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Baseline information of the benthic macroinvertebrates in the Tinabilan Marine Protected Area, Northwest Leyte as Bioindicators of Reef Health

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Abstract

Marine Protected Areas (MPAs) are established as a management strategy to protect plants and animals in the marine environment, particularly, coral reefs. Coral reefs primary inhabitants are composed of benthic macroinvertebrates which does not only provide huge economic impact to the community but act as bioindicators of reef health. In Tinabilan MPA, Northwest Leyte, no comprehensive and detailed study was conducted to determine the status of benthic macroinvertebrates in the newly-established MPA. Baseline reef macroinvertebrate assessment was done in identified permanent stations in the coral reef areas in the inside and outside portions of the MPA. The modified Reef Check methodology was used to determine the status, taxonomic composition and diversity of macroinvertebrates. Results showed that the reef macrobenthic invertebrates were in poor status dominated by several species of demosponges, asteroids, crinoids, and mollusks. The endangered gastropod species, *Trochus niloticus*, was recorded with several specimens in the area. The results of this study showed that strict implementation of protection and conservation should be imposed to improve the biodiversity and sustain the ecological balance in the coral reef ecosystem.

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Introduction

Benthic macroinvertebrates constitute to around 90 percent of species inhabiting in coral reef areas (Allen *et al.,* 2017). They contribute essential economic services as they provide food and livelihood to the communities nearby (Ibrahim *et al.,* 2006). Likewise, they provide wide array of ecosystem services as they are key components to reef structure and biodiversity and each species has its own role in maintaining ecological balance in the reef (Enochs and Hockensmith 2008; Przeslawski *et al.* 2008). Furthermore, presence of specific benthic macroinvertebrates could portray the health status of the coral reefs (Hopkins, 2009). Unfortunately, despite the massive ecological and economic importance of benthic macroinvertebrates, some species are facing the threat of extinction and their status are continuously declining due to natural events and anthropogenic activities that disrupts the balance of ecosystem (Tuang-tuang *et al.,* 2018; Kumar *et al.,* 2013).

With this, Marine Protected Areas (MPA) were established to protect and maintain the coral reef resources (Edgar *et al.,* 2014). In this milieu, coral reefs and associated benthic macroinvertebrates were given enough time to replenish their stocks and improve their status and ecological condition (Groves & Game, 2016). The reduction of human pressure and other stressors significantly contribute to sustainability and food security of marine resources (Sale *et al.,* 2005).

In Tinabilan, Palompon, Leyte, the Tinabilan MPA was recently established to primarily protect, conserve, and manage the mangrove forests, seagrass meadows, coral reefs and their associated organisms which includes benthic macroinvertebrates. Unfortunately, no baseline assessment was performed on the status of the benthic macroinvertebrates after the establishment of the MPA. Data on the baseline information is crucial for monitoring activities to establish the temporal change in their status and to determine the effectiveness of the management strategy being imposed. Hence, baseline assessment on the benthic macroinvertebrates should be performed in order to undertake comparison on the status and biodiversity through time and determine the effectiveness of the management strategy being imposed.

Materials and methods

Study Site

Tinabilan Marine Protected Area is located in Barangay Tinabilan, Palompon, Leyte. It is one of the coastal barangays in the northern part of the municipality. The permanent coral reef stations assessed by Tuang-tuang (in prep.) in 2021 were used for this assessment. There were four (4) stations sampled in this study: two (2) stations inside and two (2) stations outside the MPA (see Fig. 1).

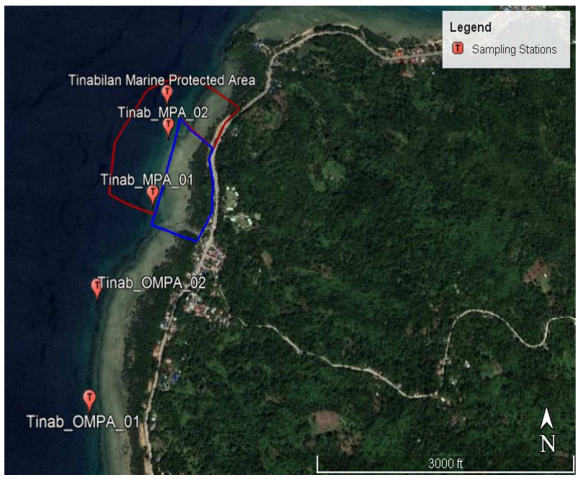

Fig. 1. Map showing the location of the sampling stations in Tinabilan Marine Protected Area, Palompon, Leyte.

Data Collection

The field sampling utilized the modified Reef Check methodology in the identified permanent stations. In each station, three (3) 50-m transect tapes were laid in the upper reef slope, parallel to the shore at a tide-corrected depth of 5m. At each transect, all benthic macroinvertebrates within the 2.5m either side of the transect line while swimming in a U-shaped search pattern were identified *in situ*, counted, and recorded to determine the taxonomic composition, abundance, and diversity.

Species were not able to identify underwater were noted and taken photos for *ex situ* identification. Underwater photographs were taken to support further identification using Canon PowerShot S95 camera.

Data Analysis

Data gathered from the assessment were processed using the appropriate statistical tools. Students t-test was used to determine significant differences between the inside and outside stations of the MPA. Shannon-Weiner diversity index was used to determine the species diversity of the benthic macroinvertebrates in each station.

Results and discussions

Species Composition and Diversity

A total of 30 species of benthic macroinvertebrates belonging to nine (9) taxa were identified in Tinabilan MPA (Table 1). The most abundant taxon was Gastropoda with eight (8) species recorded followed by Demospongiae (5 species), Asteroidea and Crinoidea (4 species), Actiniaria and Bivalvia (3 species), and Corallimorpharia, Echinoidea, and Polychaeta with one (1) representative species. In terms of species richness, there were 19 species recorded inside the MPA while 22 species recorded outside the MPA. Moreover, slightly higher diversity index in the outside station (H'= 2.75) than the inside MPA (H'=2.48). The results of the study might reflect the effectiveness and importance of establishing Marine Protected Areas (MPAs).

Table 1. Species Composition, Richness and Diversity of Reef Macroinvertebrates in Tinabilan Marine Protected Area, Tinabilan, Palompon, Leyte.

Taxon/Species		Inside Station	Outside Station
Actiniaria			
Actinodendron plumosum		-	+
Heteractis crispa		+	+
Heteractis magnifica		+	+
Asteroidea			
Acanthaster planci		+	+
Culcita novaeguineae		+	+
Choriaster granulatus		-	+
Linckia laevigata		+	+
Bivalvia			
Pedum spondyloideum		+	+
Pinctada margaritifera		+	+
Tridacna squamosa		+	-
Crinoidea			
Colobometra perspinosa		+	+
Comanthus parvicirrus		+	
Comaster schlegelii		+	+
Comatella maculata		-	+
Corallimorpharia			
Amplexidiscus fenestrafer		+	-
Demospongiae			
Aaptos chromis		-	+
Axinyssa spp.		+	-
Gelliodes spp.		+	-
Lendenfeldia sp.		+	+
Theonella sp.		-	+
Echnoidea			
Diadema setosum		-	+
Gastropoda			
Cyprea vitellus		-	+
Drupella cornus		+	+
Drupella rugosa		-	+
Lambis millepeda		+	+
Phyllidia pustulosa		+	-
Phyllidia varicosa		-	+
Tectus elatus		-	+
Trochus niloticus		+	-
Polychaeta			
Bispira variegata		-	+
Species Richness		19	22
Species Diversity		2.48	2.75
Total Number of Species Found:	30		

Sampling sites within MPAs have generally higher number of species and number of commercially important species observed as long as the management done by the Local Government Units (LGUs) in these MPAs were strictly followed and observed. Palacio (2011) observed 19 species identified 19 species from the coral reef inside the marine protected area and 10 species outside the MPA of Brgy. Mabini and Higatangan, Naval, Biliran which can suggest recruitment inside the MPA. But looking at the details, there are more species recorded in this study. However, these differences could be brought by the natural characteristic differences in each of the reefs such as the physico-chemical parameters, topography and sediment types.

Density of Macroinvertebrates

The mean macro invertebrate density of the inside station in the Tinabilan Marine Protected Are (MPA) was 186.67 ind/ha while the outside station yielded a slightly lower average density of 151.11 ind/ha (Fig. 2). Macroinvertebrates were abundant inside the MPA due to the protection being implemented. Statistically, there were no significant differences between the two stations.

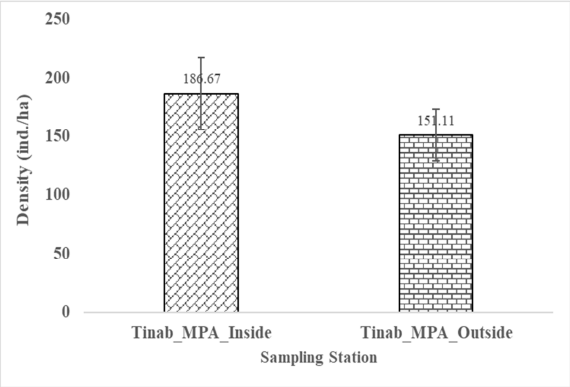

Fig. 2. Mean Density of the Benthic Macroinvertebrates in Tinabilan Marine Protected Area, Palompon, Leyte.

Different species of Demospongiae dominated inside the sanctuary with a mean density of 60.00 ind/ha followed by Actiniaria with 35.56 ind/ha, Bivalvia with 33.33 ind/ha, Asteroidea with 31.11 ind/ha and Crinoidea with 20.00 ind/ha (Fig. 3). Meanwhile, the densest taxon outside the MPA was Asteroidea with 40.00 ind/ha. Other abundant taxa were Gastropoda (26.67 ind/ha), Crinoidea (22.22 ind/ha), Actiniaria (17.78 ind/ha) and Bivalvia (17.78 ind/ha).

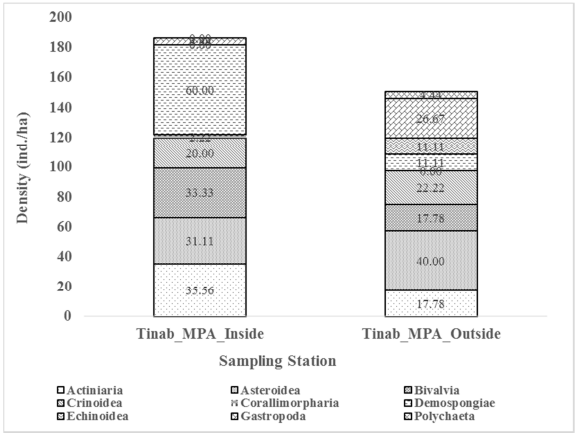

Fig. 3. Mean Density of the Benthic Macroinvertebrate Taxa in Tinabilan Marine Protected Area, Palompon, Leyte.

Demosponges are the most diverse group within the Phylum Porifera constituting more than 75% of identified species of sponges in the marine environment (Alexander, 2015). They are efficient in filtering particulate and dissolved organic matter (DOM), thus contributing to the nutrient cycle (Adams, 2016). It was noted that road widening projects were implemented near the MPA which possibly contributed to the influx of nutrients from the terrestrial environment which might affect the preponderance of sponges in the reef (Tuang-tuang, in prep; Cooper *et al.,* 2009). Moreover, Actiniaria species, *Heteractic crispa* and *H. magnifica,* serve as habitat for anemone fishes like *Amphiprion frenatus, A. clarkii,* and *A. ocellaris*. Also, the protected bivalve species, *Tridacna squamosal* was recorded in the MPA which contributed to the abundance of Bivalves in the MPA. However, the coral boring bivalve, *Pedum spondyloideum*, was the most abundant bivalve species in the MPA. This might be due to the type of coral lifeform present in the area which was dominated by massive *Porites* (Tuangtuang, in prep). Futhermore, the most abundant seastar species was *Linckia laevigata* which is considered to be an indicator of reef recovery (Chong-Seng *et al.,* 2011). In a separate study, the outside station had a higher hard coral cover (HCC) recorded compared to the inside station (Tuang-tuang, in prep).

Likewise, the coral-feeding seastar, *Acanthaster plancii*, were observed to have normal abundance in the MPA. Due to the absence of its natural predator and many underlying causes, this species tend to increase dramatically and can wreak havoc to the coral reefs. Likewise, the distant cousins of asteriods, the crinoids which are suspension feeders that heavily rely on the water current to bring their own food, may support reef recovery as they normally dwell in favorable habitat in which they can capture food (Cooper *et al.,* 2009). In addition, the endangered gastropod, *Trochus niloticus* was observed in the area.

This could mean that despite the denuded condition of the reef, it is still inhabited with endangered species possibly due to undisturbed environment in the MPA. With the continuous protection being implemented in the MPA, improvement on the status of macroinvertebrates, especially the endangered species, might be expected through time. However, anthropogenic activities indirectly introduced within the area should be regulated and minimized to lessen the stressors in the MPA.

Conclusions

This study showed the current status of benthic macroinvertebrates in Tinabilan MPA after a year of its establishment. Although water parameters were not measured, the roadwork activities adjacent to the MPA significantly contributed to the composition, abundance, and diversity of benthic macroinvertebrates. With this, strong protection should be implemented in MPA to improve their status. Moreover, the findings of this study can be used for monitoring activities to know the temporal status of benthic macroinvertebrates in the MPA through time.

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