Coral Cay Conservation
Proposed Marine Assessment Report

Barangay Bahay

Bahay, Liloan, Southern Leyte
The Philippines

January 2014

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Contents

EXECUTIVE SUMMARY

- Coral Cay Conservation conducted a full assessment of the reef environment of Barangay Bahay, Liloan between April and July 2012.

- A series of ten transects, each 50 metres long were surveyed. A pre-determined list of reef fish, invertebrates, substrate types and impacts were recorded.

- Throughout all transects fish abundances of commercially valuable species such as Grouper (Lapu lapu), Snapper (Maya maya) and Sweetlips (Lipti) were extremely low.

- Herbivorous and detritivorous species such as Surgeonfish (Indangan) and Parrotfish (Mulmul) were more abundant but still recorded in low numbers.

- Butterflyfish (Alibangbang), important indicators of reef diversity and health, were not common and few species were recorded.

- Commercially important invertebrate species including giant clams, Triton's trumpet shells, lobsters and sea cucumbers were almost or entirely absent from all transects.

- Reef health indicator species such as *Diadema* sp. urchins were found to be within acceptable limits.

- Hard Coral was the most commonly found substrate type, followed by dead coral with algae and then rock. The majority of hard corals recorded were branching non-Acroporids.

- Half the sites surveyed displayed low coral lifeform diversity, while the other half were more diverse.

- Impacts on the reef, both anthropogenic and natural, were more both more frequent and of greater intensity at sites south of the village.

- Historic and recent damage reminiscent of blasting patterns were encountered at the four most southern sites.

- Discarded fishing gears and household trash were regularly encountered.

- The current plans to create a MPA in the area receive our full support. The research findings indicate a reef under great pressure that will take time to recover but that has the potential, in time, to improve the livelihoods of those stakeholders involved.

ACKNOWLEDGEMENTS

Coral Cay Conservation would like to express our gratitude to the Provincial Government of Southern Leyte (PGSL). Our work would not be possible without the support of the Provincial Environmental and Natural Resource Management Office (PENRMO) and other members of the PGSL. We would also like to thank the Barangay Council of Bahay and the Municipality of Liloan for facilitating the reef assessment. Finally, we would like to thank our trained volunteers and staff who collected the data during this assessment.

LIST OF ACRONYMS AND ABBREVIATIONS

CCC	: Coral Cay Conservation
DENR	: Department of Environment and Natural Resources
GPS	: Global Positioning System
IEC	: Information, Education, Communication
MAO	: Municipal Agricultural Office
MPA	: Marine Protected Area
MPA MEAT	: MPA Management Effectiveness Assessment Tool
NIPAS	: National Integrated Protected Area System
PGSL	: Provincial Government of Southern Leyte
PRRCFI	: Philippines Reef and Rainforest Conservation Foundation Inc.
SCREMP	: Sustainable Coral Reef Ecosystem Management Plan
SE	: Standard Error

CORAL CAY CONSERVATION

Coral Cay Conservation (CCC) is a not for profit organisation, founded in 1986 by a British scientist. CCC's mission is:

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

In order to achieve this mission, CCC has carried out conservation projects all over the world, including in the Philippines, Belize, Honduras, Malaysia, Cambodia and Fiji. CCC has successfully set up Marine Protected Areas and provided scientific data that has been used to manage local marine resources. Since 1995, CCC has worked with the Philippine Reef and Rainforest Conservation Foundation Inc. (PRRCFI) and local communities to survey and safeguard reef and rainforest areas in the Philippines. To date these have included coastal regions of the Southern Negros Occidental, Anilao, Palawan, Danjugan Island and the forests of North Negros. The project in Danjugan Island in the Philippines between the years 1996-1999 was particularly successful and the reefs around the island received the accolade of Best Managed Reef in the Philippines in 2002.

At the invitation of the Provincial Government of Southern Leyte, CCC began its survey work in Sogod Bay in September 2002. CCC is conducting a collaborative programme to survey the region's coral reefs and provide training and conservation education opportunities for local scholars. The aim is to develop local capacity and ensure the long-term protection and sustainable use of marine resources throughout Southern Leyte.

1. INTRODUCTION

1.1. Coral Reefs and Marine Conservation in the Philippines

The Philippines lies within the Coral Triangle, the globally recognised centre of marine biodiversity (Roberts *et al*, 2002). Further to this, the region of the Verde Islands in central Philippines has been named the centre of the centre of marine biodiversity (Carpenter and Springer, 2005), especially for marine shore fish diversity. The 2.6 million hectares of coral reef within the Philippines support not only this huge and varied diversity but many livelihoods as well, providing 67% of the protein intake of more than 60% of the population (Juinio-Menez, PAMS, 2013). Finally and possibly most importantly, coral reefs are increasingly being described as key defences against the effects of climate change, both in terms of food security and coastal protection (Buddemeier *et al*, 2004).

In light of this historic and ongoing reliance on the marine resource and the certainty of future pressures on the marine environment, the Government of the Philippines has identified enhanced coastal and marine resource management as a key aspect of development goals (NEDA, 2011). One widely accepted method of resource protection is the creation of Marine Protected Areas (MPAs) (Sobel and Dahlgren, 2004), a technique that has been applied in the Philippines for many years with varying success. Currently there are around 1,640 MPAs in the country (Juinio-Menez, PAMS, 2013) varying from large nationally controlled areas such as the Tubbataha Marine Reserve to small community-led MPAs sometimes covering as little as 1 hectare of reef. Both forms of marine protection are supported internationally; the larger and more formalised MPAs and sanctuaries form unique zones where enforced fishery closures attempt to contain large sustainable stocks of targeted species for regional benefits. The smaller community-based MPAs rely on local participation and adherence to rules and ordinances (Abesamis and Russ, 2005) with the aim of providing increased fish stocks for local stakeholders via adult and larval spillover (Watson *et al*, 1997).

At the national level, the Philippine Marine Sanctuary Strategy (2002) set a requirement of 10% of all Philippine waters to be protected by 2020. The DENR aims to manage >360,000 ha as NIPAS sites by 2016 as part of SCREMP. At the Municipal level the 1998 Fisheries Code (Republic Act 8550) dictates a minimum of 15% of municipal water should be within an MPA. This was added to by the Marine and Coastal Resource Protection Act which requires every municipality with more than 15 ha of municipal waters to contain and maintain a MPA of at least 10 ha.

1.2. Study Region Overview

Liloan Municipality of Southern Leyte is in a unique location spanning from the south-eastern tip of Leyte island to Panoan island. It has municipal waters both within Sogod Bay and in Cabalian Bay on the eastern, Pacific side of Leyte. Sogod Bay contains 23 established MPAs covering 170 ha, only one of which is in Liloan municipal waters. The Pacific Municipalities have established 25 MPAs covering 349 ha none of which are in Liloan municipal waters.

There is little historical data of the reefs on the eastern side of Panoan island potentially due to its inaccessibility both by land and sea. The landslide-prone "Rising Sphere" barangays of Liloan have no national road access and limited provincial road access up to Barangay Caligangan. Amihan (the NE Monsoon) also blows strongly down through the Surigao Straight to produce rough seas for 4-6 months of the year. All these environmental factors put the livelihoods of the residents of Barangay Bahay and others at high risk, making effective management of key resources such as their coral reefs extremely important (Courtney *et al*, 1998).

Barangay Bahay is the southernmost barangay of Liloan municipality with 520 residents, 56 of them registered fisherfolk. Of the fisherfolk, 7 use motorised boats, 36 paddle bancas and 8 are registered for gleaning only. It is understood that after registration some fisherfolk vary their habits (Personal communication, Liloan MAO, 2013). A proposal was put forward by the barangay and Municipal Agricultural Office (MAO) to establish an MPA in the barangay waters. Both CCC and Southern Leyte State University (SLSU) Bontoc were requested to survey the reefs close to the *sitio*. This report covers the findings of CCC's surveys between the months of April and July 2012. Figure 1 shows the location of the 10 survey transects undertaken by CCC, as can be seen some transects were north of the *sitio* and some south.

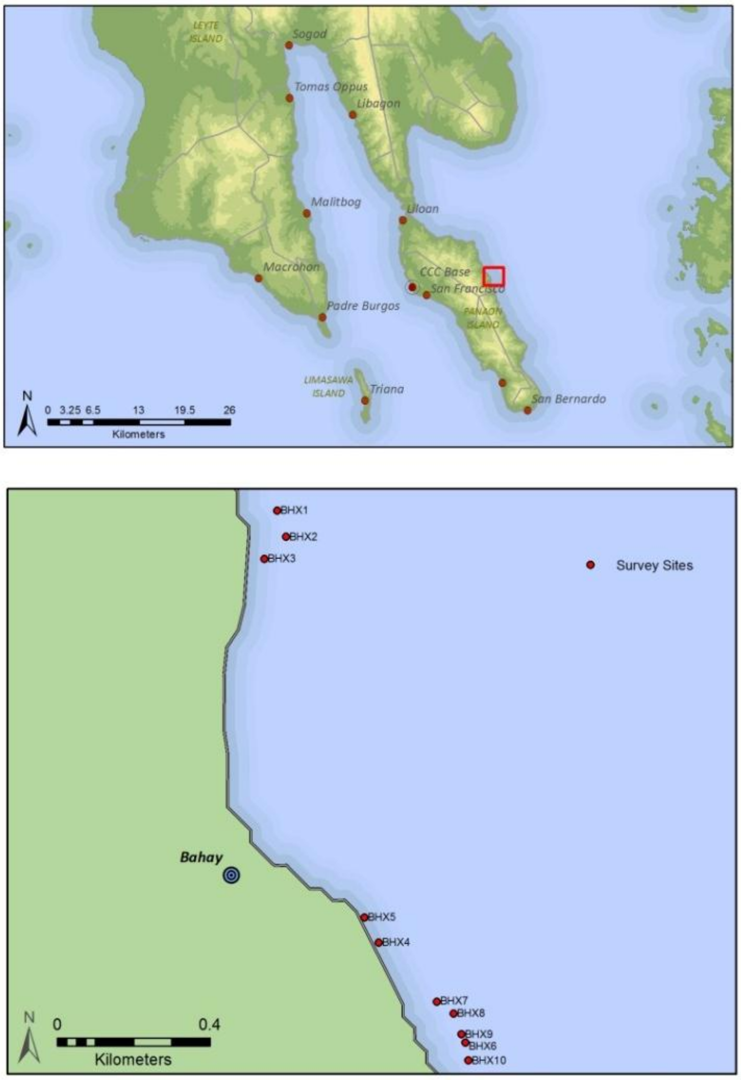

Figure 1 – Map of survey area and locations of the survey transects at barangay Bahay

2. METHODS

The survey methodology used followed closely the outline set out by Uychiaoco *et al* (2001). 10 transects of 50 metres were surveyed by CCC dive teams, all of which were between 6 and 12 metres, Table 1 shows the GPS co-ordinates of each transect hereafter described as Sites 1-10.

Table 1 - GPS points and depths of all transects

Site Number	Easting (UTM)	Northing (UTM)	Depth (metres)
BHX1	744957	1115105	12
BHX2	744981	1115036	12.5
BHX3	744923	1114978	12
BHX4	745225	1113970	12
BHX5	745186	1114036	11
BHX6	745452	1113707	12
BHX7	745376	1113815	11
BHX8	745420	1113784	9.5
BHX9	745441	1113729	8.5
BHX10	745459	1113660	6

2.1. Fish – Underwater Visual Census (UVC)

Standard UVC methods (English *et al*, 1997) were used to count fish abundance and families. A 5x5 metre box was imagined around a pair of divers for each 50 metre transect resulting in 1,250m^3 total surveyed volume (Figure 2). Swimming speed was controlled and there was a 15-minute waiting period after the line has been laid so as not to disturb the fish and let them come out of hiding. Fish families that were observed were chosen on the basis that they are (a) good indicator species of reef health or (b) important fish for consumption and hence an indicator of overfishing if their numbers are found to be low, or fishery recovery if their numbers are found to be relatively high (see Appendix A for full species list).

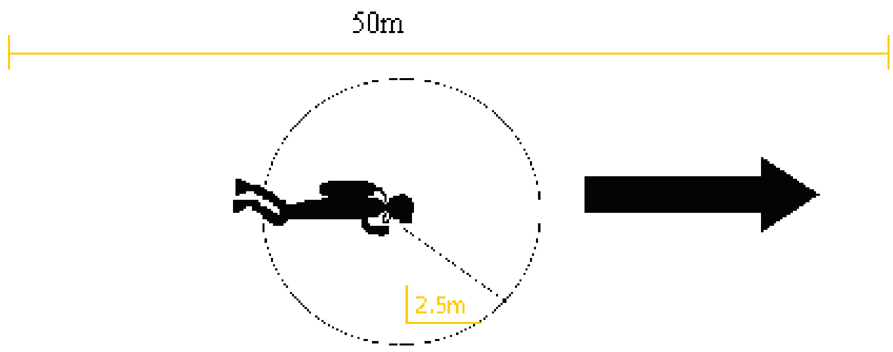

Figure 2 - One member of the fish survey buddy pair swimming along the full 50 metre transect counting all target fish with their half of the 5x5m box.

Fish from the Parrotfish (Scaridae) Grouper (Serranidae) and Snapper (Lutjanidae) families were also sized to better understand fish stocks and reproductive capacity on the reef.

2.2. Invertebrates – Belt Transect

Following the same transect line as that used for the fish UVC a pair of divers surveyed invertebrate species 2.5m either side of the line for the full 50m resulting in 250m^2 of surveyed area (Figure 3). Invertebrate species recorded are commonly used indicators of overfishing for food, curios and the aquarium trade as well as indicators of reef health (See Appendix A for species list).

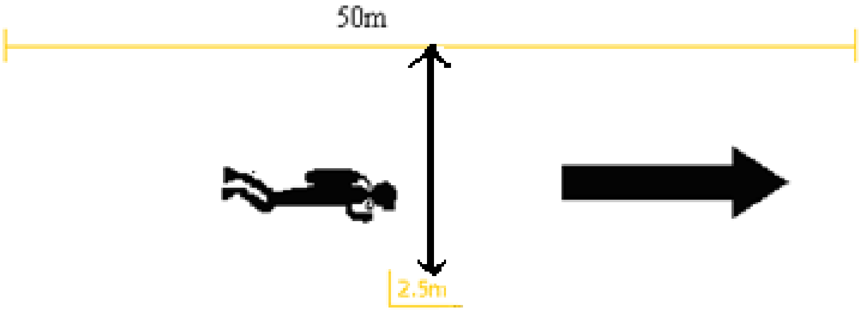

Figure 3 – One invertebrate and impact assessor swims the 50 metre transect looking for natural and man-made impacts as well as key invertebrate species

2.3. Substrates – Point Intercept Transect

Benthic diversity was measured by recording living and non-living benthic categories along a point intercept transect (see Appendix A for target benthic categories). Along the transect line, benthic organisms and substrate types directly under the line were recorded at 50cm intervals (Figure 4). Every replicate contained 100 points allowing for easy conversion into estimated percentage cover of each substrate type, living and non-living coral.

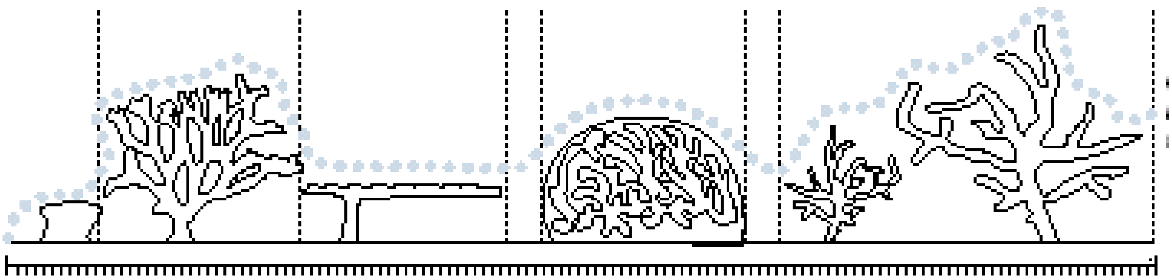

Figure 4 - A pictorial representation of the point-intercept method of substrate data collection. Each dot represents a data collection point.

2.4. Human and natural impacts

Within the same area assessed for invertebrates, divers recorded a number of impacts on the reef, Table 2 shows the impacts and the reasons they are included. Impacts are graded on a numerical scale representing level of effect from 0-3 (0 = none, 1 = low, 2 = medium, 3 = high) where category 3 or “high” indicates a cause for concern.

Table 2 - Natural and anthropogenic impacts recorded on surveys including causes and effects.

Impact	**Resulting effect and/or cause**
Sedimentation	Sediment prevents light reaching the corals, restricting their growth and can lead to coral death if severe or prolonged
Blasting patterns	From illegal dynamite fishing
Anchor damage	From boats mooring inappropriately
Other breakage	Caused by many factors including bad weather or irresponsible diving
Coral bleaching	A reaction to stress, can cause coral death if prolonged
Ghost fishing gear	Fishing equipment abandoned in the area, continues to catch and kill marine animals
Fish traps	Illegal fishing in the MPA
Coral disease	Caused by many factors, can devastate whole coral communities
Seaweed overgrowth	Prevents light reaching coral and can lead to death, often caused by low numbers of seaweed-eating fish
Coral-eating snails	Can be destructive in high numbers
Crown-of-thorns starfish	Outbreaks can destroy entire reefs
Plastics	Do not break down quickly, accumulate on reefs and harm corals, fish and other animals

3. RESULTS

Surveys were conducted at Barangay Bahay by underwater dive teams trained by Coral Cay between April and July 2012. On the surveys average surface water temperature was 28.6°C and average temperature at survey depth was 27.5°C, horizontal visibility varied from 10 to 20 metres with an average of 16.9m and current strength also varied from low to high. Survey Sites 1, 2 and 3 were classified as patch reef with the remainder being considered forereef.

3.1. Fish

Total fish abundance varied from 56 individuals per 1,250m^3 (Site 2) to only 2 individuals per 1,250m^3 (Site 6) (Figure 5) with an overall average of 23 ± 5.3 per 1,250m^3 (mean ± SE). Across all survey sites, Butterflyfish (Chaetodontidae), Surgeonfish (Acunthuridae) and Parrotfish (Scaridae) were the most abundant families recorded (Figure 6). Some commercially important families including Sweetlips (Haemulidae), Emperors (Lethrinidae), Jacks (Carangidae) and Goatfish (Mullidae) were wholly absent from all surveys, other commercial families such as Grouper (Serranidae) and Snapper (Lutjanidae) were recorded just once and twice respectively (see Appendix B for fish family abundance by site). All snappers and groupers recorded, as well as the majority of parrotfish were between 1 and 10 cm in length (Figure 7). No individuals over 20cm were recorded.

Due to their value as reef health indicators Butterfylfish (Chaetodontidae) were identified to species level. During all surveys a total of 7 out of 40 target species (see Appendix A) were identified, 62% of these were identified as Redfin Butterflyfish (*Chaetodon trifasciatus*) which were found at 70% of the sites (Figure 8). Only one site (Site 1) had more than two species of butterflyfish recorded.

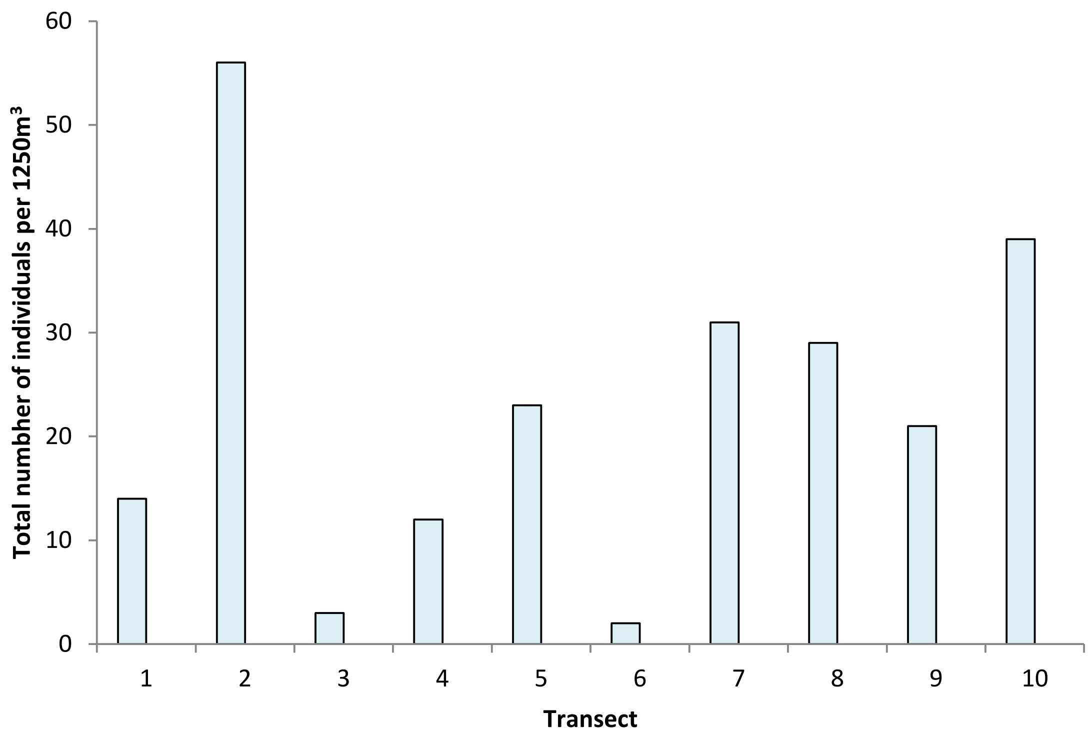

Figure 5 – Total fish abundance at each survey site

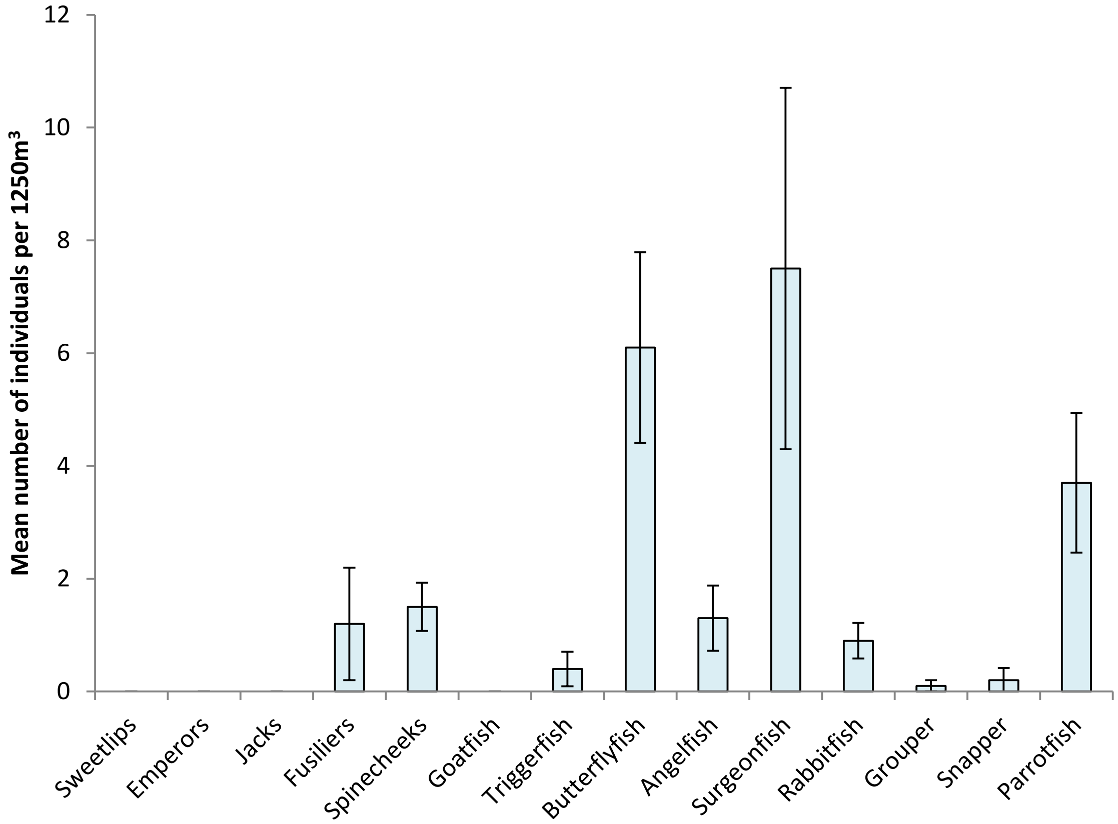

Figure 6 - Average fish abundance over all sites. Error bars represent standard error of the mean.

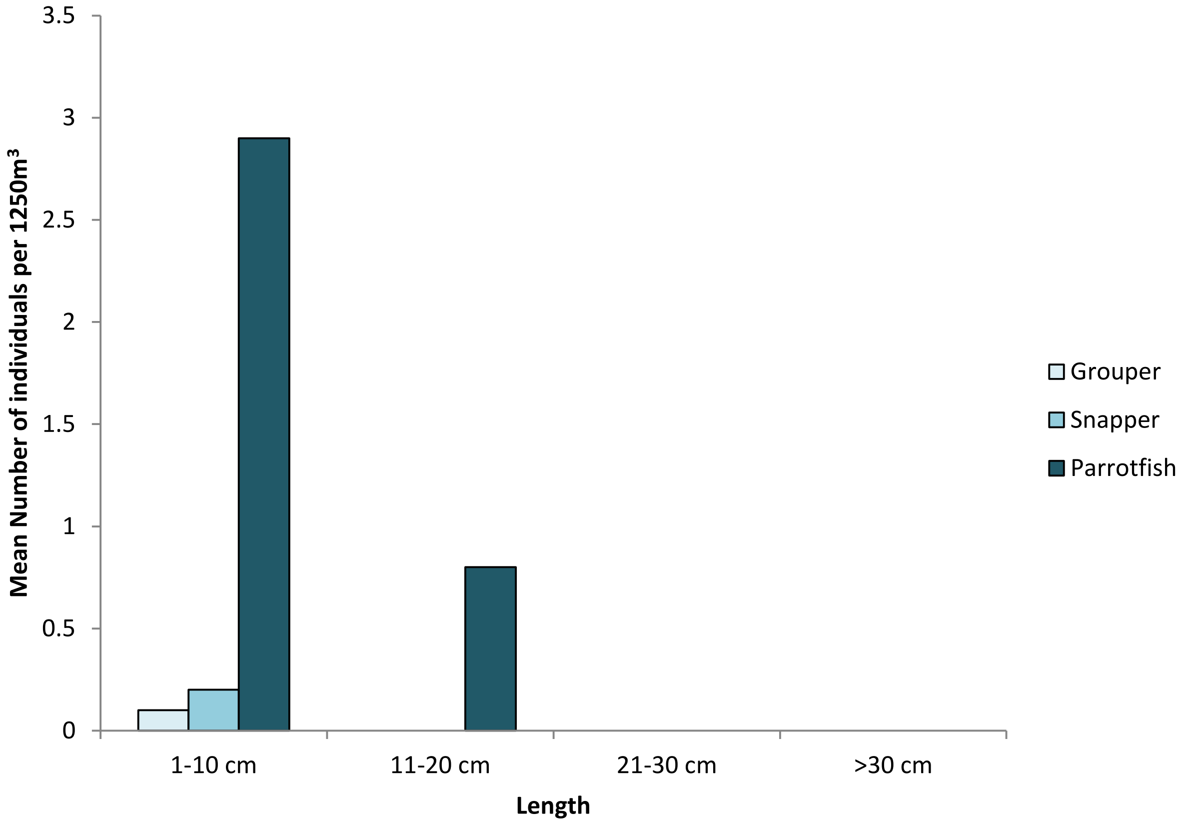

Figure 7 - Average number of individuals of each size class encountered per transect.

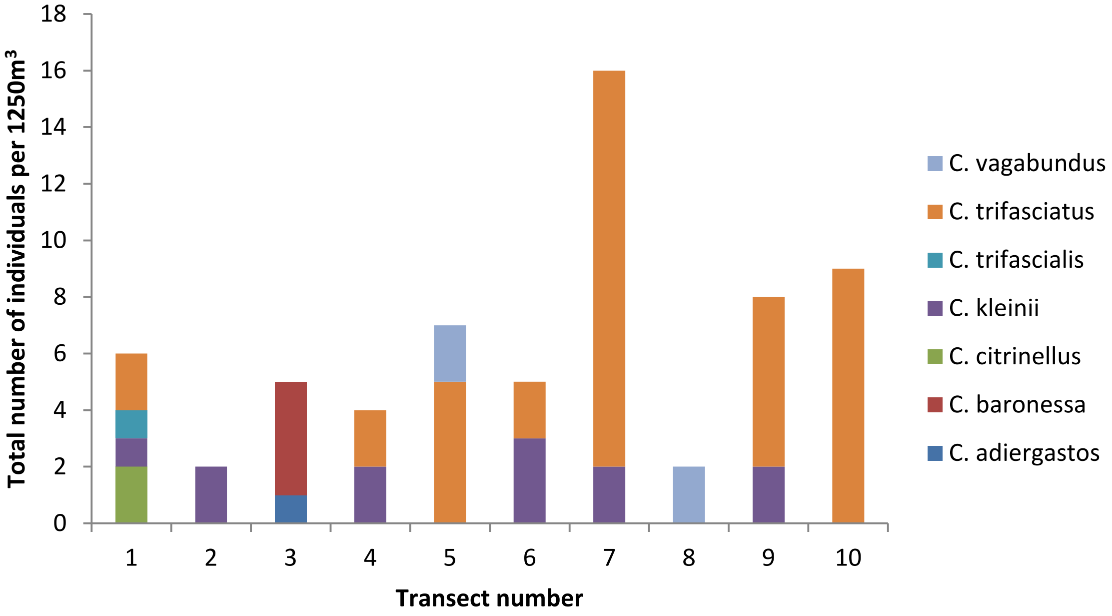

Figure 8 – Butterflyfish species abundance at each survey site

3.2. Invertebrates

Average target invertebrate abundance across all sites was generally low at 24.5 ± 6.0 individuals per 250m^2 (mean ± SE) with a high of 74 individuals per 250m^2 (Site 3) and a low of 9 individuals per 250m^2 (Site 9) (Figure 9). *Drupella* sp. snails were the sole exception, these coral eating snails were found at high abundances at Sites 4 and 10 in particular (see Appendix B invertebrate abundance at individual sites). Commercially and ecologically important Tritons' Trumpet (*Chariona tritonis*) Giant Clam (*Tridacna* sp.), Lobster (*Planuridae*) and non-synaptid sea cucumbers were encountered infrequently; only 1, 13, 2 and 3 times respectively across all transects. Banded Coral Shrimps (*Stenopus hispidus*) were completely absent throughout all surveys.

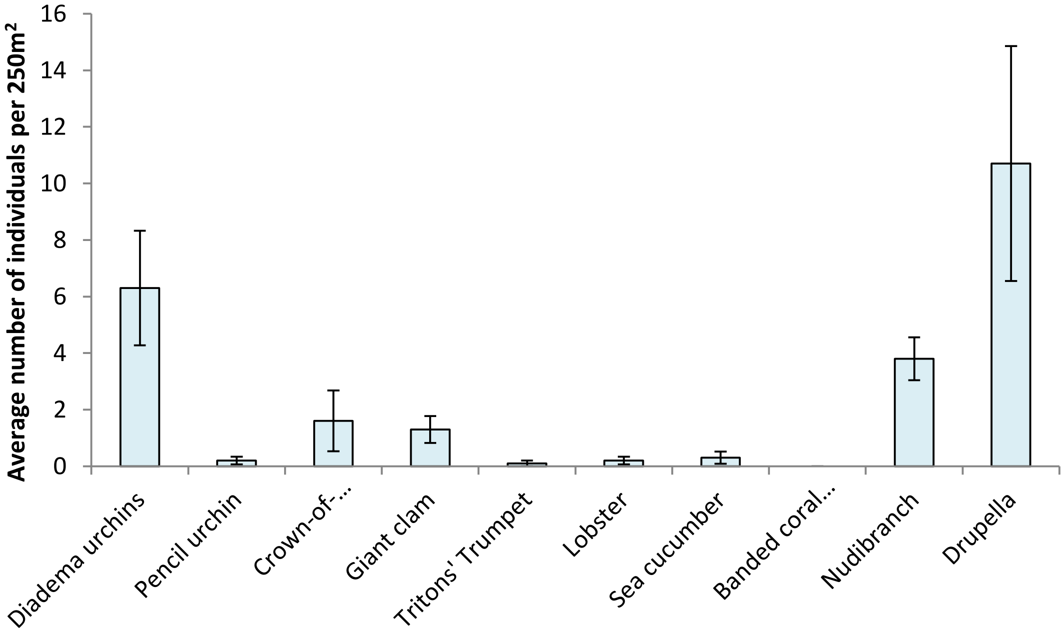

Figure 9 - Average abundance of target invertebrates across all sites. Error bars represent standard error of the mean.

3.3. Substrates

Benthic cover was not homogenous over all sites indicating a very varied reef make-up. Hard coral was the most common substrate found (averaging 27.7% cover across all sites) with dead coral with algae and rock being the next most common substrates (average 14.4% and 14% cover respectively across all sites) (Figure 10).

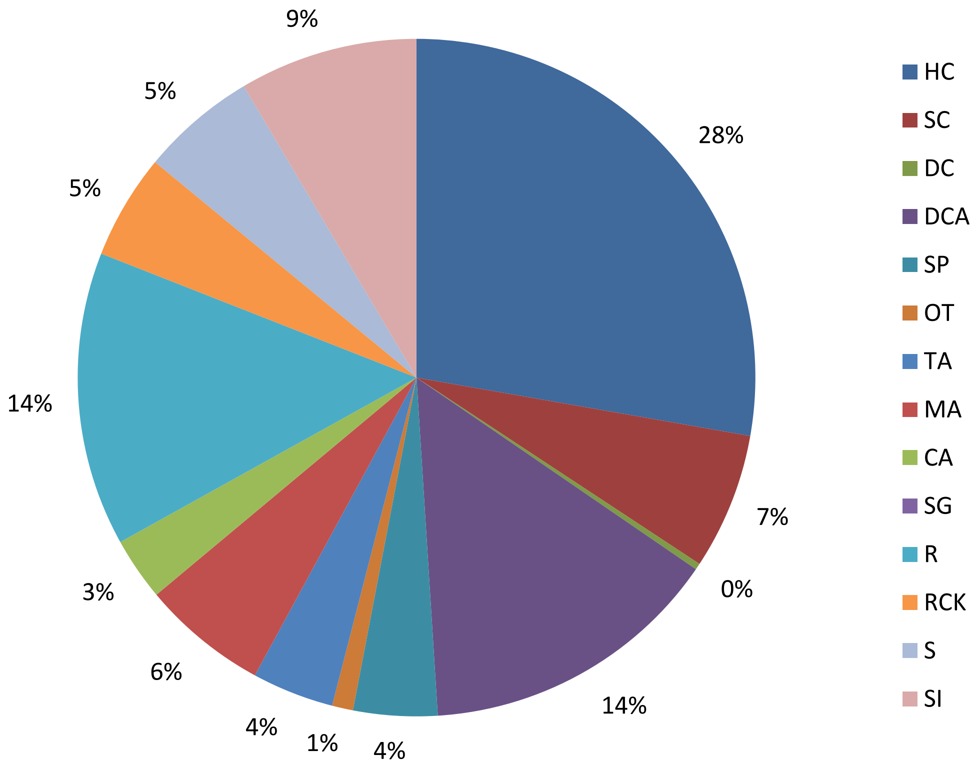

Figure 10 -. Average percentage substrate cover across all sites. Legend Key; HC – Hard Coral, SC – Soft Coral, DC – White Dead Coral, DCA – Dead Coral With Algae, SP – Sponge, OT – Other Living Organisms, TA – Turf Algae, MA – Fleshy Macro Algae, CA – Coralline Algae, SG – Sea Grass, R – Rubble, RCK – Rock, S – Sand, SI – Silt.

Of the hard coral recorded, the majority was branching non-Acropora species (64.3%), with massive, submassive and encrusting non-*Acropora* species making up the majority of the remaining hard coral recorded (17.7%, 6.9% and 7.2% respectively) (Figure 11). Hard coral at Sites 6, 7, 8, 9 and 10 was dominated by one lifeform only, while other sites displayed more diversity in the lifeforms present (Figure 12). The two most northern sites (Sites 1 and 2) were the only sites to have substantial sand cover(18% and 32% cover respectively). Sites 3, 4 and 5 were the only sites containing areas of silt and Sites 7, 8, 9 and 10 all had over 20% dead coral with algae cover (Figure 13).

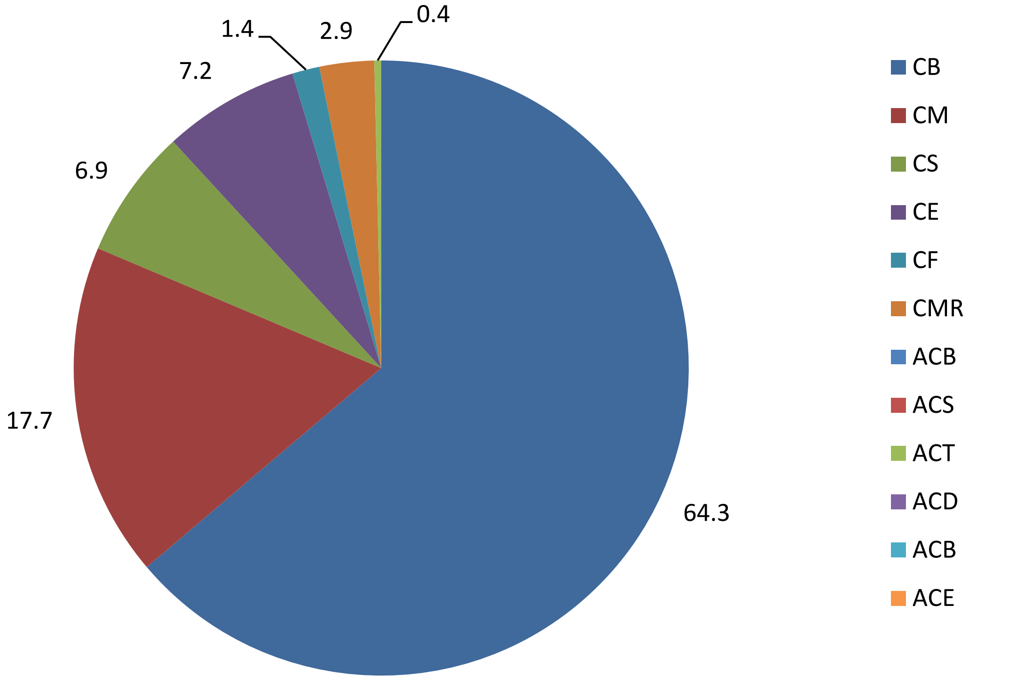

*Figure 11 – Hard coral lifeforms recorded across all surveys. Legend Key: CB – Non-*Acropora *Branching, CM – Non-*Acropora *Massive, CS – Non-*Acropora *Submassive, CE – Non-*Acropora *Encrusting, CF – Non-*Acropora *Foliose, CMR – Non-*Acropora *Mushroom, ACB –* Acropora *Branching, ACS –* Acropora *Submassive, ACT –* Acropora *Tabulate, ACD –* Acropora *Digitate, ACB –* Acropora *Branching, ACE –* Acropora *Encrusting.*

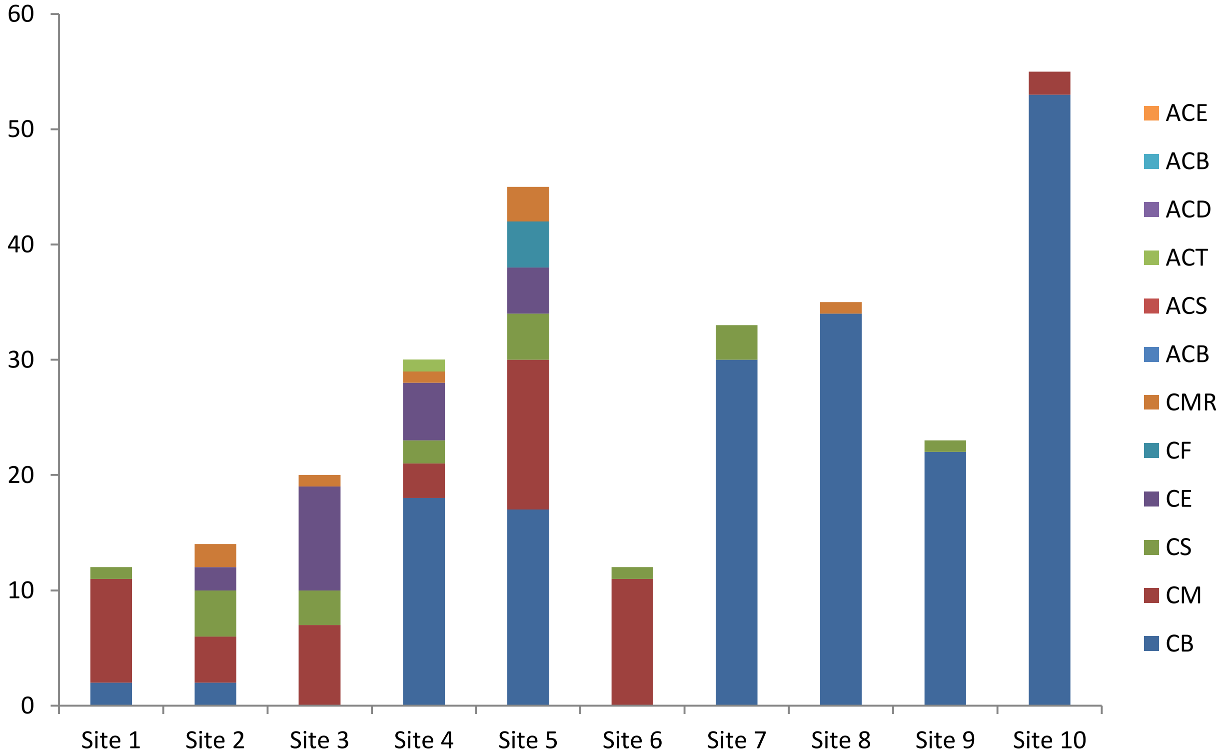

*Figure 12 – Total percentage cover of individual hard coral lifeforms at each survey site. Legend Key: CB – Non-*Acropora *Branching, CM – Non-*Acropora *Massive, CS – Non-*Acropora *Submassive, CE – Non-*Acropora *Encrusting, CF – Non-*Acropora *Foliose, CMR – Non-*Acropora *Mushroom, ACB –* Acropora *Branching, ACS –* Acropora *Submassive, ACT –* Acropora *Tabulate, ACD –* Acropora *Digitate, ACB –* Acropora *Branching, ACE –* Acropora *Encrusting.*

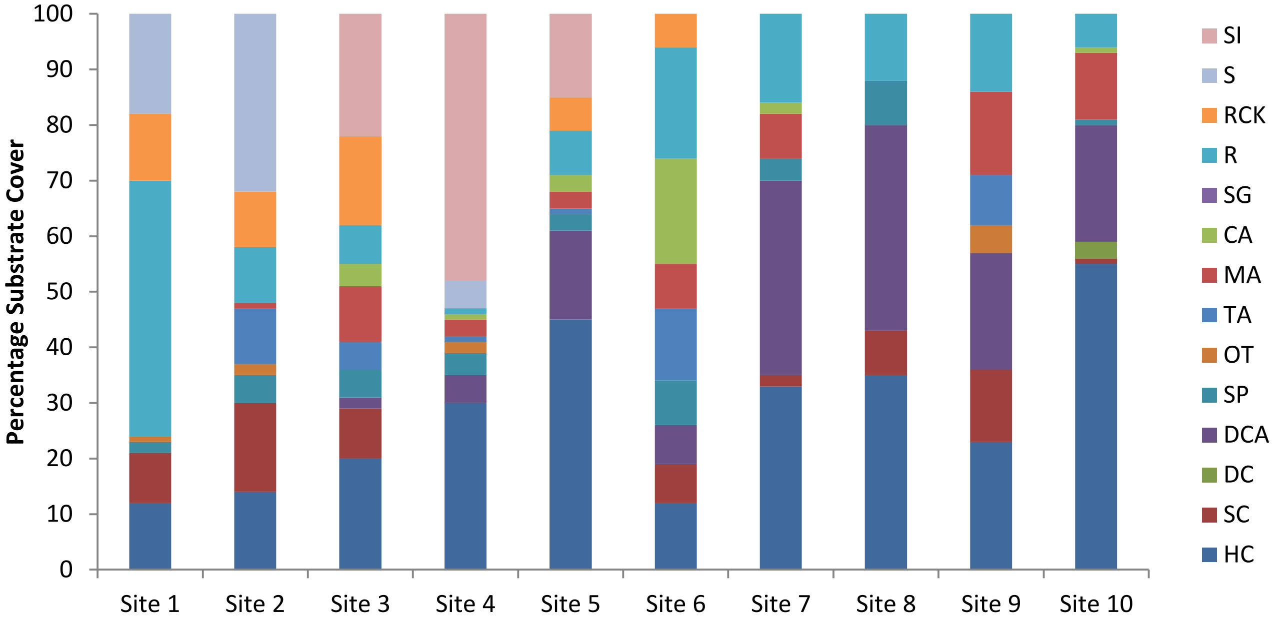

Figure 13 - Percentage substrate cover by site. Legend Key: HC – Hard Coral, SC – Soft Coral, DC – White Dead Coral, DCA – Dead Coral With Algae, SP – Sponge, OT – Other Living Organisms, TA – Turf Algae, MA – Fleshy Macro Algae, CA – Coralline Algae, SG – Sea Grass, R – Rubble, RCK – Rock, S – Sand, SI – Silt.

3.4. Anthropogenic and Natural Impacts

In general most anthropogenic and natural impacts were found in low levels or not found at all (Table 3). Coral eating snails (*Drupella* sp.) were found in high numbers at Sites 3 and 10. Other impacts that were found in high levels mostly related to fishing practices and storm or "other" damage at Sites 6, 7 and 8. Site 6 also showed the highest level of sedimentation.

Table 3 - Impacts recorded at individual survey sites. Key: Green – None, Yellow – Low, Brown – Medium, Red - High

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Blasting Patterns	Green	Green	Green	Green	Green	Green	Red	Yellow	Brown	Yellow
Anchor Damage	Green	Green	Green	Green	Green	Green	Red	Green	Green	Green
Other Breakage	Green	Green	Green	Yellow	Green	Red	Red	Red	Green	Yellow
Coral Bleaching	Green	Green	Green	Green	Yellow	Green	Yellow	Green	Green	Green
Discarded Fishing Gear	Yellow	Green	Green	Green	Yellow	Green	Green	Brown	Green	Green
Fish Traps	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green
Coral Disease	Green	Green	Green	Yellow	Green	Green	Yellow	Green	Green	Brown
Seaweed Overgrowth	Green	Green	Green	Green	Green	Green	Green	Red	Green	Yellow
Coral-eating Snails	Green	Green	Red	Brown	Yellow	Green	Green	Yellow	Green	Red
Crown-of-thorns starfish	Green	Green	Yellow	Green	Green	Green	Green	Green	Green	Green
Plastics	Green	Green	Green	Green	Green	Brown	Yellow	Green	Green	Yellow
Sedimentation	Yellow	Yellow	Green	Green	Green	Red	Green	Brown	Green	Brown

4. DISCUSSION

The surveys at Bahay provide a general overview of the ecological health, fishing pressure and threats to the reef in the area. Overall the reef is showing signs of degradation due to ongoing anthropogenic and natural pressures.

Commercial and artisanal fishing pressure for both fish and invertebrates appears to be very high in the surveyed area. Few targeted fish were present in high numbers, with the exception of small parrotfish at limited sites and this was equally true for commercially important invertebrate species. The highest value, and therefore most prized fish families, including Groupers (Lapu-lapu), Sweetlips (Lipti), Emperors (Katambak) and Jacks/Trevallies (Talakitok) were all entirely absent except for one small (<10cm) Grouper. The implication of this is that local fisherfolk are required to catch less valuable species, earning less money per individual caught. Additionally, Groupers and Jacks/Trevallies, along with sharks and barracuda, are top predators in the reef food web and their removal can have knock-on effects on the ecosystems they are part of (Fenner, 2012). It has been shown that removing top predators allows their main prey to increase in population and therefore places increased pressure on the next step down the food chain, this is called the trophic cascade effect. This trophic cascade can reduce the productivity and biodiversity of a reef overall.

The results of this survey show that, not only have the top level predators been mostly removed from the area, but secondary predators, including Sweetlips and Emperors, are also present in low numbers. Without these families present the normal ecosystem balance may be disrupted. This disruption may manifest in many ways, for example in higher frequencies of crown of thorns seastars outbreaks and coral diseases in areas where fishing pressure is unregulated (Sweatman, 2008 and Raymundo *et al*, 2009). This concept links with the ecological principle of resiliency. A naturally healthy reef (or any ecosystem) will have an inherent ability to recover from damage and detrimental impacts, however when suffering chronic stress from long term anthropogenic impacts and ecosystem disruption, this ability is compromised and the ecosystem as a whole is said to have lower resiliency. When the resiliency of an ecosystem is lowered it is more susceptible to degradation and ultimately, failure (Gunderson, 2000 and West and Salm, 2003). Overfishing is one of the most commonly cited impacts affecting reef resilience and, as such, it is likely the reefs of Bahay are at increased risk.

Substrate make-up is commonly used as a function of basic reef health, with living hard coral cover being a key indicator of a healthy reef. Nanola *et al* (2004) have set 0-25%, 26-50%, 51-75% and 76%+ living hard coral cover as showing reefs of Poor, Fair, Good and Excellent health respectively. In these terms the Bahay reefs are in Poor (Sites 1, 2, 3, 6 and 9) and Fair (Sites 4, 5, 7, 8 and 10) health. Although this information is important for long term monitoring purposes it has recently been questioned whether reef health in regards to substrates should be looked at differently (Licuanan and Aliño, In Press and Panga *et al*, In Press). In addition to the total hard coral cover in an area, the diversity of species and growth form of these corals also has an impact on the diversity of the reef as this will affect the number of ecological niches available. Hard corals at Sites 6, 7, 8, 9 and 10 are all dominated by one main lifeform, indicating that these sites may have limited ecological niches and therefore lower potential to support high biodiversity. The other survey sites showed much more diverse coral life forms indicating a good level of reef complexity that is required for a healthy reef ecosystem.

In addition to looking directly at hard coral cover in itself, management plans may also be informed by observing the levels of hard substrate available, indicating potential for rehabilitation (Panga *et al*, In Press). Hard substrates which may be colonised by new hard and soft coral colonies, as well as other sessile reef organisms, include rock, dead coral with algae and coralline algae. Sites 5, 6, 7 and 8 all had a total of over 25% cover of these colonisable hard substrates, indicating that they have good potential for new colonisation and rehabilitation. Site 1 has a more complex potential for rehabilitation as it is largely made up of unconsolidated rubble which is ordinarily ill-suited to new colonisation. Colonisation may only occur once this rubble had been consolidated, usually by coralline algal species, a process which takes a long time. New techniques of anchoring this rubble in place are being refined throughout the Philippines, often with the aid of the University of San Carlos, Cebu. These anchoring procedures are aimed at speeding up the natural consolidation of reef rubble into hard substrate in order to speed up reef recovery. Finally, reef areas such as Site 4 are as complex as they are likely to get. This is because most of the substrate not made up of hard and soft corals is sand and silt which is completely non-colonisable by reef builders.

Throughout the surveys, anthropogenic and natural impacts were, overall, fairly low. Coral damage was rarely recorded, except at Site 7 where blasting patterns, anchor damage and other coral damage were all recorded at high levels, indicating that human activity, including potentially illegal fishing techniques, is high in this area. Sites 6 and 8 also had high levels of unidentifiable coral damage as well as medium levels of discarded trash (plastics), discarded fishing gear and fish traps, again indicating that these areas see a lot of anthropogenic pressure. Discarded plastics and fishing gear are worrying signs to see as they are both damaging to the marine environment and can have adverse effects on the local human population. Plastics can be consumed by marine life causing them to suffocate or die through poisoning. Some can also slowly release toxic chemicals into the water which find their way into the food chain via microscopic plankton and can eventually build up in the tissues of larger fish species which in turn are consumed by people causing them to be sick. Discarded fishing gear can still trap and kill marine animals, this is known as “ghost fishing” and only serves to weaken the ecosystem and lower fishing potential.

Site 8 showed signs of large macro-algae or ‘seaweed’ overgrowth which is likely to coincide with the medium level of sedimentation in this area. A further study of the water quality around this site and at any nearby fresh water sources would also indicate whether nutrient run-off from the land could be a future problem for the reefs of Bahay.

5. RECOMMENDATIONS

Through the lack of most commercially important fish and invertebrate species, and the small sizes of those species still present, it is clear that the reefs local to Bahay Barangay are severely depleted and in need of management. With the support and understanding of the local community, a long term fisheries plan including the construction of a no-take MPA in the barangay waters is strongly supported by Coral Cay Conservation. The current plans to create 20 hectares of no-take zone with associated buffer zone has the potential to create huge benefits to the village and the marine ecosystems if managed effectively and continually.

Marine Protected Areas are a long term commitment that may take several years to produce visible benefits both financially to fisher folk and ecologically via increased populations and diversity as shown by Apo Island Reserve in Negros (Russ and Alcala 2004). Once this commitment has been made it is essential that proper governance and enforcement is carried out so that all may enjoy the incredible benefits the MPA will eventually bring.

It is encouraging that the current MPA application process is ongoing in consultation with all members of the community to develop buy-in and a sense of ownership within the people of the barangay. This should incorporate community MPA development workshops to provide every individual with a platform for input into the development process, this can be assisted by PENRMO via their 3 day MPA Management Planning Workshop. It is also essential that IEC campaigns are run to raise local awareness of the MPA and its rules once established. Inclusion from the outset of the designation process allows a sense of ownership to develop within the community, encouraging people to take on a stewardship role whereby compliance with the MPA does not need to be enforced but is simply a given.

An effective and active management scheme is essential to the success of any MPA. It is recommended that relevant stakeholders utilise the frameworks already in place in the Province by creating a Barangay MPA Management Committee (BMPAMC). This would function alongside the Barangay Fisheries and Aquaculture Resource Management Committee (BFARMC) but would allow closer oversight of the MPA management. The purpose of this committee would be to coordinate the collection of MPA fees, provide training and support to Bantay Dagat, oversee the enforcement of the MPA and be a link to the Municipal Government for matters concerning the MPA through the Municipal MPA Oversight Committee (MMPAOC). Furthermore 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 and a good way to achieve this is to use the MPA Management Effectiveness Assessment Tool (MPA MEAT) which was designed to identify aspects of MPA management which are good and also those which need improving (Philippines CTI NCC, 2011). Regular ecological monitoring is also essential to assess temporal trends in species abundance and diversity and determine how successfully the MPA is achieving its goals. CCC is able to support these efforts by directly conducting assessments where possible or by providing training to barangay or municipal monitoring teams.

Some of the primary considerations that need to be addressed in the establishment of an MPA will relate to enforcement. Just designating an MPA does not mean that there will be success in terms of conservation, fisheries or tourism. How the MPA will be enforced and by whom is very important. CCC can also help in this manner by providing training to individuals to become Bantay Dagat, though the management committee should give thought to how the Bantay Dagat will operate and how violations will be dealt with following Municipal and Provincial Ordinances. 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.

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APPENDIX A - TARGET SPECIES LISTS

Target Fish

Common Name	Family Name	Visayan Name
Angelfish	Pomacanthidae	Adlo
Butterflyfish*	Chaetodontidae	Alibangbang
Emperors	Lethrinidae	Katambak
Fusiliers	Caesonidae	Dalagang bukit
Goatfish	Mullidae	Timbongan
Grouper	Serranidae	Lapu-Lapu
Jacks	Carangidae	Talakitok
Parrotfish	Labridae	Mul-mul
Rabbitfish	Siganidae	Kitong
Snapper	Lutjanidae	Maya-maya
Spinecheeks	Nemipteridae	Silay
Surgeonfish	Acanthuridae	Indangan
Sweetlips	Haemulidae	Lipti
Triggerfish	Balistidae	Pakol

*Butterflyfish Common Name	Latin Name
Philippine butterflyfish	*Chaetodon adiergastos*
Threadfin butterflyfish	*Chaetodon auriga*
Eastern triangle butterflyfish	*Chaetodon baronessa*
Bluelashed butterflyfish	*Chaetodon bennetti*
Speckled butterflyfish	*Chaetodon citrinellus*
Saddle butterflyfish	*Chaetodon ephippium*
Klein's butterflyfish	*Chaetodon kleinii*
Lined butterflyfish	*Chaetodon lineolatus*
Racoon butterflyfish	*Chaetodon lunula*
Blackback butterflyfish	*Chaetodon melannotus*
Merton's butterflyfish	*Chaetodon mertensii*
Meyer's butterflyfish	*Chaetodon meyeri*
Spottail butterflyfish	*Chaetodon ocellicaudus*
Eightband butterflyfish	*Chaetodon octofasciatus*
Ornate butterflyfish	*Chaetodon ornatissimus*
Spot-nape butterflyfish	*Chaetodon oxycephgalus*
Blueblotch butterflyfish	*Chaetodon plebeius*
Spotband butterflyfish	*Chaetodon punctatofasciatus*
Latticed butterflyfish	*Chaetodon raffiesi*
Mailed butterflyfish	*Chaetodon reticulatus*
Yellowdotted butterflyfish	*Chaetodon selene*
Dotted butterflyfish	*Chaetodon semeion*
Mirror butterflyfish	*Chaetodon speculum*
Chevron butterflyfish	*Chaetodon trifascialis*
Melon butterflyfish	*Chaetodon trifasciatus*

Pacific doublesadle butterflyfish	*Chaetodon ulietensis*
Teardrop butterflyfish	*Chaetodon unimaculatus*
Vagabond butterflyfish	*Chaetodon vagabundus*
Pearscale butterflyfish	*Chaetodon xanthurus*
Copperbanded butterflyfish	*Chelmon rostratus*
Longnose butterflyfish	*Forcipiger flavissimus*
Longnose butterflyfish	*Forcipiger longirostris*
Pyramid butterflyfish	*Hemitaurichthys polyepis*
Pennant coral fish	*Heniochus acuminatus*
Threeband penant fish	*Heniochus chrysotomus*
Singular bannerfish	*Heniochus singularis*
Horned bannerfish	*Heniochus varius*
Sixspine butterflyfish	*Parachaetodon ocellatus*
Goldengirdled coral fish	*Coradion chrysozonus*
Twospot coral fish	*Coradion melanopus*

Target Invertebrates

Diadema urchin	Tritons' Trumpet	Nudibranch
Pencil urchin	Lobster	Drupella
Crown-of-thorns star	Sea cucumber	
Giant clam	Banded coral shrimp	

Target Substrates

Hard Coral*	Soft Coral	White Dead Coral
Dead Coral with Algae	Sponges	Other Animals
Turf Algae	Fleshy Macroalgae	Coralline Algae
Seagrass	Rubble	Rock
Sand	Silt	
**** Hard Coral lifeforms:***		
Acropora Branching	*Acropora* Sub-Massive	*Acropora* Tabulate
Acropora Digitate	*Acropora* Bottlebrush	*Acropora* Encrusting
Non-*Acropora* Branching	Non-*Acropora* Massive	Non-*Acropora* Sub-Massive
Non-*Acropora* Encrusting	Non-*Acropora* Foliose	Non-*Acropora* Mushroom

APPENDIX B - SPECIES ABUNDANCE GRAPHS

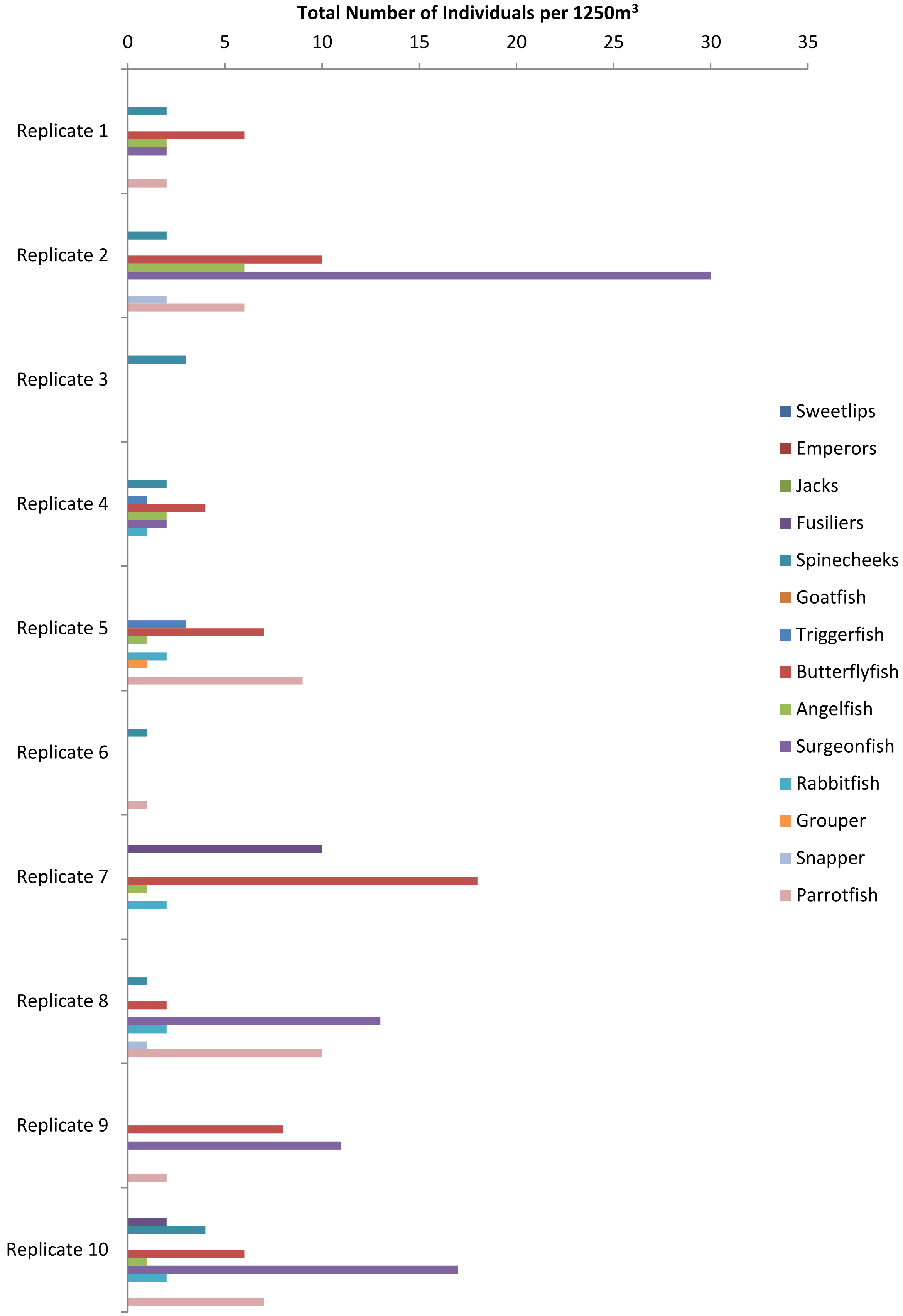

Figure 14 - Total abundance of target fish families at each survey sites.

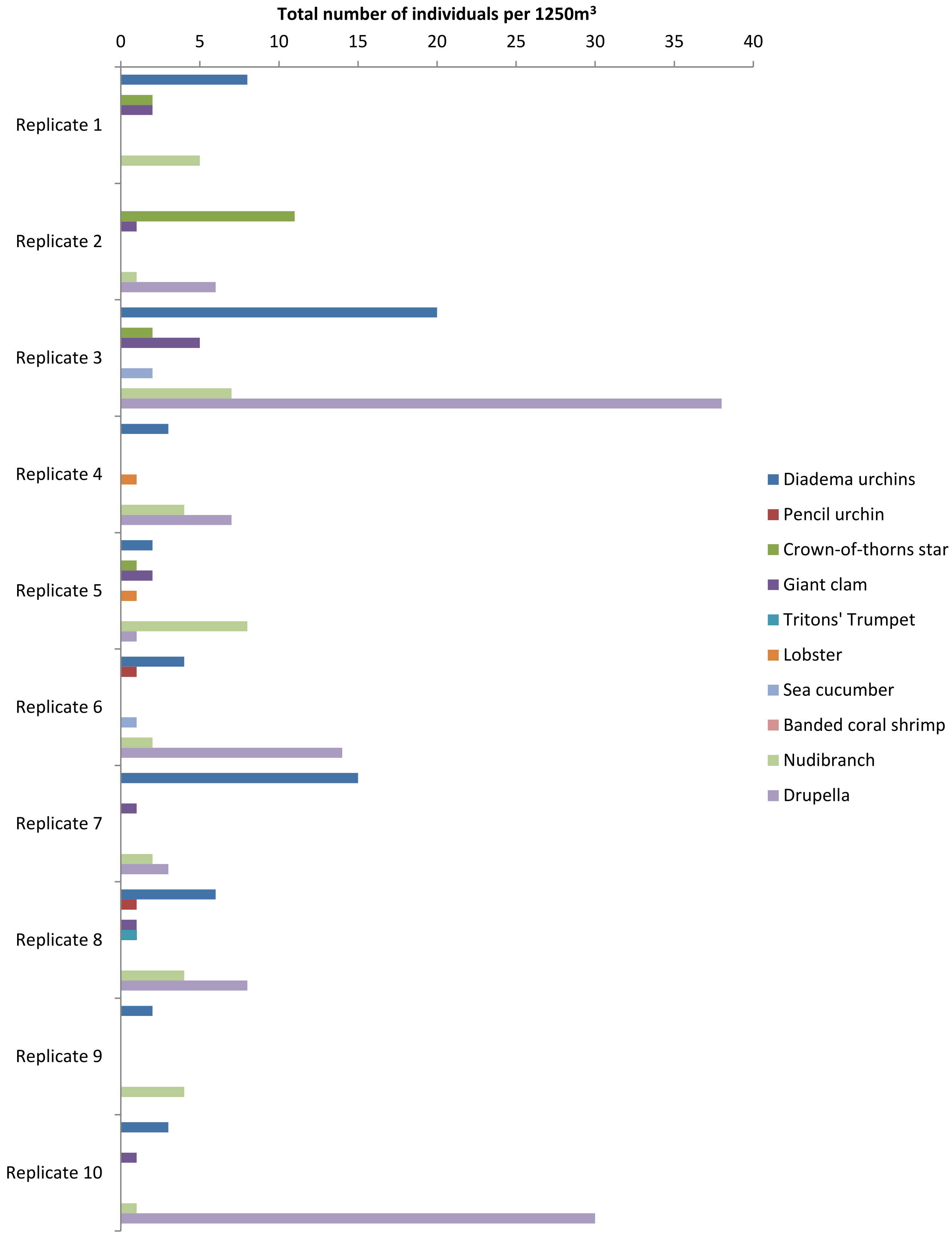

Figure 15 - Total abundance of target invertebrate species at each survey sites