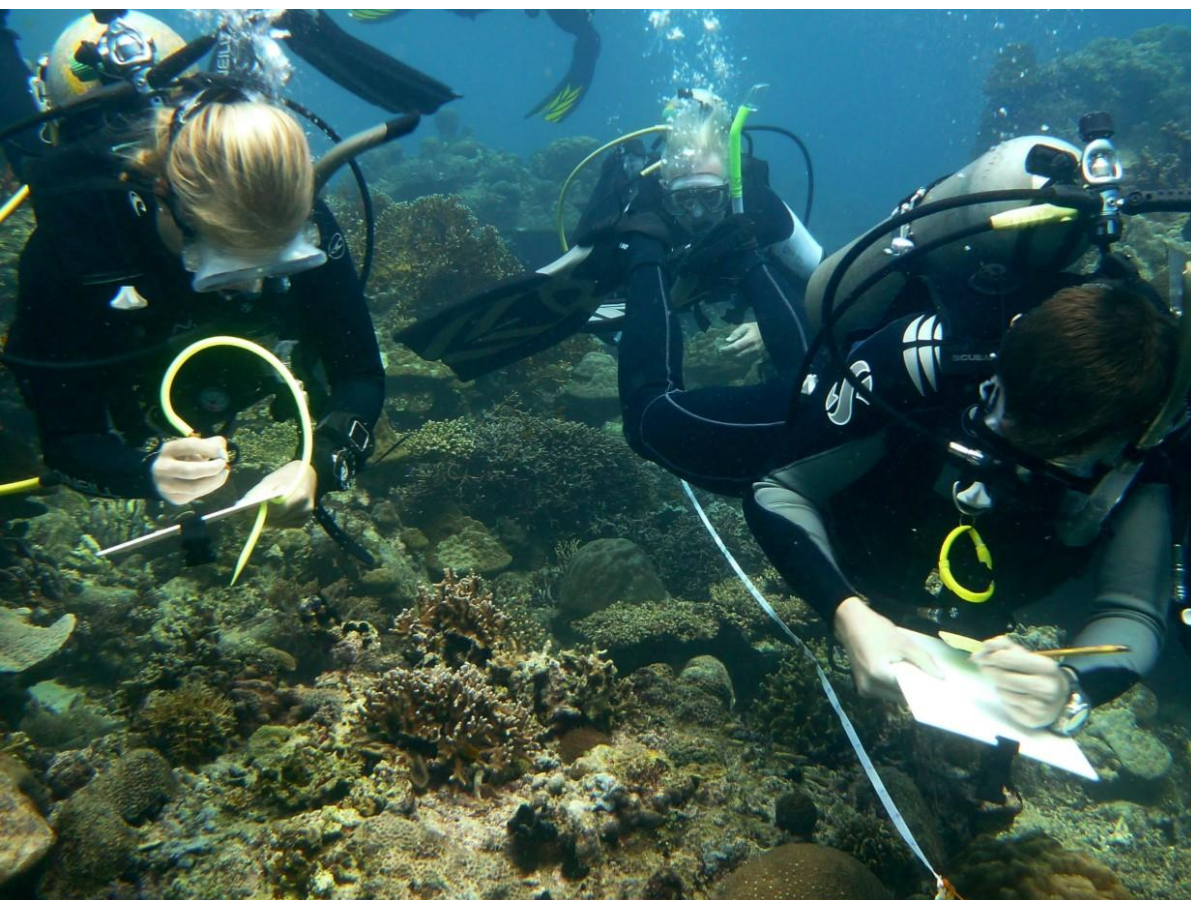




LRCP

Southern Leyte Coral Reef Conservation Project

Coral Cay Conservation Lobster Marine Reserve Viability Assessment: Barangay Catig 2016

Report Date: November 2016



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In partnership with the Southern Leyte
Provincial Government, Philippines



Executive Summary

- Coral Cay Conservation (CCC) conducted a brief biophysical and visual assessment of an area south of the proposed Catig MPA to look for appropriate lobster habitat for the creation of a Marine Reserve.
- One 100m transect line was surveyed for fish, invertebrates, and substrates. Additionally, the survey line was photographed for lobster habitat and the entire shoreline of the specified area was visually assessed via snorkelling by photographers.
- Hard coral cover, fish, and invertebrate abundances were considerably lower than those found in Napantao MPA.
- The area was characterised by sandy and rocky habitat for red reef lobsters (*Enoplometopus occidentalis*) and a local fisherman suggested that Painted Spiny Lobsters (*Panulirus versicolor*) likely inhabit the area as well, based on appropriate habitat.
- Although the surveyed area exhibited clear signs of historical anthropogenic impact, Coral Cay Conservation recommends the surveyed area be protected as a Marine Reserve for lobster in the Catig area. Signs of lobster inhabitants and positive fisherman reports provide sufficient evidence to encourage the establishment of a MR.
- Protection afforded by MR establishment, if run correctly, should also help increase the overall coral cover and fish stocks which are drastically lower to other surveyed sites in the Liloan region, as well as improve the current lobster populations.

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List of Acronyms and Abbreviations

CCC	: Coral Cay Conservation
HC	: Hard Coral
IUCN	: International Union for the Conservation of Nature
LGU	: Local Government Unit
MAO	: Municipal Agricultural Office
MR	: Marine Reserve
MPA	: Marine Protected Area
NIA	: Nutrient Indicator Algae
NIPAS	: National Integrated Protected Area System
NTA	: No Take Area
OT	: Other
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	: RB
RC	: Rock
RKC	: Recently Killed Coral
SC	: Soft Coral
SD	: Sand
SE	: Standard Error
SI	: Silt
SLRCP	: Southern Leyte Reef Conservation Project
SP	: Sponge

Coral Cay Conservation

Initially founded in 1986, CCC is an internationally renowned, not for profit 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 PGSL invited CCC and the PRRCFI to conduct research in Sogod Bay. This resulted in the formation of the Southern Leyte Reef Conservation Project (SLRCP). The SLRCP 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

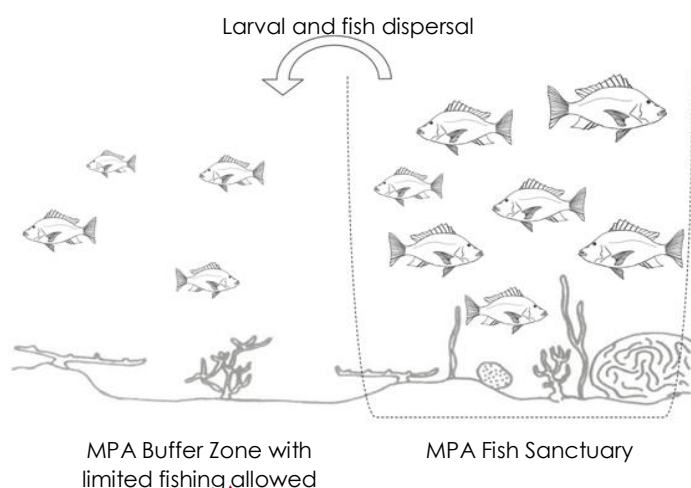
1.1. Marine Protected Areas

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 are surrounded by 50m "buffer zones" where only non-destructive fishing methods, such as hook and line fishing, are permitted (Fig. 1). 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).

To assess the beneficial impact of an MPA, resource managers often seek to measure its respective effectiveness. Effectiveness can be measured on a range of factors, however, most commonly addresses the goals established by the MPA. Measuring the MPA's impact on ecology, biodiversity, (Mora *et al.*, 2006; Selig and Bruno 2010; Solan-Fernandez *et al.*, 2012), species conservation, the general ecological status and fishery productivity (Buxton *et al.*, 2006; McDaniel 2007) as well as meeting the stakeholder-defined parameters of success (Dahl-Tacconi *et al.*, 2005) can often satisfy the quantifiable conclusion of effectiveness. The definition of effectiveness was given by Pajaro (2010) and states that effectiveness is the achievement of the ecological, socio-economic, and governance objectives outlined during the planning process. However, generally, the most desired benefit of an MPA is increased fish production. This occurs as a result of overspill and larval export from the NTA 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.



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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 certain actions are restricted, such as destructive fishing gears. As a result, low-impact, artisanal gears are promoted; single hook and line or spear fishing. This reduces habitat damage often caused by dynamite fishing, net fishing or trawling. MRs are preferable to areas of no protection but are not as effective as MPAs as fishing pressure remains present. The fauna within the MR, their size, biomass and life-stage are all at the discretion of the by-laws set for the MR during the planning stage regarding levels of exploitation. Enforcement in this regard can be fully functioning through closed seasons or restrictions on certain gears and activities, or can be minimal resulting in high levels of exploitation of all cohorts. Therefore, when enforcement is minimal or non-apparent the majority of fish and invertebrates within an MR can still be extracted. With by-catch being a void concept within tropical subsistence coral reef fisheries, it is often the case, as fishery production decreases, juveniles, unprecedentedly retain a social and economic value to fishermen. As a result, 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.

"The key to success and broad acceptance, whether for multiple use MPAs or NTAs, is a clear articulation of the management problem that the MPA is meant to solve. Such objective setting should be done with scientists working in concert with local communities, user groups and management authorities – not scientists in isolation."

Agardy *et al.* (2003).

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 and 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 centre 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) (DENR-CMMO presentation, March 19th 2013). The case study below highlights the success of two MPAs in the Philippines.

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)

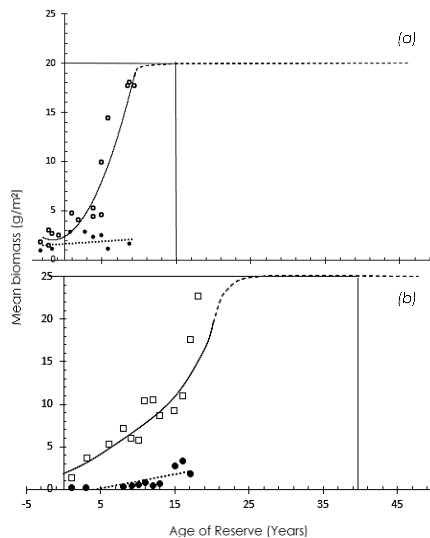


Figure 1. Observed (no-fill markers), control (filled markers) and projected (dashed line) increases in mean biomass (g/m²) of commercially important fish species inside Apo Island (a) and Sumilon Island (b) MPAs. Data and figures adapted from Russ and Alcala (2004).



1.3 Characterisation of Study Region

1.3.1 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. The region is also a feeding ground for attractive mega-fauna 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 (Calumpung *et al.* 1994).

1.3.2 Catig, Liloan: Proposed extended Marine Reserve for Lobster protection

This survey was requested by the Liloan Municipal Agricultural Office (MAO) and the Local Government Unit (LGU) as they aim to meet the requirements of the aforementioned 1998 Fisheries Code (Republic Act 8550) which states that 15% of all municipal waters should be within an MPA. The Municipality of Liloan is situated on the

Northern tip of Panaon Island, extending across both its Western and Eastern coastlines. The West coast of the island outlines the Eastern boundary of Sogod Bay. The East coast and its associated Barangays face on to the Surigao Strait; a narrow waterway connecting the Bohol Sea and the Leyte Gulf of the Philippine Sea. This is the location of Barangay Catig (Figure 2).

The reefs of Catig are exposed to moderate to high wave action caused by North-East trade winds during the season of Amihan. This generally occurs between the months of September and June each year. In April 2004 the area was subjected to a major storm which triggered a landslide directly in to the Barangay of Catig. It is thought that the coral reefs may have been affected however no survey was carried out to substantiate this. In light of the damage on land, the population of the Barangay was relocated approximately 3km north to a new settlement often referred to as Caritas. The current population of this Barangay is 353 persons. CCC surveyed coral reefs located between approximately 50-200m from the shoreline of the original Barangay Catig in a North to South orientation.

Coral Cay Conservation completed a full, proposed MPA survey in Catig in August 2015. CCC recommended the survey area be protected as an MPA. The Liloan LGU is currently drafting an ordinance for the creation of this MPA and, in August 2016, requested a visual assessment of an area just south of the proposed MPA. The visual assessment was designed to search for appropriate lobster habitat so that the LGU may create an extended lobster marine reserve around the NTA.

2. Methodology and Data Collection

2.1 Survey Sites

Coral Cay Conservation's assessment of the proposed MPA site for Catig was conducted on September 13th, 2016 by trained volunteer survey teams. The weather was cloudy with no major weather systems moving through the region. The air temperature was 31°C, water temperature was 30°C on the surface, 29°C at a depth of 3m and 29°C at 10m. The estimated horizontal visibility throughout the survey was 15m.

Poison fishing is known to occur regularly along with the recreational harvest of both fish and invertebrates for personal consumption. Furthermore, nitrification ~~occurrences, regular~~ occurrences, regular algal blooms, particularly between the months of December and April, and previous talks with Catig Barangay officials, suggests that overall the anthropogenic impact is high within the proposed lobster MR.

2.2 Biophysical Survey

A brief biophysical assessment of the proposed MPA site was conducted using an enhanced Reef Check methodology, which is widely recognised and 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 (Appendix A).

One 100m transect was laid along the reef, parallel to the shore, on a north to south bearing at 6 meters of depth (Fig. 2, Table 1). The 100m transect was divided up into four 20m replicates, separated by 5m inter-replicate gaps in which no data was collected. This produced a total surveyed length of 80m.

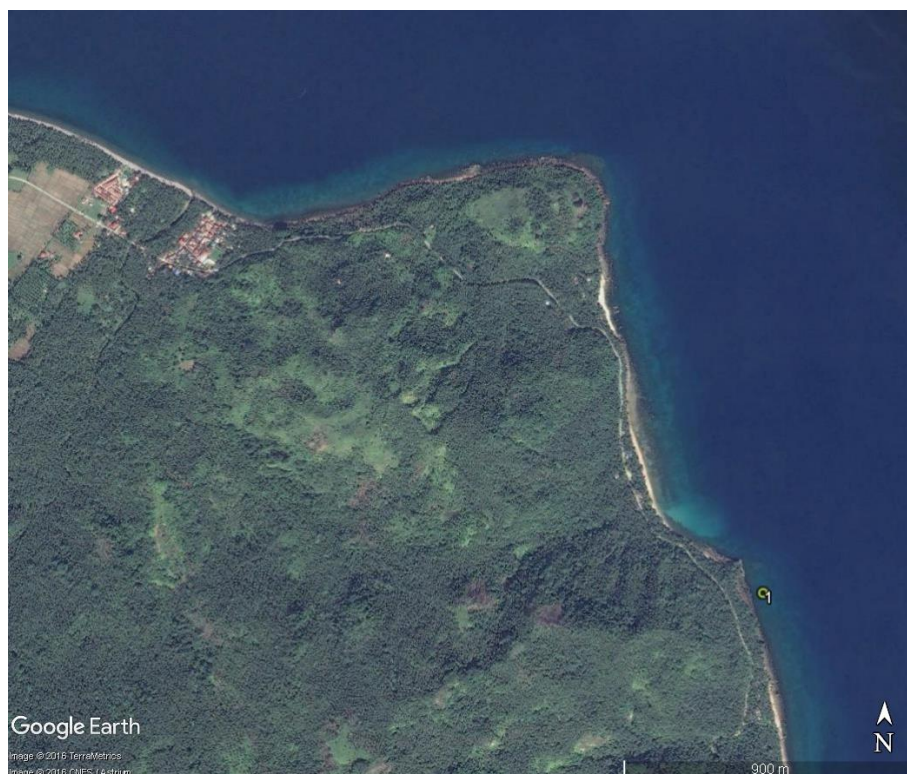


Figure 2. Map of survey location and wider geographic region [of Barangay Catig and the location surveyed.](#)

Table 1. Depth (m) and coordinates (UTM) of the 100m transect surveyed along the coast of Barangay Catig, southern Leyte, the Philippines.

Depth (m)	Easting (UTM)	Northing (UTM)
6	0742988	1119135

2.2.1 Fish

Fish diversity and abundance data was collected using Underwater Visual Census. Selected fish families and species recognised as being good indicators of fishing pressure, aquarium collection and reef health were recorded. Three commercially important fish families: Parrotfish (molmol, Scaridae); Groupers (lapulapu, Serranidae) and Snappers (mayamaya, Lutjanidae) and were also classified into the size classes 0-10cm, 11-20cm, 21-30cm, 31-40cm, 41-50cm, 51-60cm and >60cm (Appendix A).

Data was recorded using 'belt' transects, where fish were observed along each replicate of the 100m transect within an imaginary 5x5x20m (WxHxL) box (Fig. 3). Surveys were conducted by two surveyors swimming slowly along replicates, each counting indicator fish species 2.5m either side of the central transect line. Divers paused at five metre intervals along each replicate to wait one minute for fish to acclimatise to surveyor presence. Data collection continued during this one-minute pause.

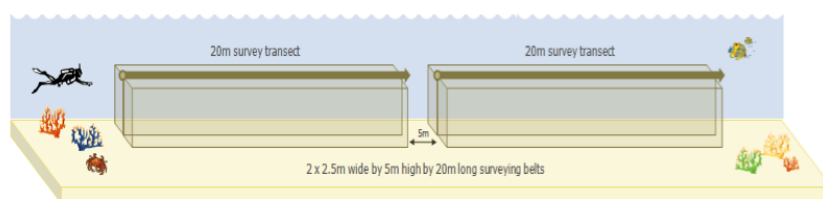


Figure 3. An augmented method that Coral Cay Conservation utilises to carry out MPA assessments that is adapted from a standardised Reef Check method. This schematic demonstrates two of the normal four replicates, of which, are separated by a 5m replicate interval. As the divers swim along the transect tape for the first 20m, they will record the specified target fish 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.

2.2.2 Invertebrates

The diversity and abundance of selected invertebrate families and species were recorded along the same belt transect used for fish. Recorded species are typically targeted for food, collected as curios or important to the ecological balance of the reef (Appendix A). Giant clams (takubo, *Tridacna gigas*) were recorded into the size classes 0-10cm, 11-20cm, 21-30cm, 31-40cm, 41-50cm, 51-60cm and >60cm. Two divers each recorded invertebrates 2.5m either side of the transect line while swimming in a U-shaped search pattern (Fig. 4). Divers looked in holes and under overhangs to find cryptic organisms such as lobsters and sea urchins.

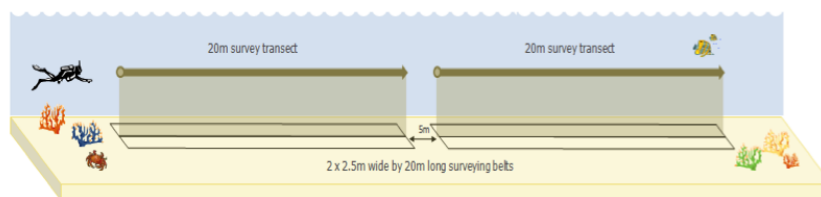


Figure 4. An augmented method that Coral Cay Conservation utilises to carry out MPA assessments that is adapted from a standardised Reef Check method. This schematic demonstrates two of the normal four replicates, of which, are separated by a 5m replicate interval. As the divers swim along the transect tape for the first 20m, they will record the specified target invertebrate 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.

2.2.3 Substrate

Benthic diversity was measured by recording living and non-living substrate categories along a 'point-intercept' transect using a plumb line to minimize bias. Benthic organisms and substrate types directly underneath the transect line were recorded at 50cm intervals along each 20m replicate (Fig. 5). Every 20m replicate contained 40 benthic points. Benthic categories included: sand (SD), rock (RC), rubble (RB), silt/mud (SI), nutrient indicator algae (NIA), sponge (SP), recently killed coral (RKC), soft coral (SC), hard coral (HC) and any other sessile organisms. All hard corals were recorded to life form and level, with targets being recorded to species level (Appendix A).

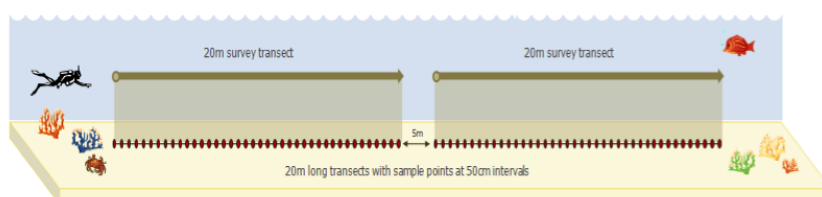


Figure 5. An augmented method that Coral Cay Conservation utilises to carry out MPA assessments that is adapted from a standardised Reef Check method. This schematic demonstrates two of the normal four replicates, of which, are separated by a 5m replicate interval. As the divers swim along the transect tape for the first 20m, they will record the specified target 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.

2.2.4 Impacts

Within the same area assessed for invertebrates, divers recorded impacts on the reef. The total percentage of bleached coral cover was estimated together with the percentage of bleaching on each individual bleached coral colony. Coral diseases were identified where present and recorded as a percentage of the colony infected. Damage was 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). The impact of trash was recorded on the same scale and separated into general and fishing nets/traps.

2.3 Visual Assessment

The proposed marine reserve was also assessed visually using underwater photographers. During data collection along the 100m transect line each survey team was accompanied by an underwater photographer who assessed the area for rocky habitat associated with lobsters and other marine life. Additionally, the entire shoreline in the proposed area was visually assessed in a snorkel survey by six underwater photographers.

2.4 Data Analysis

Each 20m belt transect was treated as an independent replicate. This produced $n=4$ at 6 metres. Abundance of fish, invertebrates and substrates was averaged across replicates and presented with standard error.

The images presented in the visual assessment represent both the most common habitat in the area as well as the diversity of marine organisms seen at the site.

3. Results

3.1 Fish

On average, Parrotfish (7.5 ± 3.5 per 500m³) and Cardinalfish (6.67 ± 1.67 per 500m³) dominated the surveyed area (Fig. 6). No other commercially important fish (i.e. Grouper (Serranidae), Snapper (Lutjanidae)) were recorded on the transect.

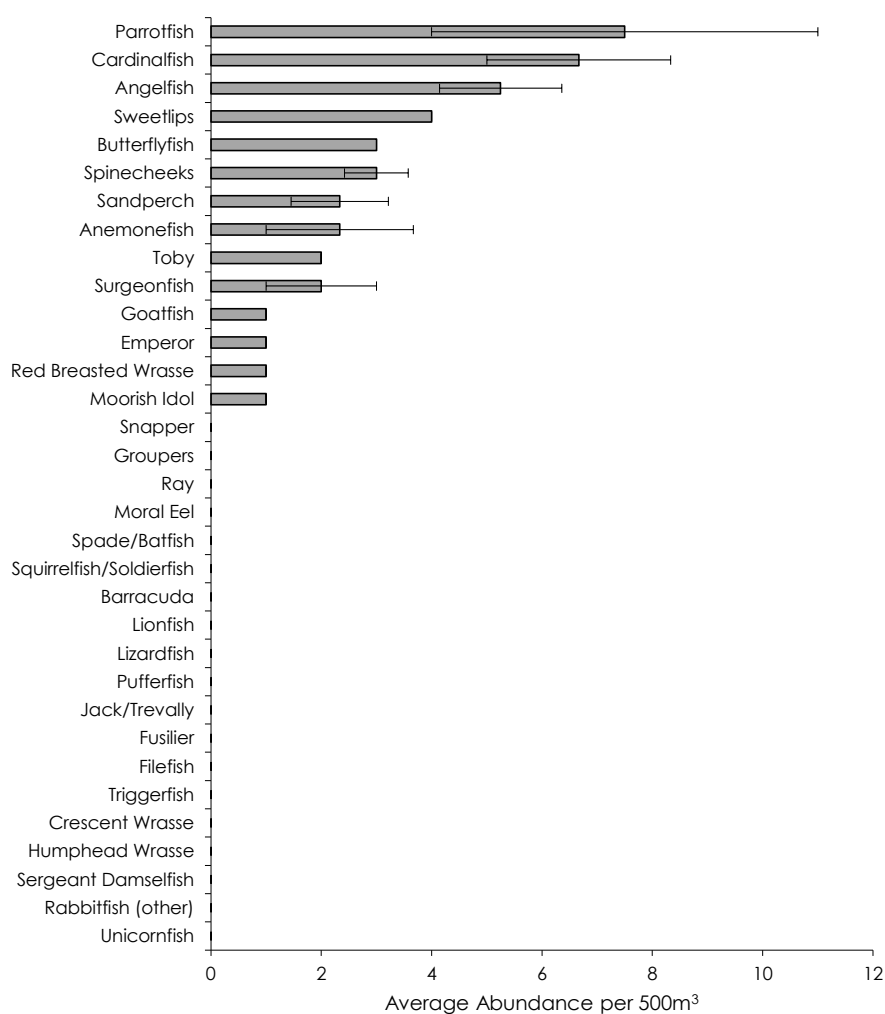


Figure 6. Average abundance of target fish families with Standard Error (SE±) for Catig proposed MR site, Municipality Liloan, Southern Leyte, Philippines.

3.2 Invertebrates

On average, Feather Stars (54.25 ± 3.92 per 100m^2) dominated the surveyed area, followed by Long Spine Sea Urchins (23.50 ± 8.96 per 100m^2) (Fig. 7). Commercially important Giant Clams were poorly represented within the survey area (1.3 ± 0.33 per 100m^2).



Figure 7. Average abundance of target invertebrates with Standard Error for Catig proposed MR site, Municipality Liloan, Southern Leyte, Philippines.

3.3 Substrates

Rubble dominated the surveyed area with nearly $44.38\% \pm 3.87$ per 20m coverage (Fig. 8). Rock and algae each covered $16.88\% \pm 0.63$ per 20m and $15.63\% \pm 0.63$ per 20m respectively of the remaining area, followed closely by sand ($13.75\% \pm 3.75$ per 20m). Hard coral covered less than 9% of the surveyed area ($8.33\% \pm 2.21$ per 20m). 5 non-*Acropora* branching colonies were found, the most of any coral form, followed by 3 non-*Acropora* encrusting, 1 non-*Acropora* massive and 1 non-*Acropora* mushroom. All other coral lifeforms were absent from the survey transect.

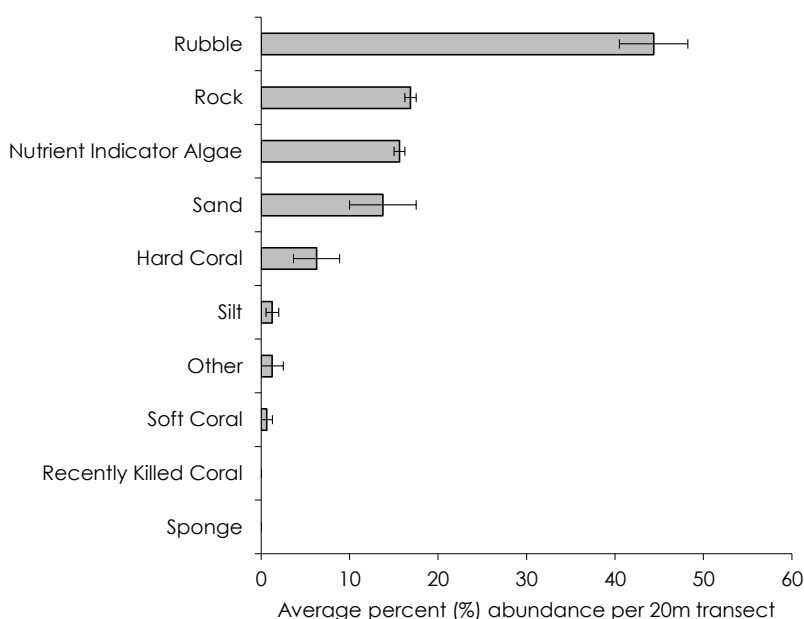


Figure 8. Average abundance of target substrates with Standard Error for Catig proposed MR site, Municipality Liloan, Southern Leyte, Philippines.

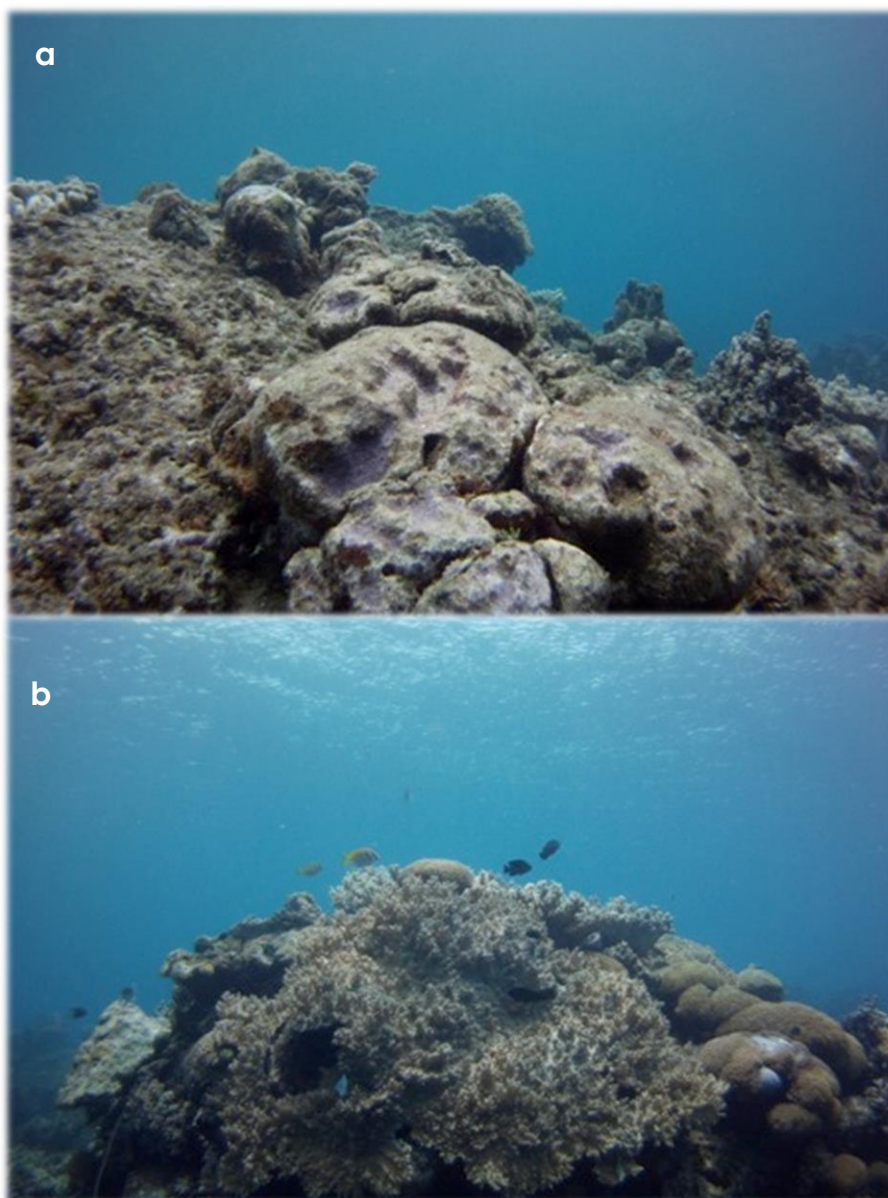
3.4 Anthropogenic Impacts

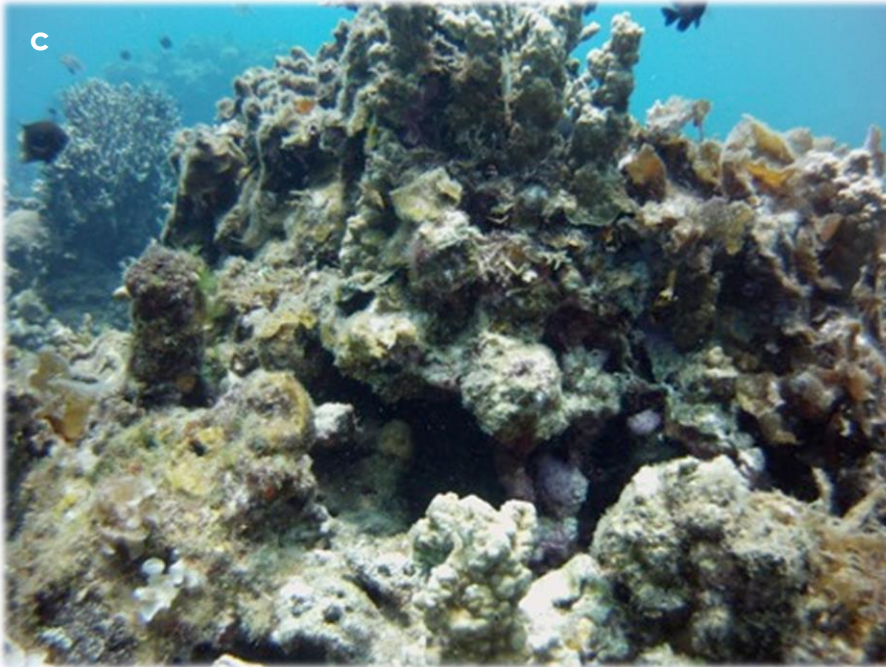
General trash was recorded 2 times during the survey and occurred on two of the four 20m transect replicates. There were no obvious signs of boat, anchor, or dynamite damage. Undetermined coral damage was observed 6 times and occurred on two of the four 20m transect replicates.

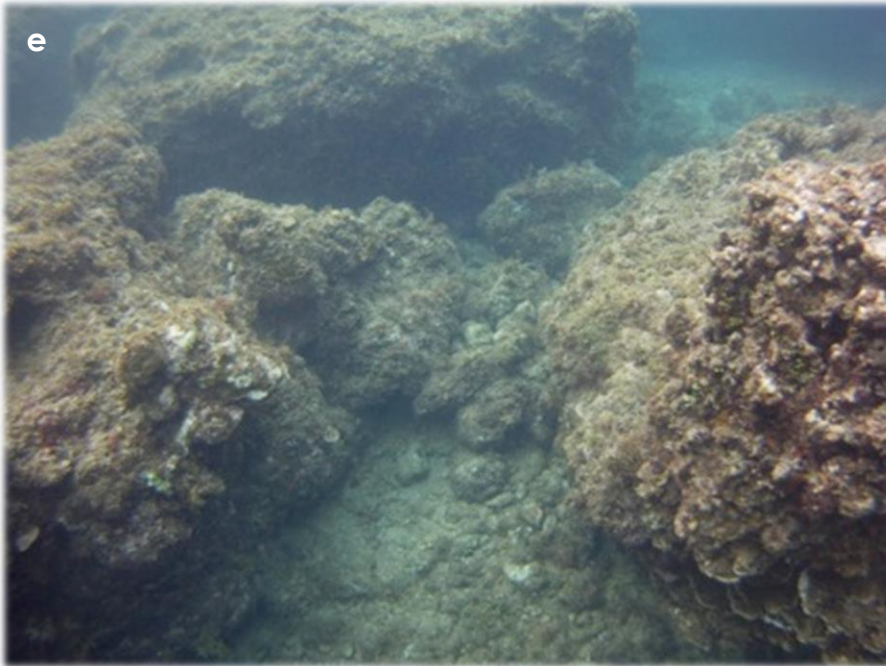
Coral bleaching was recorded on two of the 20m transect replicates but less than 1% of the population was affected. Individual colonies that exhibited bleaching were on average 16.5% bleached. No coral diseases were recorded on the transect.

4. Visual Assessment

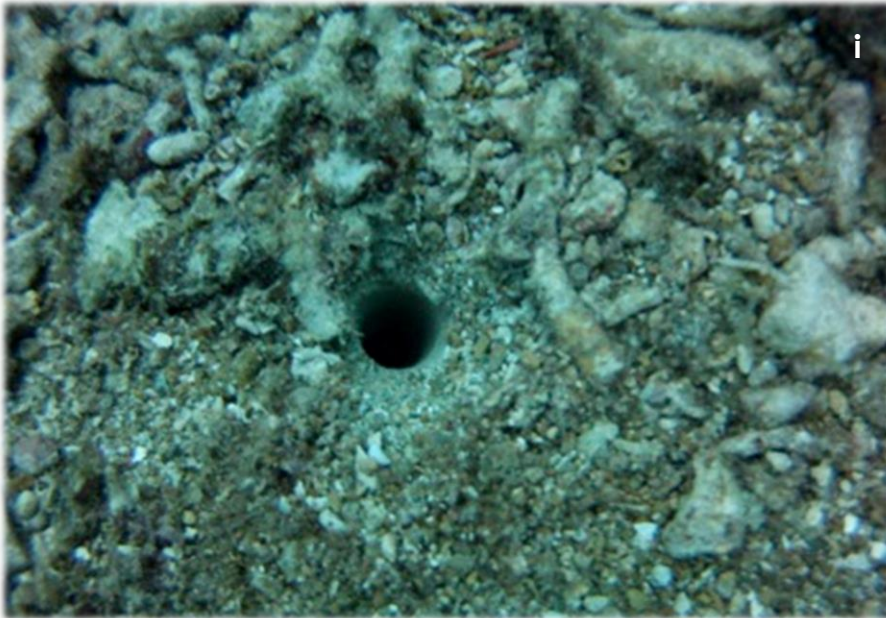
Images taken by CCC volunteers on the reefs of Catig.

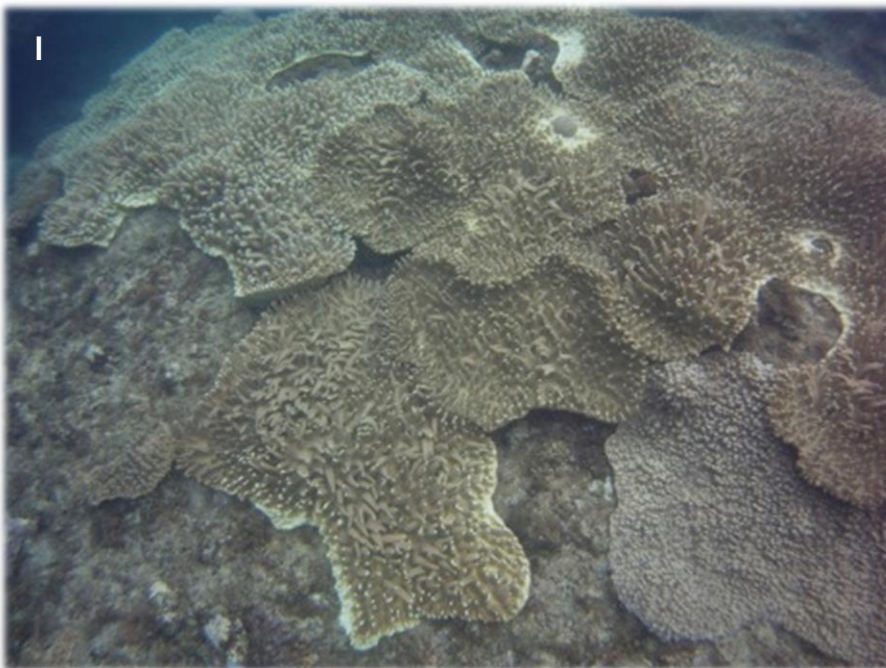














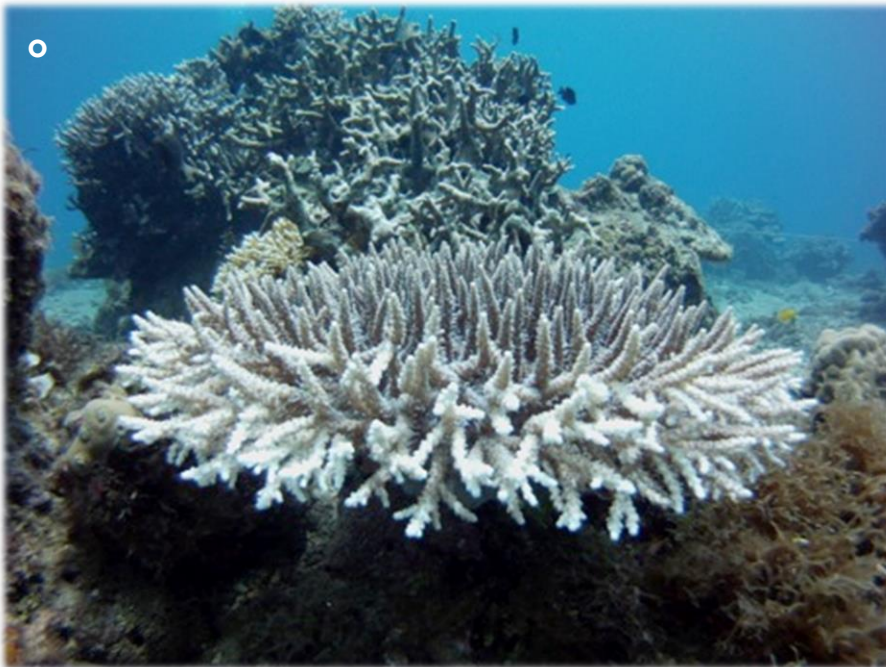


Figure 9. (a) Seascape of Catig's proposed lobster marine reserve; (b) a selection of hard coral (*Porites lobata*); (c) dense algal growth covering dead coral colonies; (d) sporadic coral bommies competing for recruitment space with algal species; (e) benthic composition and crevices ideal for lobster inhabitants; (f) presence of stress tolerant coral specie optimises the regions environmental and anthropogenic impacts; (g) a red reef lobster (*Enoplometopus occidentalis*) lingers within his cryptic home; (h) large massive coral colony (*Porites lobata*); (i) opening to a lobster burrow; (j) Blue knee hermit crab (*Dardanus guttatus*) in an abandoned cowrie shell; (k) two nudibranchs (*Chromodoris magnifica*) slowly wander across Catig's algal beds; (l) thick soft coral blankets coat Catig's coastal sea floor; (m) Giant clam (*Tridacna* sp.) covered in *Padina* sp. algae; (n) large *Euphyllia* sp. submassive hard coral colony; (o) a partially bleached tabulate *Acropora* sp. closely accompanied by a *Porites* sp. colony.

5. Discussion

~~The proposed lobster marine reserve at the south end of the proposed Catig MPA shows promise as a lobster sanctuary. Although the~~ The reef site's composition is primarily rubble, rock, algae and sand, there is appropriate sandy habitat for small red reef lobsters (*Enoplometopus occidentalis*) to burrow and create shelters in the sandy bottom between rocks. Many small (3cm – 7cm) Red Reef Lobsters were seen during the snorkel visual assessment but were not recorded along the transect. However, it is our understanding that local fishers typically collect larger lobster species including the Painted Spiny Lobster (*Panulirus versicolor*). No Painted Spiny Lobsters were seen during the biophysical survey or the snorkel survey, however, this species is nocturnal. A local fisherman believed the habitat is suitable for Painted Spiny Lobsters, after photos from our biophysical survey were presented to him. Moreover, *Panulirus argus*, another spiny lobster species found in Biscayne and Florida Bay have been ~~to~~ recorded moving from seagrass and sponge beds, to a preferred rocky habitat similar to that found in the Catig proposed lobster MR (Davis and Dodrill 1980).

The lack of hard coral at the site suggests the area may ~~have~~ experienced high levels of anthropogenic and natural stressors, which have destroyed coral formations and prevented hard coral establishment. It is possible that this area was impacted by the 2004 landslide that forced the relocation of Barangay Catig. Similarly, a previous CCC report within the Catig coastal area highlighted consistent NIA coverage within Catig's adjacent MPA, which could point to regular eutrophic occurrences in the region (Cameron and Ferguson 2015). Eutrophication describes the process whereby increased nutrient run off from the land, encourages rapid algal growth, which can then lead to the smothering of newly established corals and a reduction in the amount of photosynthetically available sunlight. Algal overgrowth also prevents coral establishment and is therefore indicative of an unhealthy reef ecosystem. The large amount of rock in the area could provide a good habitat for new corals to settle if algae consumer populations, such as Parrotfish and ~~Wrasse~~ species, return and reduce the levels of algae currently growing on rocky surfaces. Therefore, protecting this area as a marine reserve may allow algal grazing fish and invertebrates to return to the area in sufficient numbers to promote hard coral growth.

~~The data obtained from the single transect conducted on the eastern coastline is inconclusive of the areas ability to support a lobster fishery. Although presence of lobster were recorded, these do not appear to be the target Genus, as highlighted by local fisher folk. As the habitat is believed to be suitable to support such Genus of lobster (*Panulirus* sp.), it is proposed that the discussed area be established as a lobster-specific NTA. This proposed NTA must encompass specific and direct by-laws that prohibit the removal of the *Panulirus* sp. and other lobster species under outlined conditions and temporal-scales. To be effective, the NTA should also include catch-size limitations, area and/or seasonal closures of which must be designed around the species growth and reproductive characteristics. For example, as *Panulirus* sp. have been demonstrated to elicit nocturnal behaviours, lobster-specific fishing gears or gears that result in the capture of lobster are advised against during these times of increased activity. Furthermore, by removing the ability to exploit all lobster under the~~

established doctrine, for a set period of time, the aim is to enable lobster populations to recover, providing a fruitful future fishery. Other by-laws regarding fishes and other invertebrates will need to be further discussed based on the aim of this assessment.

To conclude, CCC recommends the establishment of a lobster-specific NTA that enforces direct by-laws regarding the exploitation of *Panulirus* sp. and other lobster species. Following this establishment, a re-assessment of the NTA will need to be conducted in order to determine populations; the preliminary time-scale proposed is 2 years. As a result, the by-laws will enforce their respective doctrines for 2 years; until re-assessment. The by-laws established will need to be done so with the scientific guidance of CCC directed at the ecology and behaviour of target lobster species. Following discussions, it maybe decided that a full closure would be the most suitable and other by-laws regarding catch-sizes as previously mentioned, be suitable following re-assessment. This will enable CCC to advise on the said by-laws for the specific population observed within the waters of Catig.

We recommend the surveyed area be protected as a MR targeting lobster habitat.

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APPENDIX A: TARGET SPECIES LIST

SUBSTRATES		
Soft Coral	Sponge	Recently killed coral
Rock	Silt/mud	Rubble
Sand	Nutrient indicator algae	Other*
Hard Coral Lifeforms**:		
Acropora branching	Acropora encrusting	Acroporasubmassive
Acroporadigitate	Acropora tabulate	Non-Acropora branching
Non-Acropora encrusting	Non-Acropora foliose	Non-Acroporasubmassive
Non-Acropora mushroom	Heliopora (blue coral)	Millepora (fire coral)
Tubipora (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	Acanthaster planci
Linkia laevigata	Culcita novaeguineae	Protoreaster nodosus
Choriaster granulatus	Feather star	Brittle star
Long spine sea urchin	Pencil urchin	Collector urchin
Prickly redfish	Pinkfish	Greenfish
Other sea cucumber	Giant Clam	

Common Name	Latin Name	Visayan Name
Angelfish	Pomacanthidae	Adlo
Barracuda	Sphyraenidae	
(Butterflyfish)	Chaetodontidae	Alibangbang
(Big) Longnose Butterflyfish	Forcipiger flavissimus	
Eastern Triangle Butterflyfish	Chaetodon baronessa	
Humphead Bannerfish	Heniochus varius	
Kleins Butterflyfish	Chaetodon kleinii	
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	<i>Naso</i> sp.	
Sweetlips	Haemulidae	Lipti
Toby	Tetraodontidae	
Triggerfish	Balistidae	Pakol
(Wrasse)	(Labridae)	
Crescent Wrasse	<i>Thalassoma lunare</i>	
Humphead Wrasse	<i>Cheilinus undulatus</i>	
Red Breasted Wrasse	<i>Cheilinus fasciatus</i>	