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RESEARCH

The Quality of Intertidal Sediments and Biodiversity of Macrobenthic Invertebrates

Romil T. Dandan[1(corresponding author)], Renato C. Diocton[2]

[1]Faculty of Fisheries, Eastern Visayas State University, Carigara Campus Carigara Leyte, Philippines (romildandant817@gmail.com)

[2]College of Fisheries and Marine Sciences, Samar State University-Mercedes Campus, Catbalogan City, Philippines

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ABSTRACT

This study describes for the first time the quality of intertidal sediments and biodiversity of macrobenthic invertebrates of Carigara Bay Eastern Visayas, Philippines. The objectives of the study were to describe and assess diversity of macrobenthic invertebrates of exposed sandy muddy beaches of the area. Macrobenthic community was collected using 0.5 m^2 quadrat laid parallel with the transect line across intertidal zone in three identified station. The study showed that macrobenthic invertebrates was dominated by Mollusca 51.41-(*Paphia amabilis, Tellina radiata, Pteria levanti, Nerita planopira, Scapharca sp, Modiolus metcalfe).* Crustacea 14.88 (shrimps, lobster, crabs). Porifera 13.22(sponges). Cnidaria 9.09 *Urticina columbiana.* Annelida 8.26 (polychaetes). Echinodermata 4.13 (sea stars). Sediments structure dominated by very fine (silty, clay) which indicates normal (Kolmogorov-Smirnov). H-test was rejected from three stations computed value is greater than tabulated value. 32.5146 > 5.99, 25.99>5.99, 28.77>5.99. pH average value is 6.51 which in normal range. Organic matter average 0.16 inadequate value. Phosphorus ave. 3.1 inadequate value. Exchangeable potassium 1.04 > adequate value is 0.25 (table 5).

Keywords: Intertidal, Macrobenthic, Biodiversity

INTRODUCTION

One of the smallest spot of the world oceans is the intertidal zone, which are only a few meters between high and low tides. Though this area is very limited, it has the largest variety of environmental factors compared to other ocean Petović et al. (2017)[(1)], Sahidin et al (2018)[(2)]. Sahidin et al. (2018)[(2)] describe intertidal area has a greater variety of lives than those found in larger subtidal regions. Sahidin et al. (2018)[(2)] describe further this area is mostly populated by organisms and has a great diversity both for animals and plants. The intertidal area is a habitat of diverse macrobenthic fauna that structure and earate the bottom by reworking sediments and convert organic materials into minerals substance imported from the adjacent land and the sea[(3)]. It attracts foraging fish and birds in high numbers to this coastal zone. High human activities in utilizing the waters area can lead to the degradation of aquatic environment quality which can affect the ecosystem[(4)]. Benthic communities have often been used in studies of pollution in tropical (Chang *et al*. 1992, Grey *et al*. 1992) but it was poorly documented[(5)]. Community characterization of tropical waters is lacking in general[(6)]. Macrobenthic diversity may therefore indicate the biotic importance of a particular tidal area. Benthic invertebrate's community has significant role in transitional ecosystems, acting as a food source for larger organisms such as fish and filtering phytoplankton, thereby prevent eutrophication[(3)]. Macrobenthic invertebrates found in intertidal sediments mostly are bivalvia and gastropods from phylum mollusca, crustaceans, poriferans, and polychaetas. The purpose of this study is to characterize the intertidal sediments structure and assess biodiversity of macrobenthic invertebrates.

METHODS

The study was conducted at Carigara Bay intertidal zone, Eastern Visayas Philippines. Its approximate location is at Latitude 11° 28"00' N and Longitude 124° 30"00' E (US military intelligence). The Bay has an area of about 512 km^2 with an average depth of 54 meters. The bay's substratum is soft muddy, silty-clay, however, some areas are sandy with coralline rock.

Sample were taken from February to march 2018 (Figure 1). Sampling of macrobenthic invertebrates was done in three stations using 0.5x0.5 m^2 quadrat along with 100 m transect laid across intertidal. Animals found washed and place in a glass jar brought to laboratory put with 10% formaldehyde in seawater for preservation and are identified to the genus level by looking at the morphology of the body, with the help of the identification

book of Water Invertebrates[2],[7] and the writing of the nomenclature following the World Register of Marine Species (WoRMS: http://www.marinespecies.org/index. php).

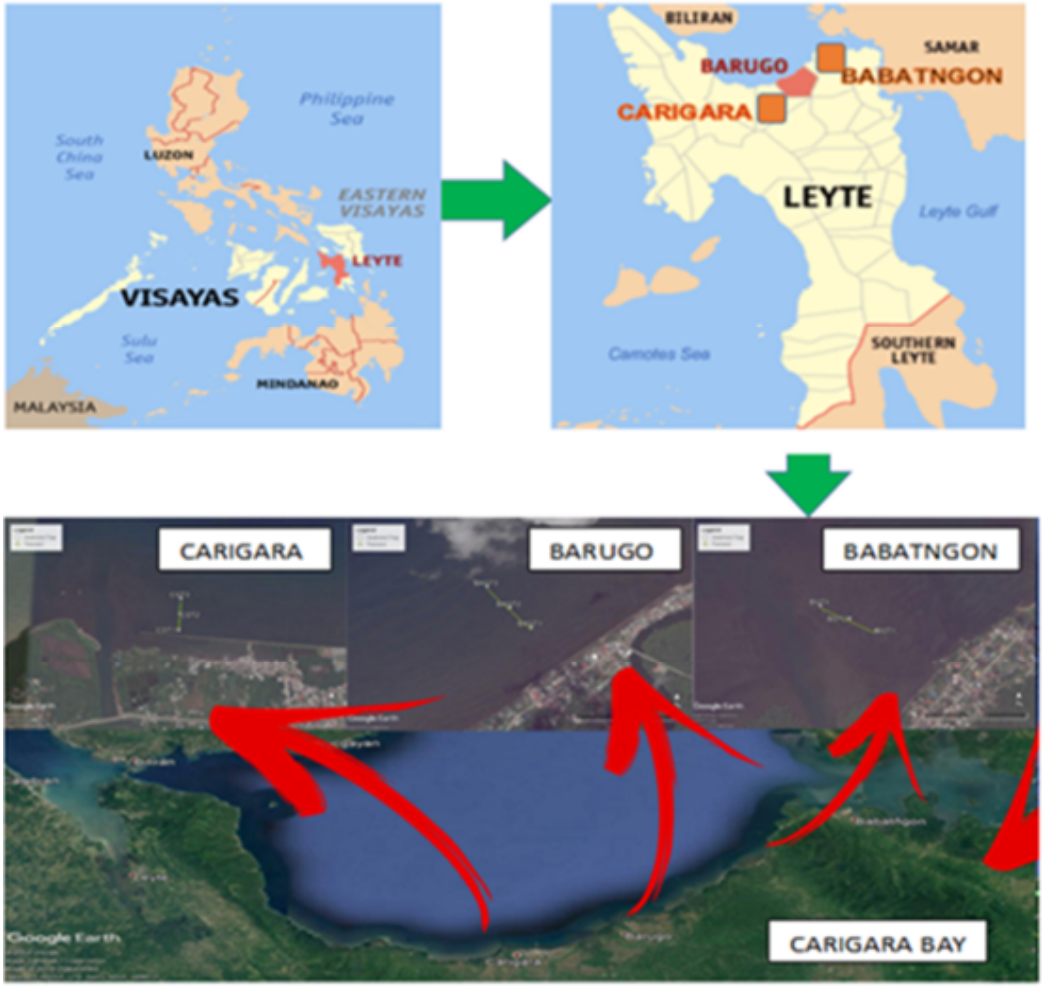

Figure 1. Study Site

Sediment samples collected using 27 pcs. pvc improvised sediment traps 4 inches in diameter six inches in length installed every station 24 hours. Sediments collected placed in plastic vials initial wet weight was done put in 100^{o}c ignite muffle furnace for decalcification after 24 hours sieved with various sieve sizes 0.3mm, 0.2mm, 0.1mm aperture. The percentage composition of a coarse, medium, fine, and very fine was calculated.

Dominance and diversity indices were utilize to determine species richness and compare community invertebrates structures. Diversity index and equality were calculated using Shannon- Wiener (1963)[8]. Sediments grain size classification used Kolmogorov-Smirnov Test. H-test Kruskal Wallis was used.

RESULTS

The general characteristics of intertidal zone of the study area was primarily due to it geological configuration a dynamic bay primarily influence by water masses from Samar Sea Philippines and waters comes from different river system abutting the bay. Surface current was generally demonstrated by Northeast monsoon, (Amihan) that wind stress drive towards the coast. this process was called down welling where surface sea water moves from the nearby coast towards the deeper waters. Via internal waves, during low tide when intertidal

zone exposed to air bottom form small series of undertaking brought about by interned waves during flooding tide until the low tide.

Species Composition

Table 1. Diversity of Macrobenthic Invertebrates in Three Station

Species/Phylum	Site 1	Site 2	Site 3	Total
Annelida	2	6	2	10
Echinodermata	2	2	1	5
Porifera	10	2	4	16
Crustacea	2	7	9	18
Mollusca	15	40	6	61
Cnidaria	3	2	6	11
Total	34	59	28	121

Station one of the study area dominated by poriferans (table 1) it implies that poriferan species thrive most in area which composed of very fine (silty clay) sediments (table 2). Mollusca found abundance in station two (table 1) it suggests that molluscs survived most in area characterized by very fine, coarse and medium sediments (table 2), however, in station three (table 1) was dominated by crustaceans it implies that decapods thrive most in area characterize by medium type of sediments (table 3). On the study conducted by Belal & Ghobashy (2014)[9] polychaetes formed highest density followed by molluscs, crustaceans and echinoderms and porifera which is not consistent with the present study, it implies that macrobenthic invertebrates found abundance depending on the quality of the habitat.

One hundred twenty-one species of macrobenthic invertebrates found on the study area belonging to six phyla. Mollusca 61, crustacea 18, porifera 16, annelida 10, cnidaria 11, and Echinodermata five. Among the species collected from three station molluscan are the most abundance. Shannon Wiener diversity index reveal station three has an index of 1.61 between 1.5<>2.5 which mean medium diversity. Station one and station two has an index of 1.43, 1.09 respectively, less than 1.5 it indicates of low diversity.

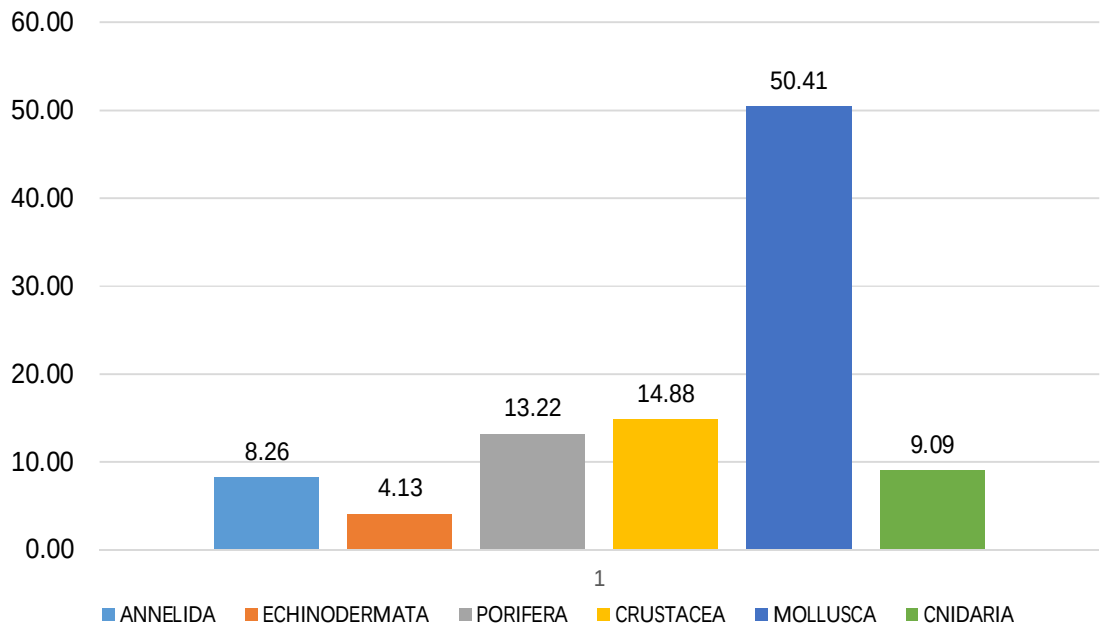

Figure 2. The Abundance of Macobenthic Invertebrates from Each Phyla

Sediment Types in Study Area

Table. 2. Sediment Types of Station 1

Sediment Type	Sieve size (aperture)			Total/g
	0.3mm.wt/g	0.2mm.wt/g	0.1mm.wt/g	
Coarse	2	3	3	8
Medium	0.5	4	4	8.5
Fine	1.6	3	3	7.6
Very Fine	5	6	7.5	18.5
Total (g)	9.1	16	17.5	42.6

Table one showed that station one dominated by very fine sediments. Sediment texture varied with depth. During premonsoon, shallow depths were dominated by very fine sediments (silty clay and clayey silt) Jayaraj et al. (2008)[6]. It implies that sediments in intertidal zone of study area is influence by depth and occurrence of rain regularly. In the study area station one characterized by very fine or silty sediments it perhaps due to influence of prevailing wind (northeast monsoon) and periodic occurrence of rain and water drained from different river system surrounded the area. Moreover, sponges are abundance on this area it may be due to the quality of sediments which poriferan preferred to live.

Table 3. Sediment Types of Station 2

Sediment type	Sieve size (aperture)			Total/g
	0.3mm.wt/g	0.2mm.wt/g	0.1mm.wt/g	
Coarse	4	4	4	12
Medium	3	3	6	12
Fine	0.6	3	4	7.6
Very Fine	6	4	7	17
Total (g)	13.6	14	21	48.6

Table two showed that fine sediments widespread in station two, however coarse and medium sediments are equal and nearly close to the dominant sediments on the area. According to Jayaraj et al. (2008)[6] the middle depth was dominated by medium-grained sediment (silty sand and clayey sand). It implies that station two moderately influence by frequent tidal action that washed sediments. Molluscan are abundance in this area. It implies further that station two intertidal zone is characterized of quality habitat suitable for the molluscs to survived.

Table 4. Sediment Types of Station 3

Sediment type	Sieve size			Total/g
	0.3mm.wt/g	0.2mm.wt/g	0.1mm.wt/g	
Coarse	8	8.57	12.1	28.67
Medium	10	19.2	21.3	50.5
Fine	10	7	9.6	26.6
Very Fine	3.9	11.3	13.7	28.9
Total (g)	31.9	46.07	56.7	134.67

Station three, the table showed that two sediments types are almost identical, however medium sediments dominated. According to Fagherazzi et al. (2014)[10] tidal bars and tidal flats in shallow, mesotidal estuaries are subject to the action of tidal currents and waves. This complex forcing gives rise to large variations in bottom sediments and related benthic ecosystems. It implies that site three sediments is influence by frequent

tidal current and wave action. Further, the table showed among the three sites, sites three has collected bigger amount of sediments.

Table 5. Soil Chemical Analysis

Determination	Test Method Potentiometric 1:1 H_2O	Adequate Value	Laboratory No.		
			3043	3044	3045
			Field No.		
			Carigara	Barugo	Babatngon
			Results of Soil Analysis		
pH	Walkley & Black	5.5 – 8.5	6.52	6.48	6.54
Organic Matter (%)	Olsen/Bray	>4.5	0.19	0.13	0.18
Available Phosphorus (mg/kg)	Ammonium Acetate	>20	0.15	8.21	0.94
Exchangeable Potassium (cmol/kg)		>0.25	1.86	0.66	0.60

DISCUSSION

One hundred twenty-one species of macrobenthic invertebrates found on the study area belonging to six phyla. Mollusca 61, crustacea 18, porifera 16, annelida 10, cnidaria 11, and Echinodermata five. Among the species collected from three station molluscan are the most abundance. Shannon Wiener diversity index reveal station three has an index of 1.61 between 1.5<>2.5 which mean medium diversity. Station one and station two has an index of 1.43, 1.09 respectively less than 1.5 indicate low diversity. Further, species distributed almost equally in station three than in station one and two. Though station two shows the higher number of animals collected but it was not equally distributed from the samples one, two, and three. Station three revealed the lowest numbers of animals collected but showed the most diverse. Coastal settlers in this area rapidly increased. Further, the area surrounded by big rivers where may indicates agricultural farm waste washed and deposited in coastal area causing habitat loss.

CONCLUSION

Moluscan is the most dominance macrobenthic invertebrates found on the study area. Shannon-Wiener index of diversity showed the different diversity index among the three station. Although station three found lowest numbers of animals but showed the most divers among the three. Sediments quality of the study area were homogeneous dominated by very fine sediments.

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