INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 16, No. 3, p. 157-166, 2020

RESEARCH PAPER OPEN ACCESS

Intertidal Microhabitat Preferences of Cerithiidae in Selected Areas of Zamboanga del Norte and Misamis Occidental, Philippines

Saliha P. Mamaroba, Carlo Stephen O. Moneva*

Department of Biological Sciences, College of Science and Mathematics, Mindanao State University – Iligan Institute of Technology, Iligan City, Philippines

Key words: Intertidal microhabitats, *Cerithium, Clypeomorus, Pseudovertagus.*

http://dx.doi.org/10.12692/ijb/16.3.157-166 Article published on March 18, 2020

Abstract

Various studies have been concerned with intertidal zones in determining the ecological interaction that produce the diverse groupings of plants and animals. This study was conducted to ascertain microhabitat preferences of Cerithiid species in intertidal areas of Bucana Sicayab and Aliguay Island in Dapitan City, Zamboanga del Norte and in Punta Sulong, Baliangao, Misamis Occidental. Microhabitats and abundance of Cerithiid snails were surveyed using the belt-transect method. Specimens encountered in different microhabitats were collected through hand-picking or hand-digging the substratum. Eight microhabitat types were observed and classified as bedrocks, macroalgae (brown, green and red), muddy sand, reef flats, seagrass beds and tidepools. A total of 14 species of Cerithiids under three genera (*Cerithium, Clypeomorus* and *Psuedovertagus*) were identified. Kruskal Wallis test revealed that there is a significant difference in the abundance of Cerithiid species among microhabitat types ($p<0.05$). Using Cramer's contingency coefficient test, the microhabitat preference of Cerithiids was determined. *Cerithium columna* had high preference on flatreefs and tidepool, while *Cerithium coralium* on muddy sand and *Cerithium nodulosum* on red algae. High proportion of *Clypeomorus bifasciata bifasciata* was observed on bedrocks, though it was also numerous in tidepools and muddy sand. *Clypeomorus pellucida* was more likely to be found on bedrocks and seagrass. *Pseudovertagus aluco* was observed to be common on seagrass, while *Pseudovertagus nobilis* on reef flats. In conclusion, Cerithiid species were less numerous in red, brown and green algae, while more numerous in rocks and tidepools to avoid high temperature and desiccation.

* **Corresponding Author:** Carlo Stephen O. Moneva ✉ carlostephen.moneva@g.msuiit.edu.ph

Introduction

Mollusks are important component of macrofauna exposed on sandy beaches. Gastropods are one of the largest and most important groups of mollusks, which are associated from the shallow intertidal and sub-tidal zones (Esqueda *et al.,* 2000). Under this large class is the superfamily Cerithioidea that includes many individual families of Cerithiidae, Battillariidae, Potamididae, and Thiaridae. Cerithiidae is a worldwide family of marine gastropods common in shallow waters of tropical and subtropical regions. It is divided into two subfamilies (Cerithiinae and Bittinae). Shells of subfamily Cerithiinae are large, with nodulose sculpture, well defined anterior canal, and are generally intertidal in habitat. Subfamily Bittiinae, has shells that are usually less than 10 mm in length, more elongate, and have a less well developed anterior canal. Among this subfamily are a few deep water species. According to Houbrick (1978), Cerithiids are found in a range of habitats; sandy and coral areas around coral reefs, sand flats, a few species live in estuarine areas at the seaward side of mangroves, and a few live in deep water. *Cerithium* species are microphagous, detrital-algal feeders, and commonly occur in large populations; they have widespread ranges, and are among the most common and numerous of prosobranchs. *Cerithium* species span a broad variety of habitats, both in regard to substrate and vertical depth distribution. The great majority of species occur in intertidal habitats on sand-rubble substrates, where they crawl on the surface or partially burrow around rocks. Many species tend to burrow partially during the day but are active crawlers on the surface during the night. A number of *Cerithium* species prefer solid rocky substrates such as large boulders, or rocky coralline platforms and benches. There are also species that are confined to intertidal algal mats, silty sand environments, and some on muddy sand in estuarine substrates around mangroves (Rao and Rao, 1984).

There are few ecological studies that have been published about Indo-Pacific *Cerithium* species, although there are various, short, unreliable reports that often cite taxa whose identity is not clear. In Houbrick's monographs, many of the Cerithiids were distinguished mostly in the Philippines. In fact, Philippines is considered as the center of *Cerithiidae* diversity followed by the Indonesian Archipelago, northeastern Australia, and the large, mountainous islands of Melanesia (Houbrick, 1973; Houbrick, 1978; Houbrick, 1980). However, the rareness of published reports of its ecology and habitat preferences is a direct reflection of our inability to deal with their confused systematics. Most of the studies under family Cerithiidae are focused on morphological information, geographical location and species abundance (Houbrick, 1992; Vallejo, 2003; Batomalaque *et al.,* 2010). Data on its habitat use are less available and not usually given emphasis. This study was conducted to contribute to the conservation of the Cerithiid species by providing information about its microhabitat in intertidal areas. The collected data will serve as baseline information, as there were no existing records about the habitat preferences of Cerithiids.

The main objective of this study is to determine the microhabitat preference of the Cerithiids species in the intertidal areas of (1) Barangay Bucana Sicayab, Dapitan City, (2) in the island of Aliguay, Dapitan City, and (3) in Punta Sulong, Baliangao of Misamis Occidental. Specifically, it aimed to: (1) Classify the microhabitat types present among selected intertidal areas; (2) Identify species and abundance of Cerithiids occurring on different microhabitat types; and (3) Determine whether there is a significant difference between the abundance of species and its microhabitat type.

Materials and methods

Study area

This study was conducted in three sampling sites located in the northwestern part of Mindanao, the second largest and southernmost island of the Philippines. The first sampling site was in Barangay Bucana Sicayab in Dapitan City. During low tide, rocky substratum was obvious. The air temperature in Barangay Bucana Sicayab ranges from 28.5°C to 28.7°C while water temperature varies between 28.13

°C to 28.67°C; and sand temperature ranges from 28.23°C to 30.67°C. Water pH reaches from 6 to 8 while water salinity varies from 26 to 35 parts per thousand (ppt). From the measured readings, it shows that the relative humidity percentage appears to range from 78% to 93%.

Second site was situated at the island of Aliguay which is part of Dapitan City. It is estimated to be 11 nautical miles (20 kilometers) away North West straight across the sea. Aliguay Island has an air temperature of 27.5°C to 28.7°C, while the sand temperature ranges from 29°C to 31.8°C. Water temperature ranges from 28.8°C to 30.8°C. Water pH obtained is 7.67 (neutral) while water salinity is 33 ppt which is a variable salinity. For relative humidity, it has a percentage of 86%.

Third site was established at the intertidal area of Punta Sulong, Baliangao which is the fifth class municipality of Misamis Occidental.

The air temperature in this site ranges from 27.17°C to 30.1°C. Sand temperature varies between 31.5°C to 31.8°C and water temperature from 30.8°C to 33.3°C. Water pH obtained is 7 (neutral) while water salinity ranges from 26 to 35 ppt (variable salinity). The measured relative humidity in Punta Sulong has a percentage that ranges from 68% to 80%.

Collection of samples

Sample collection was done during low tide conditions in the three sampling sites. Using a belt-transect method, transect line was established 60 meters along the shoreline and 50 meters away from the shoreline (60m x 50m). Quadrats were laid randomly. Microhabitats such as sandy substrates, muddy sand, rocky substrates, seagrass beds and seaweeds were surveyed. Representative samples of Cerithiid species encountered in various microhabitats were collected through hand-picking or hand-digging the substratum. Macro algae and seagrasses were also collected for identification. Samples were deposited to a glass container for further identification.

Preservation and Identification of specimens

The inner part of the collected specimens were removed and preserved in a 70% ethanol, while shells are sun-dried. The shells were identified by referring to the Monograph of the genus *Cerithium* Bruguiere in the Indo-Pacific (Cerithiidae: Prosobranchia) and genus *Clypeomorus* Jousseaume (Cerithiidae: Prosobranchia) by Richard Houbrick, Shell Catalogue of Family Cerithiidae, World Register Marine Species by Bouchet *et al.*, (2013), and The Philippine Marine Molluscs by Guido T. Poppe (Poppe, 2008a; Poppe, 2008b; Poppe, 2010). All shell characteristics (color, shape, morphometric, meristic) were considered in identifying the species. Shell measurements were taken from largest and smallest specimens (in mm) so that a size range could be established. Morphometric and meristic data, such as shell length and width, aperture length and width, number of spiral whorls and number of nodes, were also measured.

Physico-chemical parameters

Sand, water and air temperature

Water temperature was obtained by immersing the thermometer bulb in sea water until the reading became stable. Sand temperature was done by dipping the thermometer bulb in the sand for three minutes.

Measurement of air temperature was obtained by suspending the thermometer one meter above the ground for three minutes before taking any reading. Three replicates were obtained in each sampling site.

Water pH

The pH of water was obtained by immersing the pH indicator in sea water and three replicates were considered in each sampling site.

Water salinity

Water salinity was measured to the nearest parts per thousand through a single drop of water sample on the glass daylight plate area of the refract meter window and one replicate was obtained in every zone. According to McLusky (1993), seawater is regarded as >30 parts per thousand (ppt).

Water turbidity

The turbidity of the water was determined using an improvised and calibrated tie. There was a knot in same measure levels in a tie and a heavy metal was attached at the end of the knot. Water was turbid if the metal attached to the knot was clouded and cannot be seen.

Relative humidity

The relative humidity was measured using a slingshot psychrometer. A cloth wrapped around the end of the wet bulb was moistened with clean water. The psychrometer was rotated in the air for two minutes and wet and dry bulb readings were recorded. Relative humidity percentage was determined using the relative humidity table. Three replicates were obtained in every sampling site.

Determination of microhabitat types

Encounter Rate Method (ERM) was used in computing the species abundance between different microhabitat types. Descriptive Analysis Method was used to determine the preferred microhabitat type of Cerithiids (Tago, 2013).

Statistical tools

Kruskal-Wallis test was used in the study to identify whether there is a significant difference in terms of the abundance of species among the different microhabitat types (Tago, 2013). Cramer's Contingency Coefficient was also used to estimate the extent of the relationship between two variables, or to show the strength of a relationship. This test was used to determine the microhabitat preference of Cerithiids species (Goodman and Kruskal, 1972).

Results and discussion

Microhabitat types

The intertidal zone is the area where land and sea meet. This habitat is covered with water at high tide, and exposed to air at low tide.

The land in this zone can be rocky, sandy or covered in mudflats (Kennedy, 2013). In this study, eight (8) microhabitats were classified to be present in intertidal areas of Bucana Sicayab and Aliguay Island in Dapitan City, Zamboanga del Norte and in Baliangao, Misamis Occidental (Fig. 1).

Table 1. Significant difference in the abundance of species among different habitat with Kruskal Wallis test.

Microhabitat type	Mean Number of species	Mean rank
Bedrocks	8.00	125.52
Brown algae	1.50	34.75
Green algae	1.40	31.70
Red algae	1.00	19.50
Muddy sand	2.94	65.56
Reef flats	2.00	50.00
Seagrass	2.27	50.95
Tide pools	4.62	87.71
Total	4.27	
Kruskal Wallis test (Chi-square value)= 83.974	P value= 0.00	Significant

Bedrocks (Fig. 1A): The intertidal areas in Barangay Bucana Sicayab are rocky shores that consist mainly of mixture of bedrock, small boulders, and pebbles. Bedrock itself is rarely smooth and where rock pools are usually formed. Many organisms require very special conditions such as the hardness, chemical composition and surface texture because there are certain species that require smooth surfaces and others need rough surfaces on which to settle and mature. Tiny pits in the rock also provide shelter for juvenile cerithiids and other small species (Hiscock, 1996). Macroalgae: Marine macroalgae, or seaweeds, are plant-like organisms that generally live attached to rock or other hard substrata in coastal areas. They belong to three different groups distinguished on the basis of thallus color (Kennedy, 2013).

Padina minor (Fig. 1B) is a soft, flat, thin, flabellate brown macroalgae species. This is found on the rocks, gravel, or dead coral in mid intertidal to subtidal zones in Barangay Bucana Sicayab.

Ulva lactuca (Fig. 1C) is commonly called sea lettuce. This green macroalgae species is found in the tide pools, rock pools and bedrock in mid to lower levels of the intertidal zone in Barangay Bucana Sicayab. It is consumed by many invertebrates both when submerged and when exposed.

Gracilaria verrucosa (Fig. 1D) is a red macroalgae species that is typically found below the low tide mark to the upper subtidal zone. It is growing on sand to rocky seafloor areas along a coral reef, where water movement is slow to moderate.

Muddy sand (Fig. 1E): Shores are comprised of clean sands (coarse, medium or fine-grained) and muddy sands with up to 25% silt and clay fraction. Shells and stones may occasionally be present on the surface. Coastal sands exhibit varying degrees of drying at low tide depending on the steepness of the shore, the sediment grade and the height on the shore. Muddy sands, the most stable within this habitat complex, contain the highest proportion of gastropods and bivalves. Muddy sands are often present in more sheltered lower estuarine conditions and may be subject to some freshwater influence (Connor *et al.,* 2004).

Reef flat (Fig. 1F): The reef flat is the shoreward, flat, broadest area of the reef. It is found in fairly shallow water, and can be uncovered during low tide.

This area of the reef is only slightly sloped towards the open ocean. Since the reef flat is adjacent or nearly adjacent to land, it sustains the most damage from runoff and sediments (Castro and Huber, 2008).This microhabitat is noted in the island of Aliguay in Dapitan City, which is open to deep body of water.

Seagrass beds (Fig. 1G): Seagrass beds are flowering plant that lives in a marine or brackish environment. They grow in groups, forming seagrass beds and they require lots of light. *Cymodocea rotundata* is the identified seagrass species in Brgy. Sicayab and Punta Sulong. *Cymodocea* can be found in clear water and in the high intertidal areas. It is a hardy species and it is adaptable to marginal conditions. They provide important habitat for a variety of marine life because of their high organic content (Kennedy, 2013).

Tidepools (Fig. 1H): Tidepools are water puddles left behind when the ocean recedes at low tide. Tidal pools can be large or small, deep or shallow. Pools provide an intertidal habitat for obligate water dwellers including many gastropod species.

It supports low-shore organisms, such as seaweeds and anemones. Temperatures in these small bodies of water change in response to air temperatures more rapidly than those in the sea. Water evaporates from pools and rainwater and freshwater run-off collects in them, causing salinity fluctuations. During the night, a net uptake of oxygen and production of carbon dioxide occurs. Oxygen concentration drops and pH falls as a result (Hiscock, 1996).

It can be observed that not all types of microhabitats were present in the three sampling sites. In Barangay Sicayab, Cerithiids were encountered in six microhabitats such as macro algae (brown and green), muddy sand, bedrocks, sea grasses, and tide pools. In Aliguay Island, only two microhabitats were noted (reef flats and tide pools). In Punta Sulong, cerithiids were observed in three microhabitats - muddy sand, sea grasses, and red algae.

Species account

A total of 14 species under three genera of family Cerithiidae were recorded in the selected intertidal areas of Zamboanga del Norte and Misamis Occidental. Ten (10) species were identified belonging to genus *Cerithium*, two species from genus

Clypeomorus, and two species from genus *Pseudovertagus*. There were 671 collected individuals in the three sampling sites. In Barangay Bucana Sicayab, 566 individuals were gathered representing three species. 22 individuals were collected in Aliguay Island representing four species. This may be due to the elevation of water and late occurrence of low tide in the Island during the sampling period. In Punta Sulong, 83 individuals representing nine species were collected. All of these species are evaluated as native in the Philippines in terms of their occurrence by the IUCN.

Table 2. Microhabitat preference of Cerithiid species using Cramer's contingency coefficient test.

Species name	Microhabitat type								
	Bedrocks	Brown algae	Green algae	Red algae	Muddy sand	Reef flats	Sea grass	Tide pools	Total
C. columna	0	0	0	0	0	5	0	4	9
C. coralium	0	0	0	0	44	0	2	0	46
C. nodulosum	0	0	0	6	0	0	0	0	6
C. bifasciata	281	9	4	0	40	0	18	149	501
C. pellucida	39	0	0	0	3	0	22	17	81
P. aluco	0	0	0	0	1	0	5	0	6
P. nobilis	0	0	0	0	0	7	0	2	9
Total	320	9	4	6	88	12	47	172	658
Contingency Coefficient= 0.835				P value= 0.00			Significant		

Species abundance

Fig. 2 shows the relative abundance of Cerithiids species found in different microhabitat types in the study area. In this study, *Clypeomorus bifasciata bifasciata* (74.66%) is the most numerous.

It was found on the algal mats, muddy sand, rocks, seagrasses and tidepools of Barangay Bucana Sicayab. The second most abundant species is *Clypeomorus pellucida* (12.07%) that was found on the tidepools, muddy sand and bedrocks in Barangay Sicayab and Punta Sulong. *C. pellucida* was frequently found with *Cerithium coralium* and *Clypeomorus bifasciata bifasciata*.

Another species that resides on the muddy sand and seagrass bed in Barangay Bucana Sicayab and Punta Sulong is *Cerithium coralium* (6.86%). *Cerithium columna* (1.34%) along with *Pseudovertagus nobilis* (1.34%) were found on the reef flats and tidepools in Aliguay Island. *Cerithium nodulosum* (0.89%) was spotted on red seaweeds in Punta Sulong; while *Pseudovertagus aluco* (0.89%) was seen on muddy sand and seagrass bed. *Cerithium echinatum* (0.45%) was found on the flatreefs and tidepools in Aliguay Island, *Cerithium lifuense* (0.45%) on the muddy sand and along the seagrass beds in Punta Sulong, and *Cerithium citrinum* (0.30%) also in the muddy sand. *C. citrinum* was reported as a rare species and does not appear to occur in large populations as do many other cerithiids (Houbrick, 1992). *Cerithium maculosum* (0.30%) was seen on the muddy sand and seagrasses in Punta Sulong. *Cerithium atromarginatum* (0.15%) was noticed in tidepool, *Cerithium egenum* (0.15%) in muddy sand, and *Cerithium torresi* (0.15%) was encountered also on seagrass beds of Punta Sulong.

Statistical analysis

In determining whether there is a significant difference in terms of species abundance and microhabitat types, Kruskal Wallis test was used. As depicted in Table 1, there is a significant difference in the abundance of Cerithiids species among different microhabitat ($p<0.05$). This implies that the abundance of species among different microhabitat were not the same. Cerithiid species were more numerous in rocks and tidepools than in other microhabitats. On the other hand, Cerithiid species were less numerous in macroalgae. Using Cramer's contingency coefficient test, the microhabitat preference of some Cerithiid species was determined. There is a significant association between the abundance of species to microhabitat types with contingency coefficient of 0.835 at $p<0.05$ (Table 2). *Cerithium columna* had high preference on flat reefs and tidepool, which corresponds with the study of Maes (1967) wherein *C. columna* is a component of the shallow-water molluscan fauna in reef environments. Rehder (1980) recorded that *C. columna* was seen on reef flats in shallow tide pools, on a thin sandy substrate bound by algal filaments. *Cerithium coralium* appeared to be numerous on muddy sand.

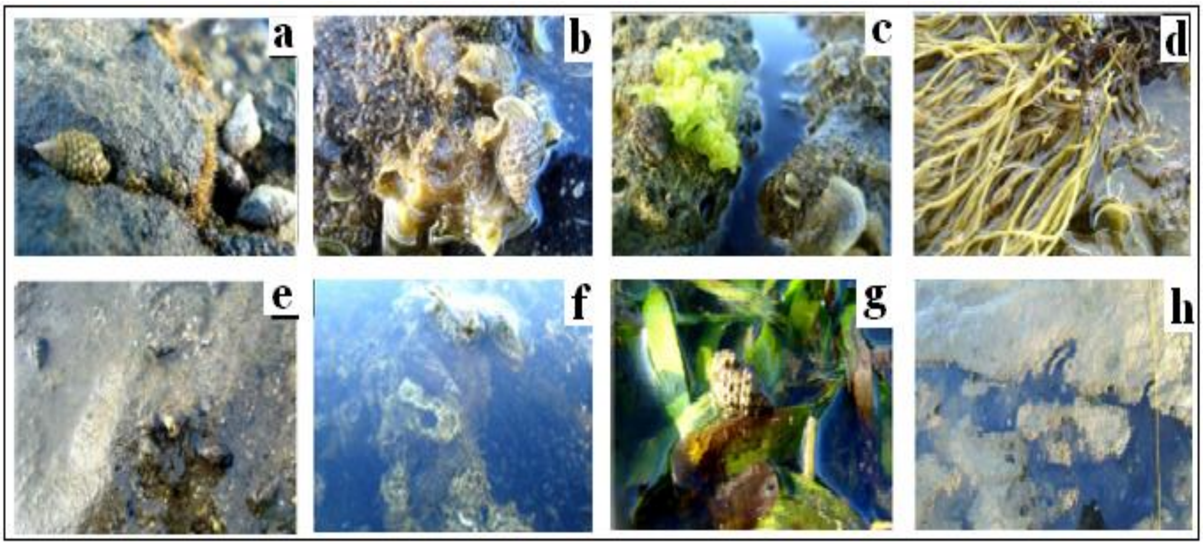

Fig. 1. Microhabitats found in the intertidal areas are A) bedrocks, B) brown macroalgae, C) green macroalgae, D) red macroalgae, E) muddy sand, F) reef flats, G) seagrass, and H) tide pools.

This agrees to one ecological study of zonation along a sandy shore in Singapore by Vohra (1971), in which *C. coralium* was found to be common on sticky, sandy areas overgrown with *Halophila ovalis*. *Cerithium nodulosum* was seen only in the red algae but according to Houbrick (1992) this species is commonly found just shoreward, intertidal and subtidal rocky shelves and sandy depressions.

Clypeomorus bifasciata bifasciata was abundant on bedrocks, yet this species was also frequent in other microhabitats such as tidepools and muddy sand. Houbrick (1985) also observed an abundant population of *C. bifasciata* in the Philippines living on the rocky, high, intertidal zone along the western Bataan peninsula. It was mentioned that *C. bifasciata* is living on the undersides of rocks during the day in which they appear to be avoiding high temperatures and dessication. This species is frequently found with *Clypeomorus pellucida* in which it also has a high proportion on bedrocks and seagrass. More likely, *Clypeomorus pellucida* prefer these two microhabitat types. However, Plaziat (1977) reported this species to live on the aerial roots of mangroves slightly above the high tide mark and believed that the distinctive shape of *Clypeomorus pellucida* morphs was correlated with their habit of living since it is well suited for clinging to roots. *Pseudovertagus aluco* was also observed to be numerous on seagrass. In contrary to the study of Cernohorsky (1972), this species is commonly found on sand-bars at the high tide level, on tidal flats, on clean sand and coral rubble. *Pseudovertagus nobilis* has a high proportion on flatreefs. According to Maes (1967), *P. nobilis* was a component of the shallow-water molluscan fauna in reef environments together with *Cerithium columna*.

Other species (*Cerithium echinatum, C. lifuense, C. citrinum, C. maculosum, C. atromarginatum, C. egenum* and *C. torresi*) that were not mentioned in

Table 2 have low proportions. Their habitat preferences were not determined because of their small count in the microhabitat types. *Cerithium echinatum* was found on the flatreefs and tidepools in Aliguay Island. Rehder (1980) reported that *C. echinatum* was common and lives on subtidal benches and rocky areas of fringing reefs. Ayal and Safriel (1981) also recorded that *C. echinatum* as common in the Red Sea sub-tidally among boulders on the reef table and on algal-covered pebbles and hard surfaces rich in holes. *Cerithium lifuense* was observed on the muddy sand and along the seagrass beds. However, as described by Houbrick (1992), *C. lifuense* was found on sandy, rubble bottoms associated with fringing reefs along continental shores; and it appears to be common offshore in the Philippines. *Cerithium citrinum* was also seen along the muddy sand.

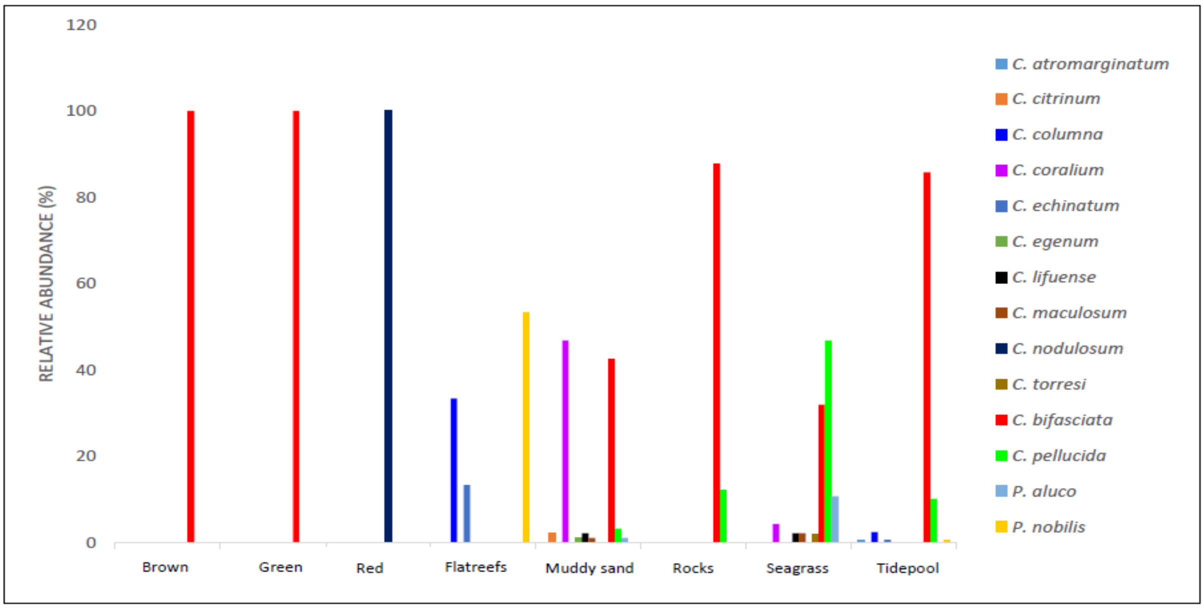

Fig. 2. Relative abundance of Cerithiid species found in the different microhabitat types in the three sampling sites.

This species was reported to be a rare species and does not appear to occur in large populations as do many other Cerithiids (Houbrick, 1992). *Cerithium maculosum* was observed on the muddy sand and seagrasses. *Cerithium atromarginatum* was seen in tidepools. Rehder (1980) stated that *C. atromarginatum* occured in intertidal high energy habitats. In this high-energy environment, this species emerged on a rising tide and crawled about on the substrate. *Cerithium egenum* was seen in the muddy sand in Punta Sulong. This finding is conflicting with Kay (1979) record on *C. egenum,* which it usually burrows in sand in tide pools and on benches. Lastly, *Cerithium torresi* was encountered on seagrass beds which is similar to the monograph of Houbrick (1974), describing that *C. torresi* occured in low- intertidal to shallow subtidal, near grass beds that is high in organic content.

Conclusion

In selected intertidal areas of Dapitan City, Zamboanga del Norte and Baliangao, Misamis Occidental, gastropod species under family Cerithiidae preferred different microhabitats such as bedrocks, reef flats, macroalgae, muddy sand, seagrass beds and tide pools. In addition, the abundance of Cerithiids among different microhabitats was not the same. Cerithiids species were more frequent in rocks and tide pools and less common in red algae, brown algae and green algae. Microhabitat preferences of these species may reflect to their ecological adaptation of avoiding high temperature and desiccation. It is recommended for future studies to incorporate the physico-chemical parameters of the microhabitat types where the species are encountered and to add morphometric/meristic data analysis, since basic shell form and sculpture of these species reflect substrate preference and microhabitat.

References

Ayal Y, Safriel UN. 1982. Role of Competition and Predation in Determining Habitat Occupancy of Cerithiidae (Gastropoda: Prosobranchia) on the Rocky, Intertidal, Red Sea Coasts of Sinai. Marine Biology **70,** 305-316. https://doi.org/10.1007/BF00396849

Batomalaque G, Arce BG, Hernandez MB, Fontanilla IK. 2010. Survey and Spatial Distribution of Shoreline Malacofauna in Grande Island, Subic Bay. Philippine Journal of Science **139(2)**, 149-159.

Bouchet P, Gofas S, Rosenberg G. 2013. World Register of Marine Species. Retrieved from http://www.marinespecies.org/

Castro P, Huber ME. 2008. Marine Biology 7th edition. McGraw-Hill, New York.

Cernohorsky WO. 1972. The Taxonomy of Some Indo - Pacific Mollusca with descriptions of New Species. Records of the Auckland Institute and Museum **9,** 195-204.

Connor DW, Allen JH, Golding N, Howell KL, Lieberknecht LM, Northen KO, Reker JB. 2004. The marine habitat classification for Britain and Ireland. Joint Nature Conservation Committee, Peterborough, p 934.

Esqueda M C, Ríos-Jara E, Michel-Morfín JE, Landa-Jaime V. 2000. The vertical distribution and abundance of gastropods and bivalves from rocky beaches of Cuastecomate Bay, Jalisco. México. Revista de Biologia Tropical **48(4),** 765-775.

Goodman LA, Kruskal WH. 1972. Measures for association for cross classification IV. Journal of the American Statistical Association **49,** 732-764. http://dx.doi.org/10.1080/01621459.1972.10482401

Hiscock K. 1990. Marine Nature Conservation Review: Methods. Marine Nature Conservation Review Report, p 5.

Houbrick RS. 1973. *Cerithium* Bruguiere, 1789 (Gastropoda): Proposed Preservation by Designation of a Type-Species under the Plenary Powers. Z.N. (S.) 2032. Bulletin of Zoological Nomenclature **30(2),** 104-107.

Houbrick RS. 1974. Growth Studies on the Genus *Cerithium* (Gastropoda: Prosobranchia) with Notes on Ecology and Microhabitats. The Nautilus **88(l)**, 14-27.

Houbrick RS. 1978. The family Cerithiidae in the Indo-Pacific. The genera *Rhinoclavis, Pseudovertagus* and *Clavocerithium*. Monographs of Marine Mollusca **1**, 1-30.

Houbrick RS. 1980. Review of the Deep- Sea Genus Argyropeza (Gastropoda: Prosobranchia: Cerithiidae). Smithsonian Contributions to Zoology.

Houbrick RS. 1985. Genus *Clypeomorus* Jousseaume(Cerithiidae: Prosobranchia). Smithsonian Contributions to Zoology **403**, 1-131.

Houbrick, RS. 1988. Cerithioidean phylogeny. Malacological Review Supplement **4**, 88–128.

Houbrick RS. 1992. Monograph of the genus Cerithium Bruguiere in the Indo-Pacific (Cerithiidae: Prosobranchia).Smithsonian Contributions to Zoology.

Kay EA. 1979. Hawaiian Marine Shells: Reef and Shore Fauna of Hawaii, Section 4: Molusca. Bernice P. Bishop Museum Special Publication, p 653.

Kennedy J. 2013. Marine Life – Microhabitat Profiles. Retrieved from http://marinelife.about.com/

Maes VO. 1967. The Littoral Marine Mollusks of

Cocos-Keeling Islands (Indian Ocean). Proceedings of the Academy of Natural Sciences of Philadelphia **119(4),** 93-217.

McLusky DS. 1993. Marine and estuarine gradients - an overview. Netherlands Journal of Aquatic Ecology **27(2-4)**, 489-493. https://doi.org/10.1007/BF02334809

Plaziat JC. 1977. Les cerithides tropicaux et leur polymorphisme lie a I'etologie littorale des mangroves. Malacologia **16(l)**, 35-44.

Poppe GT. 2008a. Philippine marine mollusks: I. (Gastropoda - Part I). ConchBooks: Hackenheim. ISBN 978-3939767084.

Poppe GT. 2008b. Philippine marine mollusks: II. (Gastropoda - Part 2). ConchBooks: Hackenheim. ISBN 978-3-939767-17-6.

Poppe GT. 2010. Philippine marine mollusks: III. (Gastropoda Part 3 & Bivalvia Part 1). ConchBooks: Hackenheim. ISBN 978-3-939767-18-3.

Rehder HA. 1980. The Marine Mollusks of Easter Island (Isla de Pascua) and Sala y Gomez. Smithsonian Contributions to Zoology, p 167.

Rao YP, Rao DGP. 1984. Effect of Body Size on the Respiration of Cerithidea (Cerithideopsilla) *cingulate* (Gmelin, 1790) and *Cerithium coralium* Kiener, 1841. Journal Molluscan Studies **50(2),** 92. https://doi.org/10.1093/oxfordjournals.mollus.a065856

Tago RM. 2013. Habitat preferences of the Philippines Hanging-Parakeet (*Loriculus philippensis*) in Mt. Timpoong, Camiguin Sur, Northern Mindanao. Unpublished Undergraduate thesis. Department of Biological Sciences. Mindanao State University - Iligan Institute Technology, Iligan City, Philippines.

Vallejo B. 2003. Biogeography of coral reef shore gastropods in the Philippines. Doctoral Dissertation. James Cook University.

Vohra FC. 1971. Zonation on a Tropical Sandy Shore. Journal of Animal Ecology **40,** 679-708. http://dx.doi.org/10.2307/3445