflyfish	Chaetodon lunulatus	
Vagabond Butterflyfish	Chaetodon vagabundus	
Cardinalfish	Apogonidae	
(Damsel fish)	(Pomacentridae)	
Anemonefish	<i>Amphiprion</i> sp.	
Sergeant Damsel fish	Pomacentridae	
Emperor	Lethrinidae	Katambak
Fusilier	Caesionidae	Dalagangbukid
Goatfish	Mullidae	Timbongan
Groupers	Serranidae	Lapu-lapu
Jack/Trevally	Carangidae	Talakitok
Lionfish	Scorpaenidae	
Lizardfish	Synodontidae	
Moorish Idol	<i>Zanclus cornutus</i>	Sanggowanding
Moray Eel	Muraenidae	
Parrotfish	Scaridae	Mulmul
Pufferfish	Tetraodontidae	
Rabbitfish	Siganidae	Kitong
Ray	Rajiformes	
Sandperch	Pinguipedidae	

Scorpionfish/Stonefish	Scorpaenidae	
Snapper	Lutjanidae	Maya-maya
Spinecheeks	Nemipteridae	Silay
Squirrelfish/Soldierfish	Holocentridae	
Surgeonfish	Acanthuridae	Indangan
Unicornfish	Naso sp.	
Sweetlips	Haemulidae	Lipti
Toby	Tetraodontidae	
Triggerfish	Balistidae	Pakol
(Wrasse)	(Labridae)	
Crescent Wrasse	<i>Thalassomalunare</i>	
Humphead Wrasse	<i>Cheilinusundulatus</i>	
Red Breasted Wrasse	<i>Cheilinusfasciatus</i>	