

Introduction to the Southern Leyte Coral Reef Conservation Project (SLRCP)

Coral Cay Conservation (CCC) has carried out marine conservation projects all over the world, including in the Philippines, Belize, Honduras, Malaysia and Fiji. CCC successfully set up Marine Protected Areas and provided scientific data that has been used to manage local marine resources. The project in Danjungan Island in the Philippines between the years 1996-1999 was particularly successful and the reefs around the island recently received the accolade of Best Managed Reef of the World. 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, Danjungan Island and the forests of North Negros.

CCC is working at the invitation of and in partnership with the Provincial Government of Southern Leyte and the Philippine Reef & Rainforest Conservation Foundation Inc (PRRCFI). The Southern Leyte Coral Reef Conservation Project (SLCRCP) is a six-year collaborative project (2002–2008), to survey the coral reefs of Sogod Bay. The programme provides training and conservation education opportunities for local Filipinos, as part of an integrated programme to develop local capacity and ensure the long-term protection and sustainable use of marine resources throughout the region.

Our surveying programme is designed to gather data about the biological and morphological standing of Sogod Bay. This data is combined with information on human and natural impacts on the reefs, along with oceanographic data, to ultimately produce a Geographical Information System (GIS) map of the various habitats of the bay. It is like a 'stock-take' of the current marine resources, which is being produced to provide policymakers and concerned institutions with information necessary to effectively manage those resources.

The reefs of Southern Leyte demonstrate a high faunal diversity; over 400 hermatypic coral species have been recorded and more than 7000 fish species. The Indo-Pacific region is renowned as one of the most diverse areas globally. However over 97% of the reefs are deemed at risk from a variety of natural and anthropogenic factors. Coral reefs are renowned for their intrinsic value to local coastal communities due to both high biological diversity and high rates of productivity. They also represent a crucial source of revenue and protein. Bryant estimated that 25% of the fish catch in the developing countries is provided from coral reef fisheries; therefore, it is imperative that these precious resources are protected immediately to ensure their recovery and sustainability for future generations.

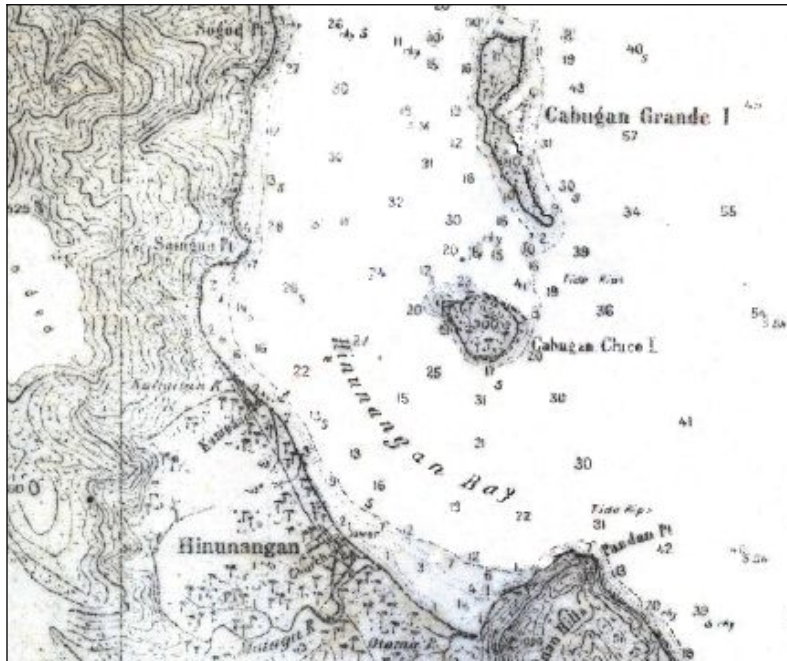


Figure 1 Map of Hinunangan Bay with San Pedro Island (Cabugan Grande) to the north-east.

CCC was invited to San Pedro Island by the Municipality of Hinunangan, Southern Leyte, to conduct assessments of its marine resources in order to provide fisheries and tourism management recommendations, based on a series of rapid underwater assessments of the islands coastal assets. The island is situated in the Pacific Ocean off the East coast of the Municipality of Hinunangan, Southern Leyte. The Island is fringed by patchy discontinuous reefs that extend down to depths of up to 40m.

Methods

Underwater visual census (UVC) methodology

The survey method closely follows the one outlined in the 'Coral Reef Monitoring for Management' book put together by the Marine Science Institute of the University of the Philippines, Diliman; the Guiuan Development Foundation Inc. and the Volunteer Service Overseas.

Point-intercept transect

For estimating the relative abundance of living and non-living coral on the reef bottom, a benthic point-intercept transect was used by SCUBA divers. "Benthic" refers to the animal and plant life growing on the seabed. A 50m transect line was laid out along a constant depth at both 6m and 12m. A note was made of the benthic cover every 25cm along the line. The total number of points along the transect line was 200. Benthic categories were chosen as follows:

Table 1 Benthic substrates and hard coral lifeforms

Live hard coral	Other benthos types		
<i>Branching</i>	Soft coral	Other animals	Seagrass
<i>Massive</i>	White dead coral	Turf Algae	Rubble
<i>Flat/encrusting</i>	Dead coral w/ algae	Fleshy macro algae	Rock and block
<i>Foliose/cup</i>	Sponges	Coralline algae	Sand/Silt

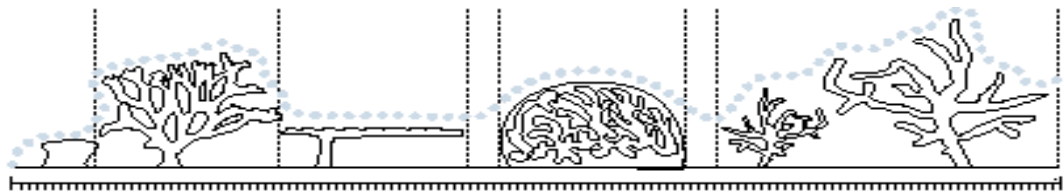


Figure 1 Schematic diagram of a point intercept line laid over different coral lifeforms

Fish Visual Census



Figure 3 A coral cay observer estimating benthic cover every 25cm along the transect line

Fish families were counted and a note was made of their size within a defined area, along the same transect line as used to estimate benthic cover. Two divers swim side by side and count numbers of target fish 5m to either side of the 50m transect line. Swimming speed is controlled and there is 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 for reef health or (b) Commercially important fish for sale or consumption (table 2). This information can indicate if the survey area is being overfished or recovering from human pressure.

Table 2 Fish families observed during surveys

Groupers (Epinephelinae)	Wrasse (Labridae)
Snapper (Lutjanidae)	Parrotfish (Scaridae)
Sweetlips (Haemulidae)	Bumphead parrot
Emperors (Lethrinidae)	Surgeonfish (Acanthuridae)
Jacks / Trevally	Rabbitfish (Siganidae)
Fusiliers	Rudderfish (Filefish) (Kyphosidae)
Coral Breams (Nemipteridae)	Damselfish (Pomacentridae)
Goatfish (Mullidae)	Anthias (Anthiinae)
Triggerfish (Balistidae)	Moorish Idol (Zanclus cornutus)
Butterfly fish (Chaetodontidae)	Angelfish (Pomacanthidae)

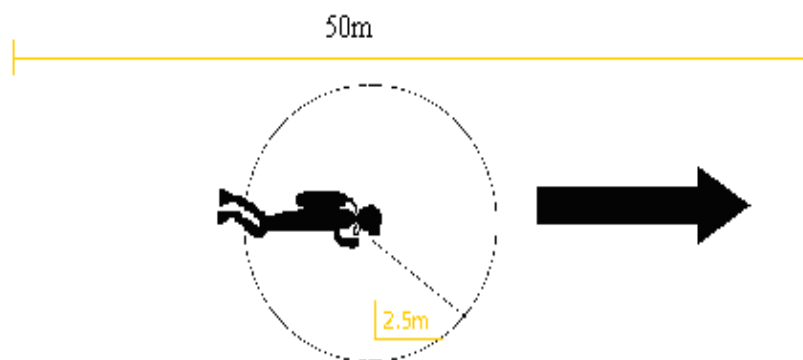


Figure 4 Fish visual survey method used to estimate fish abundance along the 50m line. The diver notes down any target fish seen 2.5m on their side of the line and also 5m above the survey area.

Human impacts and abiotic factors

In addition to the fish and benthic data, a fourth observer laid down the transect line for the other observer to follow and made a note of the following factors:

- Transect Orientation
- Depth
- Reef Zone
- Whether the site was sheltered or exposed
- Approximate steepness of the slope
- Horizontal and vertical visibility
- Weather
- Human and natural underwater impacts such as trash, nets, bleaching and coral breakage

A boat marshal made notes of human impacts, drew a map of the area and noted transect locations with a Global Positioning System (GPS) for future reference. Fishing boats, trash, gleaners and many other human influences were also recorded.

Manta Tow

Manta tows were performed in order to achieve a rapid reef assessment and locate areas of highest interest. It affords an overview of the different coral species, lifeforms, general reef health and the detection of large scale changes of habitat - for instance due to storm damage or poor fishing practices. The information gained from manta tows was used to help identify survey sites.

Initial assessment San Pedro Island (Cabugan Grande)

What follows is a summary of the most important findings from the belt transect (fish abundance estimates), point intercept (benthic cover as a percentage) and general reef health and abiotic (non-living) factors. A total of fourteen UVC surveys were completed. Nine at a depth of twelve meters (12m) and five at six meters (6m) depth. These surveys were limited to the west coast due to poor weather conditions. Two 12 m transects were completed within the MPA on the east coast of San Pedro. As the east coast data set is so limited it has not been included within the report. It will be included when all surveys for the island have been completed.

Fish analysis

Abundance, diversity and size of commercially important fish were recorded at each depth.

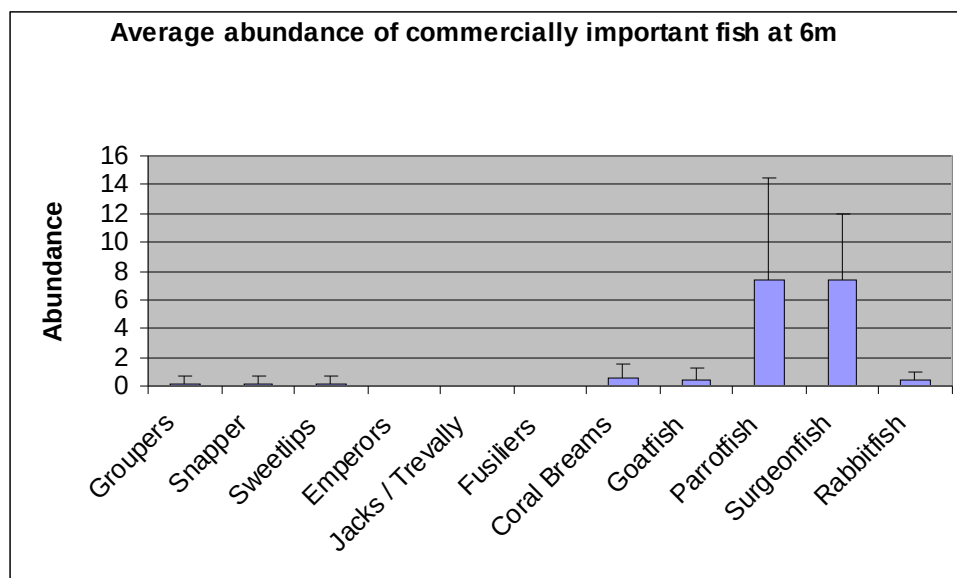


Figure 5 Average abundance of commercially important fish at a depth of 6m.

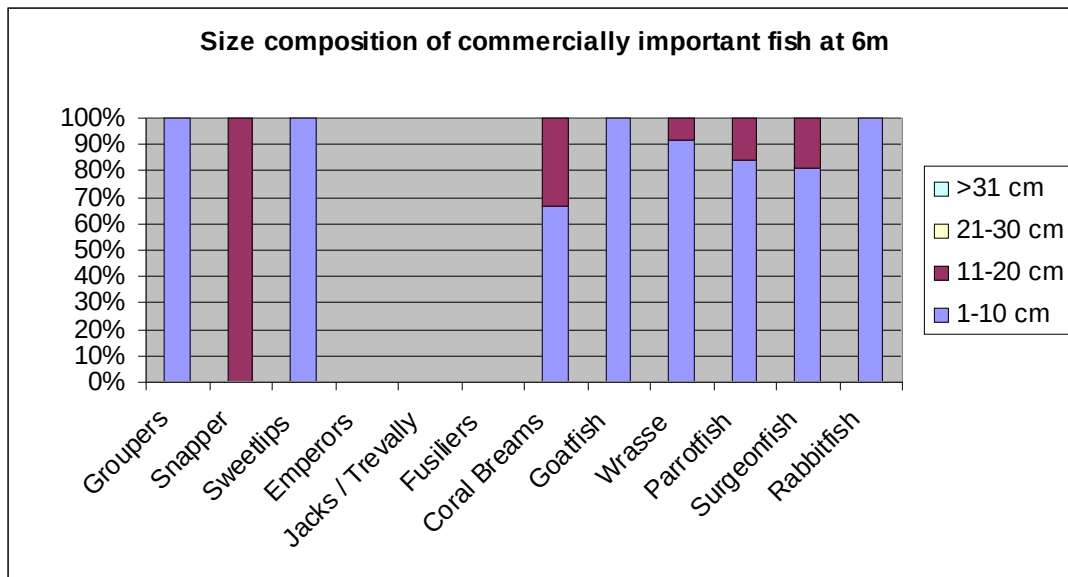
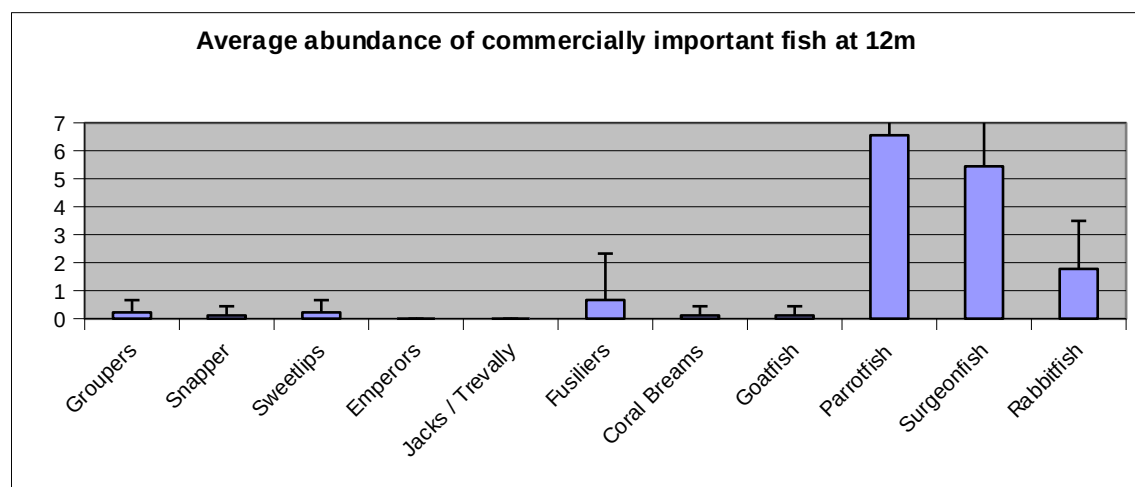


Figure 6 Size composition of commercially important fish at 6m depth.

The data illustrates overall abundance and diversity of the target fish families is low in the area surveyed compared to that of healthy reefs. Only 1 Grouper (Epinephelinae), 1 Snapper (Lutjanidae) and 1 Sweetlips (Haemulidae) were sighted over the 450m surveyed. However, it is important to note that these families would not necessarily be present at this shallow depth in large numbers.

The size of individual fish seen on the underwater visual census were categorised into four distinct size classes: 1-10cm, 11-20cm, 21-30cm and >31cm. All target species sighted at this depth fell into the first two categories of 1-20cm. This trend is most likely due to the shallow depth, where fish

Fig. 7 Abundance of commercially important fish at a depth of 12m.



families sighted were in juvenile stages.

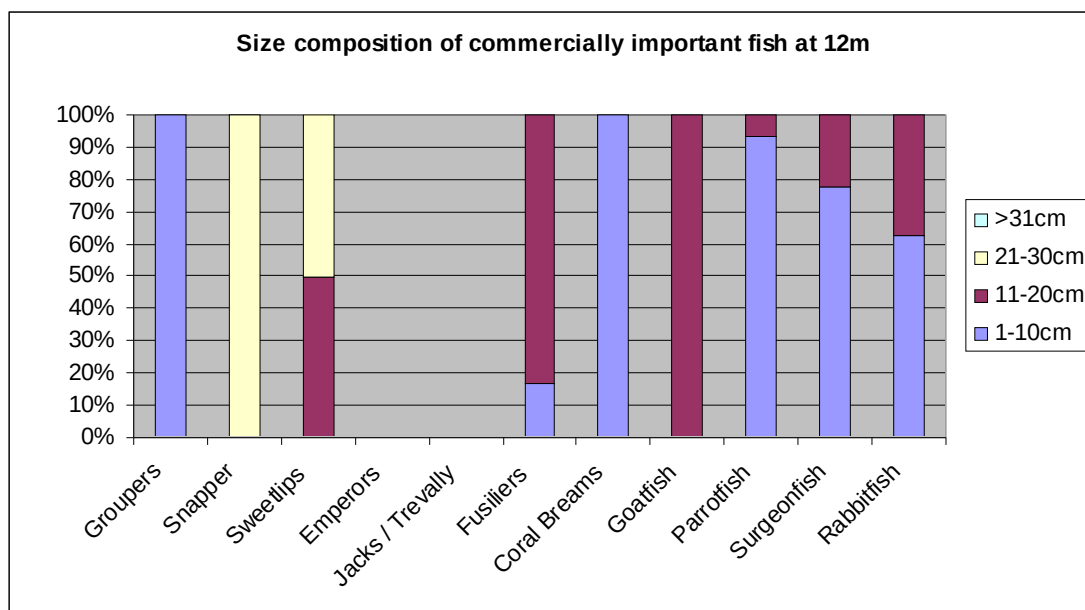


Fig 8. Size compositions of commercially important fish at 12m of depth.

At a depth of 12m, the abundance and diversity of target fish families sighted was also low. Very low numbers of Groupers, Snapper and Sweetlips were sighted. This could be accounted for by the depth. However, juveniles of these species would normally be seen in larger numbers.

Size composition analysis show fish size is increasing with depth over all families with the exception of groupers and coral breams. Snappers and Sweetlips showed the most significant size increase positively correlated to an increase in depth.

Size compositions of the commercially important fish families as seen on the underwater visual census data (UVC) tend towards the lower size classes. The majority of these target families are capable of growing well in excess of 30cm in particular Groupers whose maximum lengths, depending on the species, range from 30-70+cm, Snappers (30-50+cm) and Sweetlips (50-70+cm) these predatory species characterise inshore fisheries. The majority of individuals recorded were in juvenile and intermediate stages. The absence of mature adults can be indicative of over-fishing and high fishing pressure. Juvenile fish place all their energy into growth, once mature their energy goes into reproduction. If the juvenile fish are being caught, they are being removed long before they have reached their reproductive potential. No transient pelagic target species were seen on the surveys. This is most likely attributable to our survey depths of 6 and 12m on the coral reef and limitations of the survey methods used. Such transient species despite having an element of reef specificity are not as closely associated with the reefs as demersal species such as Parrotfish, Snappers and Rabbitfish.

It is worth noting that on the two transects within the MPA that there was an increased incidence of Parrotfish, Wrasse, Fusiliers and Rabbitfish. The dataset is limited and shouldn't be compared directly to the completed west coast data.

A well managed and community supported MPA of at least 10ha would allow the stock to recover and re-establish a healthy community structure in terms of frequency, size and age of reef-associated fish. Once this happens, the consequent spill over effect forms the basis of a sustainable fishery for the island.

Coral results and analysis

Fig. 9 Average % of hard coral lifeforms seen on UVC surveys at depths of 6 & 12m.

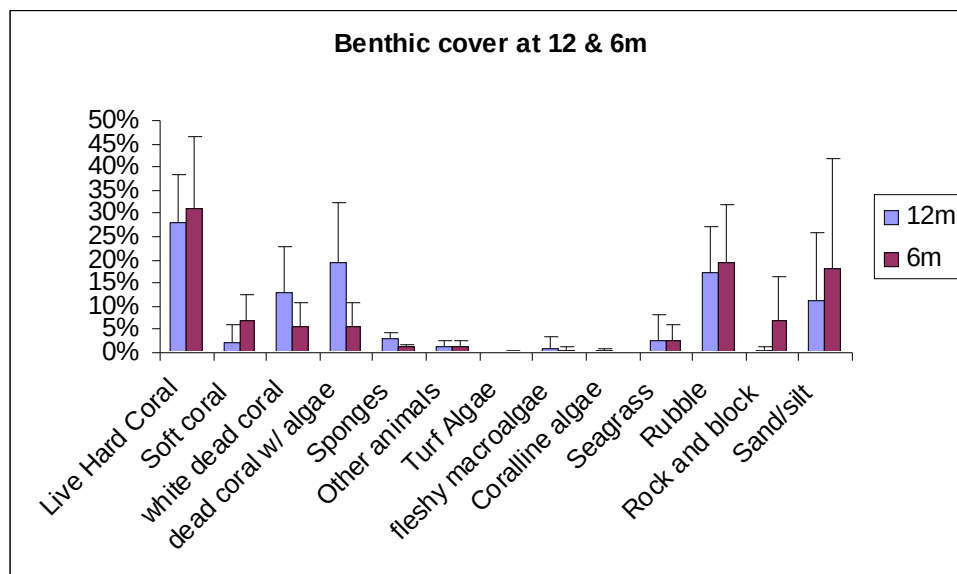
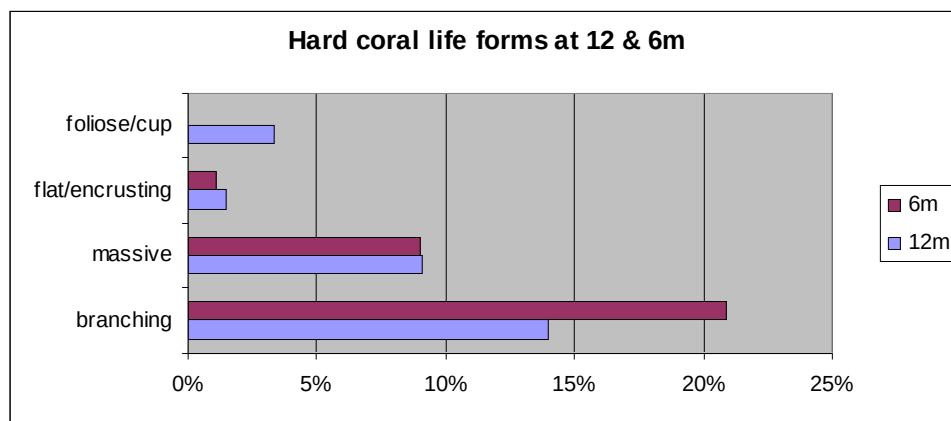


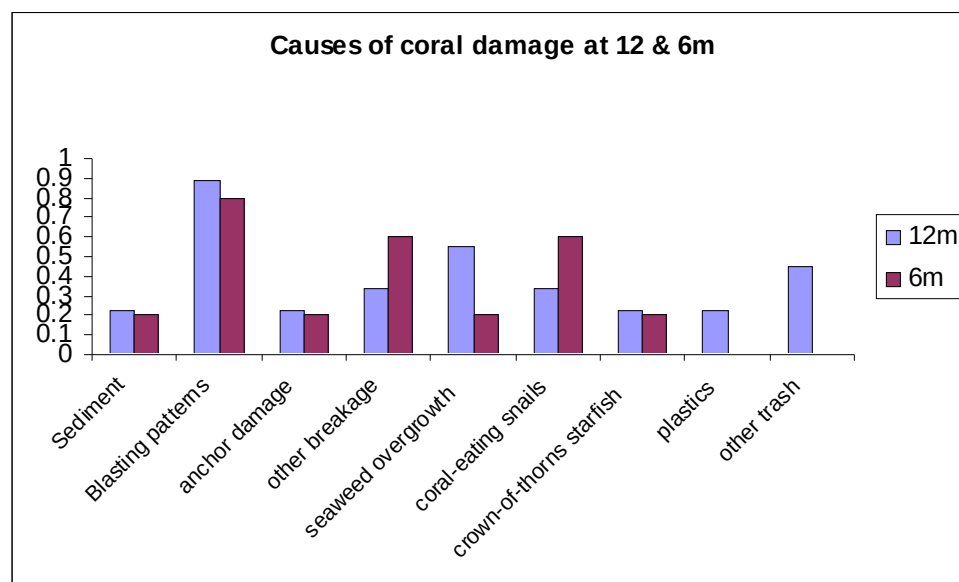
Fig. 10 Average % cover of benthic habitats as seen during surveys including live hard coral cover, dead, damaged corals. Error bars indicate standard error.

A high abundance of hard corals are essential as it provides the habitat necessary to support fish populations. An average live hard coral cover of 25-30% was seen at both survey depths. The reefs surveyed were found to be

discontinuous patch reefs characterised by coral outcrops (30% cover), sand (10-20%) and rubble (20%).

Hard coral life forms illustrate coral diversity and growth patterns and hence allow for a rough estimate of the age, composition and general health of the reef. Branching, and to some extent, foliose and cup life forms are the fastest growing and youngest corals whereas massive and encrusting corals are generally slow growing and form the oldest structures on the reef. A healthy reef will support all such life forms. This is because a more mature and diverse reef has a high structural complexity with a higher variety of ecological niches. It is able to support a higher abundance and diversity of flora and fauna.

Coral damage



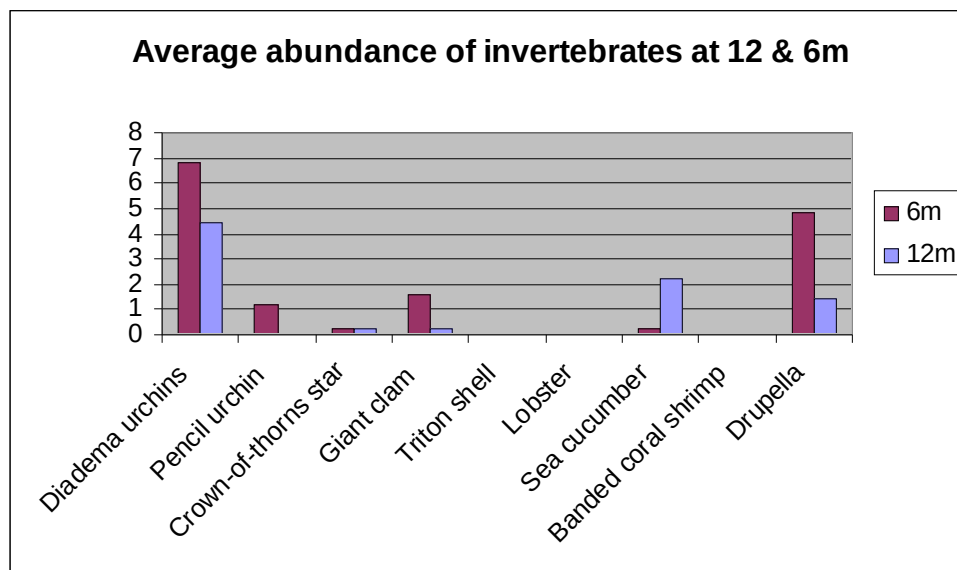
The damage observed and amount of rubble present on the surveys provide clear evidence of blast fishing. However, these observations also showed that the rubble was covered with algae, which is indicative of old damage. Blasting patterns were noted on over 80% of the surveys at both depths recorded. The reef observed at 6m was characterised by large fields of *Porites* massive sp., a branching coral. In some areas along the West coast of San Pedro it covered extensive areas but blast fishing has reduced vast areas to rubble. The sheer size and extent of these fields indicates a very old reef that deserves protecting to enable it to rehabilitate to its former state and thus support a greater fish population.

Algal overgrowth can be an indication of nutrification (too many nutrients in the water from land run off and pollution). Such overgrowth was seen on over 50 percent of the 12m transects. Algae can out compete and over grow corals when certain nutrients exceed normal levels. This problem is part of the much

wider issue of waste management and requires an integrated approach to coastal zone management.

Crown of thorns seastars and coral eating snails were present but in low numbers. This is normal for a healthy reef. Other breakage could be attributed to poor fishing practices such as muro ami and use of cyanide as historical information suggests. Plastics and trash were only seen on the deeper dives, it is important to minimise the impacts of trash as it can have damaging effects on the reef.

Invertebrates



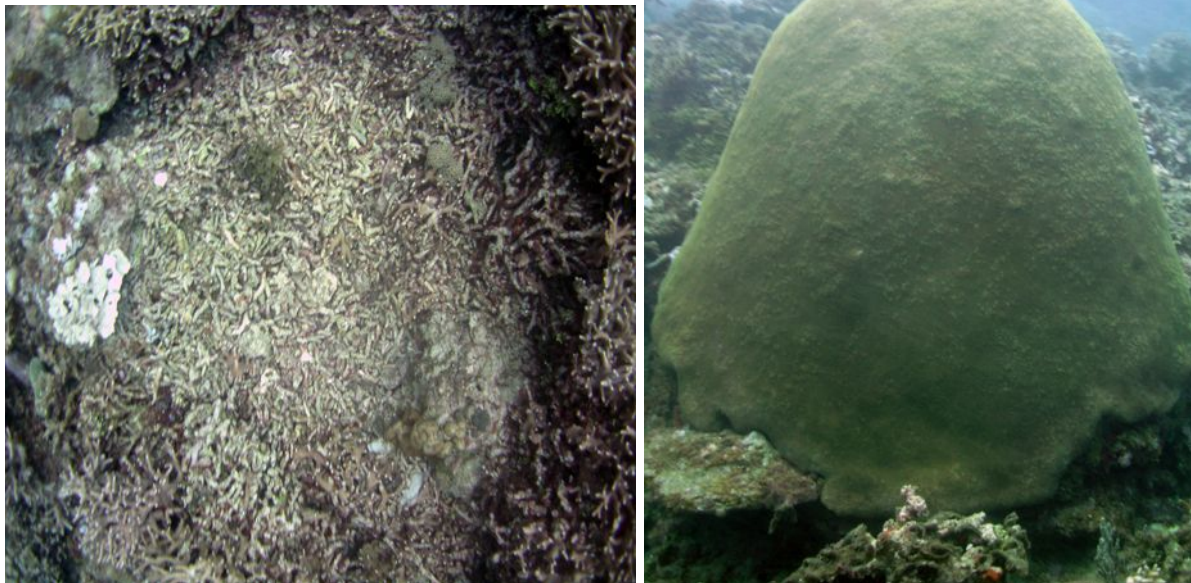
The overall average abundance of invertebrates was low. The incidence of urchins is below a normal expected level and may be attributed to reef gleaning. It is also interesting to note that the presence of algae (on benthic analysis) is also relatively high as urchins feed on algae.

As discussed earlier, the rubble damage was noted on over 80% of survey transects, a clear indication of past blast fishing. The associated damage of such blasting to the reef frame work is well documented; branching, tabulate and foliose hard corals are shattered, while massive and columnar coral structures are often fractured. A typical 1 kg bomb can leave a crater of 1-2m. While this effect is quite localised, the surrounding reefs and associated creatures suffer long lasting, indirect damage. Reefs which are subject to repeated blasting are often reduced to rubble ([image X](#)). These reefs face dim prospects for recovery, unless they are managed responsibly and given sufficient time to recover with no other anthropogenic (man made) impacts to hinder recovery. It was encouraging to find sporadic areas that still had large, intact coral colonies present approximately 100yrs old ([figure..](#)). Healthy reefs are highly productive ecosystems that are capable of supporting large fish communities. It had been estimated that healthy coral reefs may support fish

harvests up to 30t/km²/year whereas destroyed reefs will only support a small fraction of this yield (Alcala, 1998). Destructive fishing practices coupled with over-fishing only serve to accelerate a decline in coastal fisheries. Furthermore with catch composition changing towards lower value species this in turn results in a decline in economic revenue.

These reefs face dim prospects of recovery unless they are managed responsibly. It was very encouraging to see that in some areas there were many new coral recruits starting to grow. In addition the municipality of Hinunangan has taken the first step by successfully putting a halt to the illegal fishing practices of the past. Given enough time to recover, with limited anthropogenic impacts, the reefs of San Pedro should, once again, be capable of supporting large fish populations again and potentially become a popular tourism area.

Fig ...Left; Branching coral reduced to rubble, right; a massive coral, (Photographs taken of reefs of San Pedro)



Marine Protected Areas (MPA's) help protect corals so that they can capitalise on their growth potential. Corals are very slow growers, increasing their size by just a few centimetres each year. Healthy coral reefs are capable of supporting larger populations of fish. MPA's allow fish to grow into adults that swim outside the MPA in search of food. When they do, they will leave the sanctuary and be available to be fished. This means that the fish caught are larger but also more abundant because they have had the protection over the time needed to reach sexual maturity. A 12.5kg Snapper for example, will produce as many offspring as 212 1.1kg Snappers (Bohnsack, 1990). Sumilon Island off Cebu has been a very successful test case. Coral reef cover doubled in about 10 years as destructive fishing practices were halted.

The number of fish caught by Sumilon fishermen outside the sanctuary increased from 14t/km² to 36t/km² (Russ and Alcala, 1996).

Managerial Recommendations

Coral Cay recommends undertaking continued underwater visual census data collection. Unfortunately, due to poor weather and large waves, we were only able to complete two transects on the east coast and none on the northern coast of San Pedro. Therefore, this further assessment would include surveys both within and outside the existing MPA on the east coast in order to appraise its current status. The two survey transects within the MPA showed areas of considerable damage. However the damaged habitats had many new coral recruits growing although our data doesn't account for this. To this end it would be interesting to further assess the percentage coral recruit cover, as continued growth and recovery of such areas is dependent upon the success and support for the MPA.

The relative fish abundance and diversity should also be categorised, including important commercial species. From this we will then be able to advise the optimum location and size of the MPA. The assessment will also continue to locate key areas of anthropogenic impacts in order to effectively implement achievable waste management schemes.

The principle aim should be to help establish a community led MPA. To this end, community education and involvement is crucial. Therefore, CCC would further recommend undertaking community awareness presentations and informal discussions with the local community and Barangay council, to both disseminate information and allow for people to ask questions regarding their coral reefs, fish stocks and MPA's. It would also be a good opportunity to assess support for the existing MPA.

A well managed MPA also offers the opportunity to generate revenue. Divers express a 'willingness to pay' in return for healthy, vibrant coral reefs and large, abundant and diverse fish populations as well as charismatic species such as turtles and rays. If the MPA is well managed and therefore free of anthropogenic impacts including fishing, a user fee can be applied to recreational divers. The income generated by the user fee (usually P50-100/diver in So. Leyte) can be used to help maintain the upkeep and running of the MPA. Alternatively the fee could go to the Fisherfolk association, as it is the fishers who make the biggest sacrifice by giving up their traditional fishing grounds.

Placement of the MPA is crucial. As the success of MPA's is hinged on community support it is imperative to involve all stakeholders. One of the main issues is displacement of fishers, some of whom stand to lose significant portions of their fishing grounds. Therefore, CCC would like to undertake some socio-economic surveys primarily directed at fishers. From the

interviews, we hope to elucidate the fishers understanding of MPA's and to characterise their fisheries by collating data of their fishing grounds and catch per unit effort (a measure of the time invested in fishing proportionate to the amount of fish caught within that time). By understanding the trade-offs fishers make when selecting fishing grounds, i.e. the factors which influence the existing patterns of effort and distribution, we should be able predict not only the short term costs for local fishers but how their effort will be re-distributed. Social surveys are also valuable as they afford a greater understanding of community awareness, appreciation and opinions about the MPA. These surveys, when considered with the UVC data, will provide a more accurate picture of the current status of the MPA.

It is also crucial that the MPA is guarded effectively to ensure against fishing violations, thus promoting the success of the MPA. The community must be an integral part of future management decisions regarding the MPA. Without community support, the longevity of the MPA is questionable.

Acknowledgements

CCC would like to thank the Barangay community of San Pedro for all their help and hard work that made the satellite expedition a successful and memorable experience, in particular Captain Adriano, Chief Tanod Loloy, Councillor Sandoy and James and his family for their unbeatable hospitality and generosity. We would also like to extend our gratitude to Patrick, Tourism officer of Hinunangan for his logistical arrangements. We also thank our volunteers for their hard work and dedication to providing accurate survey results.

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