

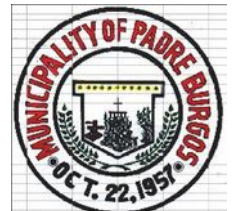
Tangkaan Marine Protected Area monitoring results 2005-2007



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1 - Introduction to Coral Cay Conservation

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.

At the invitation of the Provincial Government of Southern Leyte, CCC began its survey work in Sogod Bay in September 1999. CCC is conducting a collaborative program to survey the region's coral reefs and provide training and conservation education opportunities for project counterparts. The aim is to develop local capacity and ensure the long-term protection and sustainable use of marine resources throughout Southern Leyte. We are hoping that we can build on our previous successes, extending our stay here in Southern Leyte.

The Philippines is renowned for its rich marine environment but with as much as 97% of its reefs at risk, immediate conservation action is needed. Children living in coastal areas are recognized as the future stewards of their marine resources and CCC is working closely with this local stakeholder group to raise awareness and increase understanding of the need for greater conservation efforts in the Philippines.

2 - Tangkaan MPA

In May of 2005, four Marine Protected Areas (MPA's) were installed in the municipality of Padre Burgos. The Barangay's of Buenavista, Santa Sofia, Lungsoda'an and Tangkaan have all set aside a small part of their coastal reef to allow fish stocks to recover and conserve the rich marine life that each of the areas support.

The MPA of Tangkaan is approximately 5 ha large and is a community based MPA. This means that the Barangay community, particularly the fisher folk, have been involved in setting up the MPA and their opinion and advice was used in the deciding on the location of the MPA. Furthermore, they were invited to a seminar about the importance of marine sanctuaries for sustainable fisheries and future livelihoods as fishermen. Municipal council members and other stakeholders, Barangay captains and representatives from CCC paid a visit to Apo Island Marine Reserve off the coast of Dumaguete, Southern Negros, to have a first-hand look at how a successful marine reserve operates and can be a major source of income and provide an alternative livelihood for the community. On the basis of this excursion, plans were developed to do something similar in Padre Burgos. Diving is restricted in the MPA's and a small fee of 50 pesos has to be paid per diver. This income goes to managing the MPA. The increase in diving eco-tourism in Sogod Bay makes the MPA's a potential source of

income in the near future. Already, the MPA's are proving their value, offering some fantastic diving. This more than anything else, may help continue the momentum in preserving the rich marine resources of Sogod Bay in general and Padre Burgos in particular. The long term effects will hopefully lead to improved fish catch outside of the MPA's as has been shown in Sumilon Island; the first community based MPA that saw local fish stocks doubling within 10 years. Only with the full support of the community and upholding of the regulations and laws that apply within the sanctuary will the benefits become evident over the next years.



Fig. 2.1. Locations of four MPAs in Padre Burgos.

3 - Marine Protected Areas

MPA's are an important management and conservation tool in protecting existing fish stocks and helping them to recover. In addition to this, they allow coral reefs to grow and pristine reefs are protected from harmful human actions. Over a few years we can already begin to see the benefits that properly managed MPA's provide. A 'spill over' of fish from within the MPA to outside the MPA allows fishermen to catch fish, often more so than was the case before and ensures that a healthy fish community remains in the protected area (see diagram below). Community based MPA's have proven to be an effective way in sustainable fisheries and maintaining peoples livelihoods. A third benefit is that they can provide an income from eco-tourism when divers pay a small fee to dive within the MPA. As long as the numbers of divers is restricted and diving is done without touching or directly interacting with the marine environment, the effects of eco-friendly diving have been proven to be minimal.

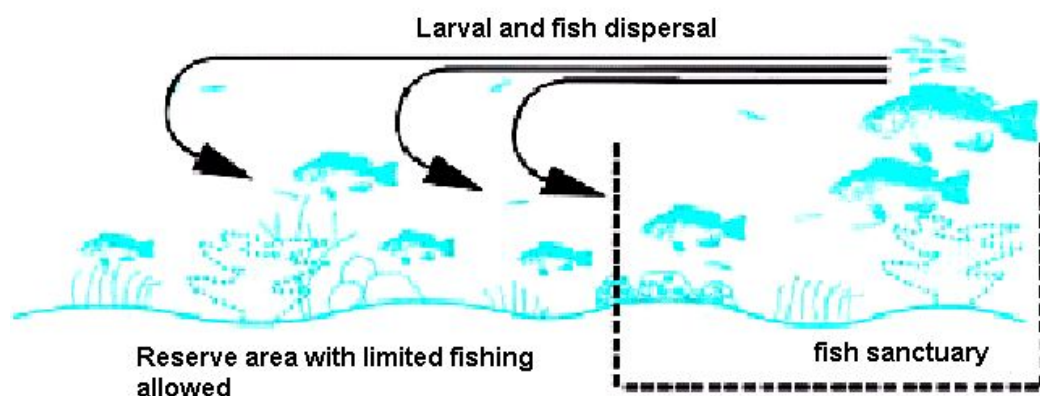


Fig. 3.1. Schematic diagram of MPA functioning. The large, protected fish within the MPA produce larvae which settle and grow outside the MPA where they can be caught by fishermen. In addition, the corals inside the MPA are not disturbed by direct human impacts. One square km of healthy reef can support over 20 tons of fish per year. One square km of damaged/destroyed reef can only produce 3 tons (Bohnsack, 1990).

4 - Methods

In 2005, several surveys were conducted within the MPA which are used as baseline data to compare with the more recent data collection, more than two years later. 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.

Results from inside and outside the MPA were collected throughout August, 2006, and in March through to June 2007. Results from before the installation of the MPA were collected at the beginning of 2005 and in July of 2005. The surveys were carried out at a depth of 12m. This depth was chosen because it usually has high coral diversity and coral as well as being subjected to significant artisinal (local) fishing pressure.

4.1 - 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 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:

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



Fig. 4.1. A Coral Cay observer estimating benthic cover every 25 cm along the transect line.

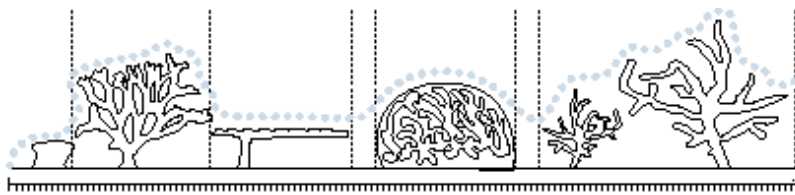


Fig. 4.2. Schematic diagram of a point intercept line laid over different coral life forms

From these results, the percentage cover of the various substrate types could be calculated. The results for the benthic surveys can be found in chapter 5.

4.2 - Fish Visual Census

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 diver's 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) important fish for consumption. The following families were counted during the surveys:

Table 4.1: Fish families which were counted on the MPA surveys. Family names are given in brackets. Local names are also given where applicable.

Groupers (<i>Epinephelinae</i>) - lapu-lapu	Wrasse (<i>Labridae</i>) - Labayan
Barramundi Cod (<i>Cromileptes</i>)	Humphead Wrasse - Mameng
Snapper (<i>Lutjanidae</i>) - maya-maya	Parrotfish (<i>Scaridae</i>) - Molmol
Sweetlips (<i>Haemulidae</i>) - lipti	Bumphead Parrotfish
Emperors (<i>Lethrinidae</i>) - katambak	Surgeonfish (<i>Acanthuridae</i>) - indangan
Jacks / Trevally (<i>Carangidae</i>) - talakitok	Rabbitfish (<i>Siganidae</i>) - kitong
Fusiliers (<i>Caesionidae</i>) - solid	Rudderfish (<i>Kyphosidae</i>) - ilak
Coral Breams (spinecheeks) (<i>Nemipteridae</i>) - silay	Damselfish (<i>Pomacentridae</i>) - palata
Goatfish (<i>Mullidae</i>) - timbongan	Anthias (<i>Anthiinae</i>) - bilong-bilong
Triggerfish (<i>Balistidae</i>) - pakol	Moorish Idol (<i>Zanclus cornutus</i>) - sanggowanding
Butterflyfish (<i>Cheatodontidae</i>) - alibangbang	Angelfish (<i>Pomacanthidae</i>) - adlo

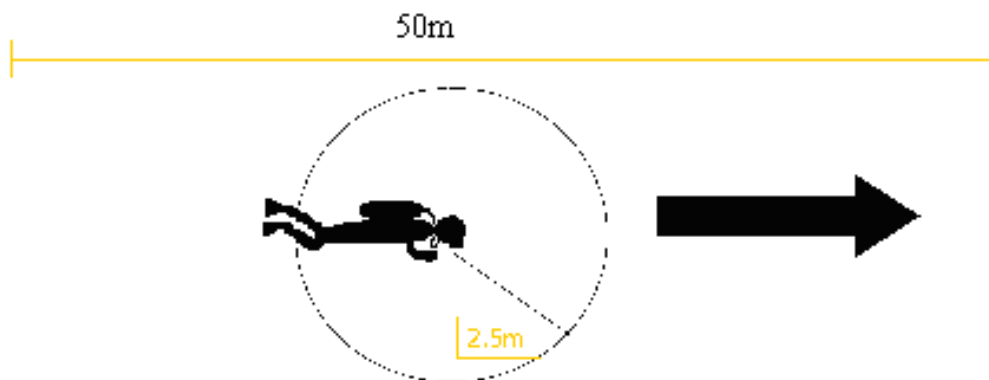


Fig. 4.3. Fish visual survey method used to estimate fish abundance along the 50m line. The diver notes down any target fish seen 2.5m to either side and 5m above him/her. The observer on the other side of the line does the same.

4.3 - 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 a note of human impacts and drew a sketch map of the area and locations of the transects with the aid of a Global Positioning System (GPS) for future reference. Numbers of fishing boats, trash, gleaners and many other human influences were also recorded.

5 - Results

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.

5.1 - Changes in fish abundance

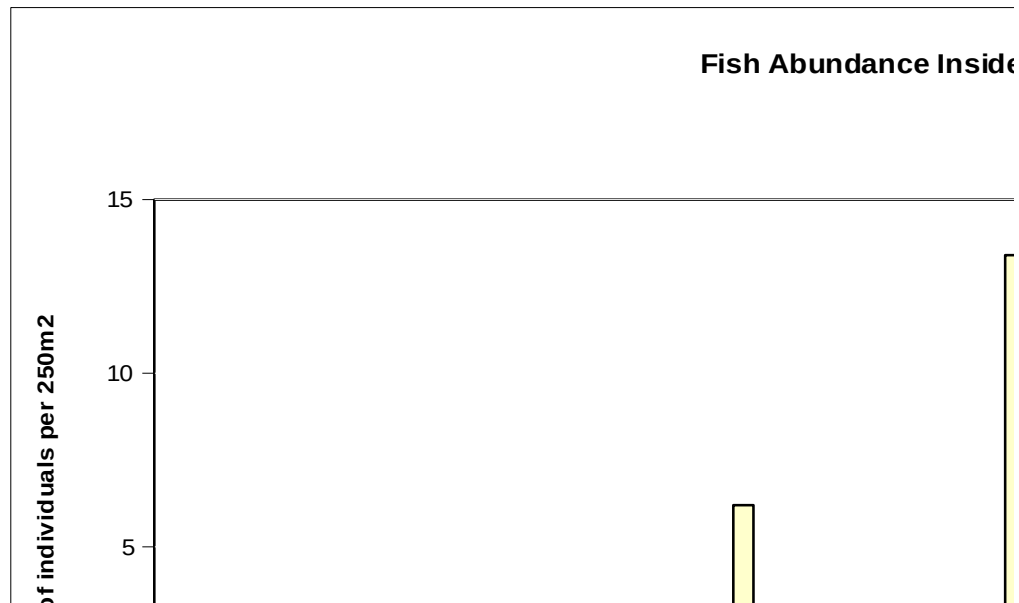


Fig. 5.1.a. Average number of fish per survey within the MPA, over the past two years since the MPA was installed. Most fish families show an increase in numbers except coral brems (*Silay*), which showed a minimal decrease between 2005 and 2006. As the figure above indicates, there is a slight decrease in the fish abundance of all fish families incorporated within this figure.

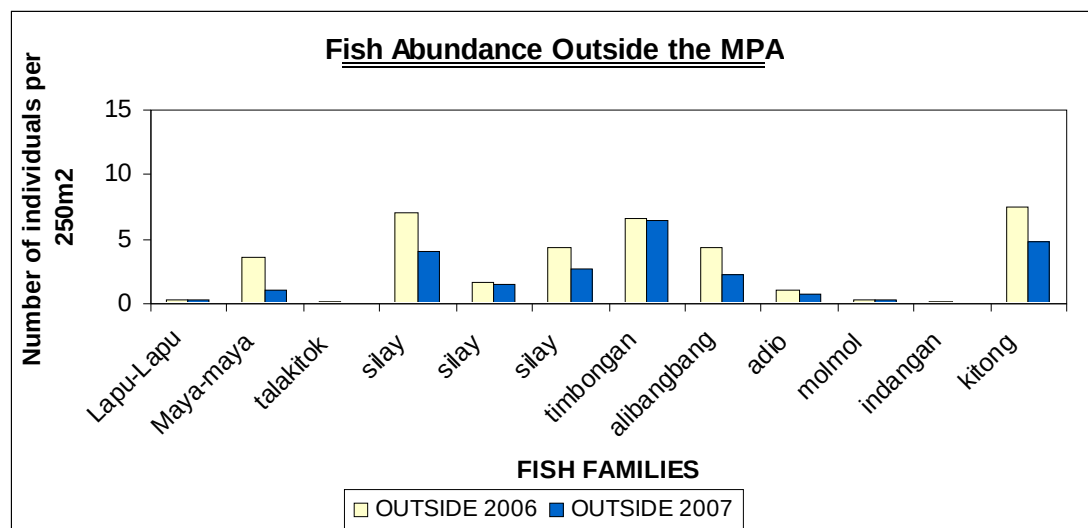


Fig. 5.1. b. Average number of fish seen per survey when outside the MPA. As with the figure above, this figure shows a slight decrease in the fish abundance between 2006 and 2007.

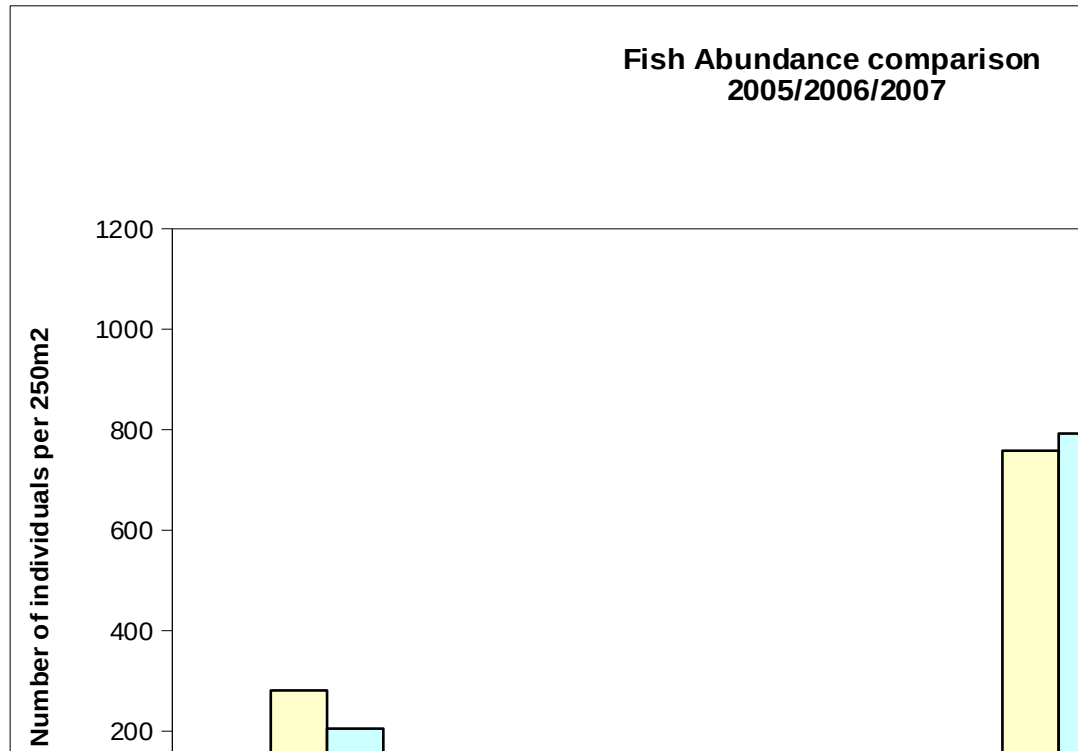


Fig. 5.2. Changes in the numbers of more abundant, smaller fishes observed one year after MPA instalment. All species increased in number though the largest increases were found for Damselfish (Palata), Fusilier (Solid) and Anthidae (Bilong-bilong) families, from 2005 to 2006; although in 2007 they show a decrease. The increase from 2005 can be attributed to the small quantity of survey data that was available, so these results are based on a couple of surveys unlike 2006/7.

SIZE CLASSES DISTRIBUTION FOR COMMERCIAL SPECIE



SIZE CLASSES DISTRIBUTION FOR COMMERCIAL

within each size class

2000%

Fig. 5.3.a. A composition of commercially important fish species for 2007, both outside (**top**) and inside (**bottom**) the MPA. The MPA has a higher percentage of larger fish. However looking at the comparison between 2006 and 2007, it is clearly seen that the overall status of the fish stocks have reduced both inside and outside the MPA. A healthy fish stock will contain individuals of all sizes. Large adults of predatory fish (groupers, snappers and sweetlips) provide many more offspring than young adults and therefore it is important to let these adults grow to their maximum size.

Biomass of Commercially Important Species

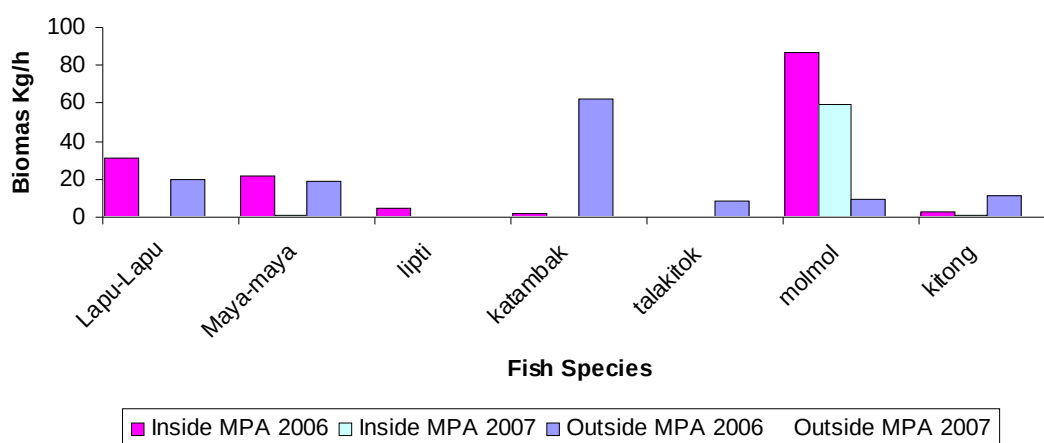


Fig. 5.3. b. Average biomass (Kg/h) of some commercially important species observed during surveys. These results show that there has been an overall reduction in the amount of fish stock within and without the MPA at Tangkaan. Parrotfish were the only family to be present within the MPA at higher biomass levels.

5.2 - Changes in benthic cover

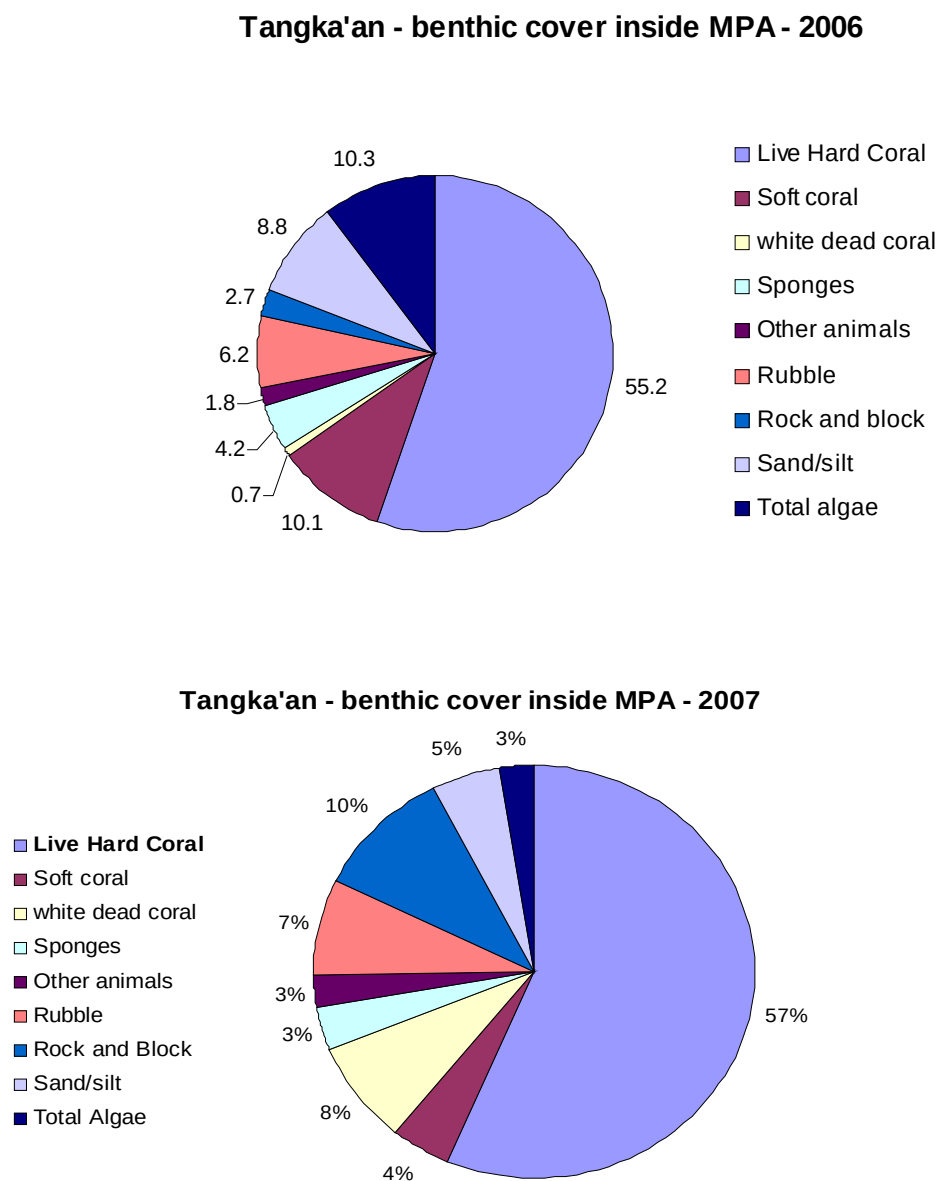


Fig. 5.4. Shows the benthic composition within the MPA in 2006 (**top**) and 2007 (**bottom**). Live hard coral (LHC) cover appeared to increase between 2006 and 2007.

Tangka'an - benthic cover outside MPA - 2006

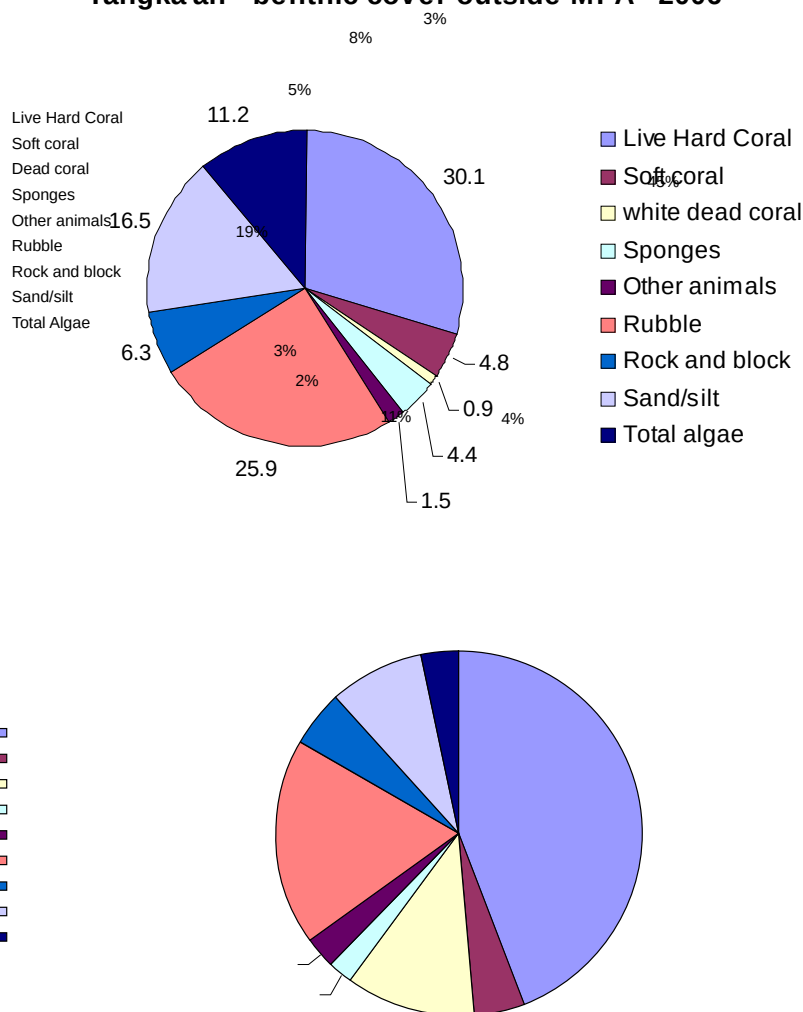


Fig. 5.5. Benthic cover outside the MPA. Relatively good coral cover was found outside the MPA. Results indicate higher proportions of rock, sand, rubble and algae outside the MPA compared to inside. The area inside the MPA appears to contain more hard and soft corals.

Changes to benthic composition indicate an increase in overall hard coral cover but are inconclusive at this stage given the short time for which the MPA has been established. The trends showing any changes to the health of the reef within the area will be obtained from further data collection over the next years.

5.3 - Human impacts inside and outside the MPA

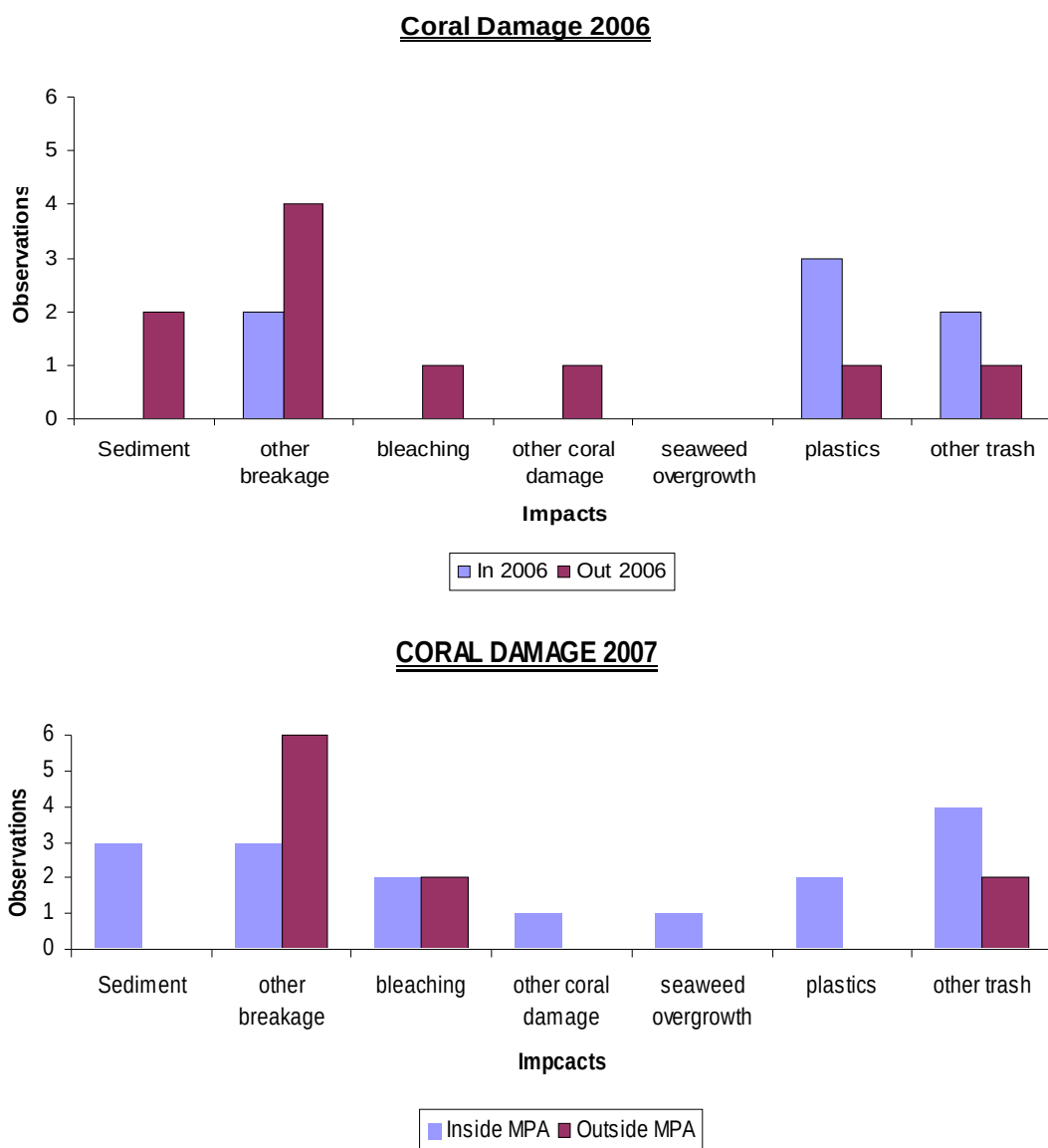


Fig. 5.6. Summary of the coral damage and human impacts found inside and outside the Tangkaan MPA, for both 2006 and 2007. In 2006, a greater number of negative impacts were noticed outside of the MPA whereas in 2007, there is evidence of an increased impacts occurring within the MPA. These impacts in comparison to 2006 are largely natural occurrences such as the crown of thorns sea star (*Acanthaster planci*) and high wave action, which can cause some coral damage. The higher levels of trash found within the MPA can be attributed to currents washing the trash from elsewhere into the MPA. One way to try to reduce this is to promote proper waste management not only locally but in neighboring Barangay's.

6 - Conclusion and recommendations

It should be noted that the number of surveys in 2005 were limited and conducted during a different season, (March) which means that there will be seasonal variations affecting the results. The 2007 data was also taken in a different time period to that of 2006 and so may show some variability due to this. 2006 was taken mainly in early

August so near the start of the rainy season, were as 2007 was surveyed in October, which should not have a large impact on the results. So the results may have a mixture of minor seasonal variation and yearly variation which is affected by environmental factors, so fish stocks will have slight variations year to year, due to reproduction capabilities for instance.

Results from 2005 to 2007 indicate an increase in hard coral cover. Further surveys are needed to establish whether corals inside the MPA are indeed recovering. Fish stocks were generally greater inside the MPA in 2006 as well as in 2007 for all fish families compared to 2005. It is likely that the MPA generally provides a healthier environment, in which fish can grow, reproduce, than that of the surrounding area. The fish stocks however have decreased between 2006 and 2007 this could be due to the surveys occurring during different seasons making true comparisons between the years difficult. Although they do appear to show that there is a general decline across the whole range of fish species. Differences in fish stocks inside and outside the MPA were minimal but suggest a higher abundance of many species inside the MPA such as Butterfly fish and Angelfish, indicating a healthier reef environment within the MPA. This is supported by the fact that within the MPA, there is a higher coral cover and with the future improvement which is hoped for then the fish stock levels should increase in the future. With proper management on both a local and provincial level, the situation inside the MPA will improve and provide a healthy fish stock that can be harvested outside the MPA. Fish stocks inside MPA's often take several years before significant increases can be seen and careful management of fishing activities is required to ensure this is the case. Without proper management the MPA will never work. There will be no benefits gained from illegal fishing inside the MPA. It will only hinder the aim of the MPA. Significant progress has been made with regards to the MPA management. With the new patrol boat operating and guards with torches to identify any illegal fishermen at night, the fish stocks stand a much better chance of recovering over the coming years.



Surveys between selected sites inside and outside the protected area do not indicate higher commercial fish abundance within the protected area. Certain fish such as snapper may be swimming in and out of the sanctuary and therefore, we could expect to encounter similar numbers both inside and outside the MPA. Fish with smaller territories did have higher numbers inside the MPA. The butterfly fish are a good example. Since they are generally associated with good reef health, we can see a relationship with the better coral cover inside the MPA and the presence of more butterfly fish. In addition, the high hard coral cover may also be the reason behind the sighting of more parrotfish within the MPA compared to outside given that this is their main food source Parrotfish generally respond quickly to a reduction in fishing

pressure and therefore make good indicator species for MPA effectiveness.

The size composition of fish within the MPA appears to be better than that outside with a general trend of a more varied and larger size composition for most fish families in 2007. However, there is a reduction in the size variations of groupers within the MPA in comparison to outside of the MPA. The size categories of fish species show us the age range of that particular fish stock and so relate to the health of the fish stocks. The decline in the fish stocks are shown in all of the fish data collected from Tongan.

Looking at the comparisons between 2006 and 2007, it is clear that fish stocks have reduced both inside and outside the MPA. This is further supported by the results indicating a reduction in size categories within the observed fish stocks. A healthy fish stock will contain individuals of all sizes. Large adults of predatory fish (groupers, snappers and Sweetlips) provide many more offspring than young adults and therefore it is important to let these adults grow to their maximum size. It is interesting to note that a large snapper of 12 kg will provide as many offspring as 100 1kg snappers. This really underlines the importance of allowing fish to grow and reproduce in an undisturbed environment so that maximum offspring outputs can be attained. It is highly unproductive in fishing juvenile fish as this will severely reduce fish stocks and prevent the desired increase in fish biomass within the MPA.

The only commercial family which had significant biomass within the MPA were Parrotfish. The other commercial species however, do move around over large areas and so it can be expected that some species such as Snappers and Jacks can be seen outside the MPA. Even with this however there is still an overall decline in the size and quantity of fish within and around Tangkaan MPA. A reasonable explanation for this may be the lack of proper management of the sanctuary over most of 2007.

The coral cover and benthic composition inside and outside the MPA were quite different. There was better hard coral cover inside the MPA than outside with both showing an increase from 2006/7. Dead coral has shown an increase both inside and outside the MPA although more coral breakage and damage was observed outside the MPA compared to inside (Fig. 5.6). In time, it is hoped that less damage will be observed inside the MPA as a result of human influences due to the fact boats, e.g. fishing boats, will not be present and dropping their anchors, or throwing rocks to direct fish into nets, which can cause coral damage. The installation of mooring buoys for dive boats outside the MPA would help prevent further anchor damage. By preventing coral damage inside and outside the MPA, the reef will be healthier and able to support more fish for the fishermen. 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). Although the area outside the MPA is not protected, efforts should be made to protect the areas used for fishing against coral damage in order to further enhance fish catches.

Although it is interesting to see that there appears to be an improvement in the benthic cover it is not substantiated by an improvement in the fish stocks which shows that the fish stocks could be suffering greatly from fishing pressures.

An indication of eutrophication (too many nutrients in the water from agricultural land runoff) is when there is significant algae overgrowth, as seen in 2006. Algae (in particular *Cyanobacteria*) can out compete and overgrow corals when there is an increase in certain nutrients in the water. This is a more complex problem that requires an integrated approach to the local coastal management. Proper waste disposal and allowing less plastic waste to enter the sea would be a good starting point for the Barangay.

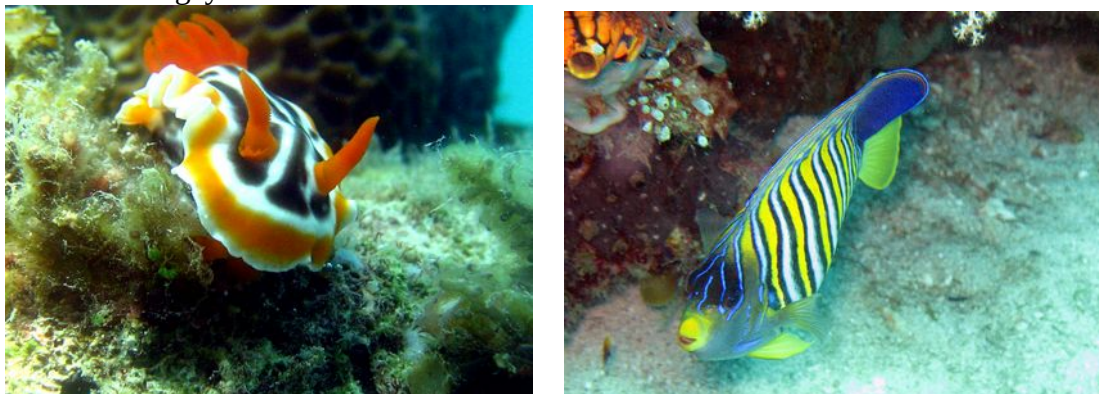


Fig. 6.2. A nudibranch (sea slug) crawls over an algae covered rock (left) whilst a regal angelfish swims close to the coral reef in Tangkaan MPA (right).

Visibility was found to be between 10 and 20 metres on all survey dives. The temperature varied between 27 and 29 degrees for all the surveys conducted. Both visibility and water temperature can affect the reef and its health.

The reef morphology (steepness and complexity) inside the MPA at the northern end made surveying difficult in areas of healthy reef cover. Many crevices and drop offs provided rich reef cover and fish abundance (observers notes) but surveying them proved difficult. This is because some of the target species that we look at can hide in these crevices, which the surveyor, cannot observe. The fact that the local dive operators are regularly diving within the MPA is proof of the high aesthetic value and beauty of the area.

CCC recommends enhancing and improving the existing management of the MPA. It has been observed that many fisher folk have been fishing within the MPA. The enforcement of the no fishing rules would prevent this. Diver access within the MPA should be allowed to continue to generate income for the community and MPA management. Only through proper management will the fishermen be able to realise the true potential of the increased fish yields that the MPA can offer. This will be easier now that the patrol boat is operational and the guards have torches which can be used to patrol the MPA at night.

Social surveys have been valuable in order to get a better picture of community awareness, appreciation and opinions about the MPA. These surveys have been undertaken by CCC and are currently being processed. Results will be made available in due course. Together with more MPA surveys, a more accurate picture can be

made of the current status of the Tangkaan MPA. For now, it is crucial that the MPA wardens watch the area at all times and make sure there are no violations such as illegal fishing and passage inside the MPA. The community must remain involved in future decisions and their voice should be heard. Without community support, the MPA cannot work.

A further recommendation would be to combine the MPA of Tangkaan with the MPA of Santa Sofia to set aside a 900m² area of coastline. Larger MPA's have a far better chance of recovering fish stocks. At this time, the management of Tangkaan MPA could be enhanced by the inclusion of the fisher folk as a force to keep others from fishing within its boundaries. The combined efforts of both Barangay's may also be the key to successful management and law enforcement. It will also save on costs such as marker buoys and help improve inter-Barangay relationships. The MPA at Molopolo/Sta. Cruz is a co-managed MPA between the two Barangay's and has been established for the past 10 years. The MPA is respected by local fishermen, and many shoals of large snapper and emperors can always be seen swimming in its waters. This is just one example of an MPA which has worked, but community support and help, in the prevention of illegal activities is necessary for any positive results to become a future trend. This is the hope for Tangkaan with the implementation of the patrol boat and with the torches for the guards to help watch over the MPA at night. With more stringent management and implementation of the restrictions within the MPA there is the possibility for a well run and managed MPA which promotes and encourages fish stocks to grow and so benefit the local communities. This is all possible under the leadership of Barangay Captain Julie Amorin and the support of the local community.

7 - Acknowledgements

Coral Cay would like to thank all the volunteers for their hard work and dedication to providing accurate survey results. We would also like to extend our gratitude to the Barangay council of Tangkaan and Captain Julie Amorin for allowing us to dive within the MPA and their continued support and motivation in creating a sustainable fisheries management in their Barangay. We also thank the Municipality of Padre Burgos for assisting us in many ways.

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