DISTRIBUTION OF INTERTIDAL HOLOTHURIAN FAUNA IN LIANGA BAY, SURIGAO DEL SUR

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ABSTRACT

This study was conducted in order to monitor the sea cucumber status in Lianga Bay. There were 16 species of holothuroids identified belonging to 3 families namely the Holothuriidae, Synaptidae and Stichopodidae and five (5) unidentified species. The results seemed to be alarming in other Municipalities because there are only 16 species and 5 unidentified species collected in the wild compared to the previous studies conducted of 35 species of holothuroids in the area for the past 12 years. It was found out that holothuroids were distributed according to the type of substrate and distribution is independent of the total area. The morphological adaptations of different species enabled them to occur in specific habitat types.

Keywords: *Holothuroids, Lianga Bay, intertidal, distribution*

1.0 Introduction

Sea cucumber fishery used to be an important source of income for fishers in some Indo- Pacific countries such as the Philippines, Indonesia, Fiji, Papua New Guinea, Tonga, the Maldives and others. In the Philippines, the processing of sea cucumber into "trepang" was first recorded in 1911 (Trinidad , 1987). The Philippines has about 100 species of sea cucumber but only few are commercially valuable (Schoppe, 2000). Its fishery served as source of livelihood for many of the coastal communities in the archipelago and forms the basis of a multi-million dollar export industry of dried sea cucumbers (Gamboa et al., 2004). Also, it served as significant source of livelihood for many of the coastal communities in the Philippines particularly in Surigao del Sur. According to Pagdilao (2009), increasing world demands, high prices and unregulated harvest drive sea cucumber into extinction. In addition, Casilagan and Menez, (2007) stated that there has been no specific effort to effectively regulate and manage the fishery on a national scale. The scarcity of useful fishery baseline information in most regions is often cited as an obstacle in the formulation of a management plan (Gamboa et al., 2004).

In the Philippines, 100 known species have been recorded recorded (Schoppe, 2000; Domantay, 1934). In study of Tiu (1981) in Central Philippines, he identified 27 species in 8 genera of holothuroids. In Calatagan, Batangas, Leonardo (1984) was able to identify 27 species in 7 genera. In Bolinao-Anda reef system, Olavides et. al., (2010) surveyed 49 species of sea cucumber. In Lianga Bay, Surigao del Sur, Baluat (2000, unpublished) reported that there were 35 species belonging to three (3) families

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namely; Holothuroidea, Synaptidae and Stichopodidae and five (5) unidentified species.

Through the increase of fishing activities, commercial and household consumption, stakeholders, particularly fisherfolks have observed the decline catch. Due to the rampant collection of sea cucumber, this leads to the over exploitation of the resource. It is feared that this will possibly be depleted or become extinct due to indiscriminate gleaning. According to Gamboa et al., (2005) there is a lack of effort, on the side of the government, in obtaining regional demographic or ecological information on holothurians in the country. Where such information exists, they are incomplete and fragmented and hardly helpful to local beneficiaries.

This study was conducted in order to monitor and assess the sea cucumber status in Lianga Bay. Hence, assessment was conducted to determine the status of the sea cucumbers species particularly in Marihatag, San Agustin, Lianga and Barobo which have established MPA. This study also provides primary information regarding the abundance and diversity of sea cucumber in different habitats, the comparison of species composition in different substrate and habitat types in Lianga Bay. Moreover, it will serve as policy formulation or in crafting schemes for the protection, conservation and preservation of holothurians.

2.0 Research Design and Methods

2.1 Species Survey

Four (4) Municipalities of Lianga bay were surveyed. Sampling was conducted from June to December 2012. The sampling areas in each site were confined to three replicates of 100 m x 10 m modified transects/ quadrats in intertidal zone of each municipalities. Each site has three (3) stations. The sampling areas were laid on the littoral zone parallel to the shoreline with five (5) sub-squares. Nocturnal sampling was conducted in each site for the data gathering. All the samples observed in every transects were identified and counted for determination of species diversity and abundance. The data gathered is tallied using the slate board.

Physico-chemical attributes were done such as temperature and salinity levels. Habitat description was limited only to the type of substrate. This was characterized according to particle size using a modified Wentworth Grain Size Classification (El-Shaarawi and Piegorsh 2002): sand (<1 cm), pebble (1-6.4 cm), rock (rubble/cobble) (6.4 25.6 cm), boulder (>25.6 cm). In the presence of mixed substrate types, a plot was assigned to a particular substrate if that substrate comprised more than 50% of the entire plot.

Only live sea cucumbers were considered in the study. For every plot, the number of individuals of each species encountered was recorded. A voucher specimen from each encountered species was brought to the laboratory for identification. All samples were identified down to the genus and possible to species level. Preservation of samples was done by 10 % formaldehyde. Species identification was based on the sample pictorials produced by WorldFish Center and the Secretariat of the Pacific Community Fisheries Information Section and Reef Fisheries Observatory. Prepared by Steve Purcell (Worldfish Center), Emmanuel Tardy (SPC), Aymeric Desurmont (SPC) and Kim Friedman (SPC).

2.2 Data Analysis

Using Paleontological Statistics (PAST), diversity indices were generated such as Berger- Parker index, Shannon Evenness and Shannon-Wiener Index. A dendogram was generated using paired group algorithm in order to illustrate such similarity by Bray Curtis (1959) on the species distribution in each stations and the substrate type they occupied.

3.0 Results and Discussions

Abundance of Holothuroids Species

There were 16 species of holothuroids identified belonging to 3 families namely the Holothuriidae, Synaptidae, and Stichopodidae and five (5) unidentified species. Family Holothuriidae had a highest number of species such *as Holothuria sp., Bohadscia sp.* and *Actinopyga sp.*, followed by the Family Synaptidae which composed of only two (2) species like *Synapta maculata* and *Synapta sp.*, and Family Stichopodidae which had only one species the *Stichopus horrens*.

As shown on Figure 2, Barobo site specifically the Dapdap Stations has no sea cucumber that was observed. Researchers did not find any sea cucumber species in the area. According to the near shore residence collection of commercial; sea cucumber in that particular area was very rampant long before. They also added that there were no more sea cucumber in the intertidal area and it can only be found in the deep area.

Surprisingly, Lianga has the highest number of individuals, this was probably due to the location which is inaccessible for the collectors and gleaners. There is also an MPA established in the area. Statistical analysis using ANOVA showed that there is significant difference ($P = 6.481e^{-05}$) in the species abundance across the four (4) sampling stations in Lianga Bay.

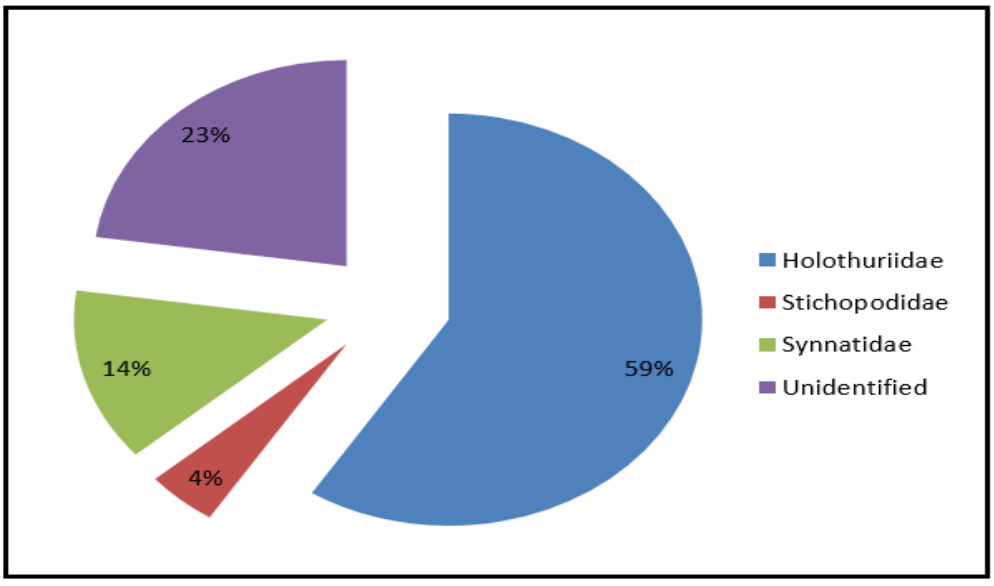

Figure 1. Abundance of Holothuroids species according to the family across sampling stations in Lianga Bay

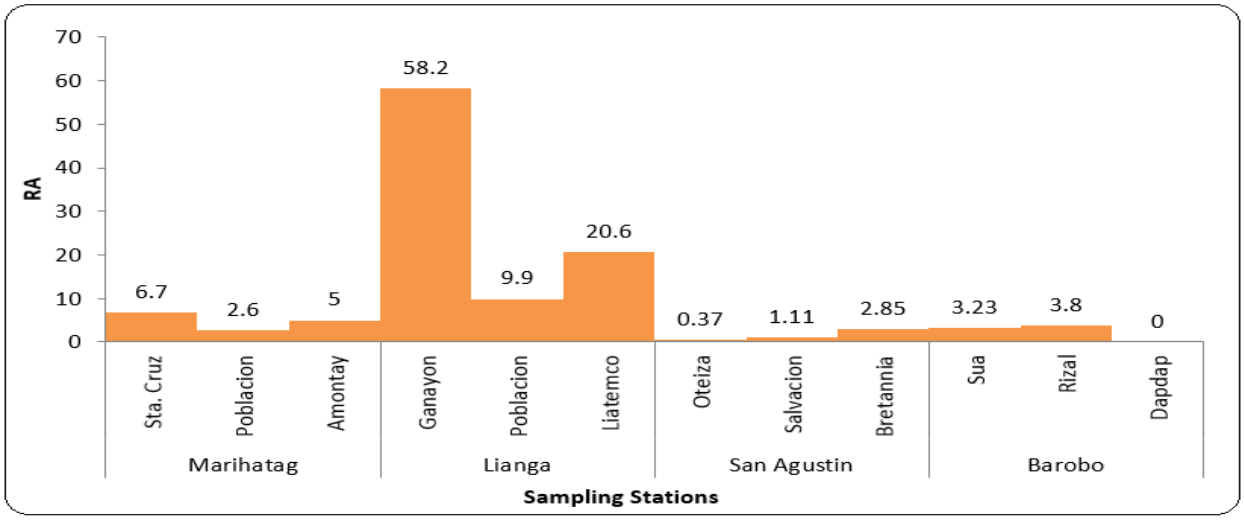

Figure 2. Total number of individuals of Holothuroids across sampling stations in Lianga Bay

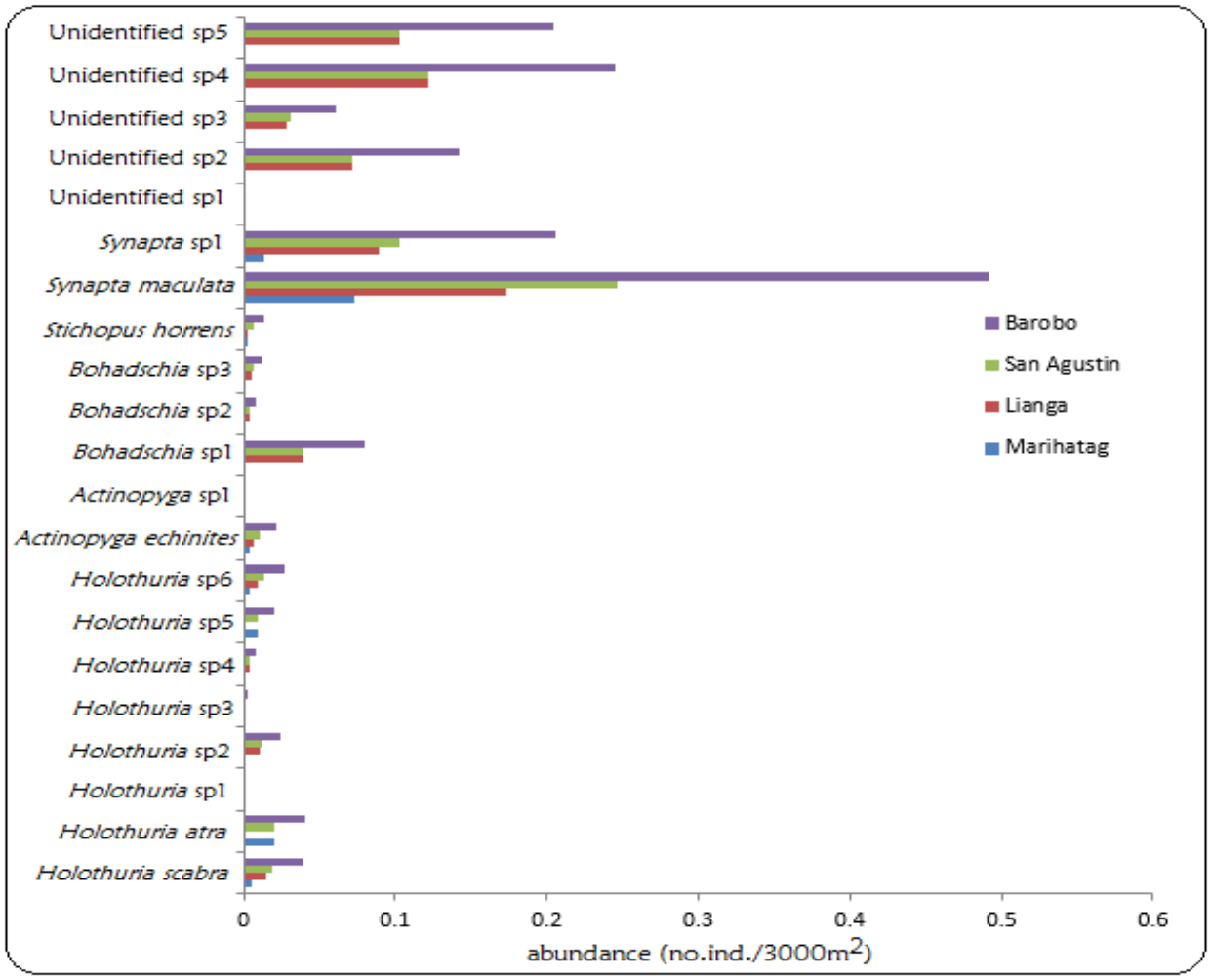

Figure 3. Abundance of Holothuroids species across sampling stations in Lianga Bay

As shown in Figure 3, Barobo obtained the highest number of specie followed by Lianga, San Agustin, Barobo and Marihatag. The *Synapta maculata* (0.984 ind/3000sq.m^2) and *Synapta sp*1 (0.412 ind/3000sq.m^2) obtained the highest abundance in all of the sampling stations. This species were described to be of no commercial value as the gleaners did not find interest to get them in the wild. On the other hand, *Bohadschia sp.* (0.1588 ind/3000sq.m^2), *Holothuria scabra* (0.0776 ind/3000sq.m^2), *Holothuria atra* (0.0816 ind/3000sq.m^2), *Stichopus horrens* (0.0264 ind/3000 sq.m^2) and *Actinopyga echinites* (0.90424 ind/3000 sq.m^2) described as commercially important sea cucumber species are less abundant in Lianga Bay. These results suggest there is a rampant collection of commercial sea cucumber. They are also accessible by gleaners. The commercial holothuroids are mostly found in shallow coral reefs, lagoons and in shore seagrass bed.

There is a marginal decrease of species of holothuroids compared to the study of Baluat (2000, unpublished) of which he reported that there are 35 species and 3 unidentified holothuroids in Lianga Bay,. The recent study has only 16 species and 5 unidentified species. These results are alarming. It might be due to lack conservation measures and weak enforcement of laws prohibiting the collection of sea cucumber as to marketable size, and this particular commodity was rampantly collected by local fishers.

Recent reviews of sea cucumber fisheries from around the world suggest that many are exploited, some are depleted and a few are nascent fisheries within relatively healthy stocks (Lovatelli et al., 2008). According to Cho (2008), throughout much of Asia, sea cucumber fisheries have been exploited and populations are severely depleted for high value and field surveys indicate that some high value species were led to extinction. Lawrence et al., (2004) stated that the insatiable demand and unsustainable fishery practices have led to a rapid decline in high value sea cucumber resources in the Philippines.

Diversity

Among the four (4) sampling sites, San Agustin and Barobo had the highest Shannons index value of 2.21. Results implies that all taxa are equally represented. This was then followed by Lianga and Marihatag having an index value of 2.13 and 1.6 respectively. But in terms of number of individuals it was

Table 1. Species diversity of Holuthoroidea in Four (4) Municipalities in Lianga Bay

Diversity Indices	Marihatag	Lianga	San Agustin	Barobo
Taxa (S)	15	18	21	21
Individuals	426	2662	120	211
Shannon H	1.654	2.133	2.21	2.21
Berger-Parker	0.5267	0.252	0.2981	0.2981
Dominance D	0.3172	0.1509	0.1551	0.1551
Simpson 1-D	0.6828	0.8491	0.8449	0.8449

inversely proportional to the Shannon Index as noted in the table 1. Lianga obtained the highest number of individuals of 2662 followed by Marihatag, Barobo and San Agustin of 426, 211 and 120 individuals respectively. In terms of dominance, same pattern was observed in Shannon Index, San Agustin and Barobo have the same value of 0.2981, and almost the same value obtained in Lianga of 0.1509 and in Marihatag of 0.3172. It implies that majority of the species were present in each of the sampling sites. Also same pattern of results were observed in Simpson and Berger Parker diversity indices. The four (4) municipalities are diverse using diversity indices. The abundance of individuals and species in Lianga Bay may have resulted from many random environmental variables acting upon the populations of a large number of species. It may also be the consequence of how species subdivided resources.

Comparison of Species Assemblages Between Substrate Types

The comparison of sea cucumber species assemblages between the substrate types of four (4) municipalities in Lianga Bay is presented using Bray-Curtis similarity indices (Figure 4). First clusters, the sandy- rocky and sandy of 0.9 similarities were most similar. These three (3) together with the coral rubble, rock and sandy muddy comprised a cluster. The high similarity between the assemblages in both substrate types is accounted for by the fact that the plots having sand substrate were distributed along those having sand-rock substrate. Having only surveyed the plots during the day, there was a very small chance of finding sea cucumbers. These sea cucumbers move only when looking for food during the night and remain buried during the day. Furthermore, the small number of species and individuals of each species found is probably due to the constant disturbance brought about by the water current and the swimming activities in the area although these factors were not quantified. Most of the five (5) unidentified species were located in the sandy muddy and cannot be seen in the other substrate type. The mangrove forest helped to give suitable habitat of the sea cucumber. According to Conand (1993), sea cucumbers are deposit feeders

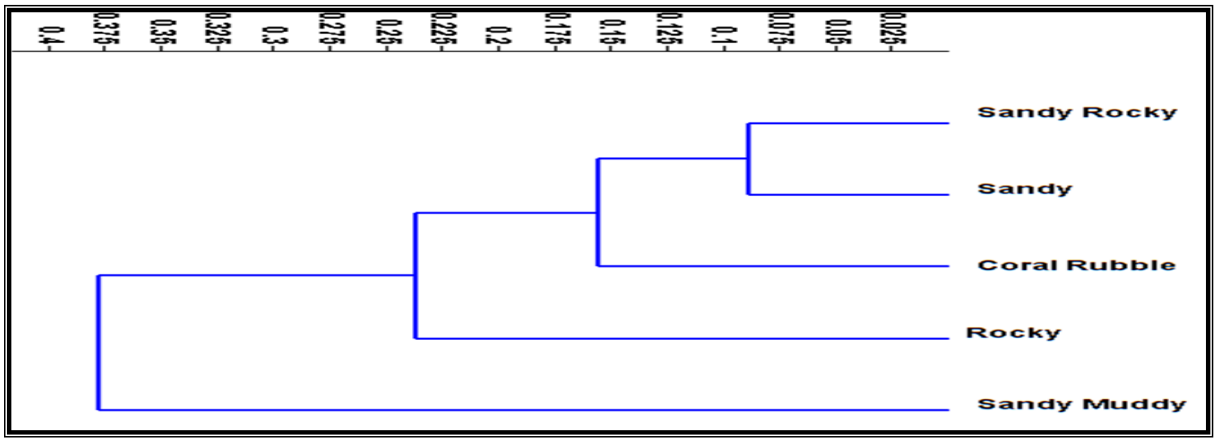

Figure 4. Comparison of Holothuroids assemblages between the substrate types in Lianga Bay using Bray-Curtis similarity indices computed from the mean quantitative measurements short distances indicate large similarity

that consume detritus and diatoms mixed with sediments on the seabed. The sand, sandy rocky substrate mixture often occurs at the lower half of the intertidal zone in coastal shores. All of the holothuroids species can be seen in this substrate. This species is usually found in large to vast groups under boulders and rocks in the tidal zone (Morton 1983). Although the sand pebble substrate is not as stable as boulders, the former was in fact compact given that the water in the area was calm and shallow. The heterogeneous substrates tend to provide more microenvironments (Calow and Petts 1994). Several properties of marine sediments are defined by the size and shape of sediment particles (Morrissey and Sumich 2006). The clustering of substrate types reflects their actual locations in the area. Hence, the factors of water movement, morphology, and dispersal modes have a role in the spatial distributions observed. The area was also dominated by rocky and boulder substrate which were exposed to intense wave action.

Result revealed that San Agustin and Barobo have the same species occupied in the area. However there were no species located in Marihatag sites such as *Holothuria sp*1*, Holothuria sp*3*, Holothuria sp*4*,* and the three (3) unidentified species in the three (3) sampling sites. While in Lianga, there are three (3) species that cannot be seen in the three (3) sampling municipalities or sites such as *Holothuria atra, Actinopyga sp*1*,* and *Holothuria sp*5. The species that are not seen in Lianga during the sampling stations are commercially important. But in the survey of Baluat (2000), they are present in the area. There are two reasons obtained, they decline in number because of over exploitation of the resource and more sampling stations in the area will be established.

In Marihatag, the substrate types are almost the same in other sampling sites. Their habitat maybe on rocks and corals. Most sea cucumbers live among sea grasses. Some do live in the mud or in the sand. In the case of Marihatag, the habitat is suitable for the holothuroids. This study suggest that there is an over exploitation of sea cucumber in the area of commercially highly priced sea cucumbers. However, some low value species are abundant in the area. In Lianga there are several commercial sea cucumbers that cannot be seen in other sampling stations during the sampling period but in terms of number of individuals, Lianga is the most abundant. This implies that people or the gleaners in the area are not interested to collect them in the wild because these animals are not included in fisheries trade in the area. Fisherfolks in Lianga are focused in the sea weeds industry and fish cultured activities.

Comparison of species assemblages between sampling stations

The comparison of sea cucumber species assemblages across the sampling stations of four (4) Municipalities in Lianga Bay is presented using Bray-Curtis similarity indices computed from the mean quantitative measurements. Short distances indicate large similarity. Longer nodes indicate larger differences between sampling stations. Species assemblages in Lianga and San Agustin of 0.9 were most similar. In assemblage differences (Figure 5), only one main cluster was generated, this implied that sea cucumber assemblage in different

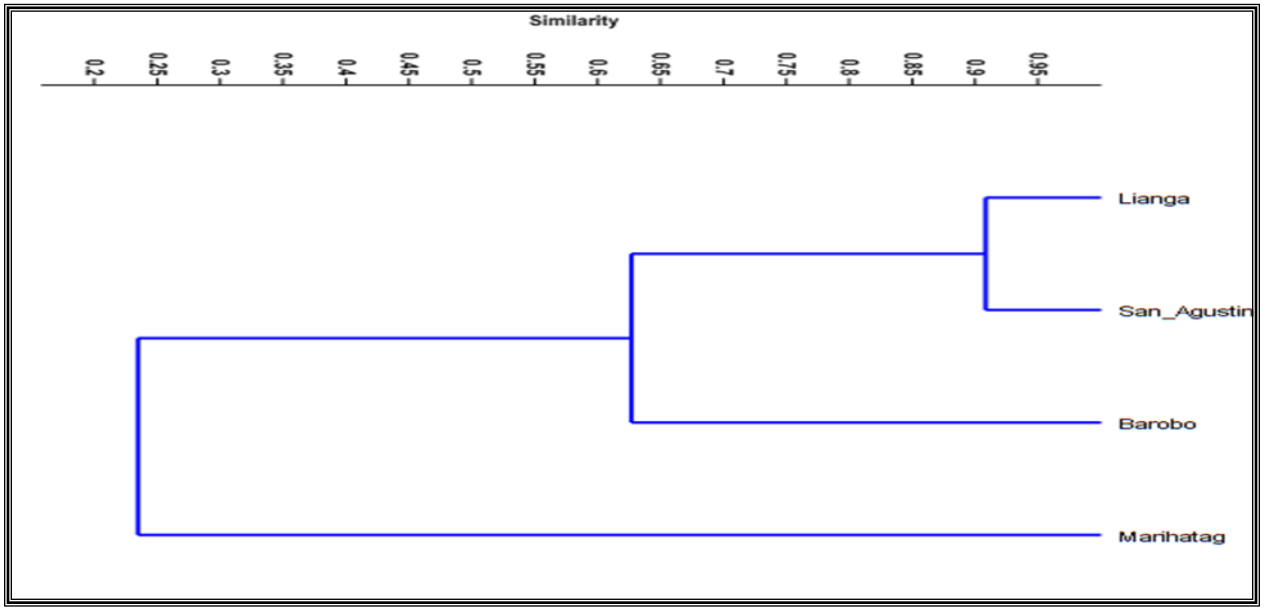

Figure 5. Comparison of Holuthoroids assemblages between sampling sites in Lianga Bay using Bray-Curtis similarity indices computed from the mean quantitative measurements short distances indicate large similarity

sampling stations shared same species across sampling stations.

Great variety of environmental conditions exist in the intertidal zone. This is due, in large part, to various levels on the shore being exposed to the air and submerged in seawater for different periods of time during the tidal cycle. In this study, holothuroids species dominated in the sand and sandy-muddy substrate. Morrissey (2006) described that sand has a depth of six (6) meters, while sandy- muddy of twelve (12) meters depth and mud is 20 – 30 meters depth in littoral zone. According to Brown, (1990) these substrates are depositional environments characterized by deposits of unconsolidated sediments and accumulation of detritus.

The physico-chemical attributes in the 12 sampling stations in Lianga Bay were conducted in the Month of November and December. In terms of salinity readings, San Agustin has the highest mean values of 31 ppt, followed by Marihatag with the mean value of 28.5 ppt, while Barobo and Lianga obtained the mean values of 27.6 ppt and 27.33 ppt respectively. In terms of temperature Marihatag obtained the highest mean value of 29.6°C, followed by San Agustin, Lianga, and Barobo with mean values of 29°C, 28.6°C, and 27.6°C respectively.

The sampling months, November and December bring colder winds. This maybe considered as one factor in the physico-chemical attributes of the sampling area. According to Almase (1972), the range of salinity readings of 34-35 ppt is reflected normal temperature. However, the sampling area was on the intertidal and on the freshwater channels. There is a fluctuation of salinity readings because of runoff coming from rivers, mountains and other sources. Temperature is a major factor in regulating the distribution and abundance of marine organisms.

As indicated by an R= -0.45 from the abundance of Holothuroids in terms of salinity concentrations (ppt), as the abundance will decrease the salinity concentration will also increase. The high abundance of Holothuroids was observed in not much higher concentration of salinity ranges from 28- 29 ppt.

The relationship between abundance and temperature reveals a negative relationship, as indicated by an R=- 0.16 from the abundance of Holothuroids in Lianga Bay and in terms of temperature (°C). This study reveals that in part of the intertidal zone, Holothuroids favor the temperature condition that ranges from 28- 30°C. Most Holothuroids prefer to remain in seawater, and thus exposure at low tide is a time of serious physiological stress for them. The returning waters during the high tide and runoff coming form the rivers. Moderate temperature and salinity fluctuations were brought on by the previous low tide.

4.0 Conclusion

Results from this study demonstrate a rich assemblage of shoreline Holothuroids in Lianga Bay using quadrat sampling technique. This study provides a preliminary look at the spatial distributions of shore Holothuroids around four (4) municipalities in Lianga Bay. The results seemed to be alarming in other Municipalities because there are only 16 species collected in the wild compared to the previous studies conducted of 35 species of Holothuroids in the area for the past 12 years. It was found out that Holothuroids were distributed according to the type of substrate and distribution is independent of the total area. The morphological adaptations of different species enabled them to occur in specific habitat types.

5.0 Recommendation

It is recommended that further studies should be done in deeper areas in Lianga Bay. The identification of samples will be possible to species level. Municipalities should craft ordinances that will protect the sea cucumber resources in the area for the recovery of this important commodity

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