INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 18, No. 6, p. 1-7, 2021
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Status of scleractinian corals and reef-associated benthos in Tres Marias Islets, Northwest Leyte, Eastern Philippines

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Article published on June 02, 2021

Key words: Hard corals, Generic diversity, Taxonomic agglomeration units, EDGE species, Palompon

Abstract

Coral reefs of the Tres Marias Islets provide habitat for diverse marine organisms and significantly contribute to the economic activities in Northwest Leyte, Eastern Philippines. Unfortunately, no comprehensive and detailed study was conducted to determine the status of the hard coral and the reef-associated benthic resources in Tres Marias Islets, particularly, Tabuk Islet being a marine protected area. Baseline coral resources assessment was done in randomly identified stations in the Tres Marias Islets. The modified Reef Check methodology was used to determine the percentage covers and generic diversity based on the Taxonomic Agglomeration Units (TAUs). Tabuk Islet had the highest hard coral cover and generic diversity than the other two Islets. Four Evolutionary Distinct and Globally Endangered (EDGE) hard coral species were recorded in Tres Marias Islets. Furthermore, a coral bleaching event was observed in the area and reported officially in this study. The findings of this study highlight the effectiveness of the establishment of a marine protected area in the growth and recruitment of reef-building corals.

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Introduction

Statuses of coral reefs in the country were assessed over the years (Gomez *et al.,* 1981; Gomez *et al.,* 1994; Licuanan and Gomez, 2000; Licuanan *et al.,* 2017; Licuanan *et al.,* 2019). Results of these assessments revealed significant loss of scleractinian coral cover in the country affecting the ecosystem services it provides (Licuanan *et al.,* 2019). Coral reefs provides significant environmental and economic contributions in the country which accounts a total of US $ 352,249.00/ha/year (Azanza *et al.,* 2017). Unfortunately, reef-building corals are continuously declining due to competition for resources caused by unprecedented rise of population, and global stressors (Hughes *et al.,* 2017).

Management strategies like establishment of Marine Protected Areas (MPA) were launched. This approach provides enough time for reef-building corals to grow into bigger sizes, thus improving the coral cover (Edgar *et al.,* 2014). Moreover, the reef-associated organisms will replenish their stocks through the reduction of pressures and stressors (Groves & Game, 2016). Protections imposed in the MPAs are helpful in achieving its primal objective for the sustainability of marine resources (Sale *et al.,* 2015).

In Palompon, Leyte, one of the islets in Tres Marias Islets, Tabuk Islet, was declared a marine protected area since 1996. This declaration was executed in response to the declining fishery stocks brought by unsustainable and illegal fishing practices done in the area. However, no comprehensive and detailed assessments were done to check the improvement of coral cover, biodiversity, and fishery stocks in Tres Marias Islets, particularly in Tabuk Islet. Studies conducted in Palompon, Leyte focused on the siganid fishery (Paraboles and Campos, 2018) and fish corral industry (Cabansag *et al.,* 2011). Hence, effectiveness of conservation and protection could not be determined without data from monitoring activities.

Thus, the establishment of baseline data on the status of coral and other associated benthic resources in the Tres Marias Islets needs to be undertaken for future comparison to determine effectiveness, improvement of hard coral cover, and biodiversity and address sustainability of reef-associated stocks.

Materials and methods

Study Areas

Tres Marias Islets (which comprises Tabuk Islet, Gumalac Islet, and Cabgan Islet) can be found adjacent to the Leyte Island (Fig. 1). These groups of islets are mangrove islets harboring diverse marine organisms and serve as resting, feeding, and breeding areas for pelagic and reef marine species. The reef in Tabuk Islet is considered to be well-developed reef with more than 200m reef flat and well-defined reef crest and upper reef slope where the coral reef surveys are conducted following the protocols of Licuanan *et al.* (2019). However, the coral reef in Gumalac Islet is a barrier reef with a deep lagoon separating the reef flat from the fore reef. Furthermore, Cabgan Islet has an incipient reef (van Woesik and Done, 1997) with remaining patchy coral colonies dominated by massive corals.

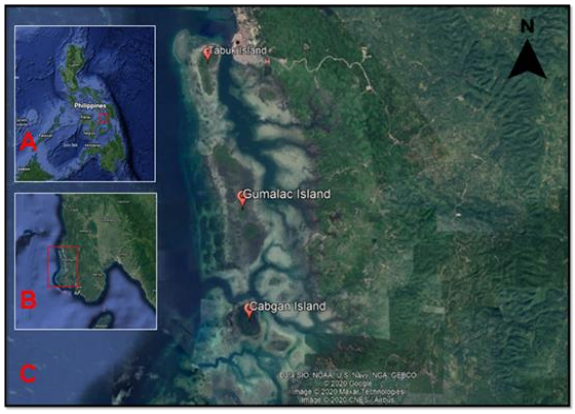

Fig. 1. Map showing the location of Tres Marias Islets (Map of the Philippines (A), showing the location of Palompon, Leyte (B), surveyed Islets (C) (Source map: Google Earth Pro, 2020).

Data Collection and Analyses

A total of eight stations were surveyed in this study: three (3) stations were established in Tabuk and Gumalac Islets while two (2) stations in Cabgan Islet. The field sampling was done using the modified Reef Check methodology in the randomly identified survey stations. In each station, two 50-m transect lines were laid in the upper reef slope, following topographic contours at 5-m tide corrected depth.

A total of 201 points were gathered at 0.25m interval, starting from 0m of the transect line. The substratum directly under each point was identified using the Taxonomic Agglomeration Units (TAUs). The study applied a one-of-kind methodology that was adopted for the first time, where the Reef Check method was supplemented with TAUs to provide more details on the taxonomic composition of hard corals.

Percentage cover of the coral colonies and associated benthos as well as the generic diversity were computed from the data gathered. The revised scheme based on Licuanan *et al.* (2019) was utilized to describe the status of the hard coral cover and generic diversity (Table 1).

Table 1. Categories for hard corals.

Parameter	Measure	Category
	% hard coral	
	> 44% HCC	HCC Category A
Coral cover	> 33-44% HCC	HCC Category B
	> 22-33% HCC	HCC Category C
	0-22% HCC	HCC Category D
	> 26 coral TAUS	Diversity Category A
Generic	> 22-26 coral TAUS	Diversity Category B
Diversity	> 18-22 coral TAUS	Diversity Category C
	0-18 coral TAUS	Diversity Category D

Results and discussion

Hard Coral Cover

The overall hard coral cover in Tres Marias was 31.14% which belongs to Hard Coral Coral (HCC) category C (Licuanan *et al.,* 2019). Among the three islets, Tabuk Islet has the highest mean HCC with 51.82% which belongs to HCC Category A (Fig. 2). Gumalac Islet has 25.04% HCC which falls under HCC Category C while Cabgan Islet has the lowest HCC with only 16.54% which belongs to HCC category D.

Among the stations, Tabuk Islet's station 1 has the highest HCC. This station is known as a diving and snorkeling site. The high cover and rich diversity of hard corals in this station provides habitat to different reef fish and macroinvertebrates. However, coral colonies are prone to boat damages as it is next to the channel where commercial boats and roro pass by.

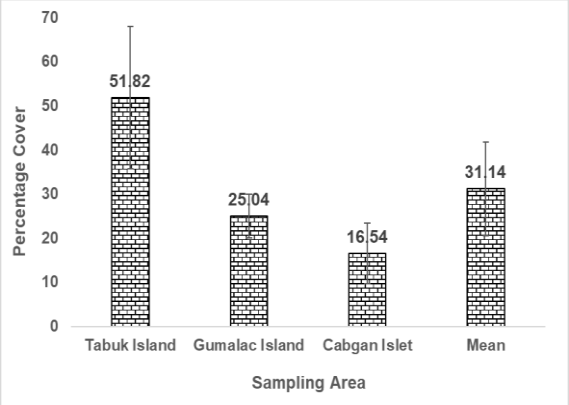

Fig. 2. Percentage covers of the hard coral resources in Tres Marias, Northwest Leyte. Data were analyzed using the mean ± SEM.

The hard coral cover in Tres Marias was mostly attributed through the different lifeform of the genus *Porites* which is known to tolerate environmental stressors, not prone to physical stress (Guest *et al.*, 2016) and to dominate in degraded reefs (Licuanan *et al.*, 2019). Other stress tolerant genera like *Diploastrea, Favia, Favites,* and *Cyphastrea* were also recorded with low percentage covers. Hard corals under the stress-sensitive genus *Acropora* were observed with poor percentage covers. Unfortunately, most of the coral colonies in the sampling sites were dead (particularly in Gumalac Islet and Cabgan Islet), affecting the reef structure, which led to the loss of structural complexity and reduction of biodiversity (Graham and Nash, 2012).

Octocorals *Heliopora coerulea* and *Tubipora musica* were also recorded in the sampling stations. Gumalac Islet has the highest cover of *H. coerulea*. High percentage cover of this species in a coral reef could imply that reef is degraded with changes in seawater chemistry (Guzman *et al.,* 2018).

Despite the low mean hard coral cover and no significant differences, results could suggest how effective the protection and strong management imposed in Tabuk Islet. Reefs in this islet continue to grow as they were spared from further anthropogenic damages and pressures. Thus, same protection should also be applied to some coral reef areas in Gumalac and Cabgan Islets to provide enough time for recovery.

Other Reef Associated Benthos

Table 2 shows the mean percentage covers of the other reef-associated benthos as well as the corresponding overall mean cover computed for Tres Marias Islets.

Turf algae which cover dead coral colonies have 19.33% mean cover. Gumalac Islet has the highest mean cover with 27.11% followed by Tabuk Islet with 25.79%. As observed, Cabgan Islet has the lowest mean cover with only 5.10% knowing that dead coral colonies in this area have been dominated mostly by macroalgae. The high turf algal cover is typical of a degrading reef as they quickly dominate the available space that was left by coral colonies (Littler *et al,* 2006). However, these algal assemblages were considered possible settlements for coral juveniles (Licuanan *et al*., 2019).

Table 2. Summary of the percentage covers of the other benthos in Tres Marias Islets, Northwest Leyte.

Category	Sampling Sites			Mean
	Tabuk Islet	Gumalac Islet	Cabgan Islet	
Algal Assemblage	25.7877	27.1144	5.0995	19.33
Dead Coral with Algae	1.0779	1.0779	0.0000	0.72
Macroalgae	0.5804	28.9386	47.7612	25.76
Rubble	2.1559	4.8093	15.0498	7.34
Sand	15.4229	11.8574	14.4279	13.90
Other Biota	1.8242	0.6633	1.2438	1.24

Macroalgae have higher mean percentage cover with 25.76%. Cabgan Islet has the highest cover of macroalgae with 47.76% followed by Gumalac Islet with 28.94%. Tabuk has the lowest cover with only 0.58%. Most of the macroalgae which thrived and dominated in Gumalac Islet and Cabgan Islet were brown algae belonging to the genera *Sargassum* spp., *Dictyota* spp., *Padina* spp. and red algae, *Actinotrichia* spp.

High percentage cover in Cabgan Islet could denote shift from coral dominance to macroalgal dominance which has been documented in other areas in the Indo-Pacific (Ward-Paige *et al.,* 2015). Aside from the decline of hard corals, influx of nutrients coming from nearby rivers and mangrove area in the Cabgan Islet influenced the preponderance of macroalgae.

Abiotic factors like sand and rubble have considerably higher mean percentage covers in Tres Marias. Sand has 13.90% mean cover where Tabuk Islet has the highest cover with 15.42% followed by Cabgan Islet with 14.43% and Gumalac Islet with 11.86%. Sand accretion in the reef can be attributed to the mangrove forests and river systems near the area, though Gumalac Islet is less affected knowing its orientation as a barrier reef. This sand accretion can affect water turbidity (Flower *et al.,* 2016) which limits the light penetration essential for coral growth and photosynthesis of its symbiotic algae. Sediments tend to smother corals and other resources which coral juvenile could not grow bigger.

Furthermore, coral rubble has 7.34% overall mean cover. Cabgan Islet has the highest mean cover with 15.05%, knowing the area as an open fishing ground, coral colonies were exposed to different anthropogenic damages. Also, it was observed during the sampling that these coral rubbles were fragments of branching coral colonies. Gumalac and Tabuk Islets have 4.81% and 2.16% coral rubble cover, respectively. Associated benthos composed of heterotrophic filter-feeding sponges, sea anemones, crinoids and grazing sea cucumbers constitutes a mean percentage cover of 1.24%, coralline algae with 0.14 and soft corals with 0.48%.

Coral Generic Diversity

Coral generic diversity has an average of 23.9 coral TAUs which falls under Diversity Category B (based on the diversity scheme proposed by Licuanan *et al.,* (2019) (Table 3). Tabuk Islet has the highest diversity with 27.7 mean coral TAUs which is categorized under Diversity Category A followed by Gumalac Islet with 24.0 mean coral TAUs which falls under Diversity Category B. Cabgan Islet has the lowest generic diversity with only 20.0 mean coral TAUs recorded which belongs to Diversity Category C.

Among the stations, station 1 in Tabuk Islet has the highest generic diversity with 36 coral TAUs recorded, the same station with the highest hard coral cover.

It can be expected for Tabuk Islet to have high generic diversity knowing that it was established as a marine protected area for 23 years. These could suggest that the protection is implemented in the MPA positively affects coral recruitment, which will gradually improve the coral cover through time.

Table 3. Summary of the generic diversities in Tres Marias Islets, Northwest Leyte.

Sampling Site	Sampling Stations			
	Station 1	Station 2	Station 3	Mean
Tabuk Islet	36	19	28	27.7
Gumalac Islet	27	26	19	24.0
Cabgan Islet	27	13	-	20.0
Mean Generic Diversity				23.9

Endangered Coral Species

Four (4) coral species listed in the International Union for Conservation of Nature (IUCN) Red List and Zoological Society of London (ZSL) Evolutionary Distinct and Globally Endangered (EDGE) were recorded, namely: *Turbinaria peltata*, *Pachyseris rugosa*, *Fimbriaphyllia ancora*, and *Heliofungia actiniformis* (Fig. 3A-D).

The presence of these EDGE hard coral species can be used as basis in the creation of conservation policies as part of conservation plans of stakeholders (Crabbe, 2016), mainly, in local areas which they existed before they lead to extinction which could significantly impact biodiversity in the marine environment.

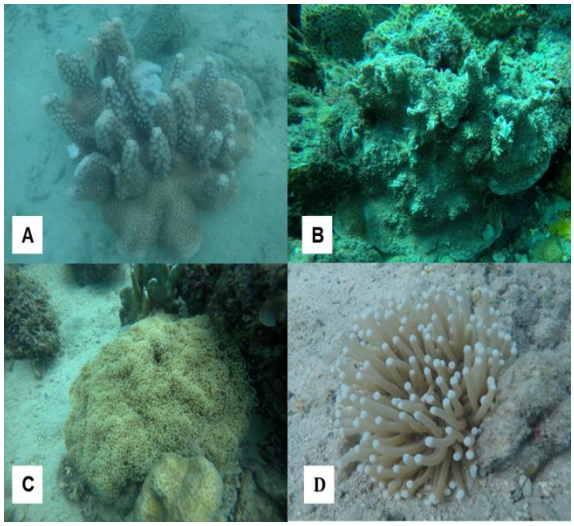

Fig. 3. Colony shots of the EDGE hard coral species: *Turbinaria peltata* (A); *Pachyseris rugosa* (B); *Fimbriaphyllia ancora* (C); and *Heliofungia actinoformis* (D).

Bleached Coral Colonies

Coral bleaching has been observed in Tres Marias which is the first to have been officially recorded. Partially and completely bleached corals were apparent in all stations. Most of the colonies showing signs of bleaching belong to the following genera: *Acropora, Astreopora, Pocillopora,* and surprisingly, *Porites* (Fig. 4A-C), when as mentioned earlier, the species belonging to this genus are known to adapt to wide variety of stressors. Also, the soft coral, *Lobophytum spp*., was observed to be partially bleached (Fig. 4D).

Coral bleaching usually happens when coral polyps eject their endosymbiotic algae that reside within their tissues as a stress response. The coral bleaching recorded in sampling areas was associated with the warming of the seawater brought by climate change. The National Oceanic and Atmospheric Administration (NOAA) issued a warning through their real-time satellite seawater temperature that coral colonies would likely to bleach in the coastal waters of Northwest Leyte. With the use of thermometer, the recorded average seawater surface temperature in Tres Marias Islets was 33.5°C while the underwater temperature was 32.2°C. According to Cesar *et al.* (2014) these temperatures can potentially induce stress to coral colonies which could lead to bleaching.

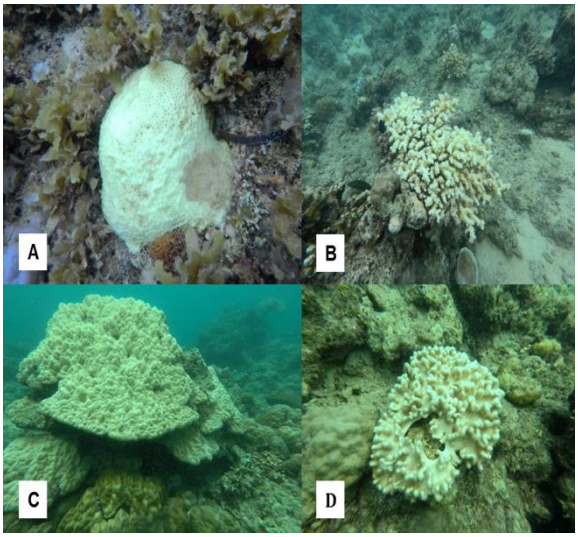

Fig. 4. Colony shots of the bleached corals recorded in the sampling sites: *Astreopora* (A); *Pocillopora* (B); *Porites* (C); and *Lobophytum* (D).

Conclusions

This study revealed the status of hard coral in Tres Marias Islets using the modified Reef Check method supplemented for the first time with the Taxonomic Agglomeration Units. The mean hard coral cover belongs to HCC Category C while the generic diversity falls under Diversity Category B. Tabuk Islet as a protected area had the highest hard coral cover and generic diversity, which implies strong protection and management, is implemented.

Presence of evolutionary distinct and globally endangered hard coral species was also recorded. Bleaching was also apparent in some coral colonies in the sampling areas. The findings of this baseline assessment can be utilized for future reassessment and monitoring activities to detect changes in the temporal status of hard corals in Tres Marias Islets to formulate appropriate management and conservation strategies especially with the presence of endangered hard corals species.

Acknowledgement

This research study was accomplished under the efforts of the Palompon Institute of Technology – Research Services Office led by Dr. Roel I. Sabang, in close collaboration and cooperation with the Local Government of Palompon, Leyte thru the Municipal Environment and Eco-Tourism Office (MEETO) with the assistance of the Bantay Dagat especially Mr. Eduardo S. Quiamco. Logistics support of the City Government of Ormoc thru the City Fisheries Office is also acknowledged.

References

Azanza RV, Aliño PM, Cabral RB, Junio-Meñez MA, Pernia, EM, Mendoza RU, Siriban CS. 2017. Valuing and Managing the Philippines' Marine Resources toward a Prosperous Ocean-Based Blue Economy. Public Policy (Philippines) **18,** 1-26.

Cabansag JBP, Tuazon AKRT, Paraboles LC. 2011. Fish Corral Composition, Abundance and Distribution in the Reef Flat of Palompon, Leyte, Philippines. Annals of Tropical Research **33,** 62-84.

Cesar SA, Amoin NB, De Dios HHY, Dy DT. 2014. Thermal stress affects zooxanthellae density and chlorophyll-a concentration of the solitary mushroom coral, *Heliofungia actiniformis*. Philippine Journal of Science **143,** 35-42.

Crabbe MJC. 2016. Coral at the EDGE of Existence. Journal of Marine Science: Research and Development **6,** e143.

Edgar GJ, Stuart-Smith RD, Willis TJ, Kininmonth S, Baker SC, Banks S, Barrett NS, Becerro MA, Bernard ATF, Berkhout J, Buxton CD, Campbell SJ, Cooper AT, Davey, M, Edgar SC, Försterra G, Galvan DE, Irigoyen AJ, Kushner DJ, Moura R, Parnell PE, Shears NT, Soler G, Strain EMA, Thomson RJ. 2014. Global Conservation outcomes depend on marine protected areas with five key features. Nature **506,** 216-220.

Flower J, Ortiz JC, Cholett I, Abdullah S, Castro-Sanguino C, Hock K, Lam V, Mumby PJ. 2016. Interpreting coral reef monitoring data: A guide for improved management decision. Ecological Indicator **72,** 848-869.

Gomez ED, Alcala AC, San Diego AC. 1981. Status of Philippine Coral Reefs – 1981. Proceedings of the Fourth International Coral Reef Symposium; 1981; Manila. **1,** 275-282.

Gomez ED, Aliño PM, Yap HT, Licuanan WY. 1994. A review of the status of Philippine reefs. Marine Pollution Bulletin **29,** 62-68

Graham NAJ, Nash KL. 2012. The importance of structural complexity in coral reef ecosystems. Coral Reefs **32,** 315-326.

Groves CR, Game ET. 2016. Conservation planning: Informed decisions for a healthier planet. Greenwood Village, Colorado: Roberts and Company Publishers.

Guest JR, Low J, Tun K, Wilson B, Ng C, Raingeard D, Ulstrup KE, Tanzil JTI, Todd PA, Toh TC, McDougald D, Chous LM, Steinberg PD. 2016. Coral community response to bleaching on a highly disturbed reef. Science Reports **6,** e20717.

Guzman C, Shinzato C, Lu T, Conaco C. 2018. Transcriptome analysis of the reef-building octocoral, *Heliopora coerulea*. Science Reports **8,** 8397.

Hughes TP, Barnes ML, Bellwood DR, Cinner JE, Cumming GS, Jackson JB, Kleypas J, van de Leemput IA, Lough JM, Morrison TH, Palumbi SR, van Nes EH, Scheff M. 2017. Coral reefs in the Anthropocene. Nature **546,** 82-90.

Licuanan AM, Reyes MZ, Luzon, KS, Chan MAA, Licuanan, WY. 2017. Initial findings of the nationwide assessment of Philippine coral reefs. Philippine Journal of Science **146,** 177-185.

Licuanan WY, Gomez ED. 2000. Philippine coral reefs: status and the role of the academe to improve their management. Proceedings 9th International Coral Reef Symposium; October 23-27, 2000. Bali, Indonesia.

Licuanan WY, Robles R, Reyes M. 2019. Status and recent trends in coral reefs of the Philippines. Marine Pollution Bulletin **142,** 554-550.

Littler MM, Littler DS, Brooks BL. 2006. Harmful algae on tropical coral reefs: bottom-up eutrophication and top-down herbivory. Harmful Algae 5:565-585 Sale, P.F. *et al.* 2005. Critical science gaps impede use of no-take fishery reserves. Trends in Biology & Evolution **20,** 74-80.

Paraboles LC, Campos WL. 2018. Fecundity and Oocyte Development of the White-spotted Rabbitfish *Siganus canaliculatus* (Park, 1797) in Palompon, Leyte, Eastern Visayas, Philippines. Asian Fisheries Science **31,** 245-251

Sale PF, Cowen RK, Danilowicz BS, Jones GP, Kritzer JP, Lindeman KC, Planes S, Polunin NVC, Russ GR, Sadovy YJ, Steneck RS. 2005. Critical science gaps impede use of no-take fishery reserves. Trends in Biology & Evolution **20,** 74-80

Van Woesik R, Done TJ. 1997. Coral communities and reef growth in the southern Great Barrier Reef. Coral Reefs **16,** 103-115.

Ward-Paige CA, Risk MJ, Sherwood OA, Jaap WC. 2015. Clinoid sponge surveys on the Florida Reef Tract suggest land-based nutrient inputs. Marine Pollution Bulletin **51,** 570-579.