CHAPTER ONE

INTRODUCTION

The diversity of marine life is most obvious on the bottom where animals have adapted to a multitude of niches with extremely diverse looks and behavior (Soundarapandian, 2015). Benthos is the community of aquatic organism which lives in, above or near the bottom of lake, sea, river streams or any other aquatic environment. Light, temperature, pressure, salinity and depth of water all influence the diversity of the population of this community in a location. These organisms live in benthic zones in the ocean where the nature is very diverse (Lalli & Parsons, 1997). Benthic Community is diversified from species including plants, animals and bacteria from diverse range of food chain (Covich et al., 1999).

There are different types of benthos, some of which hide in sediment throughout their life, some stay on sandy bottom, some are calm and logy and others wander throughout the seabed. Based on the habitats benthos are 2 types; infauna, buried in the bottom into the sediment i.e. worms, and epifauna, stay may be by attaching to a hard surface like rocks, stones or live on the surface of bottom sediments i.e. oysters (Stites, 1999). It can be divided into two more categories based on their size. They are macrobenthos and microbenthos. Macrobenthos are comparatively large organisms living on or near in the bottom. Size varies from minimum 0.5 mm to normally more than 1 mm in length which can be seen in naked eye. Another name of macrobenthos is macrofauna, which includes Seagrass, Echinoderms, sponges, crustaceans and others. Meiobenthos are smaller in size ranges from 0.1 mm to 1.0 mm. Meiobenthos is also known as meiofauna. It includes Gastrotrich, water bears. Microbenthos or microfauna is the community of species living in, on or near the bottom of marine water. Microscope is required to see this microscopic organism (Lalli and Parsons, 1997).

Study of macro and micro benthos is very crucial because of many reasons. Abundance and distribution pattern of these benthos can indicate the types and nature of any ecosystem including bottom condition, soil types, pollution status etc. Both macro and micro fauna play an important role in food chains (Snelgrove, 1998), including as food for humans and some play a critical role in the breakdown of organic matter (Somerfield and Gage, 2000). Living macro, meio and micro fauna and flora are more sensitive to environmental disturbances making them potential bio indicators of the changes in the water and soil environment (Alongi, 1990; Somerfield and Gage, 2000).

Benthos plays a big role in ecosystem by decomposition. Dead organic matter is one of the main sources of energy for benthic species in shallow-water habitats. Benthic invertebrates inferential to produce 20– 73% of riverine leaf inputs to shallow water streams. Benthic invertebrates release good number of nutrients naturally by their feeding activities, excretion, and burrowing into sediments (Lalli and Parsons, 1997). Microbial plant is grown from this solution by the help of algae, bacteria and other aquatic angiosperm. The more benthic microbes increase, the more food source for fishes. Benthos filter large amount of water and pump into their bodies. By this activity sediment and organic matters washed out that clean the water. The unused organic matter felled out on the bottom of the sea bed. That is called reminaralized matter. These reminaralized matters increase primary production rate of the ecosystem. This helps in high growth rate of fish production (Covich et al., 1999).

Benthic animals have an intimate relationship with the substratum and the components, texture and chemical attributes of the sediment has a regulatory effect on the species that can live in any particular area (Sanders, 1968). Many of benthic animals move actively on the bottom and mix the sediments around there and improve the oxygen concentration which help in higher production. For this reason, the benthos is often use as an environmental indicator for determination of the impacts of hydrologic alterations and sediment disturbance (Thrush et al., 1994; Knox, 2000). The Benthic organisms are most versatile on the coastal zone where the fish and other aquatic animals have multifaceted to a vast array of effects. Shallow maritime biological community is highly affected by the gathering of human and environmental changes. It can be providing information regarding the integrated effects of stress due to disturbances, if any and hence spatial and temporal distribution of benthic fauna are good indicators of early warning of potential damage. Studies on benthos are limited (Harkantra, 1982; Parulekar et al., 1982; Joydas and Damodaran, 2001; Joy Das, 2002; Mahapatro, 2006; Jayaraj, et al., 2007; Joydas and Damodaran, 2009) of Cox's Bazar coastal environment. However, the differences in benthic organisms on a marine transect, in the coastal water zone, of a beach with different kinds of sediments.

Himchori beach Point is the zone of tourist attraction of Himchori, Cox's Bazar. The place is locally known as "Battumiar Khamar", which flourished greatly during the last 10 years. A substantial number of human settlement, housing construction, hotels, restaurants, shops and markets and farms has been established to support the tourism activities. All these structures were created mainly by cutting the adjacent hilly region of the beach and are situated just beside the waterline. In a consequence of these development activities, there are some visible changes of sedimentation pattern in the adjacent intertidal zone. Like most of the beaches in the south-eastern coast of Bangladesh, Himchori beach is a muddy beach. This specific area of interest i.e. Himchori beach Point area was also sandy in nature, which seems changed to muddy beach now. There are no records of community structures of benthos of Himchori, Cox's Bazar. This study was undertaken to study the benthic community of Himchori Beach Point with a view to know if there are any influence of this newly deposited muddy beaches on the benthic community structure compared to adjacent sandy beaches in the north and south of Himchori Beach Point.

At the beginning of this work, it was believed that the community structure of benthic organisms in these beaches (muddy and sandy) will differ a lot and will show resembles with similar beaches.

1.1. Objectives of this research

The aims and objectives of this study are: -

i. To compare the benthic community structure of muddy Himchori beach point with adjacent sandy beaches

ii. To understand the influences of newly deposited muddy beaches on the benthic community structure of Himchori beach point

CHAPTER TWO

LITERATURE REVIEW

Sandy beaches provide several ecosystem services such as coastal protection and resilience, water filtration and nutrient mineralization. Beaches also represent a hub for social, cultural and economic relationships as well as educational activities. Increasing urbanization, recreational activities and mechanical beach cleaning represent major anthropogenic disturbances on sandy beaches leading to loss of biodiversity as well as good and services. Information about the impacts of anthropogenic pressures on benthic macro faunal communities could be useful to assess the environmental status of sandy beaches and to promote a sustainable use of beach ecosystem (Afghan et al., 2020).

Natural sandy beaches provide key ecosystem services such as balancing transport, storage of sand, increasing coastal protection and resilience (Short, 1996; Nel et al., 2014; Parlagreco et al., 2000). Sandy beaches also offer water filtration (Huettel, 2000), shape energy fluxes between biotic and abiotic components (Pacheco et al., 2010), modulate bentho-pelagic exchange into sediments (Volkenborn et al., 2007) and allow the establishment of trophic relationships among marine and dune ecosystems (Defeo, 2009).

There is an increasing pressure on shoreline due to coastal engineering (Dafforn et al., 2015; Pioch et al., 2018; Morris et al., 2019), and several other anthropogenic activities like trampling, mechanical beach cleaning and motor vehicle traffic that impact the sandy beach environments at different spatial and temporal scale (Devenport, 2006; Schlacher, 2007; McLachlan, 2013, Machado et al., 2017). Besides the vital role of sandy beaches in modern society, the ecological and socioeconomic impacts are not investigated appropriately (Cardoso et al., 2015). Anthropogenic changes in sandy beaches had been there since long time and are projected to become even more intense in coming decades (Defeo, 2009). These activities could potentially alter habitat features and macrofaunal community structure resulting in the loss of biodiversity (Reyes-Martínez et al., 2015), loss of ecosystem services and difficulties in facing climate crisis. Benthic macrofauna living in soft substrates plays a pivotal role in particles reworking, nutrient cycling (Aller, 1988; Kristensen et al., 2012;

D'Andrea, 2009) and serving as food for other organisms (Constable, 1999; Carvalho et al., 2018).

Ecological status of submerged sandy beaches can be assessed by analyzing the composition and abundance of macrofauna and through the elaboration of biotic indexes (Borja, 2000; Muxika, 2007); however, these indexes put in evidence the sensitivity to organic enrichment and they do not consider effects of other forms of impact. Macrofauna living in the intertidal zone can be particularly vulnerable to beach activities (Reis, 2019; Burnett, 2019; Bessa et al., 2013, 2014).

In recent decades, there are some studies based on understanding the response of macrofaunal communities and populations towards physical disturbances (Veloso et al., 2006, 2008, 2010). Community structure of macro-, meio- and microfauna hosted in beach environments is influenced by the interaction of several physico-chemical factors such as sand granulometry, mineralogy and tides or beach exposure (Defeo et al., 2009; Wright, 1984; Dexter, 1992; Barboza, 2015), suggesting that alteration of natural beach dynamics due to human pressure could affect ecological traits of these organisms and overall functioning of beach ecosystem (Thrush et al., 2017).

2.1. Macrobenthos

Benthic macrofauna live in constant contact with the sediment (sand, mud) during their adult life stages and constitute an important part of the species inhabiting beaches and estuaries, both in quantity and diversity. These species (worms, molluscs, crabs, shrimps, etc...) are largely sedentary and interact both with each other and with their environment, to constitute a constantly evolving macrobenthic community. It is therefore critical to have an accurate knowledge on the characteristics of these communities, especially on their spatial distribution, a necessary step before attempting to implement actions of conservation for these systems (Cabioch et Gentil, 1975; Cabioch et Glaçon, 1975; Cabioch et Glaçon, 1977; Souplet et Dewarumez, 1980; Souplet et al., 1980; Prygiel et al., 1988 ; Davoult et al., 1988; Gentil et Cabioch, 1997; Desroy et al., 2003 ; Foveau, 2009).

Macrobenthos in coastal environment that play a significant role in the food web. It could also use as a good indicator of aquatic ecosystem health. The abundance and composition of macrobenthos in Bakkhali channel system, Cox's Bazar were conducted in relation to the soil parameters. Samples were collected using Ekman Berge bottom grab from five different stations of Bakkhali channel. Macrobenthos were comprised of five major groups namely Polychaeta (9.96-30.31%), Oligochaeta (3.68-59.707%), Crustacea (0.02-58.40%), Bivalvia (1.40-82.09%) and Gastropoda (0.08-4.25%). Total number of macrobenthos was higher at station I (9000 individual's m-2) and station II (8517 individuals m-2) compared to other stations. Shannon diversity index among the stations ranged from 0.65-1.04. Soil pH and soil moisture ranged from 6.1-6.4 and 23.44-31.29%, respectively. The highest organic carbon concentration was observed at station I (2.11%) and lowest at station III (1.40%). Maximum fraction of sand by weight was found at stations II (81.88%) and III (87.88) while the highest fraction of clay (21.52%) and silt (8.0%) were recorded in station I. It was observed that benthic bivalves were positively correlated ($r = 0.891$, $p>0.05$) with silt fraction of the sediments (Abu et al., 2012). Intertidal stations were numerically dominated by the polychaete, the amphipod and the bivalve (Knott et al., 1983).

2.2. Microbenthos

Microbenthos comprises all the small organisms, protozoa (excluding fora-minifera, i.e. ciliates, amoebae and flagellates), bottom diatoms and bacteria. The word micro-organisms here denotes all the members of the microbenthos. The fauna of intermediate size has been called the microfauna (Krogh & Sparck, 1936; Rees, 1940), and Remane used the term to include small metazoa and some protozoa. In a freshwater deposit including small metazoa and such protozoa as were found by direct searching under the term microfauna; some small metazoa appeared also in the lists of the macrofauna (Rawson, 1930). This use of the term seems rather unsatisfactory and inadequate for the present study. Bacteria are frequently called the micro-organisms of the sea bottom, but the omission of protozoa and diatoms has been largely on account of lack of knowledge of these groups. The exact limits of the macro, meio- and microbenthos will probably vary according to the habitat under consideration and the methods which have to be employed for collection. The two larger groups can be separated according to size, depending on the mesh of the sieves employed for their extraction from the deposit. The groups can also be separated on the basis of weight, the weights of the microbenthos being deduced from volumes. The difference in generation time provides a further reason for separating the foraminifera with the small metazoa from the micro-benthos (Mare, 1942). Various groups of the White Sea microbenthos have been studied in various depths. While free-living ciliates in the region are relatively well studied, both in taxonomic and eco-logical aspects (Burkovsky, 1970; Burkovsky and Mazei, 2010; Mazei and Burkovsky, 2005; Mazei and Burkovsky, 2006; Raikov, 1962), information regarding the diversity ofbenthic diatoms is rather scarce (Bondarchuk, 1980; Saburova, 1995; Tchesunov et al., 2008).

CHAPTER THREE

MATERIALS AND METHODS

3.1. Study area

Himchori Beach Point area is located around 12 km south from the main town of Cox’s Bazar, Bangladesh (Figure 1). The geographical position of this area lies between 21^{0}20’40.6” N to 21^{0}19’56” N Latitude and 92^{0}1’43.7” E to 92^{0}1’53.7” E longitude. The area is about 1.22 km^2. This location is directly influenced by semi-diurnal tides and climatology impacted by monsoon winds where it is consisted mostly of mud in upper part and sandy particles in the lower zone. This location is selected for this research purpose because it seemed unique due to its special muddy characteristics.

Figure 1. Map of the study area.

At the beginning a sampling design consisting of five sampling positions were selected purposely considering three stations namely A, B and C representing the main newly deposited location, one station from left (Station X), right (Station Y). Three samples were collected from upper, middle and lower part of each station considering the station as a transect. An average distance of 0.305 km was maintained between upper and middle and also middle and lower part of each transect (Figure 2). The GPS position of these five stations are given in Table 1.

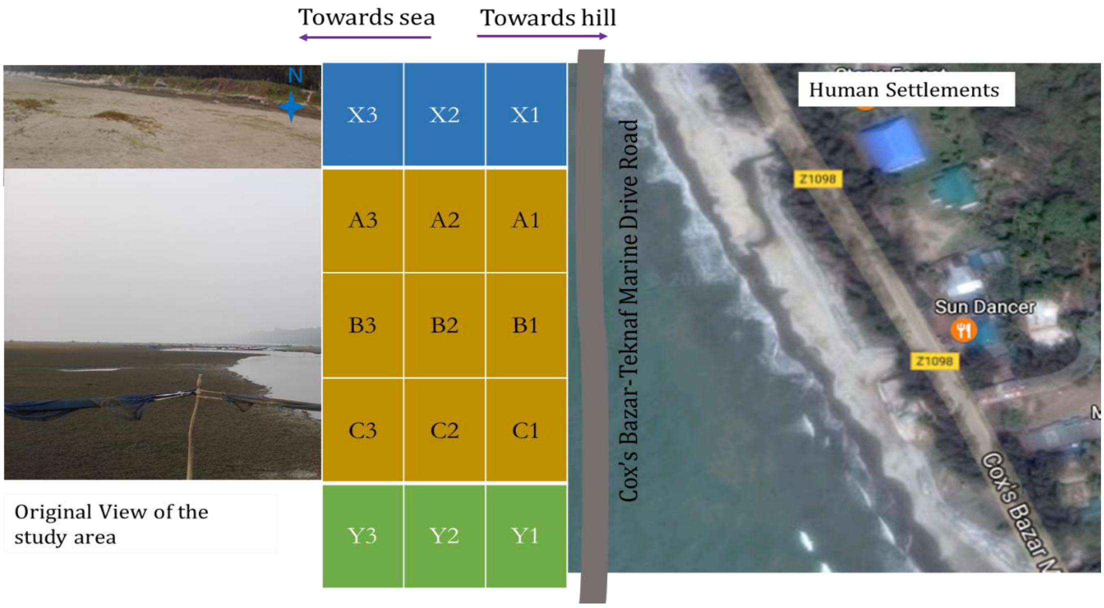

Figure 2. Map of the study area showing the sampling stations. Right part shows the map view of the study area, middle colored table describes the sampling design and left side's photographs are taken from the study area.

Table 1. Station name with their GPS coordinate.

Station name	GPS coordinate
X	21°30′ 38.8″ N 92°01′ 39.2″ E to 21°20′37.8″ N 92° 01′ 36.2″ E
A	21°20′ 34.3″ N 92° 01′ 48.2″ E to 21°20′ 31.6″ N 92° 01′ 37.5″ E
B	21°20′ 12.3″ N 92° 01′ 51.6″ E to 21°20′ 10.8″ N 92° 01′ 38.1″ E
C	21°20′ 0.05″ N 92° 01′ 38.1″ E to 21°20′ 03.2″ N 92° 01′ 36.3″ E
Y	21°19′ 56.0″ N 92° 01′53.7″ E to 21°19′ 51.4″ N 92° 01′ 38.4″ E

3.2. Research Plan and Working Schedule

Sampling activities (Table-2) were carried out in July, 2019 to February, 2020.

Table 2. Working Schedule for conducting the research.

Time	2019			2020	
	Jul	Aug	Sep	Jan	Feb
Literature Review	|||||				
Research Planning		|||||			
Sampling Design		|||||			
Sample Collection			|||||	|||||	
Sample Identification			|||||	|||||	
Result Analysis				|||||	
Thesis Drafting				|||||	
Draft Editing					|||||
Thesis Submission					|||||

3.3. Sample Collection and Preservation

A hand held round shaped mud corer was used to collect benthic fauna from the sampling stations. From each station, three sediment were collected longwise. Each sample was taken into polyethene bag and marked properly according to the GPS data serially. Then the samples were transferred into bucket and mixed with water one by one. After that, the sample sediment mixed water was sieved through net of mesh size 1.0 mm and 0.35 mm sequentially to retain the desired macro and micro fauna and also to remove fine sediments and any other extraneous material. Finally, the remainders were preserved in labeled small plastic containers with 5% and 10% formalin and brought to laboratory for further analysis (Cummins, 1962).

3.4. Sample Processing and Sorting

Samples collected and preserved in the field were returned to the laboratory for further processing. The sample was washed and different sized floating debris were removed through gentle water flow. Prior to species sorting, small amount of 'Rose Bengal' was applied in each sample to increase visibility of organisms though in some cases 'Rose Bengal' stained some parts of detritus (Ciborowski, 1991).

Species sorting was consisted of picking up from the sieved material all the animals that were alive at the moment of the sampling. Large samples were subdivided into sub-samples of roughly equal size that can be sorted more comfortably. The sub-samples were placed in different jars with preserving solution and labelled. A small quantity of unsorted material is placed on a tray for an initial general sorting for larger organisms with the help of a magnifying lens. Shell fragments, vegetal debris or coarse detritus in the sample were rinsed in a separate container and checked for the presence of invertebrates. Large organisms were placed immediately in appropriate containers making sure that no other smaller animals were attached to their bodies. Fine sorting was performed under a dissection microscope. During this phase, a small quantity of the sample was spread onto a Petri dish and carefully examined to identify the organisms. Organisms were picked up and placed in different containers according to the main taxonomic groups, usually polychaetas, other worms (oligochaetes, nematodes, etc.), bivalves, gastropods, amphipods, other crustaceans, insects, and cnidarians (Ciborowski, 1991).

3.5. Identification

Once sorted, benthic organisms were identified to the possible taxonomic level. The instruments used in identification are compound microscopes. Identification was done with help of identification keys as there are keys for any major group of organisms, for example, gastropods, bivalves, amphipods etc. For correct identification, accurate analytical keys for the geographic region from which the samples taken were used. To catalogue species correctly, the regional and international checklists of species (e.g. Integrated Taxonomic Information System 'ITIS') were consulted (Ahmed, 1990; Alam, 1993; Arnold and Birtles, 1989; Chuang, 1961; Harkanta and Parulekar, 1985; Huys et al., 1996; Day, 1967; and Fauchald, 1977).

3.6. Statistical Analysis

All the identified species were categorized first. Number of individuals recorded from each sub-sample were summed up. Thus 9 sub-samples of Station A, B and C are counted together and shown as representative sample of Station A, i.e. muddy beach of Himchori Beach Point. 3 sub-samples of Station X and Station Y are calculated together. For the ease of comparison, the values of observations are multiplied by three and finally shown as Station X and Station Y.

Calculation and statistical analysis were accomplished by using MS-Excel, office 2016.

CHAPTER FOUR

RESULTS

4.1. Macro benthos

A total of twenty species of benthos were found at Station A, Station X and Station Y (Table 3). Out of 20 species, maximum 13 species were found at Station A. At Station X and Station Y, 9 and 5 species of macro benthos were found respectively. Number of individuals were 84, 84 and 129 at Station A, Station X and Station Y, respectively. Photographs of some benthic species of Himchori beach Point are shown in Figure 3 and 4.

Table 3. List of macro benthos found from Himchori Beach Point.

Sl. No	Macro benthos	Station A	Station X	Station Y
1	Isopoda	1	0	0
2	Maldanidae	1	0	0
3	Ostracoda	3	0	0
4	Snail	7	0	0
5	Mesogastropoda	33	12	9
6	Nematoda	2	0	0
7	Corbicula	11	0	0
8	Polybranchia	3	0	0
9	Amphipoda	0	3	0
10	Surf Clam	16	21	30
11	*Pila globosa*	3	30	30
12	Crab larvae	1	0	0
13	Unidentified sp.	1	0	0
14	Whelk	0	6	6
15	*Urothoe sp.*	0	3	0
16	Common blue mussel	0	3	9
17	Opalinidae	0	3	0

18	Ribbed mussel	0	3	0
19	Ponderous ark	0	0	45
20	Nephtys polybranchia	2	0	0
	Total	84	84	129

The percentage of total individuals of macro benthos at each station are shown at Table 3. In Station A, the most dominant species was Mesogastropoda comprising 39.29% of total individuals followed by Surf Clam (19.04%) and Corbicula (13.10%). The lowest percentage of individuals were found of Isopoda, Maldanidae, Crab larvae, Unidentified sp. each with 1.20% of total individuals at Station A.

In Station X, the highest percentage (35.71%) of individuals of *Pila globosa* was recorded. The second most dominant species was Surf Clam (25%) followed by Mesogastropoda (14.30%). While the lowest dominant species was Urothoe sp., Common blue mussel, Opalinidae, Ribbed mussel comprising 3.57% of total individuals of macro benthos.

In Station Y, Ponderous ark comprised the highest percentage of individuals (34.90%) followed by Surf Clam and *Pila globosa* (23.30%). 7% of Mesogastropoda and Common blue mussel was recorded. Here, the lowest dominant species was whelk (4.70%).

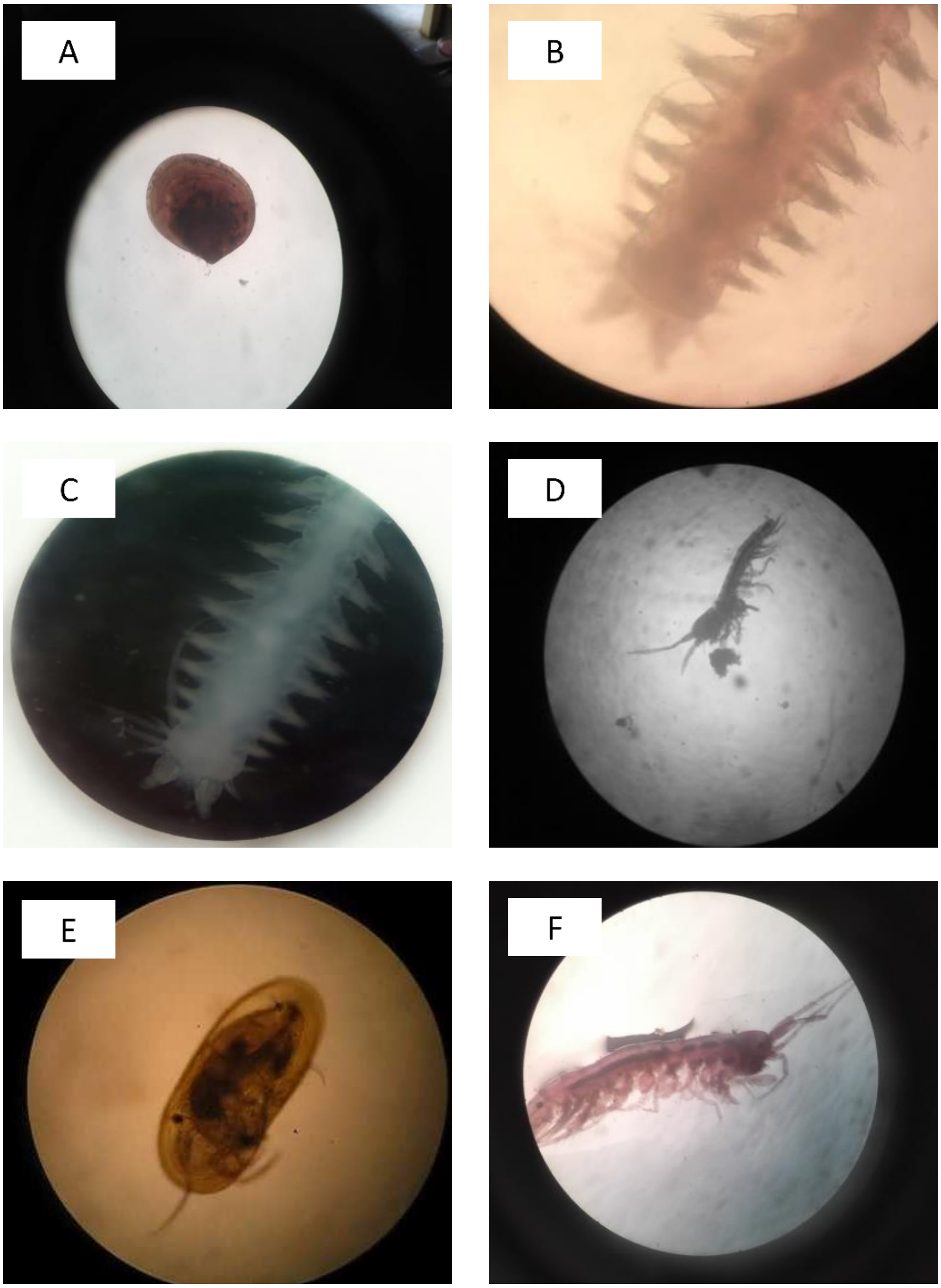

Figure 3. Microscopic Photographs of some benthic species of Himchori Beach Point. *A. Corbicula*, *B. Perinereis sp.*, *C. Nephtys*, *D. Isopoda sp.*, *E. Ostracoda and F. Corophium sp.*

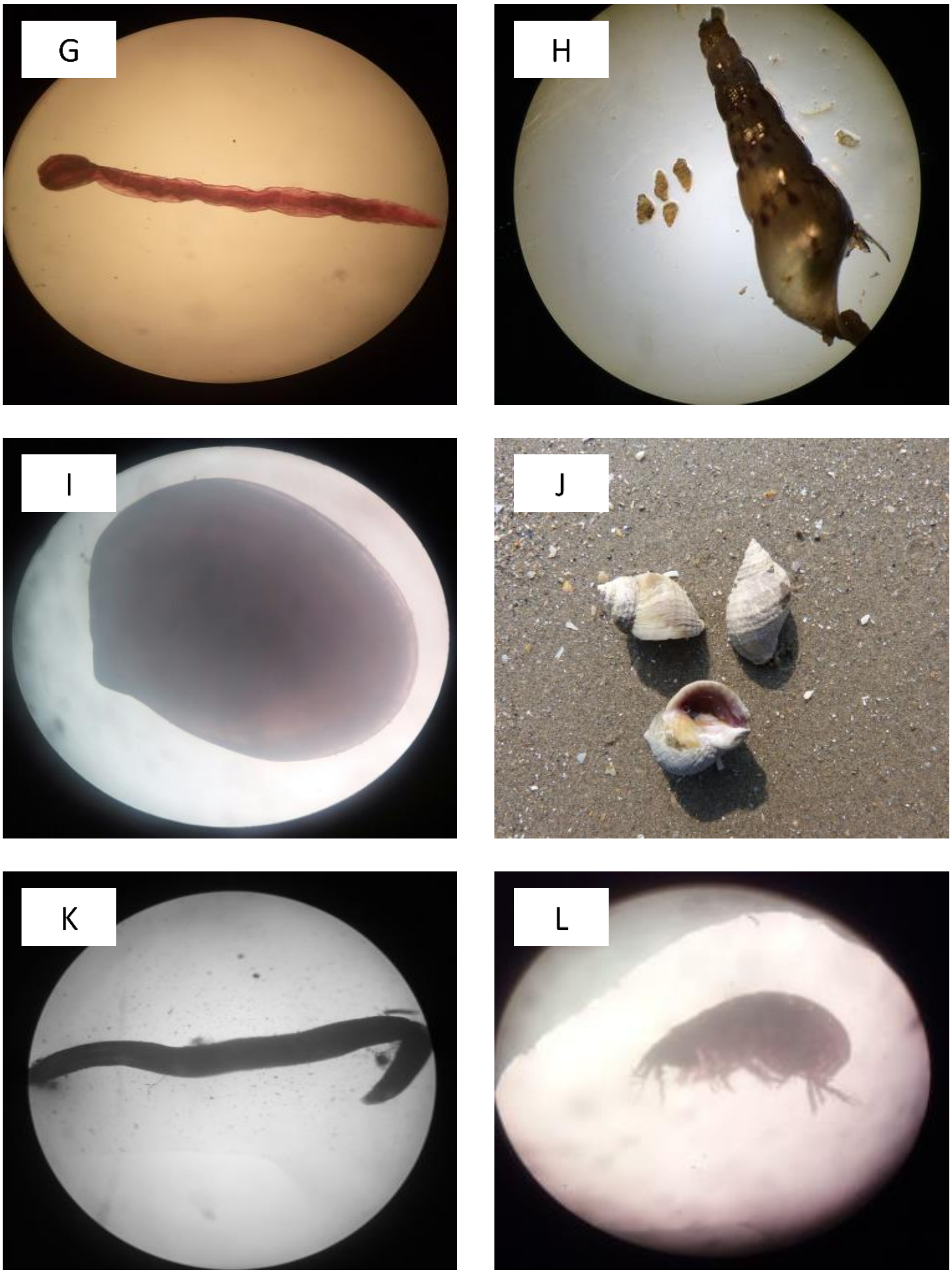

Figure 4. Photographs of some benthic species of Himchori Beach Point. *G. Polychaeta, H. Mesogastropoda, I. Corbicula, J. Whelk, K. Nematoda and L. Amphipoda.*

Table 4. Percentage of composition of macro benthos recorded from Himchori Beach point

Sl. No.	Macro Species	Station A	Station X	Station Y
1	Isopoda	1.20%	0%	0%
2	Maldanidae	1.20%	0%	0%
3	Ostracoda	3.56%	0%	0%
4	Snail	8.33%	0%	0%
5	Mesogastropoda	39.29%	14.30%	7%
6	Nematoda	2.38%	0%	0%
7	Corbicula	13.10%	0%	0%
8	Polybranchia	3.57%	0%	0%
9	Amphipoda	0%	3.57%	0%
10	Surf Clam	19.04%	25%	23.30%
11	*Pila globosa*	3.56%	35.71%	23.30%
12	Crab larvae	1.20%	0%	0%
13	Unidentified sp.	1.20%	0%	0%
14	Whelk	0%	7.14%	4.70%
15	*Urothoe sp.*	0%	3.57%	0%
16	Common blue mussel	0%	3.57%	7%
17	Opalinidae	0%	3.57%	0%
18	Ribbed mussel	0%	3.57%	0%
19	Ponderous ark	0%	0%	34.90%
20	*Nephtys polybranchia*	2.37%	0%	0%
	Total	100%	100%	100%

4.2. Micro benthos

The numbers of micro benthos species were 18 at Station A, Station X and Station Y (Table 5). Out of 20 species, maximum 15 species were found at Station A. At Station X and Station Y, 4 and 2 species of macro benthos were found respectively. Numbers of individuals were 77, 30 and 39 at Station A, Station X and Station Y, respectively. The percentages of total individuals of macro benthos at each station are shown at Table 5. In Station A, the most dominant species of micro benthos was Nephtys comprising 27.27% of total individuals followed by Mesogastropoda (16.87%) and Nematoda (11.70%). The lowest percentage of individuals were found of Corophium sp., Polybranchia, Polychaeta, Surf clam, Mysidae, each with 1.30% of total individuals at Station A.

Table 5. List of micro benthos found from Himchori Beach Point.

Sl. No	Micro Species	Station A	Station X	Station Y
1	Isopoda	3	0	0
2	Maldanidae	6	0	0
3	Mesogastropoda	13	3	0
4	Nematoda	9	0	0
5	Nephtys	21	0	0
6	Corbicula	8	0	0
7	*Perinereis sp.*	2	0	0
8	Polybranchia	1	0	0
9	Amphipoda	4	0	0
10	Surf Clam	1	0	3
11	*Corophium sp.*	1	0	0
12	Polychaeta	1	0	0
13	Shrimp Larvae	2	0	0
14	*Pila globosa*	4	0	0
15	Mysidae	1	0	0
16	*Urothoe sp.*	0	12	0
17	Bivalves	0	12	0
18	Unionidae	0	3	36
	Total	77	30	39

In Station X, only four species and 30 individuals of micro benthos were identified. Four bivalve and Urothoe sp. are the dominant group. Both comprises 40% of total individuals. While the other two species Unionidae and Mesogastropoda comprises the remaining 10% of total individuals.

The lowest amount (only two) of species were recorded from Station Y and the number of recorded individuals were 39. Unionidae was the dominant group comprising 92.30% of individuals alone. The remaining 7.70% are comprises by the other group of Surf clam.

Table 6. Percentage of composition of micro benthos recorded from Himchori Beach Point.

Sl. No.	Micro Species	Station A	Station X	Station Y
1	Isopoda	3.90%	0%	0%
2	Maldanidae	7.80%	0%	0%
3	Mesogastropoda	16.87%	10%	0%
4	Nematoda	11.70%	0%	0%
5	Nephtys	27.27%	0%	0%
6	Corbicula	10.40%	0%	0%
7	*Perinereis sp.*	2.60%	0%	0%
8	Polybranchia	1.30%	0%	0%
9	Amphipoda	5.18%	0%	0%
10	Surf Clam	1.30%	0%	7.70%
11	*Corophium sp.*	1.30%	0%	0%
12	Polychaeta	1.30%	0%	0%
13	Shrimp Larvae	2.60%	0%	0%
14	*Pila globosa*	5.18%	0%	0%
15	Mysidae	1.30%	0%	0%
16	*Urothoe sp.*	0%	40%	0%
17	Bivalves	0%	40%	0%
18	Unionidae	0%	10%	92.30%
	Total	100%	100%	100%

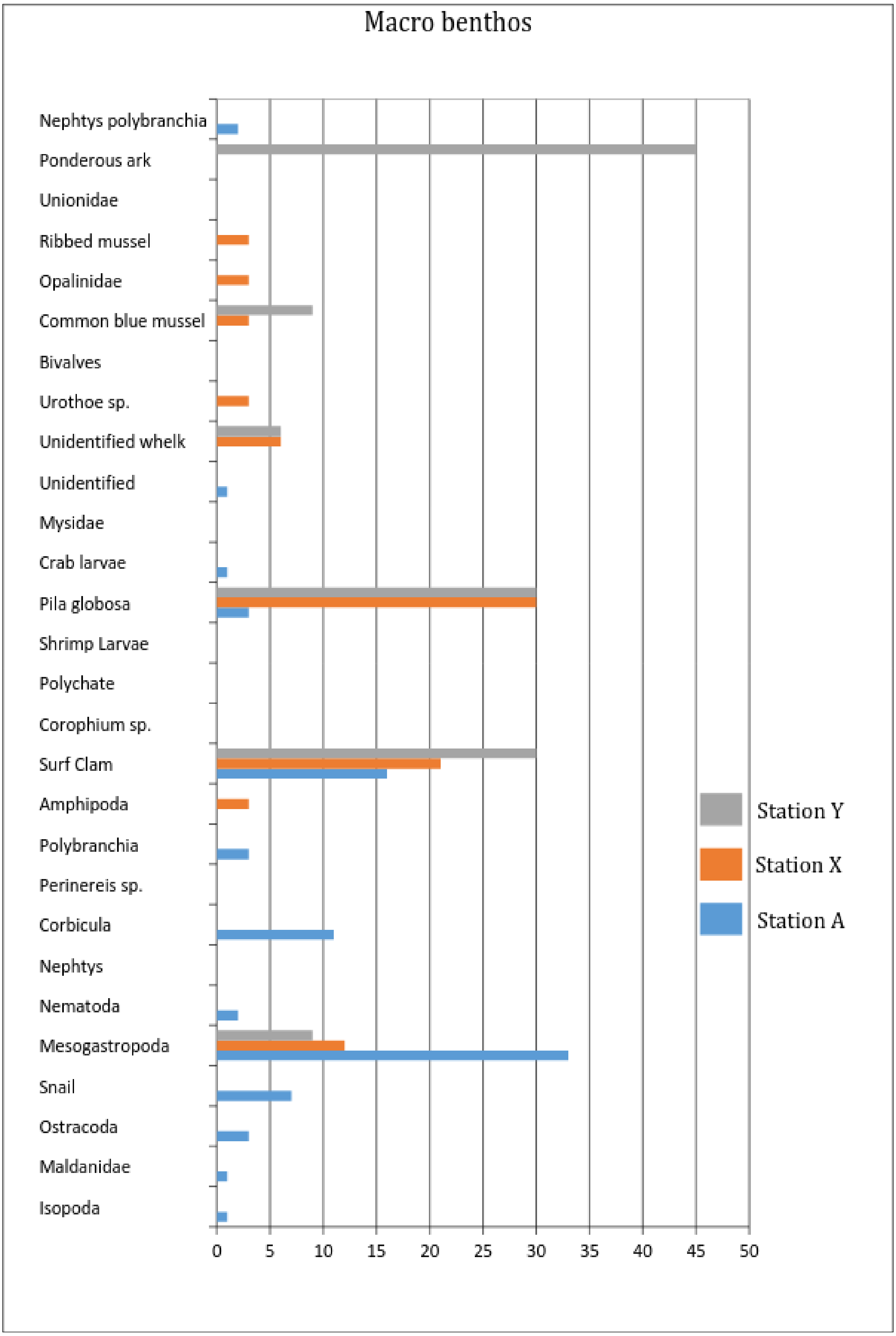

Figure 5. Abundance and distribution pattern of macro benthos in Himchori Beach Point.

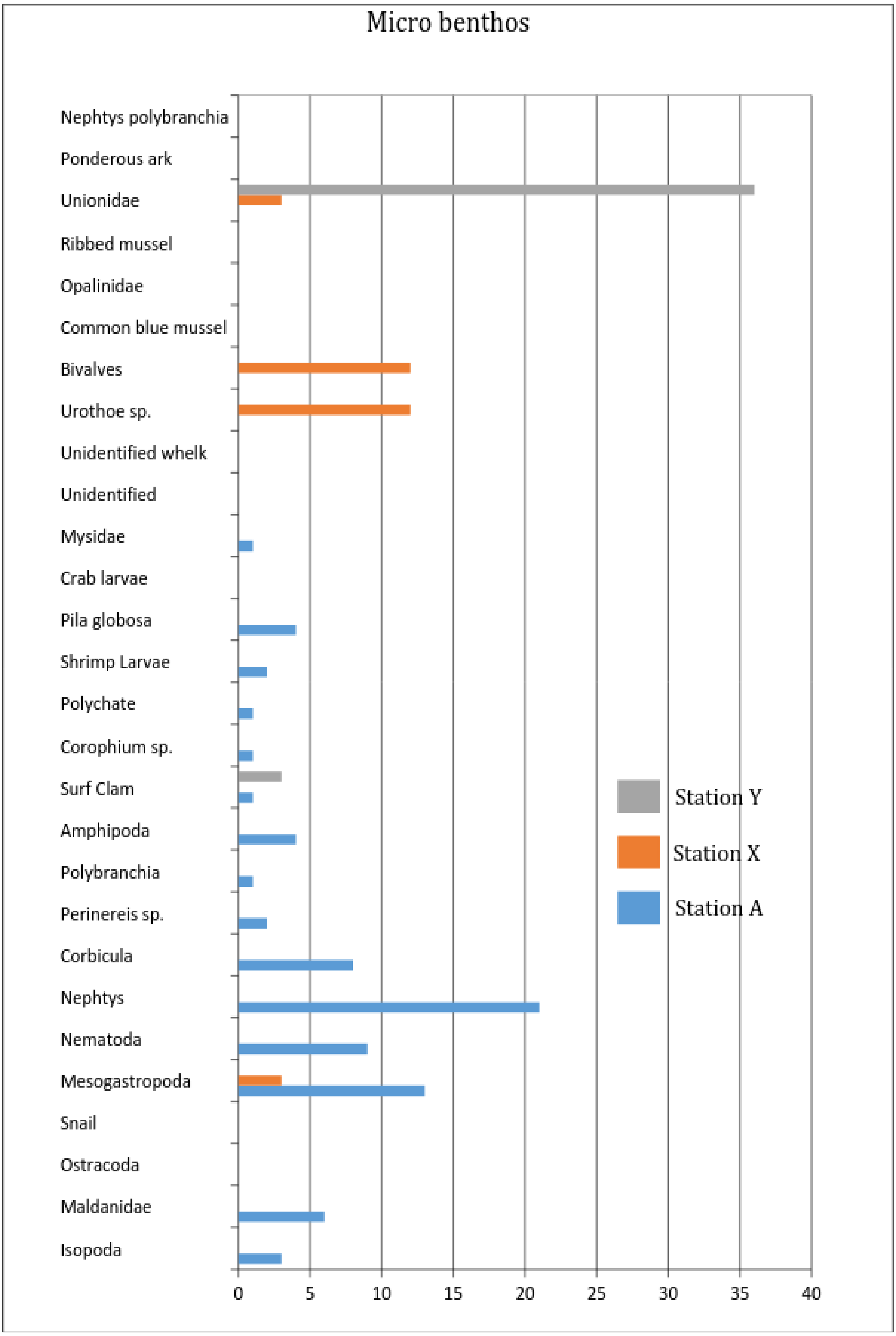

Figure 6. Abundance and distribution pattern of micro benthos in Himchori Beach Point.

CHAPTER FIVE

DISCUSSION

This study was carried out with a view to identify the community structure of benthic organism in Himchori Beach Point, Cox's Bazar. A total of 20 species of macro benthos and 18 species of micro benthos were identified in the study area.

5.1. Macro benthos

Earlier a study on composition of macrobenthos recorded all the major groups of macro benthos namely Polychaeta, Oligochaeta, Crustacea, Bivalvia and Gastropoda in the Bakkhali channel system, Cox's Bazar (Abu et a., 2012). The study also tried to find out if there are any differences between benthic community in a newly deposited muddy beach (Station A) and existing sandy beaches in north (Station X) and south (Station Y) part of the muddy beach. In both types of benthos (macro and micro) the differences were observed through this study. For example, ten species of macro benthos were found only in the station A, these are Isopoda, Maldanidae, Ostracoda, Snail, Nematoda, Corbicula, Polybranchia, Crab larvae, Unidentified sp. and Nephtys polybranchia (Figure 5). Similarly, two species of macro benthos were found only in sandy beaches of Station X and Y but not in the newly deposited muddy beach comprising the Station A (Figure 5). These species are Common blue mussel and Whelk. Though, three species of macro benthos (*Pila globosa*, Surf clam and Mesogastropoda) were common in all station of this study area. Macro benthos blue mussel and whelk were described common in some other sandy shores (Alongi, 2016; and Felix et al., 2016). Abundance of macrobenthos depends on soft sediment surface and concentration of high detritus and organic matter (Abu et al., 2012).

5.2. Micro benthos

In case of micro benthos distinct differences were also recorded through this study between the newly deposited muddy beach and the sandy beaches in north and south. Thirteen species of microbenthos out of eighteen species were restricted to the newly deposited muddy beach (Figure 6). These species are Isopoda, Maldanidae, Nematoda, Nephtys, Corbicula, *Perinereis sp.*, Polybranchia, Amphipoda, *Corophium sp.*, Polychaeta, Shrimp Larvae, *Pila globosa* and Mysidae. Contrary to this only one species 'Unionidae' was common in Station X and Y and absent in muddy beach of Station A. Micro benthos species Bivalves and *Urothoe sp.* were confined to the sandy beach of north (Station X). From this study, it can be said that some species of benthic organisms are abundant only in muddy beach while some other species are identical to sandy shore. Of course, there should be some other species which are common in muddy shore as well as sandy shore.

Again, from these differences in the abundance and distribution pattern of both macro and micro benthos of three study stations in Himchori Beach Point, it can be concluding that the newly deposited beach which visually seems muddy is different from the existing sandy beaches of north and south part. Probably, this newly deposited beach is of muddy characters. Abundance and distribution of benthos, e. g. benthic bivalves found positively correlated with silt fraction of the sediments (Abu et al., 2012).

The study also revealed that biodiversity of the muddy beach was more rich compare to sandy beaches in the north and south of the Himchori Beach Point. This was true for both the number of species and number of individuals. Similar observation was found species richness of macrobenthic community is positively influenced by dissolved oxygen and percentage of silt while it was negatively influenced by percentage of sand and particle density (Islam, 2013). Species distribution and community structure of benthic organisms are more strongly influenced by sediment particle characteristics than by the chemical properties of the water (pH and salinity) (Hossain and Marshall, 2014).

Species of macro benthos were dominant regarding number of species and number of individuals than micro benthos throughout the study area of Himchori Beach Point.

CHAPTER SIX

CONCLUSION

The marine drive road connecting the southern tip 'Teknaf' with Cox's Bazar is very crucial one mainly for transportation and tourism perspective. Problems associated with sedimentation around this region generally occur because of human interference in the form of settlement and development. This study was carried out to evaluate the short-term changes in the adjacent inter-tidal zone by means of studying the differences in abundance and distribution of benthic organism. This study revealed that there are some differences between newly deposited muddy beach and existing sandy beaches in north and south part of the muddy beach, which in terms can be concluded that structure of benthic community can lead to identify the environmental changes occurred by human alteration and can also create scope for future assessment of the benthos in response to urbanization.

CHAPTER SEVEN

RECOMMENDATION

Assessment of benthic community distribution leads to reveal the reason of spatial diversity and their impacts. This study depicted how muddy environment within the sandy beach area changes due to the urbanization and marine drive road development leads to change the distribution of macro and micro benthos distribution in the study area. The study also revealed that biodiversity of the muddy beach was more rich compare to sandy beaches in the north and south of the Himchori Beach Point. In this case related authority should take proper measures in building infrastructure to keep the vegetation level up to the mark and mud from the hill-slide should keep away from the beach.

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APPENDIX

Table 3. List of macro benthos found from Himchori Beach Point.

Sl. No	Macro benthos	Station A	Station X	Station Y
1	Isopoda	1	0	0
2	Maldanidae	1	0	0
3	Ostracoda	3	0	0
4	Snail	7	0	0
5	Mesogastropoda	33	12	9
6	Nematoda	2	0	0
7	Corbicula	11	0	0
8	Polybranchia	3	0	0
9	Amphipoda	0	3	0
10	Surf Clam	16	21	30
11	*Pila globosa*	3	30	30
12	Crab larvae	1	0	0
13	Unidentified sp.	1	0	0
14	Whelk	0	6	6
15	*Urothoe sp.*	0	3	0
16	Common blue mussel	0	3	9
17	Opalinidae	0	3	0
18	Ribbed mussel	0	3	0
19	Ponderous ark	0	0	45
20	Nephtys polybranchia	2	0	0
	Total	84	84	129

Table 4. Percentage of composition of macro benthos recorded from Himchori Beach Point.

Sl. No.	Macro Species	Station A	Station X	Station Y
1	Isopoda	1.20%	0%	0%
2	Maldanidae	1.20%	0%	0%
3	Ostracoda	3.56%	0%	0%
4	Snail	8.33%	0%	0%
5	Mesogastropoda	39.29%	14.30%	7%
6	Nematoda	2.38%	0%	0%
7	Corbicula	13.10%	0%	0%
8	Polybranchia	3.57%	0%	0%
9	Amphipoda	0%	3.57%	0%
10	Surf Clam	19.04%	25%	23.30%
11	*Pila globosa*	3.56%	35.71%	23.30%
12	Crab larvae	1.20%	0%	0%
13	Unidentified sp.	1.20%	0%	0%
14	Whelk	0%	7.14%	4.70%
15	*Urothoe sp.*	0%	3.57%	0%
16	Common blue mussel	0%	3.57%	7%
17	Opalinidae	0%	3.57%	0%
18	Ribbed mussel	0%	3.57%	0%
19	Ponderous ark	0%	0%	34.90%
20	*Nephtys polybranchia*	2.37%	0%	0%
	Total	100%	100%	100%

Table 5. List of micro benthos found from Himchori Beach Point.

Sl. No	Micro Species	Station A	Station X	Station Y
1	Isopoda	3	0	0
2	Maldanidae	6	0	0
3	Mesogastropoda	13	3	0
4	Nematoda	9	0	0
5	Nephtys	21	0	0
6	Corbicula	8	0	0
7	*Perinereis sp.*	2	0	0
8	Polybranchia	1	0	0
9	Amphipoda	4	0	0
10	Surf Clam	1	0	3
11	*Corophium sp.*	1	0	0
12	Polychaeta	1	0	0
13	Shrimp Larvae	2	0	0
14	*Pila globosa*	4	0	0
15	Mysidae	1	0	0
16	*Urothoe sp.*	0	12	0
17	Bivalves	0	12	0
18	Unionidae	0	3	36
	Total	77	30	39

Table 6. Percentage of composition of micro benthos recorded from Himchori Beach Point.

Sl. No.	Micro Species	Station A	Station X	Station Y
1	Isopoda	3.90%	0%	0%
2	Maldanidae	7.80%	0%	0%
3	Mesogastropoda	16.87%	10%	0%
4	Nematoda	11.70%	0%	0%
5	Nephtys	27.27%	0%	0%
6	Corbicula	10.40%	0%	0%
7	*Perinereis sp.*	2.60%	0%	0%
8	Polybranchia	1.30%	0%	0%
9	Amphipoda	5.18%	0%	0%
10	Surf Clam	1.30%	0%	7.70%
11	*Corophium sp.*	1.30%	0%	0%
12	Polychaeta	1.30%	0%	0%
13	Shrimp Larvae	2.60%	0%	0%
14	*Pila globosa*	5.18%	0%	0%
15	Mysidae	1.30%	0%	0%
16	*Urothoe sp.*	0%	40%	0%
17	Bivalves	0%	40%	0%
18	Unionidae	0%	10%	92.30%
	Total	100%	100%	100%

Photo Gallery

Some picture of field work:















Some picture of lab work:

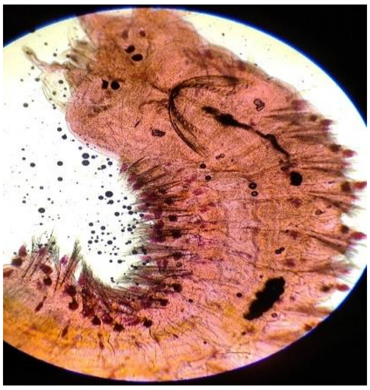
  

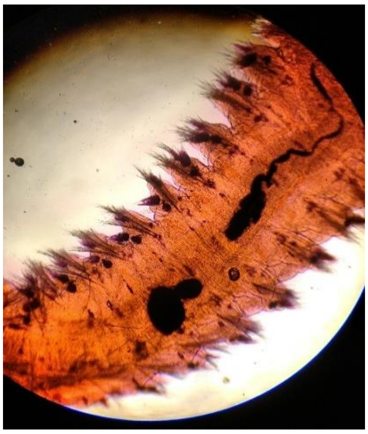
Some picture of benthos:




















Brief Biography of the Author

This is Md. Shafikul Alam; son of Ikbal Hossen and Nur Kusum Begum from Chandanish Upazila under Chattogram district of Bangladesh. He passed the Secondary School Certificate Examination in 2009 from Barkal S.Z High School and Higher Secondary Certificate Examination in 2012 from B.A.F Shaheen College, Chattogram. He obtained his B. Sc. in Fisheries (Hons.) Degree in 2017 from Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University (CVASU), Chattogram, Bangladesh. Now, he is a candidate for the degree of MS in Marine Bioresource Science under the Department of Marine Bioresource Science, Faculty of Fisheries, CVASU. He has great interest on scientific research on Marine Science.