Kuroshio Science 13-1, 49-52, 2019

Symposium Proceedings

Status of coral reef on Malabungot Protected Landscape and Seascape

Ronnel A. Dioneda Jr.[1]* and Ronnel R. Dioneda Sr.[2]
[1] Partido State University, Goa, Camarines Sur, 4422 Philippines
[2] Bicol University, Legazpi City, Albay, 4500 Philippines

Abstract
Coral reefs are among the most important yet severely threatened ecosystems. The case of MPLS reef is one of this, despite its declaration as a protected area. There is an insufficient data on comprehensive ecological assessment that will served as benchmark data. This report will serve as the baseline data of the coral reef ecosystem in the protected area. It aims to determine the percentage cover of live hard corals and biotic-abiotic components, and to provide technical information as a basis for managing the coral reef ecosystem in the municipality. The benthic components were assessed adopting the Line Intercept Transect method. The coral reef ecosystem of MPLS is a fringing reef system. In terms of hard coral cover, T1 showed high % cover (34%) while T2 and T3 has 25% and 18%, respectively. High prevalence of dead corals was observed at T2 (62%). Massive corals were the dominant life form (*Favia* sp, and *Porites* sp.) in all transects while other coral morphologies were low in abundance resulting in low reef complexity. Coral reef health is under the fair condition. Few sightings of crown-of-thorns starfish in the protected area and abundant macroalgae population. Siltation mainly affects the coral condition. Human fishing intensity also contributed in the fair reef health. MPLS would benefit greatly from enhanced management protection predicted to increase the fish diversity and decrease algal abundance and, over time increase the coral cover. There is a need to strengthen law enforcement of the protected area.

Key words: Corals, Siltation, Coastal Management, Protected area

INTRODUCTION

Coral reefs are among the most diverse ecosystems on earth. One forth to one third of all marine species lives within the reef, with recent estimates suggesting that between 550,000-1,330,000 multi-cellular species inhabit coral reefs worldwide (Fisher et al 2015). It is among the most important yet severely vulnerable ecosystems due to the increasing scale and frequency of human impacts (Hughes et al. 2003; West and Salm 2003, Buddemeier *et al*. 2004). In addition to the threats from human impacts, coral reefs and reef biodiversity are facing an developing threat from global climate change (Hoegh-Guldberg et al. 2007). In the fast few decades, it was estimated that there are 19-61% of coral cover loss with further declines globally (Carpenter et al. 2008). Human-related activities such as coastal development and nutrient pollution may also exacerbate the effects of natural phenomena and climate change (Mumby 2006). Therefore, it is mainly affected by the synergistic impact of human and natural interventions.

One important quantification to enhance coral reefs' ability to withstand (resistance) or recover (resilience) from any form of disturbance (either natural or anthropogenic) is through the creation of marine reserves (West and Salm 2003, Grimsdith and Salm 2006, Green et al. 2009, Hughes et al. 2003). These are "Ocean areas that are permanently and fully protected from human activities that remove animals and plants and alter habitats…" (PISCO 2007). They have been shown to improve biodiversity within their boundaries and may potentially export adult fish biomass (Abesamis *et al*. 2006) as well as replenish larvae in fished areas (Abesamis and Russ 2010).

* Correspondence. E-mail: rondioneda@gmail.com

In the Philippines, there are about 1, 600 established marine reserves (Horigue et al. 2012), more than half of this figure, 564 as of 2008, are located in the Visayas (Alcala et al. 2008). Most of these marine reserves, however, lack baseline data that are crucial for the management (including protection) of these reserves. In addition, such information will be of great importance to convince policymakers to formulate ecologically sound management strategies. The case of Malabungot Protected Landscape and Seascape (MPLS) is one of this. Despite its declaration on April 23, 2000 under Proclamation No. 288, which was later formally legislated under the senate bill no. 2895. There is no comprehensive assessment was conducted to established benchmark data as a basis for measuring the management effort.

This paper determined the current condition of the coral reefs in MPLS. Specifically, it determined the percentage cover of live hard corals and associated abiotic and biotic components to generate technical information as a basis for managing the coral reef ecosystem in the MPLS.

MATERIALS AND METHODS

Sampling Sites

Reconnaissance survey was conducted. Coordinates of the selected sites were obtained using Garmin GPS device. Satellite image of the sampling areas was presented in the Figure 1. Transect 1 (T1) is located at Latitude N' 13° 55'52.40, and Longitude E' 123° 35'27.50. While transect 2 (T2) is located 1 km away from T1; 13° 56'3.89"N; 123° 35'12.58"E and lastly transect 3 (T3) is located at 13° 55'52.40"N ; 123° 35'27.50"E , 600 m away from T2. Coordinates were plotted at a qGIS mapping software to establish the sampling points as shown in Fig. 1.

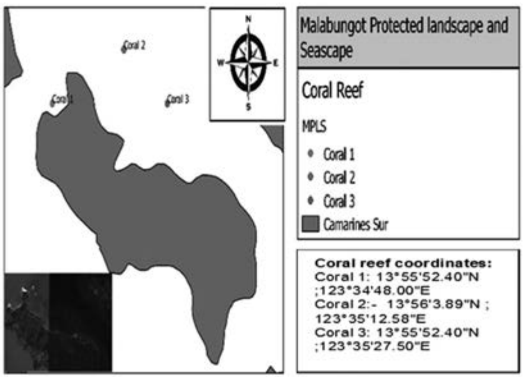

Fig. 1. Coral Reef Assessment Sampling Stations at MPLS.

Survey of Benthic Communities

A 50-m transect line was generally set parallel to the shoreline bisecting the coral communities at an average depth of 13ft. The benthic components were quantitatively assessed adopting the Line Intercept Transect (LIT) method of English et al. (1997). Using SCUBA, the LIT was made by recording the intercept of each life form observed underneath transect and record the corresponding code to underwater slate. The data gathered then processed using the Microsoft Excel and coral condition was classified on the scale listed in Table 1.

Table 1. Quartile Index of Coral Reef Condition (Gomez et al. 1975).

Live Hard Coral Cover	Classification/Condition
1-24.9%	Poor
25-49.9%	Fair
50-74.9%	Good
75-100%	Excellent

$$\text{Percent Cover} = \frac{\text{Length of Category}}{\text{Total Transect Length}} \times 100$$

RESULTS

The coral reef ecosystem of MPLS is a fringing type of reef system with coral communities concentrated in the northwestern portion of the island. Patches of coral reefs were located at the north side of the island. The reef flats, 3-15 ft depth have varied and expanse with most part having gradual slope while few have a drop off to 50-70 ft depth particularly in the western tip of the island. Coral are concentrated in the reef flat to the reef ledge while the upper tidal limits are growth various species of macro-algae and seagrasses.

In terms of hard coral cover, T1 showed high % cover (34%) while T2 and T3 has 25% and 18%, respectively. Mean live coral percent cover (T1, T2, T3) is 31%. Based on Gomez et al. (1975), within the range of 25-49.9% it is considered under 'fair' condition. Addition to this, high prevalence of dead corals was observed at T2 (62%) than the two stations (Fig. 2). *Porites sp.* and *Favia sp.* as shown in Fig 3, were the

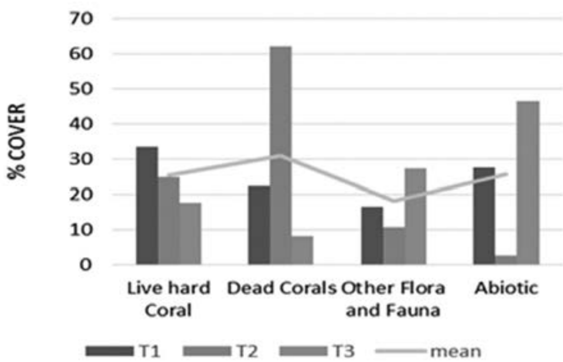

Fig. 2. Comparative percentages cover of benthic components at the three transects.

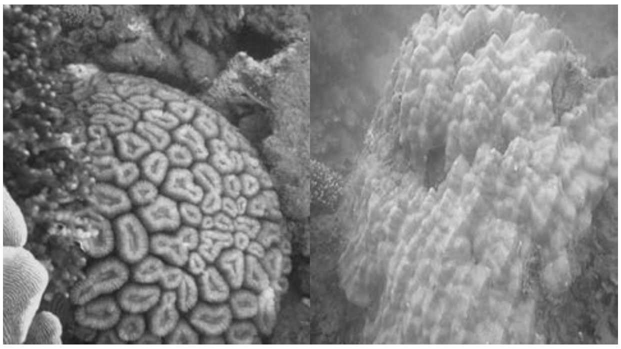

Fig. 3. Species of *Favia* sp (left) and *Porites* sp (right) type of massive corals found to be abundant in the area.

common genera of coral observed.

The possible cause of observed mortalities in corals is unknown. However, it is likely that silt deposition, unsustainable fishing practices, and infestation contributed to these mortalities as traces have been observed. Massive corals were the dominant coral life form in all transects accounting more than half of the overall hard coral population while other coral morphologies were relatively low in abundance resulting in low reef complexity. The structural morphology of the dominant corals indicates frequent exposure of the ecosystem to strong wave and siltation as these species are considered silt tolerant.

Other benthic biota recorded were algae and sponges with a low occurrence of soft corals. T3 (28%) showed abundance of these associated organisms. Few (3) sightings of crown-of-thorns starfish (*Acanthaster planci*) in the protected area eating massive and encrusting colonies.

Large area was dominated by macroalgae and some *Padina sp*. within coral areas. The substrate types were sand, rubble, and silt. However, the substrates were commonly made of silts allowing the growth of other opportunistic marine organisms such as macroalgae and thus, preventing the recruitment of corals to hard substrates. Heavy siltation was observed especially within T1 and T2. Signs of human fishing intensity were observed during the assessment such as entangled fishing lines and nets covering the massive type of coral reefs.

DISCUSSION

Based on the assessment, various assumptions can be drawn. First, the coral condition shows lack of law enforcement since its establishment as a protected area. This is obviously reflected by signs of disturbance in the benthic communities. Traces of fishing intensity is shown by the entangled fishing materials fouling several coral colonies. In addition, some harmful human activities in the area indicated by the poor water quality, and overexploitation of key species (Hughes et al. 2003) provide threatening conditions for reef system.

Second, siltation has contributed to the coral mortalities in T1 and east and west coral communities. It is suspected that the silts were deposited through the several tributaries. According to Bryant et al (1998), coastal coral reefs, like other marine coastal ecosystems, are very vulnerable to nutrient loading, sediments and pollutants discharged from the land resulting to poor water quality and thus, affecting the coral health.

Silt smothered several numbers of coral colonies under branching and table forming *Acropora*. Excessive sedimentation covering the corals prevents the capture of sunlight needed by the photosynthetic zooxanthellae which lead to the deterioration of the corals (Rogers 1990). Siltation also leads to declining biodiversity and will cause inhibition of coral recruitment and settlement (Cortes and Risk 1985) as exemplified by the MPLS coral fair condition. The dead coral skeletons are intact and had accumulated silt at varying thickness. This damage is exacerbated by crown-of-thorns starfish (COTS) (*Acanthaster planci*) and infestation by other coral-eating organisms. Although not considered in an outbreak situation, COTS is known as voracious predator of reef-building corals and brings substantial effects by reducing the abundance of corals, thus, increasing surface cover of algae (Madl 1998).

This paper demonstrated that siltation mainly affects the condition of coral reefs (under fair status) of MPLS in several ways. It covered the corals and later suffocated the organisms leading to their death. The excessive sedimentation caused opportunistic organisms to thrive outcompeting the coral settlement and recruitment process. The siltation may be due to the nearby tributaries that deposited silt throughout the protected seascape area. Fishing intensity exerted by communities also contributed to the reef fair health as evinced by the fishing lines and nets entangled within the coral reefs. The site would benefit greatly from enhanced management protection which is predicted to increase the coral diversity and decrease algal abundance and, over time increase the coral cover. There is a need for vigorous law enforcement activities through regular patrolling and monitoring of the protected zones. In addition, strengthening of network of marine protected areas within the MPLS and adjacent bays such as the Sisiran Bay need to be pursued. Coral rehabilitation will be possible at Coral Station 1, because siltation is much lesser than the two established stations. The occurrence of some COTS infestation necessitates immediate extraction of these pests to protect corals from escalated level of infestation. More extensive coral reef assessment outside the MPLS is also recommended to provide inputs to the overall management and conservation of the coral reef communities in the area.

REFERENCES

Abesamis and Russ, 2010. Patterns of recruitment of coral reef fishes in a monsoonal environment. Coral Reefs 29:911 - 921.

Abesamis, R.A., A.C. Alcala and G.R. Russ. 2006. How much does the fishery at Apo Island benefit from spillover of adult fish from adjacent marine reserve? *Fishery Bulletin* 104: 360-375.

Alcala, A.C., A. Bucol and P. Nillos-Kleiven. 2008. Directory of Marine Reserves in the Visayas, Philippines. Foundation for the Philippine Environment and SUAKCREM, 178p., 10 Figs.

Bryant, D.G., Burke, L., McManus, J., Spalding, M., 1998. Reefs at Risk: A Map-based Indicator of Threats to the Worlds Coral Reefs. World Resources Institute, Washington, DC

Buddemeier, R., J.A. Kleypas and R.B. Aronson. 2004. Coral Reefs and Global Climate Change. Pew Center on Global Climate Change, 42p.

Carpenter KE, Abrar M, Aeby G, Aronson RB, Banks S, Bruckner A et al. One-third of reef-building corals face elevated extinction risk from climate change and local impacts. Science. 2008; 321:560-563. https://doi.org/10.1126/science.1159196 PMID: 18653892

Cortés, J. & M.J. Risk. 1985. A reef under siltation stress: Cahuita, Costa Rica. Bull. Mar. Sci. 36: 339-356.

English et al. 1997. Survey Manual for Tropical Marine Resources. 2nd Edition. Australian Institute of Marine Science. Australia

Fisher R, O'Leary RA, Low-Choy S, Mengersen K, Knowlton N, Brainard RE et al. Species richness on coral reefs and the pursuit of convergent global estimates. Cur Biol. 2015; 25:500-505.

Green, A., S. E. Smith, G. Lipsett-Moore, C. Groves, N. Peterson, S. Sheppard, P. Lokania, R. Hamilton, J. Almany, J. Aitsi and L. Bualia. 2009. Designing a resilient network of marine protected area for Kimbe Bay, Papua New Guinea. *Oryx* 43(4): 488-498.

Grimsdith, B.D., and R.V. Salm. 2006. Coral Reef Resiliency and Resistance to Bleaching. IUCN Resilience Science Group. IUCN, Gland, Switzerland.

Gomez, E.D., A.C. Alcal a, H.T. Yap, L.C. Alcala and P.M. Alino. 1985. Growth studies of commercially important scleractin ians. Proc. Fifth Int. Coral Reef Congress. 6: 199-204.

Hoegh-Guldberg, O., P.J. Mumby, A.J. Hooten, R.S. Steneck, P. Greenfield, E.D. Gomez and M.E. Hatziolos. 2007. Coral reefs under rapid climate change and ocean acidification. *Science* 318: 1737-1742.

Horigue, V., Aliño, P. M., White, A. T., and Pressey, R. L. (2012). Marine protected area networks in the Philippines: trends and challenges for establishment and governance. Ocean and Coastal Management, 64, 15-26.

Hughes, T. P. et al. 2003. Climate change, human impacts, and the resilience of coral reefs. Science 301:929-933.

Madl, P. (1998) *Acanthaster planci*: An Overview of the Crown of Thorns Starfish (CoT) As Observed on the Great Barrier Reef (Australia) − Development, Primary Food Sources, Predators and Toxicity. Colloquial Meeting of Marine Biology I, Salzburg

Mumby PJ, Dahlgren, C.P, Harborne, A.R., *et al* (2006). Fishing trophic cascades, and the process of grazing on coral reefs. Science 311:98-101

Rogers, C. S. (1990). Responses of coral reefs and reef organisms to sedimentation. Marine Ecology Progress Series, Olendorf, 62(1), 185-202

West J.M.and Salm R.V.2003. Resistance and Resilience to Coral Bleaching: Implications for Coral Reef Conservation and Management. doi. org/10. 1046/j. 1523 1739.2003.02055.x

Partnership for Interdisciplinary Studies of Coastal Oceans. 2007. The Science of Marine Reserves (2nd Edition, International Version). www.piscoweb.org. 22 pages.

Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO). 2007. The science of marine reserves. 2nd edition, United States Version. Santa Barbara, CA: The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) in collaboration with the Communication Partnership for Science and the Sea (COMPASS, www.compassonline.org).