International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 8, Issue 8 -2021

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.08.016

A field assessment on Karnawphuli Estuarine Environment: Identify the Relation of Biotic Factors, Sedimentation and other Physio-chemical parameters

Mazharul Islam Sajeeb
Institute of Marine Sciences, University of Chittagong, Bangladesh

Abstract

This study describes the influence of Sedimentation and other Physio- chemical parameters of biotic factors and faunal assemblages in the Karnawphuli estuary, Bangladesh at the period of December 2015. A total of 22 phytoplankton, 9 zooplankton and 10 benthic species/taxa belonging to annelids, molluscs, arthropods and Chaetognatha were recorded. Sub-surface water samples were collected from two stations: site-1 and site-2 namely Jetti no. 10 and Jetti no. 15 region of the Karnawphuli river estuary. Air-water temperature, Water transparency, water salinity, water pH and sediments of bottom layer were identified, observed and collected as for the best environmental variables that influenced the ecological factors at different areas. The most influential factors predicting the variations of total number of individuals recorded in different sampling seasons was salinity. Species richness of phytoplankton, zooplankton and benthos community was positively influenced by salinity and percentage of silt while it was negatively influenced by percentage of sand and the density of clay. Salinity, percentage of sand, slit, clay and water transparency showed higher contribution to explain the variance in species diversity in the present observations. It is assumed from the observation that the estuary has been polluted from domestic sewage, land washout, river run-off, shipping activities, industrial sewage.

Keywords: Sedimentation, Estuary, Phytoplankton, Zooplankton, Benthic, Salinity

Introduction

Bangladesh has a large coast line of about 711 km offering a good potential for exploration of coastal and estuarine water for fishery resources, production of salt and navigation etc. Phytoplankton, Zooplankton and Benthos are very important components of aquatic biotic communities, playing a great ecological roles in wetland ecosystem functions. They play significant roles in the energy pathway and nutrient significant roles in the energy pathway and nutrient cycling and they also constitute an important link in the aquatic food chain as food resource for fishes and other animals. The distribution of aquatic organisms is the result of interactions among their ecological role, the physical conditions that characterize the habitat and food availability. Thus, the community structure of plankton and benthos of Karnawphuli depends on a number of factors namely water quality, type of substrate, particle size of sediment, water flow, sediment, air- water temperature and salinity as well as environmental conditions surrounding the watercourse. The Karnawphuli is the principal river of Chittagong region of Bangladesh. The biggest sea port of the country is situated in the bank of this river for its advantageous geographical position. The country earns a lot of foreign currencies through port activities. Though it has great economic value, but the water body of river, estuary and sea is impacted much due to accumulation of waste from

agricultural land, urban run-off, industries, power plant sewage and sedimentation. Unplanned urbanization, industrialization, discharging untreated sewage on the bank of the Karnawphuli River has exerted unbearable pressure and stress on the river.

Materials and Methods

Water, sediment and benthic faunal samples were collected from the intertidal zone of the Karnawphuli estuary (22°23.387'-22°23.411'N and 91°80.981'-91°80.987'E) Chittagong, Bangladesh during the period of December 2015 (fig-1). All the samples were collected from two sites namely Jetti no. 10 and Jetti no.15.

Among the two sites, Site 2 (Jetti no. 15) was set in front of a power station named Barakah Power Plant Ltd and lighterage vessel standing place through which sewage of power plant and the discharge of vessels wastage falls into the Karnawphuli estuary and thus it was considered as impacted site (fig-2). The other site like Site 1 (Jetti no. 10) considered as moderately impacted site (fig-2). Sampling site is highly crowded by ships and economically one of the most important place in Bangladesh. At the time of acquiring sample about 53 small transport boat, about 13 troller and about 33 lighterage vessel has been located around the sampling area. Samples were collected in winter season.

Fig-1: Karnawphuli Estuary

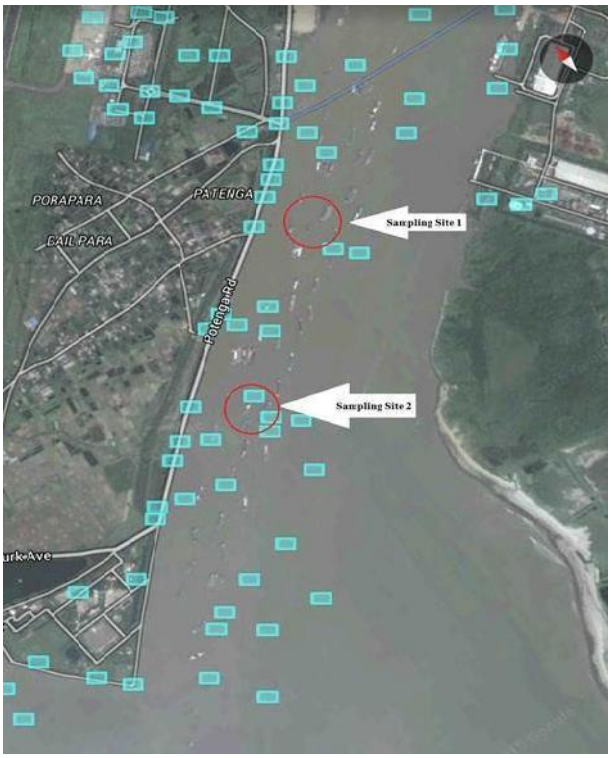

Fig-2: The map of indication about the area of sampling.

Subsurface water samples were collected from two sites during the high tide condition for measuring water temperature, salinity, pH, plankton and all the process determined followed by Standard Method.

Water temperature was measured by using standard mercury filled centigrade thermometer having a range of from 0° to 100°C (Parabu, 2008). In the site 1 at the time of 12.50 pm, water temperature was recorded 20°C and the weather temperature was 23°C and in the site 2 at the time of 1.11pm, water temperature was recorded 22°C and the weather temperature was 23°C.

Water pH was determined by using a digital pen pH meter (HANNA Instruments), Water pH meter was calibrated before every measurement. As recorded in the site 1, at the time of 12.50 pm water pH was 6.5 and in the site 2, at the time of 1.11 pm water pH was 7. In the site 1, at the time of 12.50pm salinity measured 20 ppt and in the site 2, at the time of 01.11pm salinity was measured 21 ppt. In the site 1 at the time of 12.50pm water transparency measured up to 9cm and in the site 2 at the time of 1.11pm water transparency measured up to 10cm through sacchi desk.

Sediment and benthic faunal samples were collected from the study sites by using Grab Sampler. One grab sampler was used in the Site 1 (Jetti no. 10) and Site 2 (Jetti no. 15) by turns. One sediment sample was taken from each station for analysis of soil temperature, soil water salinity, soil texture, sediment texture, particle density.

Grab sampler used to collecting sediment sample from the High tide mark station at High tide period of various sampling time. The diameter of core sampler is 10 cm and the length 20 cm. The collected sediment sample were kept into a polythene bag (500gram to 1 kg). In the laboratory collected sediment samples were spread on the sheet of paper or trays and dried in air (exposure to sun light hasten the drying). The larger aggregates were broken down preferably in a wooden mortar and pestle and pass the sediment sample through a 0.30mm sieve. The sieved sediment sample in then weighted and the mouth of the plastic container are well capped (each container are marked as necessary). The containers were stored in a cold place in laboratory. Though immediate analysis is ideal. Storing in low temperature (4°C) is perhaps the best way to preserve most samples until the next day use. Sediment sample preserve in low temperature (less than 25°C) room in the plastic pack for further analysis.

Soil texture was determined by the method described by Bouyoucos method (1962). 25g of oven dry soil (150°C) was taken in a breaker. After that 50ml distilled water was added. The contents were stirred thoroughly with a glass for half an hour. Then 10ml 1N NaOH solution was added, stirred thoroughly. The contents were transferred to a 1000ml sedimentation cylinder. The volume of contents was making up to 1000ml by adding distilled water. The suspension was allowed settle and reading was taken by a soil hydrometer and thermometer exactly after 1min and after 2 hrs. A similar blank was run without soil but following all above criteria.

Benthic faunal communities were sampled by taking sediments with grab sampler at each of the station. The collected samples were sieved through a 0.5mm mesh. Mud sample has been collected from Jetti no. 10 and 15 by using grab sampler from 5 meter and 7 meter depth from water level. The sample has been preserved by using 5% of formalin solution. After that it has been colorized by Euosine and kept for 24 hours. Then Benthos organisms has been sorted from the raw sample and assembled according to species.

Phytoplankton and Zooplankton samples were collected from surface water. Plankton net is conical in shape and consists of ring (rigid/flexible and round/square), the filtering cone and the collecting bucket for collection of organisms (phytoplankton and zooplankton). The collected sample was immediately preserved in 5% neutralized and transferred to laboratory for analysis. For efficient sorting the samples were stained with rose bangle and let for overnight. All the plankton attained pink (eosin) color rendering easy identification. The stained plankton was sorted out from debris with fine brush, needle. Forceps and a complex microscope was used during sorting. The sorted organisms were preserved in 5% formalin. The sorted organisms were brought under microscope and identified following Islam (1982 & 2003). The total numbers of major taxa of zooplankton and phytoplankton were determined and their concentrations were compute as ind/m3 of water and their other respective percentage.

Results

The mean value of different hydrological factors like water temperature, water salinity and water pH were 21±1°C, 20±1%, and 6.8±0.2.5 respectively. Mean values of different pedological factors like percentage (Diagram-1) sand, silt, clay assemblages consist of 10 benthic species/taxons of the habitat were 73.28%, 21.6%, 5.12% and mean air temperature of the study area during the sampling period

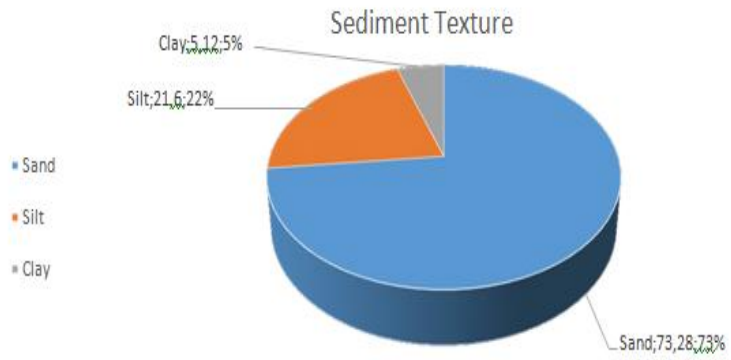

Diagram-1

Among 10 species/taxon, 4 species of molluscs, 2 species of annelids, 3 species of arthropods 1 species of Chaetognatha, a vast majority of bacteria are found in the sediments of benthic zone; Diatoms, ciliates are also found in the present study. The abundance of the benthic species are *Neptunea lyrata, Pecten albicans Sagitta elegans, Gammarus roeseli, Pectinaria koreni, Nereis pelagisa, Littorina littoriea, Carcinus meanus, Caprella mutica, Buccinum undatu.* After analyzing mud sample collected from grab sampler there are 44 benthic organisms of 20 species recorded (given in table-1).

Table-1: A chart of the species recorded from the collected mud sample.

PHYLUM	SPECIES	QUANTITY
Annelida	1. Ragworm 2. Pectinaria worm	17 13
Molluscsa	1. Common whelk	1
	2. Periwinkle 3. Neptune whelk	3 2
	4. Scallop	3
Arthropoda	1. Skeleton shrimp	2
	2. Crab larvae	1
	3. Benthic amphipod	1
Chaetognatha	1. Sagitta	1

After analyzing the sample of phytoplankton, there were 22 types of species recorded from two sites of sampling (name of the species given in table-2).

Tabel-2: Phytoplankton recorded from both of the sampling sites.

Collected from Site-1		**Collected from Site-2**	
SL. no.	Name of the Species	SL. no.	Name of the Species
01	*Coscinodiscus sp.*	01	*Coscinodiscus sp.*
02	*Chaetoceros sp.*	02	*Pleuorosigma sp.*
03	*Nitzschia sp.*	03	*Cheatoceros sp.*
04	*Pseudonitzschia sp.*	04	*Skeletonema sp.*
05	*Pleorosigma sp.*	05	*Thalassionema sp.*
06	*Rhizosolenia sp.*	06	*Rhizosolenia sp.*
07	*Thallasionema sp.*	07	*Pseudonitzschia sp.*
08	*Tabellaria sp.*	08	*Pseudonitzschia sp.*
09	*Amphiprora sp.*	09	*Guinardia sp.*
10	*Melosira sp.*	10	*Ceratium sp.*
		11	*Odontella sp.*
		12	*Asterionella sp.*

From the collected sample the total number of zooplankton specimens/individuals of all groups is equal to total counts of the specimens (say x) is divided to Volume of water filtered (V). The volume of the water filtered is normally expressed in cubic meters. It is calculated as follows.

$V = (A \times R)/k$ (m^3); V1=4.450 m^3 and V2= 75.438m^3,

Where
K = Calibration constant= 0.63
A = Mouth area of the net= $(3.14) \times (.12)^2$=.04522 m^2
R = Flow meter reading and = R1= 62, R2= 1051
V = Volume of water filtered.

After analyzing the sample of zooplankton, there were 9 types of species recorded from two sites of sampling (name of the species and the total faunal composition are given in table-3).

Table-3: Faunal composition

SL. no.	**Name of the species**	**Sample -1 (Quantity)**	**Sample-2 (Quantity)**	**Ind/m^3 sample-1**	**Ind/m^3 Sample-2**
01	Copepod	808	3208	181.57	42.52
02	Sagitta	8	45	1.797	.596
03	Isopod	4	9	.898	.119
04	Crab larvae	6	17	1.34	.225
05	Acari	1	2	.225	.026
06	Shrimp larvae	10	22	2.247	.292
07	Ostracods	15	10	3.37	.1326
08	Fish larvae	1	4	.225	.053
09	oligochaeta	2	1	.449	.0133
Total		855	3318	192.121	43.976

After analyzing the samples it is observed that the species richness of phytoplankton, zooplankton and benthos community was positively influenced by salinity and percentage of silt while it was negatively influenced by percentage of sand and the density of clay. Salinity, percentage of sand, slit, clay and water transparency showed higher contribution to explain the variance in species diversity in the present observations.

Discussion

The hydropedological factors like total suspended solids was identified as the best variables highly correlated with the phytoplankton, zooplankton and benthic faunal assemblages of the study area in the present study. Islam found total suspended solids (TSS), sand content of soil were identified as the best variables highly correlated with the benthic faunal assemblages of the study area. Yuan reported that salinity and sediment were the main factors affecting benthic macro fauna. Some other studies conducted by different authors in different locations also proved that the sedimentation and the percentage of sand, slit and clay have a great influence on the existence and amount of phytoplankton, zooplankton and benthic organism. Sarda et al. found that the grain size defined distinct species assemblages. Otani et al. indicated that distribution of benthos could be explained by the classification of physical characteristics of sediment in tidal flats. Kundu et al. postulated that the species diversity is mainly controlled by the fluctuations in the environment that lead to less diversity. Environmental variability is believed to be the key to the changes in biotic structure expressed by variation in taxa richness and abundance that was similar with the present findings. A number of environmental variables including sediment structure; temperature and salinity have been correlated with the abundance, density and diversity of estuarine organisms. The main environmental factors affecting the distribution and structure of estuarine organisms reported by most authors were salinity and sediment characteristics, especially mud or clay content. Mud content and water content of the sediments of the sediments were found to influence the abundance intertidal biotic communities that were reported by Growenewald. Hirst reported that variations in salinity can promote marked shifts in species representation and community structure because marine organisms have different salinity tolerances. In this study water and sedimentation, salinity, water temperature, water pH and water transparency also influenced various phytoplankton species that lived in the estuarine region at different significant levels either positively or negatively which confirm the findings of the previous studies.

Conclusion

It can be concluded that the abundance and diversity of phytoplankton, zooplankton and benthos community of the intertidal zone of the Karnawphuli estuary is significantly influenced by some physio-chemical parameters of the existing environment. Indiscriminate discharge of untreated sewage and industrial wastes should stop now to save the environment as well as the biotic community of this estuary.

References

1. Omori, M and T. Ikeda, (1984). Methods in Marine Zooplankton. Ecology. John –Willy and Sons Pub. New York: 332 pp.
2. Raymont, J. E. E. (1963). Plankton and productivity in the Oceans. Part 2, Zooplankton Pergamon Press Oxford,New York. Toronto. Sydney, Paris; Franfrut: 824 pp.
3. Steedman, F. H. (ed) (1976). Zooplankton fixation and preservation. Monographs on Oceanographic Methodology, 4; UNESCO, Paris.
4. UNESCO, (1968) Zooplankton sampling Monographs on Oceanography Methodology, 2, UNESCO, Paris.
5. C.C 1955. The marine and fresh water plankton. Michigan state univ. press pp:562
6. MS 1982 zooplankton communities of the karnafully estuary during north east monsoon with special reference to chaetognaths Msc. Thesis (unpublished) ins. Mar univ. ctg 61 pp.
7. Ahmed S. 1984. Zooplankton communities of the estuarine area of Sathkhira with special reference to icthyoplankton Msc. Thesis (unpublished) in marine science, university Chittagong Bangladesh, 117 pp.
8. ESCAP. , 1987, Coastal Environment Management Plan for Bangladesh, Vol. 1 and final report, pp: 53-88.
9. DOE. , 1990, Bangladesh Paribesh Adhidapter, Dhaka.

10. NEMCP/DOE, Progress Report, 1988-90.
11. McLusky, D.S. and D. Elliot, 2006. The Estuarine Ecosystem: Ecology, Threats and Management. Oxford University Press, Third Edition, pp: 214.
12. Asadujjaman, M., M.B. Hossain, M. Shamsuddin, M.A. Amin and A.K.M. Azam, 2012. Occurrence and Abundance of Macrobenthos of Hatiya and Nijhum Dweep Islands, Bangladesh, Middle-East J. Sci. Res., 11(2): 184-188.
13. Hossain, M.B. and R. Das N.G. Sharmeen, 2009. Seasonal and spatial distribution of macrozoobenthos of the Meghna River estuarine bed. Int. J. Sustain. Agril. Tech., 5(3): 11-16.
14. Merrit, R.W. and K.W. Cummins, 1984. An introduction to the aquatic insects of North America. Dubuque: Iowa, Kendal/Hunt Publishes. pp: 862.
15. Salam, A., 1976. Algal flora of the Karnafuli estuary and ecological observations on changes in growth of some intertidal algae at Patenga coast. IMSF, Uni. Ctg. pp: 228.
16. Islam, M.S., 1982. Zooplankton communities of the Karnafuli River estuary during Northeast monsoon with special reference to Chaetognaths. IMSF, Uni. Ctg. pp: 61.
17. Haque, S.M.A., 1983. Study on phytoplankton of the Matamuhuri estuary and fish ponds in the vicinity. Postgraduate dissertation. IMSF, Uni. Ctg., pp: 174.
18. Elias, S., 1983. Abundance of Zooplankton of the Matamuhuri River Estuary with special reference to shrimp and larvae. Postgraduate dissertation. IMSF, Uni. Ctg. pp: 172.
19. Mohi,S.A., 1977. Distribution of ichthyoplankton in the Karnafuli River estuary in relation to salinity. Postgraduate dissertation. IMSF, Uni. Ctg. pp: 53.
20. Zafar, M. and N. Mahmood, 1989. Studies on the distribution of zooplankton communities in the estuarine system. Ctg. Uni., Pt. II (Sc.) 13(I): 115-122 pp.
21. Mahmood, N., 1990. A Study on immigration of commercially important penaeid shrimp post-larvae in the estuarine area of Chakaria, Cox's Bazar, Bangladesh. Ph. D. Thesis. Dept. Zool. Uni. Raj. pp: 133.
22. Hossain, M.M., 1983. Pollution as revealed by macrobenthic organisms in the Karnafuli River estuary. Postgraduate dissertation. IMSF, Uni. Ctg. pp: 96.
23. Hossain, M.S., M.S. Islam and M.A.T. Chowdhury, 2006. Shore based pollution of the Karnafulli River and the effects of oil-grease on the riverine environment. The J. of Geo- Envior. 5: 55-66.
24. APHA, 2005. Standard Methods for the examination of water and wastes water. 21 ed. Broadway, New York, USA. 00119.
25. Islam, M.S., 2012. Ecological aspects of the benthic macrofauna of satlmarsh of Fauzderhat Chittagong coast, Bangladesh. Ph.D. Thesis.
Yuan, X.Z., 2001. Ecology study on the zoobenthic community in the wetland of the estuarine tidal flat. PhD thesis, East China Normal University, Shanghai. pp: 195.
26. Sarda, R., K. Foreman and I. Valiela, 1995. Macroinfauna of a Southern New England salt marsh: seasonal dynamics and production. Marine Biology 121: 431-445.
27. Otani, S., Y. Kozuki, R. Yamanaka, H. Sasaoka, T. Ishiyama, Y. Okitsu, H. Sakai and Y. Yoji Fujiki, 2010. The role of crabs (Macrophthalmus japonicus) burrows on organic carbon cycle in estuarine tidal flat, Japan. Estuarine, Coastal and Shelf Science 86: 434-440.
28. Kundu, S., N. Mondal, P.S. Lyla and S.A. Khan, 2010. Biodiversity and seasonal variation of macrobenthic in faunal community in the inshore waters of Parangipettai Coast. Environment Monitoring and Assessment, 163: 67-79.
29. Ysebaert, T. and P.M.J. Herman, 2002. Spatial and temporal variation in benthic macrofauna and relationships with environmental variables in an estuarine, intertidal soft-sediment environment. Mar. Ecol. Prog. Ser., 244: 105-124.
30. Parsons, T.R., M. Takahashi and B. Hargrave, 1984. Biological Oceanographic Process. Pergamon Press, London. pp: 332.
31. Groenewald, C.J., 2010. Macrobenthic community structure across an inter- and subtidal gradient in a mangrove estuary. M. Sc thesis. Nelson Mandela Metropolitan University. pp: 113.

32. Hirst, A.J., 2004. Broad-scale environmental gradients among estuarine benthic macrofaunal assemblages of south-eastern Australia: implications for monitoring estuaries. Marine and Freshwater Research, 55: 79-92.
33. SHEPARD, F.P. (1954) Nomenclature based on sand-silt-clay ratios: Jour. Sed. Pet. 24. Pp.151-158.
34. W. Preddy, DzThe mixing and movement of water in the estuary of Thamesdz, J. Mar. Biol. Assoc. UK., 1954, 33, 645-662.

Access this Article in Online

Website: www.ijarbs.com

Subject: Marine Sciences

Quick Response Code

DOI:10.22192/ijarbs.2021.08.08.016

How to cite this article:
Mazharul Islam Sajeeb. (2021). A field assessment on Karnawphuli Estuarine Environment: Identify the Relation of Biotic Factors, Sedimentation and other Physio-chemical parameters. Int. J. Adv. Res. Biol. Sci. 8(8): 139-146.
DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.08.016