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Abundance of Macrobenthos with Special Reference to Some Physico-Chemical Parameters of South-Eastern Coastal Area, Bangladesh

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Abstract: Benthic communities are important to any aquatic ecosystem and form important food source for most organisms especially fish. The study about macro benthos was carried out in a canal of south-eastern coast of Bangladesh with some physico-chemical parameters of water and soil during post and pre-monsoon seasons. The canal originates from hilly areas and opens into the Bay of Bengal. Polychaetes were the most abundant group followed by Oligocheates Bivalves crabs during post-monsoon. Oligocheates were the most abundant group followed by Polychaetes, Bivalves during pre-monsoon. Salinity showed positive significant relationship with the Polycheates and as well as Phosphate-Phosphorus. A negative significant relationship was found between Chemical Oxygen Demand (COD) and Oligocheates abundance in the investigated canal and a positive relationship was found between Total Suspended Solids and Oligocheates abundance. There was no relationship among the parameters of water as well as soil and crab abundance. The abundance of macro benthos is useful indicators of the condition of the canal and of the canal habitat as a whole. The effect of anthropogenic induced stressors had resulted in an unstable physically controlled environment characterized by a low density of macrobenthos.

Key words: Benthic communities, physico-chemical parameters, monsoon seasons, south-eastern coast of Bangladesh.

Introduction

Bangladesh is said to be the land of rivers. Increasing industrialization and unplanned urbanization have greatly transformed the natural environment, particularly water sector or natural hydrological system of Bangladesh. Bangladesh is criss-crossed by numerous small and large rivers. Most of the country is drained by rivers, tributaries and canals numbering about 230. Besides this, there are some canals which carry water for Bay of Bengal. During high tide these canals become filled by the tidal water and during low tide they become exposed maintaining a level of water which comes from upstream area (Barua and Chakrabarty, 2011; Barua and Chowdhury, 2011; Barua and Rahman, 2016; Barua et al., 2017a; Barua and Rahman, 2018).

Biological production of river and canal shows that water parameters, in that ecosystem depends on the physical, chemical, biological and ecological factors. Such aquatic ecosystem benthic fauna is important for food recycle; therefore benthic fauna at the determination of productivity of the rivers and canals is the major organisms. Benthic macro fauna are those organisms that live on or inside the deposit at the bottom of a water body (Idowu and Ugwumba, 2005; Barua and Zamal, 2006; Barua et al., 2017b).In the brackish water

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ecosystem, they include several species of organisms, which cut across different phyla including annelids, coelenterates, mollusks, arthropods and chordates. These organisms play a vital role in the circulation and recirculation of nutrients in aquatic ecosystems. They constitute the link between the unavailable nutrients in detritus and useful protein materials in fish and shellfish. Most benthic organisms feed on debris that settle on the bottom of the water and in turn serve as food for a wide range of fishes (Idowu and Ugwumba, 2005; Siddiqui et al., 2009; Siddika et al., 2012). They also accelerate the breakdown of decaying organic matter into simpler inorganic forms such as phosphates and nitrates (Gallup et al., 1995; Nupur et al., 2013).

All forms of aquatic plants, which are the first link of several food chains existing in aquatic environment, can utilize the nutrients. These organisms therefore form a major link in the food chain as most estuarine and marine fishes, birds and mammals depend directly or indirectly on the benthos for their food supply (Barnes and Hughes, 1988; Kailasam and Sivakami, 2004). Macro benthic invertebrates are useful bio-indicators providing a more accurate understanding of changing aquatic conditions than chemical and microbiological data, which at least give short-term fluctuations (Ikomi et al., 2005; Hossain et al., 2009). Odiete (1999) stated that the most popular biological method in assessment of freshwater bodies receiving domestic and industrial wastewaters is the use of benthic macro-invertebrates.

The composition, abundance and distribution of biodiversity can be influenced by water quality (Odiete, 1999). He stated that variations in the distribution of macrobenthic organisms could be as a result of differences in the local environmental conditions. Despite the importance of benthic macro invertebrate in the aquatic environment, information on the benthic macro invertebrate fauna and physico-chemical parameters is still lacking. The benthos consists of the organisms living in association with the floor sea ocean, estuary fresh waterbenthic fauna can be categorized according to their size as macrofauna (0.5 mm), meiofauna (62 to 0.5 mm) and microfauna (62) (Belaluzaman, 1995; Asadujjaman et al., 2012).

Most important characteristic of the benthic organisms are related to the association of benthic environment and have evolved as adaptation to this situation. The abundance of benthic fauna is a biological parameter that may indicate overall aquatic productivity of the bottom sediments. They are also the main source of food for both migratory and permanent faunas as well as higher predators in the food chain. Moreover, benthic communities are widely used in monitoring the effect of marine pollution as the organisms are mostly sessile and readily integrate the effects of pollutants.

It has been suggested that benthic fauna might be used as an integrating indicator of water quality within an area (Giere, 1993). Any fluctuation in their quality and quantity will directly affect the abundance of demersal fishes that are important fishery resources in the sea. Therefore, a benthic study may be used as baseline information to evaluate the existing demersal stocks and may serve as a baseline study of future investigations on environmental changes in this area (Giere, 1993; Nkwoji and Awodeyi, 2018).

Canal ecosystem is a dynamic ecosystem with two times flooding by tidal water and continuous flowing of fresh water of upstream. The benthic macro fauna which crawls about on the bottom of the sea or other water bodies or silt or firmly attached to it are referred to as epi-macro fauna, some of which live as or in the bottom by day and ascend into the plankton by night e.g. Amphipods, Isopods and Cumacean, etc. (Barua, 1983; Sogbamu et al., 2016). They become associated with sand and or other substratum which are deposited by tidal currents. Other benthic animals like macro in fauna find food or protection within the bottom. As for example mollusks, polycheates crab etc. excavated burrows in the bottom material or constitute tube, variety of these benthic macro fauna obtain their feed from organic materials and other nutrients contained in the sediment (Khan et al., 2007; Yakub and Igbo, 2014). However, to conserve and develop the coastal zone in sustainable way, it is important to undertake research work of the canal on the environmental issues, because these canals carry a significant amount of effluent in the coastal environment. Keeping this philosophy in mind, the study was conducted for investigation of determining the abundance of macro benthos with some physico-chemical parameters of water and soil in the south-eastern coast of Bangladesh.

Materials and Methods

The Study Area

The study area is in Kumira of Sitakunda Upazila. The canal is divided into four sampling stations. Station 1 is beside the sluice gate. Station 2 is in west of Kumira by-pass road. Station 3 is at the branch of the canal along Bazar para. Station 4 is in Choto Kumira. Four selected sampling stations (map) being located in Table 1 and Figure 1.

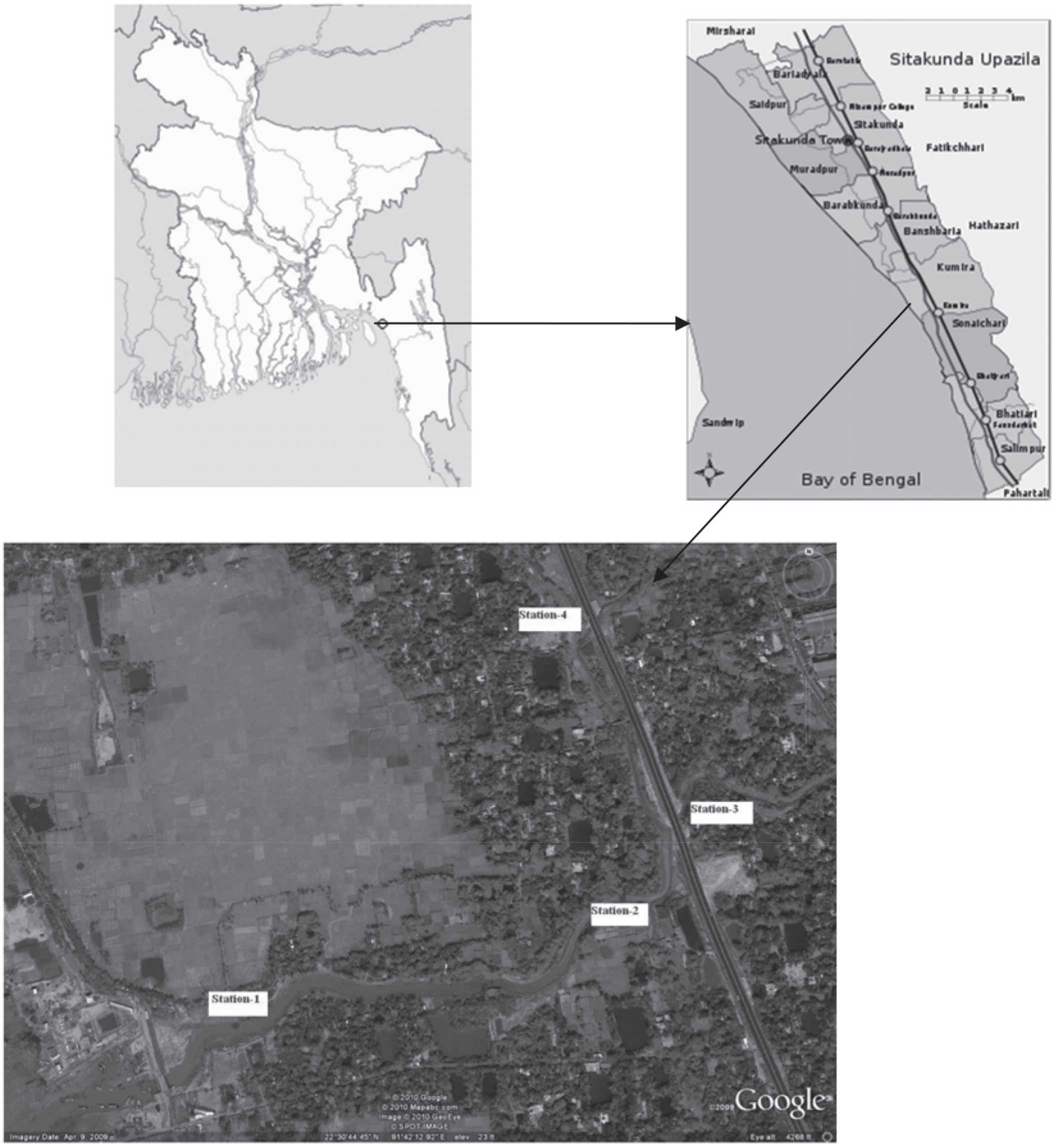

Figure 1: Map showing different sampling stations in Kumira canal.

Table 1: Sampling stations with geographical positions

Stations	*Geographical positions*
Station 1	22°31.31′N, 91°42.14′E
Sation 2	22°30.33′N, 91°41.57′E
Station 3	22°30.43′N, 91°42.41′E
Station 4	22°30.31′N, 91°42.34′E

Sampling Design

The present study is based on observations from January 2016 to May 2016. Two samples were taken from four sampling stations during new moon. In each station four replicates were taken. For the collection of macro benthic fauna a square steel quadrate of 11 cm × 11 cm × 15 cm was used as followed by Bellaluzaman (1995) and Holme and McIntyre (1984). The sampler was pushed into the sediment and sediment in the quadrate was taken in a bucket by a shovel. Samples were taken during low tide.

For sieving of the collected sediments, steel made round sieve 19.5 cm dia and 3.85 mm mesh was used as followed by a number of workers (Bellaluzaman, 1995; Perkins, 1976). The sediments were shifted by using a plentiful supply of adjacent water. Shifted organisms with sand particles or with detritus partials, retained by the sieve were kept in plastic container and preserved with 5% formalin. Samples of macro benthos were then transferred into 10% formalin containing Rose Bengal stain for identification, while benthos samples were transferred into 5% formalin with addition of the same stain. These methods were applied with some modifications based on Holmes and McIntyre (1984), Aswandy et al. (1991) and Zaleha et al. (2001). Identification and detailed observation of macro benthos was done using compound microscope.

The relevant hydrological parameters in connection to shrimp culture are surface water salinity, pH, temperature, dissolved oxygen (DO), BOD (3-day at 27°C), nitrate, phosphate, silicate and sediment organic carbon (for the present site). Surface water salinity was measured in the field by refractometer and cross-checked by argentometric method. Water pH was measured by a portable pH meter (sensitivity = ±0.02). Surface water temperature was measured by a Celsius thermometer. D.O., B.O.D., nitrate, phosphate, silicate and total suspended solids (TSS) were measured as per the procedure stated in Strickland and Parson (1968), APHA (2005)and Zhang and Stoffeka (2005).

The sediment samples were taken in plastic polythene without addition of any chemicals. The preserved samples were analyzed in the chemical laboratory of Bangladesh Scientific and Chemical Industrial Research (BSCIR), on the following day after arriving. All the frozen samples in the Icebox were analyzed in the laboratory after attaining room temperature. Sediment samples were mixed thoroughly in equal proportion to prepare a composite sample. Sediment samples were dried in air and then the sediment particles were passed through a 2 mm mesh size sieve. Before analysis, soil samples were finely dried in an oven at 105 °C for 24 hours. pH of sediment collected was determined by digital pH meter in wet condition. Soil texture was measured followed by the hydrometer method (Bouvoucos, 1962). Soil organic matter was detected following procedure by Boyd (1995). Soil organic carbon was calculated dividing the organic matter by a factor of 1.9 following the procedure described by Nelson and Sommers (1982). Fe concentration from sediment samples were detected following the method descried in Analytical Method for plants and soil by Comfort et al., 1988.

Qualitative and quantitative analysis of benthos from the intertidal zone of study area were analysed through quadrate analysis (1 m × 1 m) covering an area of 1000 m × 500 m through random sampling (10-20) in each area. Then the samples were washed and sieved using a net having 0.5 mm mesh size to remove the debris and clay particles. Collected samples were preserved in 70% alcohol (APHA, 1976). The containers were marked and transferred to the laboratory for analysis. To facilitate sorting of organisms from debris, the samples were stained with 'Rose Bengal' preservatives (APHA, 1976). The sorted organisms were preserved in 70% ethanol. The sorted organisms were identified and enumerated under major taxa and kept preserved in small vials for further analysis.

Correlation coefficient analysis was applied for the relationship between the hydrological parameters and abundance of macro benthos in the study area.

Result and Discussion

Water Quality Analysis

Air temperature in the canal ranged between 21°C and 34°C. The highest temperature recorded during pre-monsoon in station 1 and lowest in post monsoon in station 3. The average air temperature values 27.5°C, 29.50°C, 26°C and 29.5°C at stations 1-4 respectively. The highest and lowest temperature was recorded by Hossain et al. (1988) in April and December respectively in the coast of the Cox's Bazar. Bellauzzaman (1995) recorded maximum air temperature in the same area. Uddin (2003) recorded the temperature of the lower Maghna river estuary. The present findings have similarity with those of the previous works (Table 2).

In the Kumira canal water temperature during low tide ranged between 22° and 32°; highest temperature recorded during pre-monsoon in station 4 and lowest in post monsoon in station 1 and 3. The average values of water temperature 26°C, 26.5°, 25°C and 25.5°C at stations 1-4 respectively. The water temperature were recorded by Mahmood et al. (1993), Bellaluzzaman (1995), Hossain et al. (1988) and Uddin (2003); in present investigation the highest temperature was found in pre-monsoon, which is similar to the previous investigation. But minimum temperature was found in post monsoon which is only similar to Uddin (2003) (Table 2).

Salinity in the canal was ranged between 0-16‰. The highest salinity was recorded in station 1 during post-monsoon and lowest in stations 3 and 4 during pre-monsoon. The average values of salinity are 11.5‰, 4‰, 2.5‰ and 2.5‰ at stations 1-4 respectively. Mclusky stated that the salinity of an estuary ranged between 0.05 and 35‰. Salinity also recorded by Pati (1980), Ali et al. (1985), Bellaluzzaman (1995), Kamal (1992), Rashid (1999), Uddin (2003), Hasan et al. (2009) and Haider et al. (2017) and they observed that maximum salinity in pre-monsoon which is similar to the present investigation (Table 2).

Water pH recorded between 4.50 and 7.24; lowest and highest was in station 1 during both post-monsoon and pre monsoon. The average pH values 6.72, 6.00, 5.87 and 6.49 at stations 1-4 respectively during the period of investigation. During pre-monsoon the pH found acidic (4.5) in the canal water due to discharge of industrial effluent and during post-monsoon it is almost neutral which is similar to the early studies (Bellaluzzaman, 1995; Kamal, 1992; Noori, 1999; Uddin, 2003; Hossain et al., 2009; Barua and Chowdhury, 2011; Asaduzzaman et al., 2012; Hossain, 2013; Haider et al., 2017) (Table 2).

Dissolved oxygen content in the canal water ranged from 4.07 to 6.43. Highest in station 1 in both seasons and lowest in station 3 during pre-monsoon. The average values of DO 6.0, 4.96, 4.19 and 4.29 mg/l at stations 1-4 respectively during the period of investigation. Marked fluctuations were recorded during the present investigation. Highest was recorded in station 1 and lowest in station 3 which is close to industries. Devi et al. (1983) reported that DO content of surface water of some estuaries in India ranged from 1.9 to 5.53 ml/l. The results of present investigation were within the range except the station 1 (Table 2). Biochemical Oxygen Demand (BOD) for four hours of the canal water during low tide ranged from 0.48 mg/l to 1.72 mg/l. Highest BOD was recorded during post-monsoon in station 1 and lowest was in station 3 during post-monsoon. .The average values of BOD are 1.22, 0.91, 0.53 and 1.42 mg/l at stations 1-4 respectively (Table 2). During the period of investigation Chemical Oxygen Demand (COD) in the canal water was ranged 100 mg/l to 140 mg/l. Highest was recorded in station 3 during post-monsoon and pre-monsoon highest COD was recorded 140 mg/l and lowest was 100 mg/l in stations 1 and 4.

The average values COD are 105, 120, 130, 110 mg/l at stations 1-4 respectively (Table 2). NO_2-N in the canal water during the period of investigation was engaged between 2.18 and 5.56 µg/l; highest in station 1 during post-monsoon and lowest in station 4 during post-monsoon. The average values of NO_2–N are 4.72, 3.97, 4.32 and 2.58 µg/l at stations 1-4 respectively (Table 2). PO_4–P of the study area was ranged from 0.23 to 5.74 µg/l; highest value was recorded in station 1 and lowest in station 3 during pre-monsoon. The average value 6.0, 5.2, 6.05 and 6.25 µg/l at stations 1-4 respectively (Table 2). SiO_3-Si in canal water ranged between 2.23 µg/l and 6.70 µg/l; highest was in station 1 during pre-monsoon and lowest was in station 4 during post-monsoon. The average value 6.0, 5.2, 6.05 and 6.25 µg/l at stations 1-4 respectively (Table 2). Total suspended in the study areas ranged from 0.34 to 1.56 mg/l highest was recorded during pre-monsoon in station 1 and lowest in station 4 during post-monsoon. The result of present investigation coincide with Uddin (2003) and Asaduzzaman et al. (2012) of Lowe Maghna river estuary (Table 2). The result of present investigation ranged between 21.87 and 33.6 mg/l. Hossain and Islam (2006) reported Fe concentration of the water of ship-breaking areas of Sitakunda as 36.02, 37.62 and 2.26 mg/l. This is close to the result of the present investigation (Table 2). Barua et al. (2017b) found the almost same range of finding as the author found the value of Fe concentration in the water of the study area.

Sediment Quality Analysis

Sediment particles in station 1 are dominated by sand (65.68-75.88%), clay (25.12-33.12%) and silt minor present. In station 2 are dominated by sand (61.68-65.68%), clay (29.12-33.12%) and silt minor present. In station 3 are dominated by sand (73.68-77.68%), clay (21.12-25.12%) and silt minor present here also. In station 4 clay is 25.12-33.12%, silt is 2.4-4.6% and sand is 64.48-7.28% (Table 3). pH of the sediment of canal ranged between 5.2 and 7.0. The average values 6.0, 5.2, 6.05 and 6.25 at stations 1-4 respectively. The highest value was recorded in station 4 and lowest value from stations 1, 2 and 3 during post-monsoon (Table 3). The maximum amount of OM 4.02% was found in station 1 during post-monsoon and lowest 1.85% in station 4 during pre-monsoon. The mean values of organic matter is 3.42, 2.82, 2.68 and 2.84% respectively at stations 1-4. The present result is very close to previous work of Abu Hena et al. (2012) on Bakkhali river estuary (Table 3). The maximum amount of OC 2.12% was found in station 1 during post-monsoon and lowest 0.97% in station 4 during pre-monsoon. The mean values of OC are 1.78, 1.48, 1.41 and 1.33% at stations 1-4 respectively (Table 3). The present result is very close to previous work of Khohinoor (2008) on Bakkhali river estuary. Fe content in the sediment of collected samples was ranged between 16.17 ppm and 20.83 mg/g. Maximum Fe was found in station 3 during post-monsoon and lowest was recorded in stations 1 and 2 during pre-monsoon. The average value 17.15, 19.39, 20.21 and 18.87 mg/g at stations 1-4 respectively. Islam and Hossain (2006) reported 2.0, 1.6, 0.56 mg/l of Fe in the sediment of ship-breaking areas of Sitakunda. Barua et al. (2017b) identified the trace metal level in ship-breaking area of Bangladesh as alarming stage for coastal biodiversity and the range of soil pH, organic matter, organic carbon and Fe are the same finding of

Table 2: Physico-chemical parameters of water of Kumira Canal

	Season	*Air temp. (ºC)*	*Water temp. (ºC)*	*Salinity (‰)*	*Water pH*	*DO (mg/l)*	*BOD (mg/l)*	*COD (mg/l)*	*NO_2-N (µg/L)*	*PO_4-P (µg/L)*	*SiO_3-Si (µg/L)*	*TSS (mg/l)*	*Fe conc. (ppm)*
Station 1	Post-monsoon (January)	21	22	16	6.50	7.57	0.40	100	5.56	5.74	5.26	1.33	23.12
	Pre-monsoon (May)	34	30	07	6.94	6.43	0.71	110	3.87	0.69	6.70	1.56	29.04
Station 2	Post-monsoon (January)	26	23	5	5.00	6.79	0.48	120	3.17	1.61	2.23	0.98	33.60
	Pre-monsoon (May)	33	30	03	7.01	6.72	1.33	120	4.76	0.46	5.40	1.02	30.70
Station 3	Post-monsoon (January)	20	22	05	4.50	609	0.48	140	3.08	1.84	4.90	0.52	31.55
	Pre-monsoon (May)	32	28	0.50	7.24	6.29	0.71	120	5.56	0.23	3.30	0.62	30.20
Station 4	Post-monsoon (January)	26	19	05	6.00	5.29	1.42	120	3.18	1.38	5.10	0.34	25.02
	Pre-monsoon (May)	33	32	0.50	6.98	4.28	1.42	100	3.98	1.46	5.20	0.35	21.87

Table 3: Soil parameters of the Kumira canal, Chittagong

	Season	*Sediment particle*			*Organic matter (%)*	*Organic carbon (%)*	*Soil pH*	*Fe (mg/gm)*
		% Clay	*% Silt*	*% Sand*				
Station 1	Post-monsoon (January)	33.12	1.12	65.68	4.02	2.12	5.20	18.13
	Pre-monsoon (May)	25.12	4.00	70.88	2.81	1.47	6.80	16.17
Station 2	Post-monsoon (January)	29.12	5.20	65.68	2.68	1.41	5.20	18.62
	Pre-monsoon (May)	33.12	5.20	61.68	2.95	1.55	6.50	16.17
Station 3	Post-monsoon (January)	25.12	1.20	73.68	2.15	1.13	5.20	20.83
	Pre-monsoon (May)	21.12	1.2	77.68	3.21	1.69	6.90	19.60
Station 4	Post-monsoon (January)	25.12	4.6	70.28	3.82	1.68	5.50	19.60
	Pre-monsoon (May)	33.12	2.40	64.48	1.85	0.97	7.00	18.13

the author. The result of present investigation is higher than Fe of ship-breaking areas (Table 3).

Abundance of Macrobenthos

The mean abundance of macrobenthos at station 1 was higher compared with other stations. Usually, the mean abundance of macrobenthos was higher (1611 individual/m^2) in station 1 than station 2 (1154 individual/m^2) and at station 3 (620 individual/m^2) and at last (558 individual/m^2) in station 4. Polychaetes were the most abundant group (72%) followed by Oligocheates (23%), Bivalves (2%) and crabs (1%) during post-monsoon. Oligocheates were the most abundant group (50%) followed by Polychaetes (42%) and Bivalves (3%) during pre-monsoon.

Belaluzaman (1995) studied on the Macro benthic community structure of the Cox's Bazar Sandy beach and Muddy beach of Bakkhali river estuary. Mean density was 212800.44 indivs/m^2 and 18562.67 indivs/m^2. Highest mean density of the study area was 1611 indivs/m^2. Comparing with the mean densities, mean density of present study area is 11.52 times lower than the Bakkhali river estuary. On the other hand, Barua et al. (2017b) found the mean density of macrobenthic fauna in the ship-breaking zone 1600 indivs/m^2 which is very close to the study. Alam (1993) reported mean density of macrofauna 1200.88 individual/m^2 ranging from 40-4960, which is 1.34 times lower than the present study area. Molla et al. (2016) found similar level of mean density of macro fauna in the Chittagong coastal area. Nandi and Cowdhury (1983) found the mean density 125 indivs/m^2 ranging from 68-329 indivs/m^2 from Sagar Island, West Bengal India by sieve of 1 mm mesh size, which is 12.89 times lower than the present study area (Tables 4 and 5). Percentage composition of macrobenthos were found for Polycheats (22.73-71.79%), Oligocheates (7.89-63.64%), Bivalves (0.02-8.11%) and crabs (00-10.00%).

Abundance is high in all stations except station 1 during post-monsoon than pre-monsoon. Polycheates abundance is high near the coast .and decrease towards the territorial area. Conversely Oligocheates abundance is high in territorial environment and gradually decrease towards the seawards. Bivalves and Mollusks are the minor organisms.

Table 4: Abundance of macro benthos (individuals/m^2) of Kumira canal

	Season	*Polycheates*	*Oligocheates*	*Bivalves*	*Crabs*	*Others*
Station 1	Post-monsoon (January)	1735	558	41	21	41
	Pre-monsoon (May)	351	413	21	00	41
Station 2	Post-monsoon (January)	826	434	00	21	62
	Pre-monsoon (May)	310	310	62	62	21
Station 3	Post-monsoon (January)	641	62	21	00	62
	Pre-monsoon (May)	103	289	21	00	41
Station 4	Post-monsoon (January)	186	165	21	41	21
	Pre-monsoon (May)	269	351	21	00	41

Table 5: Composition of macro benthos(%) in Kumira canal

	Season	*Polycheates*	*Oligocheates*	*Bivalves*	*Crabs*	*Others*
Station 1	Post-monsoon (January)	71.79	23.08	1.71	0.85	1.71
	Pre-monsoon (May)	42.50	50.00	2.50	00	5.00
Station 2	Post-monsoon (January)	61.54	32.31	0.02	00	4.62
	Pre-monsoon (May)	40.54	40.54	8.11	8.11	2.70
Station 3	Post-monsoon (January)	81.58	7.89	2.63	00	7.89
	Pre-monsoon (May)	22.73	63.64	4.55	00	9.09
Station 4	Post-monsoon (January)	45.00	40.00	5.00	10.00	5.00
	Pre-monsoon (May)	39.39	51.51	3.03	00	6.06

Statistical Relationship

Salinity shows positive significant relationship with the Polycheates ($P = 0.0029$, $t = 5$, $DF = 7$) and as well as PO_4-P ($P = 0.0005$, $t = 7$, $DF = 7$). A negative significant relationship was found between C.O.D and Oligocheates abundance in the Kumira canal ($P = 0.0169$, $t = 3$, $DF = 7$) and a positive relationship was found between TSS and Oligocheates abundance ($P = 0.0489$, $t = 2$, $DF = 7$). A low degree relationship was found between Bivalves and SiO_3-Si ($P = 0.1981$, $t = 1$, $DF = 7$). There was no relationship among the parameters of water as well as soil and crab abundance. In case of soil, OC shows insignificant positive relationship with Polycheates ($P = 0.2031$, $t = 1$, $DF = 6$) and there is no difference in Polycheates distribution between pre and post-monsoon.

Conclusions and Recommendation

An ecosystem may be sustainable when the parameters of soil water and biological organizations will be present in an appropriate ratio. When any of these is disturbed the whole ecosystem will be imbalanced because these elements interact with each other. Factors that have been shown, or are thought, to determine population sizes of macrobenthic species in coastal waters are numerous, and they can interact in complex ways. Because enrichment causes changes in populations it can be viewed as a perturbation that affects these factors. The recent trends of modern sciences is concentrating in the study of biodiversity of flora and fauna in assessing the condition of the environment. Investigation of macro benthos in Kumira canal has been done in the two seasons with some physico-chemical parameters of the water and soil. From the above result it can be said that the water and soil of the canal is being polluted and as a consequences of this, the abundance of the macrobenthos is low.

A comprehensive study of physico-chemical parameters of the water and soil such as heavy metals and so on was not possible during this research. Activities should be managed properly that are responsible for changing the physico-chemical parameters of the canal because this water is mixing with the Bay of Bengal after a period of time. So it is also a threat for Bay of Bengal. The present research is a part of continuation of research process. The information of the present investigation may be helpful for further research and ecological management for the coastal zone management.

References

Abu Hena, M.K., Kohinoor, S.M.S., Siddique, M.A.M., Ismail, J. and M.H. Idris (2012). Composition of Macrobenthos in the Bakkhali Channel System, Cox's Bazar with Notes on the Soil Parameter. *Pakistan Journal of Biological Sciences*, **15:** 641-646.

Alam, M. (1993). Ecology of the Intertidal Macrobenthos of Halishahar coast, Chittagong, Bangladesh. *Bangladesh Journal for Scientific Research*, **15:** 335-340.

Ali, S., Saha, S. and N. Mahamood, N (1985). Studies on the Physico-Chemical aspects of Moheskhali ChennalChannel, Bay of Bengal. *Dhaka University Studies*, **15:** 43-49.

APHA (1976). Standard methods for the examination of water and wastewater, 14th Edition. American Public Health Association, Washington, USA. 1108 p.

APHA (2005). Standard methods for the examination of water and wastewater, 20th ed. American Public Health Association, New York, USA. 1120 p.

Asadujjaman, M., Hossain, B., Shamsuddin, M., Amin, M.A. and A.K.M. Azam (2012). Occurrence and Abundance of Macrobenthos of Hatiya and Nijhum Dweep Islands, Bangladesh. *Middle-East Journal of Scientific Research*, **11(2):** 184-188.

Aswandy, I., Kastoro, W.W., Aziz, A., Hakim, I.A. and Mujiono (1991). Distribution, abundance and species composition of macrobenthos in Seribu Islands, Indonesia. *In:* C.A. Angel (Ed.). Proceedings of the regional symposium on living resources in coastal areas.

Barua, P. and H. Zamal (2006). Nutrient dyanmics and health management of coastal aquaculture activities in and around Cox's Bazar coastal area, Bangladesh. *Journal of Marine Sciences*, **2:** 30-45.

Barua, P. and S. Chakraborty (2011). Assessment of aquatic health index for coastal aquaculture activity in and around South-east coast of Bangladesh. *Current Biotica*, **5(2):** 1801-1895.

Barua, P. and S.H. Rahman (2016). Climate Change Adaptation in Relation with Human Environment Interactions for Cope with Climate Variability: A Risk Management Approach of Bangladesh. *Social Change*, **6(2):** 144-163.

Barua, P., Rahman, S.H. and M.H. Molla (2017a). Sustainable Adaptation for resolving climate displacement issues of south-eastern islands in Bangladesh. *International Journal of Climate Change Stratgeies and Management*, **9:** 790-810.

Barua, P., Rahman, S.H. and M.H. Molla (2017b). Heavy metals influence in sediments and its impact on macrobenthos at shipbreaking area of Bangladesh. *Asian Profile*, **45(2):** 50-65.

Barua, P. and S.H. Rahman (2018). Community Based Rehabilitation attempt for Resolve Climate Displacement crisis in the coastal area of Bangladesh. *International*

Journal of Migration and Residential Mobility, **1(4):** 385-400.

Barua, P.K. (1983). Preliminary studies on macrobenthic fauna of brackish water fish pond of Chakaria Sundarbans. *Bangladesh Journal of Scientific and Industrial Research*, **18:** 35-50.

Bellaluzaman, A.M. (1995). Ecology of the intertidal macro benthic fauna in Cox's Bazar Costal area, Bangladesh. *Pakistan Journal of Biological Sciences*, **8:** 24-40.

Bouvoucos, G.J. (1962). Hydrometer Method improved for making particle size analysis of soils. *Journal of Agronomy*, **54:** 464-465.

Boyd, C.E. (1995). Bottom Soils: Sediment and Pond Aquaculture. Chapmanand Hall, New York, U.S.A.

Comfort, S.D. Kelling, K.A., Keeney, D.R. and J.C. Converse (1988). The Fate of Nitrogen from Injected Liquid Manure in a Silt Loam Soil. *Journal of Environmental Quality*, **17:** 317-322.

Devi, K.S., Venugopal, P., Remani, K.N., Zacharias, D. and R.V. Unnithan (1983). Nutrients in some estuaries of Kerala. *Mahasagar*, **16:** 161-173.

Gallup, G.G., Jr, Povinelli, D.J., Suarez, S.D., Anderson, J.R., Lethmate, J. and E.W. Menzel (1995). Further reflections on self-recognition in primates. *Animal Behaviour*, **50:** 1525-1535.

Giere, O. (1993). Meiobenthology, the Microscopic Fauna in Aquatic Sediments. Springer-Verlag, Berlin (Germany).

Haider, M.L., Shahariar, I.M., Hosen, M.H., Mousumi, S. and M. Khatun (2017). A study on water quality parameters and benthos abundance in freshwater homestead ponds of Dinajpur, Bangladesh. *International Journal of Fisheries and Aquatic Studies*, **5(2):** 27-32.

Hasan, R., Hossain, M.S., Amin, M.R., Ali, H. and M.O. Rahman (2009). Depth wise abundance of benthic fauna in a selected pond of Mymensingh district. *Bangladesh Journal of Agriculture*, **2:** 44-54.

Holme, N.A. and A.D. McIntyre (1984). Methods for the study of marine benthos. Blackwell Scientific Publications, Oxford, United Kingdom.

Hossain, M.A., Alam, M.R., Haque, M.R. and M.F. Mehbub (2013). Study on present status of carp-sis polyculture in Dinajpur district of Bangladesh. *Bangladesh Research Publications Journal*, **9:** 123-130.

Hossain, M.B., Das, N.G. and R. Sharmeen (2009). Seasonal and spatial distribution of macrozoo benthos of the Meghna River estuarine bed. *International Journal of Sustainable Agricultural Technology*, **5(3):** 11-16.

Hossain, M.M. and M. Islam (2006). Shipbreaking Activities and its impact on the Coastal zone of Chittagong, Bangladesh: Towards sustainable Management. Young Power in Social Action, Chittagong, Bangladesh.

Hossain, M.M., Mahamood, N. and A.M. Bhouyan (1988). Some water quality characteristic of the Karnafully river estuary. *Mahasagar*, **21(3):** 183-188.

Idowu, E.O. and A.A. Ugwumba (2005). Physical, chemical and benthic faunal characteristics of a southern Nigerian reservoir. *The Zoologist*, **3:** 15-25.

Ikomi, R.B., Arimoro, F.O. and O.K. Odihirin (2005). Composition, distribution and abundance of macro invertebrates of the Upper Reaches of River Ethiope Delta State, Nigeria. *The Zoologist*, **3:** 68-81.

Kailasam, M. and S. Sivakami (2004). Effect of thermal effluent discharge on benthic fauna of Tuticorin Bay, South East coast of India. *Indian Journal of Marine Science*, **33:** 194-201.

Kamal, K. (1993). Studies on the intertidal Green mussel perna viridis L. inhibiting Moheshkhali Channel, Bay of Bengal. *Fishing Chimes*, **10:** 35-40.

Khan, A.N., Kamal, D., Mahmud, M.M., Rahman, M.A. and M.A. Hossain (2007). Diversity, Distribution and Abundance of Benthos in Mouri River, Khulna, Bangladesh. *International Journal of Sustainable Crop Production*, **2:** 19-23.

Mahamood, N., Zafar, M., Barua, P.K. and S. Ali (1993). Macro benthic fauna of an aquaculture pond of Chakaria Sundarban. *Pakistan Journal of Sciences and Industrial Research*, **36(4):** 156-158.

Nandi, S. and A. Chowdhury (1983). Quantitative studies on the benthic macrofauna of Sagar Island, intertidal zones, Sunderbans, India. *Mahasagar*, **16(3):** 409-414.

Nelson, D.W. and L.E. Sommers (1982). Total carbon, organic carbon, and organic matter. *In:* A.L. Page, R.H. Miller, D.R. Keeney (Eds). Methods of Soil Analysis. USA.

Nkwoji, J.A. and S.I. Awodeyi (2018). Impacts of sediment mining on the hydrochemistry and macrozoo benthos community in a coastal lagoon, Lagos, Nigeria. *Archives of Agriculture and Environmental Science*, **3(3):** 209-215.

Noori, M. (1999). An investigation on seasonal variation of micronutrients and standing crop of phytoplankton in neritic waters of the southeast coast of Bangladesh. *Current Sciences*, **20:** 45-65.

Nupur, N., Shahjahan, M., Rahman, M. and M.K. Fatema (2013). Abundance of macrozoo benthos in relation to bottom soil textural types and water depth in aquaculture ponds. *International Journal of Agriculture, Research and Innovation Technology*, **3(2):** 1-6.

Odiete, W.O. (1999). Environmental physiology of animals and pollution. Diversified Resources, Lagos, Nigeria.

Pati, S. (1980). Observations on the hydrography and inshore plankton of the Bay of Bengal of Balasore. *Hydrobiologia*, **70:** 123-132.

Perkins, E.J. (1976). The Biology of Estuaries and Coastal Waters. Academic Press, London and New York.

Rashid, K. (1999). Study on the water quality commercial Ichthyofauna of the Bakkhali river estuary. *Indian Journal of Marine Sciences*, **25:** 25-38.

Siddika, F., Shahjahan, M. and M.S. Rahman (2012). Abundance of plankton population densities in relation to bottom soil textural types in aquaculture ponds. *International Journal of Agriculture, Research, Innovation and Technology*, **2(1):** 56-62.

Sogbanmu, T.O., Nagy, E., Phillips, D.H., Arlt, V.M., Otitoloju, A.A. and N.R. Bury (2016). Lagos lagoon sediment organic extracts and polycyclic aromatic hydrocarbons induce embryotoxic, teratogenic and genotoxic effects in Daniorerio. *Environmental Science and Pollution Research*, **23(14):** 14489-14501.

Strickland, J.H. and T.R. Parson (1972). A practical handbook of seawater analysis. Second Edition, Bulletin 167. Fisheries Research Board of Canada, Ottawa.

Uddin, M.M. (2003). An assessment of material budget along with some physico-chemical parameters of the lower Meghna river estuary, Bangladesh. *Bangladesh Journal of Scientific and Industrial Research*, **25:** 18-30.

Yakub, A.S. and J.K. Igbo (2014). Assessment of benthic macroinvertebrate fauna of two contiguous coastal water bodies within barrier lagoon complex, western Nigeria. *Journal of Environment and Human*, **1(2):** 39-46.

Zaleha, K., Ismail, A. and A.G. Idris (2001). Survey on the density and composition of sublittoral meiobenthos from Pulau Redang. *In:* H. Mohd Lokman (Ed.). National Symposium on Marine Park and Terengganu Islands, 'Towards Sustainable Usage and Management of Islands', Malaysia.

Zhang, M., Li, Y. and P.J. Stoffella (2005). Comparison of analytical methods for organic matter in composts and organic mulches. *Communications in Soil Science and Plant Analysis*, **36:** 2587-2599.