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Status of Pasil Reef Marine Sanctuary in Cogtong Bay, Philippines

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ABSTRACT

The status of corals and reef fish resources inside Pasil Reef Marine Sanctuary in Cogtong Bay, Bohol, Philippines was surveyed using 50m Line Intercept Transect method to obtain percent coral cover. The coral reef fish populations in the sanctuary were assessed using Fish Visual Census along 50m transect covering 2 coral communities separated by 2 depth gradients (2m and 10m.). Benthic life forms intercepted by the transects were recorded and identified in situ. A similar census was also conducted outside the Marine Protected Area (MPA) to serve as controls. The results showed that in both areas live hard massive corals dominate. However, live hard and soft coral cover was significantly higher inside the sanctuary than outside. The difference of coral structure inside and outside the sanctuary was analyzed through independent sample t-test and the result showed that there was no significant difference. The results of the present survey was compared with a survey conducted two years ago and it showed that the percent live coral cover and fish populations inside and outside the sanctuary significantly increased. Friedman's tests revealed that the abundance of fish population in the MPA between 2003 and 2005 were statistically significant. The researcher concluded that the implementation of Pasil Reef Marine Sanctuary indeed positively impacted the biological parameters of the sites.

Keywords: marine sanctuary, corals, benthic, marine protected area, in situ

INTRODUCTION

Coral reefs in the world cover an estimated minimum area of 600,000 km^2 and located between latitudes 30° north and south of the equator. They are a dominant feature of shallow waters throughout the tropics and an essential ecological and life support system necessary for human survival and sustainable development. The Philippines have an estimated 25,000 square kilometers total reef area generating a considerable contribution to fisheries. A more productive reef has a yield of 36 tons of fish per square kilometer per year whereas the poor reefs may give only one-tenth of this or less.[1] In the Philippines, coral reef fisheries provide livelihood for more than a million small-scale fishers who contribute almost US$ 1 billion annually to the country's economy.[2]

The world's coral reefs are subjected to several anthropogenic disturbances that eventually threaten the natural equilibrium of these resources. The anthropogenic causes

of coral reef destruction include: sedimentation from soil erosion, use of explosives to capture fishes, use of cyanide, muro-ami and kayakas fishing, pollution from industry and coral reef quarrying.[3] In the Philippines, most reef areas have been adversely affected by human activities and less than 5% are considered to be in excellent condition.[4] In the ASEAN region, up to 70% of the reefs have been considerably degraded by human activities.[5]

Serious economic losses have resulted from fish production lost due to deterioration of the marine environment. It is also a major contributor to poverty in coastal communities.[6] Coastal management has been practiced in the Philippines over the last two decades to try to amend this increasing tide of habitat degradation and fishery production decline.[7] Current approach towards the sustainable use and management of coastal resources is integrative, holistic, multi-disciplinary and system oriented, otherwise known as ICM (Integrated Coastal Management). The current trend in ICM is toward the establishment of Marine Protected Areas (MPA's) .[8]

MPA's are becoming prominent worldwide as a tool to protect biologically rich habitats, resolve user conflicts, and help restore overexploited stocks and degraded areas. The outcomes of MPA implementation has demonstrated successes at several locations.[9]

MPA's are widely advocated as a means for managing coastal resources and are being touted as the most efficient tool for the management of over-exploited coastal resources in developing, tropical countries.[10] Despite the long experience of the Philippines in ICM, only a meager 20 to 25% of the over 400 MPA's are considered as successful.[11] In Bohol, only 10% are considered as functional and effective among 50-implemented sanctuaries.[12] In the municipality of Candijay, Bohol, the Pasil Reef Marine Sanctuary was established in 2001 through a Municipal Ordinance No. 9 dated December 19, 2001, which is more popularly known as Kawasihan Reef Sanctuary (Figure 2). This is a culmination of a decade of coastal resource management undertaking in Cogtong Bay (Figure 1). The primary objective of the implementation of this sanctuary was to rehabilitate the status of the coral reef and reef fishes in the area. In order to evaluate its impact and effectiveness this study was conducted to assess and compare its present status with that of the baseline assessment data taken years ago.

OBJECTIVES OF THE STUDY

The general objective of this study was to determine the status of corals and coral reef fish populations of the MPA.

The following are the specific objectives of the study:

1. To determine the present status of the Pasil Reef Marine Sanctuary in the aspects of:
    a. per cent coral cover
    b. species composition of reef fishes
    c. abundance of fish

2. To compare the present status of the coral reef and reef fishes in and outside the sanctuary.
3. To compare the present status of the sanctuary with that of the baseline information generated in previous similar study.

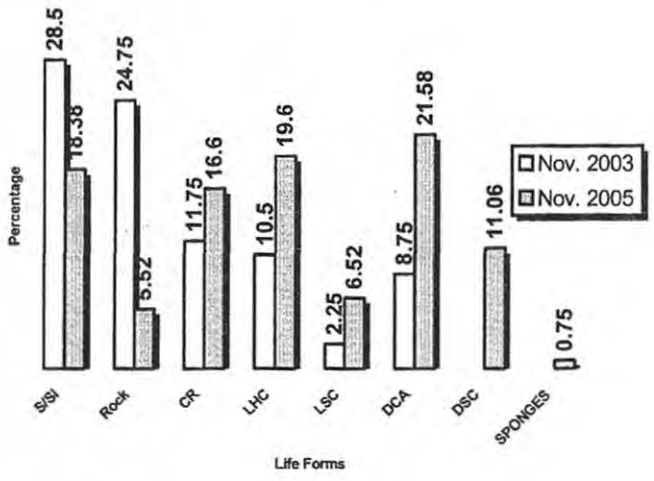


Figure 1. Map of Cogtong Bay showing the location of the MPA (Katon et al, 1998)

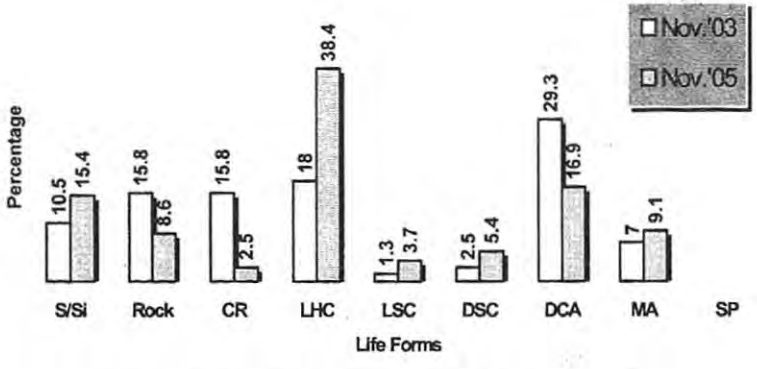


Figure 2. Sketch of Pasil Reef Marine Sanctuary

METHODS

Status of Coral Reefs

The LIT method as prescribed by English et al (1994) was used in determining coral condition and life form inventory. A 50m transect was laid at random covering 2 coral communities separated by 2 depth gradients (2m and 10m). Benthic life forms intercepted by the transect were recorded and identified in situ. From the LIT percent coral cover was generated and compared to the MPA's previous baseline assessment. A control transect outside the MPA was laid and surveyed to serve as controls.

Reef Fish Assemblages

The coral reef fish population of targeted species was assessed using Fish Visual Census (FVC). Fish species and abundance was estimated. This method was conducted in conjunction with the LIT. A 50 m transect was laid following the depth contour similar to the LIT for corals, FVC of fish population was conducted within a 5 m area along the transect. A similar census was also conducted outside the MPA to serve as controls.

Figure 3. Laying the Transect

Statistical Analysis

The differences in fish abundance between the two time frames (2003 and 2005) were compared using Friedman's tests. Coral forms inside and outside the MPA were compared through independent-sample t-test using Statistical Package for Social Sciences (SPSS, version 10, 1999).

RESULTS AND DISCUSSIONS

The type of reef around Kawasihan sanctuary is fringing (Figure 2). Rows of massive rocks surround the reef, which is locally known as pasil where the reef derived its name. We observed a number of giant clams *Tridacna squamosa* and *T. derasa* in medium sizes outside the transect during the survey. They were the result of the stock enhancement done by MPA management council years before.

Figure 3 shows the comparison of benthic forms and their percent composition inside the MPA between the 2003 and 2005 surveys. It shows that live hard and soft corals inside the sanctuary dramatically increased in percent cover from 18.0% in 2003 to 38.4% or an increase of 213.3 % and 1.3 in 2003 to 3.7% or an increase of 284.6%, respectively in this survey. Macro-algae and dead standing corals

also increased by 130% and 216% respectively in percent cover.

Figure 4 shows the benthic forms and their percent composition outside the MPA between the 2003 and 2005 surveys. It shows that the percent cover of sand and silt (S/Si) was highest in 2003 with 28.5% cover but decreased to 18.38% in 2005. Live hard coral cover increased from 18% in 2003 to 34.4% in 2005. Live soft coral cover also increased from 1.3% to 3.7% in 2005.

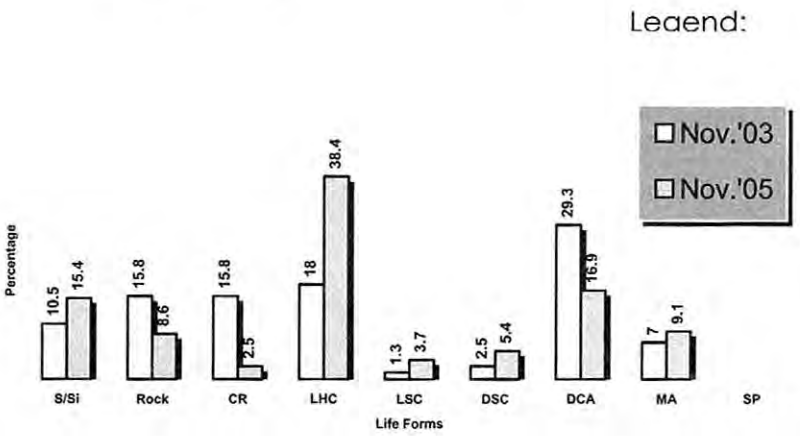
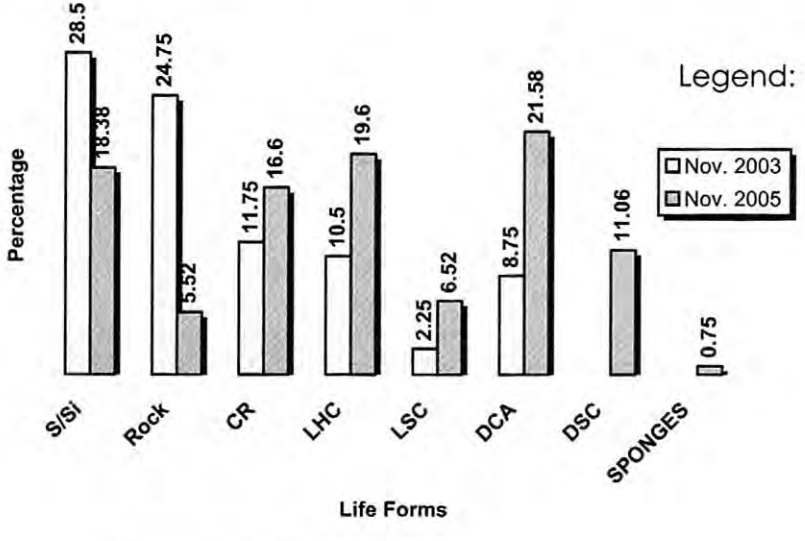


Figure 3. Comparison of Benthic Forms and Percent Composition inside the Sanctuary between the 2003 and 2005 surveys

Figure 4. Comparison of Benthic Forms and Percent Composition Outside the MPA



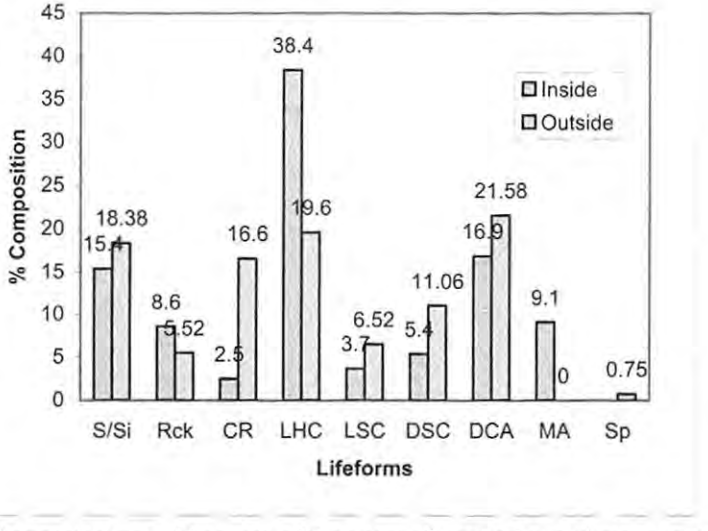
between the 2003 and 2005 surveys

Figure 5 shows that the percent cover of live hard corals inside the sanctuary was higher than that outside but live soft coral cover outside the sanctuary was comparatively higher than that of the inside of the MPA.

Table 1 shows the result of independent sample t-test where it revealed that there was no significant difference between the coral forms inside and outside of the sanctuary.

Table 2 presents the result of the Fish Visual Census inside and outside of the MPA comparative of the FVC conducted in November 2003. Result showed that in 2003 the total coded number of fishes inside and outside of the MPA were 24 and 12 respectively, while in the present census, the figures increased to 48 and 32, respectively, or an increase of 200% inside the sanctuary and 266.6% outside it.

Table 3 shows that the median of the abundance of fish population inside the MPA in 2003 and 2005 was statistically significant, so was the abundance of the fish population outside during the period (Table 4). Moreover, there was no significant difference in the median of the abundance of fish population inside and outside the MPA in 2003 (Table5). The same was also true in 2005 (Table 6).



These changes happened because of the years of protection and management done on the sites.

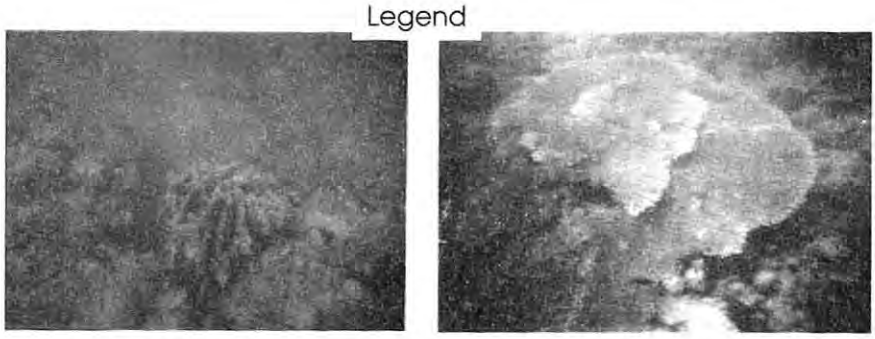


Figure 5. Millepora sp. (left) and Acropora sp. (right) were the most dominant coral species in and outside the MPA (Photo taken by the author 2005)

Figure 5. Comparison of benthic forms and % composition inside and outside of the MPA

Table 1. Independent sample t-test for the analysis of coral forms inside and outside the MPA.

Reef site	N	Mean	SD	SE	Sig.	df	Sig. (2-tailed)
Inside	263	4.7186	3.7697	0.2324	0.05	377.00	p<0.05
Outside	116	4.3966	3.3463	0.3107			

Table 2 pecies composition and abundance of fish inside and outside the MPA

Fish Type	November 2003		November 2005	
	Inside	Outside	Inside	Outside
1. Zanclus cornutus	2	2	3	2
2. adiorynx cornutus	0	2	3	3
3. S. cannaliculatus	2	0	4	0
4. Acanthurus philippinensis	0	1	0	2
5. P. anguillaris	3	0	4	4
6. A. bengalensis	1	0	2	2
7. Lethrinus amboinensis	2	2	0	2
8. S. guttatus	2	2	2	3
9. Pseudocoris philippina	3	0	4	3
10. Pelates quadrilineatus	2	0	3	2
11. Cheilinus fasciatus	3	0	0	3

12. Pomacentridae sp.	4	2	2	0
13. Loligo sp.	0	1	2	0
14. Apogon notatus	0	0	2	2
15. Amphiprion clarkii	0	0	1	0
16. Stolephorous ronquilloi	0	0	4	0
17. Saurida tumbil	0	0	1	0
18. Siganus lineatus	0	0	2	0
19. Epinephelus sp.	0	0	1	2
20. Liza vaigiensis	0	0	2	2
21. Siganus sp.	0	0	1	0
22. L. miniatus	0	0	3	0
Total	24	12	48	32
% increase between Nov. 2003 to Nov. 2004			200%	266.6%

Legend:

Code		Number of fishes	Code		Number of fishes
1	=	1 – 5	4	=	126 – 625
2	=	6 – 25	5	=	more than 625
3	=	26 – 125			

Fish visual census data

Table 3. Result of Friedman's test on the differences in the abundance of fish population in the site in 2003 and 2005.

N	22
Chi-Square	9.800
df	1
Asymp. Sig.	.002

Ho : Before MPA (inside) = (After MPA inside)

H1: Before MPA ≠ After MPA

RQ: Is there a significant difference in the abundance of fish population in the site before and after?

Conclusion:

Statistical:

Since $p < 0.05$, we reject the Ho

Biological:

The researcher concluded that the median among the abundance of fish population in the MPA between 2003 and 2005 is statistically significant ($H_{df=1} = 9.80$, $p<0.05$).

Table 4. Result of Friedman's Test on the Differences in the Abundance of Fish Population Outside the site Before and After the MPA.

N	22
Chi-Square	6.231
df	1
Asymp. Sig.	.013

Ho: Before MPA (outside) = After MPA (outside)

H1: Before MPA ≠ After MPA

RQ: Is there a significant difference in the abundance of fish population outside the MPA between 2003 and 2005?

Conclusion:

Statistical:

Since $p<0.05$ we reject the Ho

Biological:

The researcher concluded that the median among the abundance of fish population outside the MPA before and after is statistically significant ($H_{df=1} = 6.23$, $p<0.05$).

Table 5. Result of Friedman's Test on the Abundance of Fish Population inside and Outside the MPA in 2003.

N	22
Chi-Square	1.600
df	1
Asymp. Sig.	.206

Hypotheses:

Ho: Inside MPA (2003) = Outside MPA (2003)

H1: Inside MPA ≠ Outside MPA

RQ: Is there a significant difference on the abundance of fish population inside and outside the MPA in 2003?

Conclusion:

Statistical:

Since $p>0.05$, we failed to reject the Ho.

Biological:

The researcher concluded that the median on the abundance of fish population inside and outside the MPA in 2003 is not statistically significant ($H_{df=1}$ = 1.60, p>0.05).

Table 6. Result of Friedman's Test on the Differences in Fish Population inside and Outside

the MPA in 2005

N	22
Chi-Square	2.882
df	1
Asymp. Sig.	.090

Hypotheses:

Ho: Inside MPA (2005) = Outside MPA (2005)

H1: Inside MPA ≠ Outside MPA

RQ: Is there a significant difference on the abundance of fish population inside and outside of the MPA in 2005?

Conclusion:

Statistical:

Since p>0.05, we fail to reject the Ho

Biological:

The researcher concluded that the median on the abundance of fish population inside and outside the MPA in 2005 is not statistically significant ($H_{df=1}$ = 2.88, p>0.05).

CONCLUSIONS

Our results clearly pointed out that the percent cover of both hard and soft corals increased both inside and outside of the sanctuary within a period of two years, so were the results of fish visual census on fish assemblages. The number of species aggregating inside the MPA increased by 200%, from 24 in 2003 to 48 in 2005 survey, so with the outside increased by 266.6%. Per cent cover of live hard corals inside the sanctuary increased from 18% in 2003 to 38.4% in 2005 while live soft corals increased in cover from 1.3 in 2003 to 3.7 in 2005. We took this as a partial impact of protection brought about by the implementation of the MPA. We safely conclude that the implementation of Pasil Reef Marine Sanctuary indeed positively impacted the biological parameters of the sites.

RECOMMENDATIONS

We recommend that continuous scientific monitoring shall be done on the MPA to closely observe the growth of corals and other changes in benthic forms over time. It is also recommended that seeding of animals with high commercial value such as giant clam, *Haliotis asinina* and others shall be done on the MPA to enhance its biodiversity and that continuous education of the local stakeholders shall be conducted to sustain the MPA.

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