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A rapid marine biodiversity assessment of the coral reefs in Morales Beach, Benoni, Glan, Sarangani Province, Philippine

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Abstract

Morales beach is one of the beaches located in the coastal town of Glan, Sarangani Province and noted for its quite enormous coral reef which is continuously degrading. This study was conducted to assess the health status of coral reef ecosystem and to evaluate the physico-chemical parameters of the area. Point Intercept Transect (PIT) method was used to monitor live coral condition and the supporting fauna at a coral reef ecosystem. Physico-chemical parameters were obtained *in situ* using a thermometer, refractometer, and a pH meter. The result of the study showed a very low percentage cover of hard corals, no cover percentage of soft corals and high cover percentage of other biota or substrate. The reef areas exhibited poor coral cover with an average of 15 percent live hard corals having family *Acropora* as the most dominant species (Shannon diversity index of 1.653). Water samples obtained were within the DENR (1990) standards suitable for the optimum growth of coral reefs. The health status of the coral reefs in Morales beach showed a partially disturbed reef due to human intervention. It is greatly recommended to constantly monitor the coral conditions in order to effectively manage and protect the increasing number of Marine Protected Areas (MPA).

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Introduction

One of the countries that is blessed with great biodiversity of coral reefs due to its archipelagic setting is the Philippines. The combined impacts of human exploitation, physical disturbance, pollution and sedimentation adversely affect the ecological balance of the ecosystem (White and Cruz-Trinidad, 1998). To combat the trend of this depleting resources Marine Key Biodiversity Areas (MKBA) are identified as sites of global significance for biodiversity conservation identified using globally standard criteria and thresholds, based on the needs of biodiversity requiring safeguard at the site scale (Conservation International, 2008).

Locally, a key management strategy to address the issues is being initiated through implementation of Marine Protected Areas (MPAs) (Aliño *et al.*, 2007). MPAs are a useful tool for conserving biodiversity and managing fisheries (Bennet, 2015).

To date, more than 1,300 MPAs in the Philippines were established but only around 10% are actually being effectively managed (PhilReefs, 2008), a reason why most MPAs have had mixed success in meeting their management objectives in terms of ecological, socio-economic, and fisheries benefits (Claudet *et al.*, 2011).

One of the MPAs is the Morales Beach sanctuary. Morales Beach sanctuary is one of the marine sanctuaries located in Barangay Benoni of the municipality of Glan, Sarangani Province. Coral reefs in Morales Beach are patchy in distribution, indicating that the coral reef ecosystem on the location is just starting to flourish. These coral reefs are located approximately 300 meters offshore.

The coral reef ecosystem is threatened by anthropogenic modification of chemical and physical atmospheric dynamics (Reigl *et al.*, 2009). Biophysical profiling through biodiversity assessment is a means if collecting information on the species present in a specific area (Halpern and Warner, 2002). This process provides reliable data through scientific process and gives a basis for information comparison over regional up to global scale. In totality, biodiversity assessment involves conducting a survey or inventory of the species in a certain area. Our coastal resource assessment aims to survey the coral reef condition on the said condition.

Corals were identified based on the lifeforms and physico-chemical parameters limited to salinity, temperature, pH, visibility and depth. The objective was to evaluate some physico-chemical parameters and to assess the status of the coral reef ecosystem.

Materials and methods

Study area and period

The study was conducted in Morales Beach, Benoni, Glan, Sarangani Province located between 05°46.661'N and 125°11.172'E. Mapping was obtained through Global Positioning System (GPS) by the use of online mapping (https:maps.google.com) shown in Fig. 1.

The study area provided excellent sites for studying other marine organisms. The study site includes different types of faunas: seagrass, intertidal molluscs, soft bottom communities, mangrove, and coral reef fishes.

Physico-chemical parameters

The physico-chemical parameters are obtained in the sampling station located in the buffer zone and the core zone (Fig.1). *In situ* sampling was conducted for the salinity, atmospheric temperature and water temperature, pH, visibility, and depth. Salinity was taken by obtaining a water sample from the site and testing it using a refractometer.

Temperature was taken using a thermometer. Visibility was recorded using a Secchi disk. The length of the string submerged was measured at the point of disappearance of the disk. The depth was taken using the depth gauge provided in the SCUBA divers equipment.

Fig. 1. Map of Morales Beach, Benoni, Glan, Sarangani Province, Philippines.

Laying the transect

Point Intercept Transect (PIT) method was used to determine sessile benthic community in the coral reef based on their percentage, by noting the number of benthic biota at each marked of the transect line. The 50m long transect line (a nylon rope of 5 cm in diameter), marked in every 0.25m, and is positioned parallel to the shore line between the depths of 3-5 m. The geographical position of each transect line was determined by GPS. Every coral under the transect line was noted of its presence per mark, starting from mark 1,2,3 and so on until the end of the line. Other biota or bottom substrate will be noted as its presence under every marked of the line. Coral covers were categorized based on the criteria provided by Lagnason *et al* (2015) as shown in Table 1.

Biodiversity measurements

Biodiversity index is a quantitative measure that reveals the totality of the different individual species seen on the area of interest. The following categories were determined in the study: Abundance, Dominance, Evenness and Shannon's Diversity Index. In measuring the biodiversity indices, the PAST software (Hammer, Ø. *et al*, 2001) was used. Abundance refers to the overall total of individual species present. Evenness implies how even the distribution of the individual species among the different species within the plots. Species diversity is described according to the Shannon Index (H) as per the following equations:

$$H = -\sum_{i=1}^{S}(p_i \times \ln p_i) = -\sum_{i=1}^{S}(\frac{n_i}{N} \times \ln \frac{n_i}{N})$$

In this formula, S is the total number of species, N is the total number of individuals, and n_i is the number of individuals of the i-the species. n-i/N is equivalent to pi, the probability of finding the i-th species (Magurran, 2004).

Data gathering

Coral colony under the transect, other biota and/or other substrate under the transect line was noted of its presence per mark using an A4 size white

clipboard. The number of mark underneath it is the colony of hard coral or other biota or substrate, each should be grouped and counted as percent cover.

Data analysis

Simple tools were utilized in data interpretation. Data were presented in simple graphs, percentages, and tables to determine the percentage cover of the area surveyed.

$$Percent\ Cover = \frac{no.of\ each\ component}{200\ (component\ total)}\ x\ 100$$

Results and discussion

Results show that the pH value of the sampling area was at 8.1 which is normal (pH 8.2). Water temperature is about 30 °C and atmospheric temperature is about 34 °C. Furthermore, salinity reading is at 35 ppt. The depth of water from the shoreline to the reef areas is about 0-15 ft (Table 2).

The study was conducted in a very sunny day and the waters were clear that's why the corals were very visible. The obtained results in the physico-chemical sampling were within the optimum growth of coral reefs as illustrated in Table 2 based on the DENR (1990) standards.

Table 1. Criteria for lifeform cover.

Status	Cover
Excellent	75 – 100 % coral cover
Good	50 – 74.9 % coral cover
Fair	25 – 49.9 % coral cover
Poor	< 25 % coral cover

Table 2. Physico-chemical results in Morales Beach, Glan, Sarangani Province.

Parameters	Morales Beach	DENR (1990) Standards (Class SA)
pH	8.1	6.5 – 8.5
Temperature	30 °C	Max. rise of 3 °C
Salinity	35 ppt	Not stated
Visibility	Very clear	Not stated

The fringing reef of Morales Beach has an average of 15 % hard corals and 0 % soft corals as depicted in Table 3, which therefore exhibited a poor coral cover based on the criteria provided by Lagnason *et al.* (2015) as shown in Table 1. The transects are located inside the MPA of the sampling site wherein it is constantly disturbed with human activities. The live hard coral cover poorly exhibited by the area is about 11 percent for Transect 1, 22.5 percent for Transect 2, and 11.5 percent for Transect 3 which is composed of *Acropora, Astreopora*, *Symphillia, Turbinaria, Montastrea, Echinopora*, and *Porites* coral genera. Coral growth formation varies from table *Acropora*, encrusting, branching, massive and submassive formation. Among the culprit of the declining coral cover is human exploitation, sedimentation, and the sewage waste from fish cages bringing inorganic nutrients, than severely impair coral growth and reproduction (Wear and Thurber, 2015).

Biodiversity

The average abundance was 9.352 individuals. The dominance of 0.2501 may imply that the probability of two individuals may belong to the same species category is low. On the other hand, the result for Shannon's diversity was high. Evenness (0.7462) was relatively high suggesting that throughout the area distribution of corals was uniform (Table 4).

In this study, we have rapidly assessed the coral conditions in Morales Beach, Benoni, Glan, Sarangani Province. It is better to assess coral conditions

through constant monitoring. Monitoring is the gathering of data and information on coral reef ecosystems or on those people who use coral reef resources. Monitoring should be repeated on a regular basis, preferably over an extended period of time. A major goal of a coral reef monitoring program is to provide the data to support effective management. As more Marine Protected Areas (MPAs) are established, it is becoming increasingly important to monitor whether they are achieving their management goals (Hill *et al.*, 2004).

Table 3. Percentage cover of the lifeforms found in Morales Beach, Glan, Sarangani Province.

Lifeform Category	Transect 1	Transect 2	Transect 3	Average Percent Cover
Hard Corals (HC)	11 %	22.5 %	11.5 %	15 %
Soft Corals (SC)	0 %	0 %	0 %	0 %
Dead Corals (DC)	14.5 %	20.5 %	15.5 %	16.83 %
Dead Corals with Algae (DCA)	3 %	15.5 %	14.5 %	11 %
Other Organisms (OT)	24 %	4 %	11 %	13 %
Algal Assemblage (AA)	1.5 %	15.5 %	15.5 %	10.83 %
Plants	44.5 %	2 %	2.5 %	16.33 %
Abiotic	7.5 %	20 %	26 %	17.83 %

Table 4. Mean Diversity Indices of Corals in Morales Beach, Glan, Sarangani Province.

	Abundance	Dominance	Evenness	Shannon's Diversity
Mean Attributes	9.352	0.2501	0.7462	1.653

In comparison to nearby coastal area showed a marked difference with regards to coral health and biodiversity. The Kawas Marine Sanctuary in Alabel, Sarangani Province, Philippines exhibited a fair to excellent coral cover, with Live Hard Coral (LHC) Cover of 53% (Lagnason *et al.*, 2015).

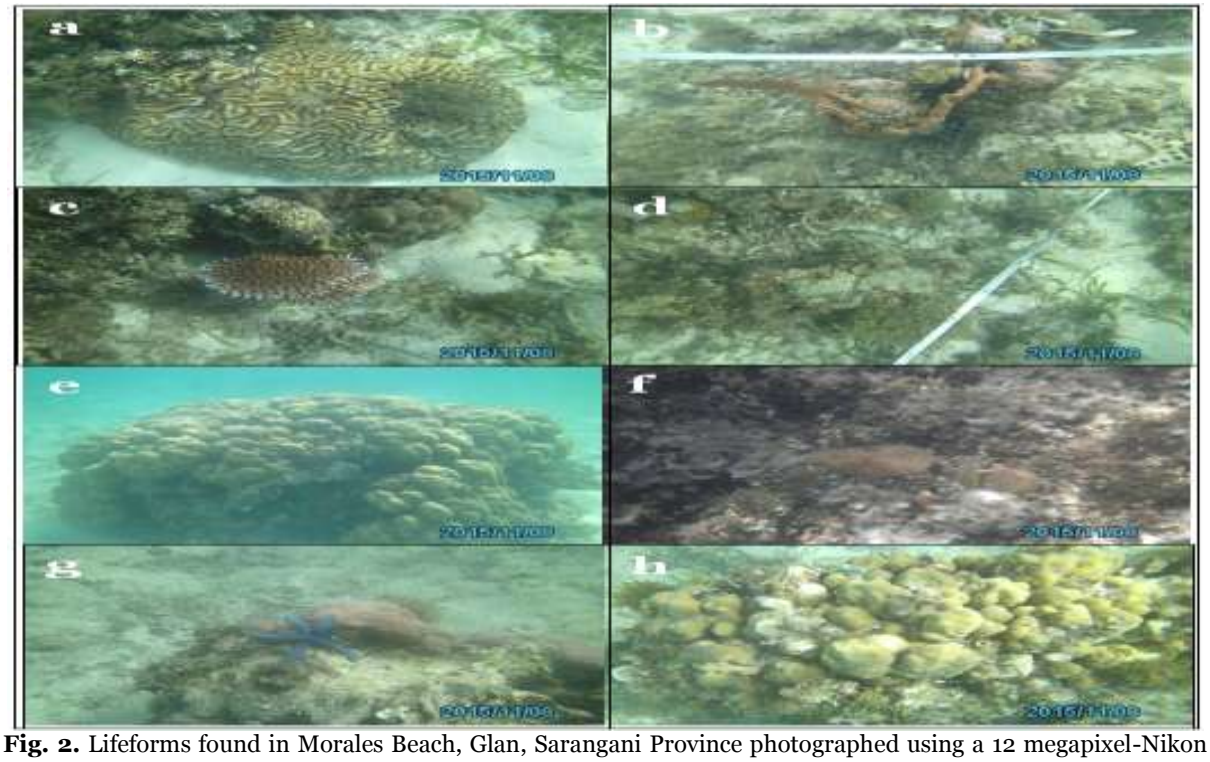

Fig. 2. Lifeforms found in Morales Beach, Glan, Sarangani Province photographed using a 12 megapixel-Nikon Waterproof Camera. (a) *Faviidae* or Brain Coral, (b) *Acropora submassive*, (c) *Acropora digitate,* (d) *Coral encrusting*, (e) *Coral massive*, (f) *Mushroom Coral*, (g) *Other organisms*, (h) *Coral massive.*

The Philippines report contains an update on time-series data of over 50 coral reef sites along the length of the archipelago, most of which started in the 1990s. In the Philippine Sea, hard coral cover is decreasing and reef fish abundance is stable to decreasing. Hard coral and reef fish abundance trends are variable across sites in the Sulu Sea. In the Celebes Sea, hard coral cover increased at 21% of sites, but decreased at another 33% of sites. There was no clear trend for the remaining 46% (although these tended to decline) (Chuo *et al.*, 2002).

On the other hand, Palau has the most diverse coral fauna of Micronesia and the archipelago's coral diversity is comparable to the highest coral diversity areas of the Philippines, Indonesia and Australia. But during the El Niño event in 1997-1998, approximately one-third of Palau's corals died, with coral mortality as high as 90% in some areas. Spot check results shows that 87% of the sites surveyed had low *Acropora* cover in the range of 0-5%. 68% of the sites surveyed had coral other than *Acropora* covering less than 25%. Overall, percent coral cover was generally low to moderate; only 1% of spot check sites had *Acropora* cover greater than 50% and only 9% of the sites had non-*Acropora* coral cover greater than 50%. (Gulbuu *et al.*, 2004).

Conclusion

Based on the data gathered, Morales beach exhibited a poor coral cover with 15 percent live hard coral cover, based on the criteria provided by Lagnason *et al* (2015). The physico-chemical parameters which include pH of 8.1, temperature of 30 degrees Celsius, salinity of 35 ppt, depth at 0-15 ft, and a very clear visibility are within the range to provide optimum growth and survival for the resources. In this study, we have done a rapid assessment of the corals in Morales Beach, Benoni, Glan, Sarangani Province. It is also recommended to conduct a constant monitoring to manage and protect Marine Protected Areas (MPA).

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