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Effectiveness of Abundance and Distribution of Benthos in Aquatic Ecosystem

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Abstract

Benthic organisms have a great ecological impact in any aquatic ecosystem. The study was done at Rush River under Khulna region, Bangladesh to enhance the effectiveness of abundance for aquatic eco-system. The study was conducted at two different stations such as fresh area and processing plan area of Rush River from July to December of last three years. The investigation was connected with different months, the abundance-distribution of benthos varied and effects of pH on salinity and alkalinity of the river water has been propounded in this article to enhance ecosystem of benthos living. Arthropods were also found in relatively low in number both the fresh and polluted area relatively to the Mollusks. The Mollusks distribution increases up to 77% from June to October in Fresh area but at Polluted area, it reduces 28% than fresh area. Annelid at June-September and October is same but on July-August it's become higher at both type of water. Arthropods reduce 33.3% from June to October in Fresh area but in polluted area it is very rare.

Keywords: Aquatic-Environment, Benthos, Eco-system, Micro- and Macro-organisms

Introduction

Generally benthos are found in any sediments where water is present it can be in the sea, river, pond or any close water body, lagoon, *etc*. They are generally abundant and can be found year round so are easily sampled. Benthos is an important part of aquatic ecosystem. The benthic fauna constitute an important food items for many fishes and thus play important role in the aquatic food chains. They have a fundamental importance to the ecosystem of aquatic environment as they take part in nutrient release from the sediment to the water as to enrich the productivity of water body. Benthic community can be regarded as a biological indicator because they can provide information on environmental conditions. So the composition, profusion and allocation of benthic organisms in the natural water throughout the year provide an index of ecosystem. Benthic organisms are rich in amino acid, fatty acid, vitamins and minerals. Some benthic invertebrates particularly clam's crabs are enthusiastic by human. Rupsha is one of the biggest freshwater running water bodies in the district of Khulna with a wide biodiversity. There are many organisms which are closely inter-related as a river based ecosystem. Benthos is one of the most important ones. It has a great influence in the life cycle of the fishes and birds community as their abundance and distribution. Species composition of the benthos in Rupsha River is quite different from the Estuarine and the marine ecosystem. In the Rupsha River there are fresh area and polluted area also (due to the location of the processing plants). So, it is very easy to find out the benthos variation in two different environmental conditions in the river of Rupsha. Types and verities of water animals like benthos are discussed by Boycott (1936) and then illustrated by Mellanby (1963). Silver Botts *et al.* (1996) exhibited that taxa of benthic physical configuration allied with aggregates. Crowl and Covich (1990) showed cue and snails of benthic rapidly grew and become 10 mm within 8 months. Chakma *et al.* (2015) presented that macro-benthos consists of larvae Gastropods, Polychaetes, Prawn, Oligochaetes, Bivalvia Amphipods, Isopods, Diptera, Crab and Copepods. Bose and Lakra (1994) explained that benthos was in relation to certain ecological parameters and found significant

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correlation between population number of chironomus larvae and total alkalinity content. Freckman *et al.* (1997) proved that sustainability of benthos mainly depend on soils as well as freshwaters. Goedkoop and Johnson (1996) described that 1.9 and 12.4% of phytodetritus deposition caused mineralized with help of sediment bacteria. Schramm Jr. and Jirka (1989) showed that benthic invertebrate was more plentiful in vegetated than other resource of open water. Groffman and Bohlen (1999) showed correlation between soil and sediment of biodiversity in ecosystem and presented various organisms if that habitats. Parkyn *et al.* (1997) proposed that freshwater koura played vital role for configuration of benthic communities. Wallace and Webster (1996) described invertebrates constitute as a main food source for several fish. Baby *et al.* (2010) showed that *Pila globosa* contained 2.902±0.03% carbohydrate and *Melania tuberculata* hold 7.566±0.37% carbohydrate. Zenetos *et al.* (2005) explained that molluscan grew exponentially by time 13 to 26 in Greek waters. Salinity generated a stratified layer in epilimnion and hypolimnion zone assured by Rouf *et al.* (2022). Bouregreg are dogged by pollution control and assessment (PCA) described by Priya *et al.* (2022). Reiss *et al.* (2015) explained that benthic distribution mainly depended on climate change and assist to hold up ecosystem. Giri *et al.* (2021) have demonstrated that 78% cultivator advocated that BBFS productivity is more acceptable than chemical and BBFS system is more entrusted for living of micro-organisms. Chowdhury *et al.* (2024) described that more abundance of benthos were 1650 ind. m^{-2} in Sarawak and Crustacean was 597 ind. m^{-2} in Selangor.

After reviewing the recent papers, the objective of the articles has been defined to find out the available benthos and identify them with the morphology and to find out the abundance and distribution of the benthos.

Materials and Methods

Site Selection

Samples were collected from two different stations of Rupsha river (Station 1 - besides the processing plant and Station 2 - from the fresh area) the probable distance of two stations was near about 1 to 1.5 km. Location of sampling-1: 22.769732 N and 89.584631 E; location of sampling-2: 22.8609895 N and 89.4804953 E. Figure 1 shows the site.

Sampling

Three replicate samples were collected randomly. Samples were collected during the lowest tide period. Core sampler was used for sampling with 4.5 inch height and 4 inch in diameter. So, the volume of each sediment sample was,

$$\frac{4}{3}\pi r^2 h = \frac{4}{3}\pi\left(\frac{d}{2}\right)^2 h = 56.544 \text{ inch}^3$$

The collected sediment with any materials kept in poly bag with tagging.

Laboratory Process

Isolation

After sampling the samples were diluted in a bucket with water then sieved in a 5 set sieve of mesh size 0.075, 0.2, 0.92, 2.0 and 4.0 mm. After the sieving the organisms were isolated and kept into separated vials with a forceps or a spoon.

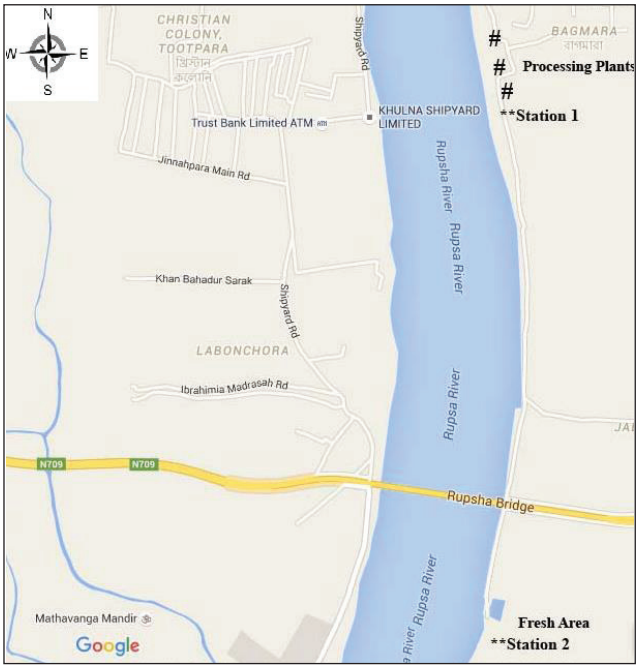

Figure 1: Map of the site (Google Map)

Preservation

5% formaldehyde was used for the preservation of mega organisms. The macro- and micro-organisms were preserved in refrigerator with vials. The vials were marked properly with a marker pen and taken into the laboratory.

Identification

The organisms were identified with the check list (morphological characteristics) with the help of different books, papers and internet. Different groups, texas of animals were studied for the identification of the organisms at list to the genus. The mega benthic organisms were easily identified. The microscopic specimen was taken in to a SR-cell and then covered with a slide, then put into the microscope. Sometimes, only slide and cover slip was used in the microscope. Some species (specially the macro benthos) was not clear in the microscope or made so big picture, in this case for clear visual impact/ identification migraine glass was used.

Counting

After identification the benthic organisms were counted and kept the record for observations.

Such types of works enhance fishery cultivations, like "Benthic Resources Assessment Technique, a Method for Quantifying the Effects of Benthic Community Changes on Fish Resources" which is illustrated by Lunz and Kendall (1982).

Results and Discussion

Available Benthos and Effectiveness

The study was conducted at two distinct station of Rupsha

River from July to December of last 3 years. Samples were collected randomly from two different stations from one time in a month with the lowest tide period of the month. In the investigation 15 different species were found. They are given below at a glance with a table 1.

Table 1: Three major groups/ phylum of Mollusk, Annelid and Arthropod

Sl. No.	Local/ Ordinary Name	Common Name	Scientific Name
1	Jhinuk	Freshwater/ Duck Mussel	*Anodonta* sp.
2	Husla Shamuk	Freshwater Snail	*Melanoides* sp.
3	Chapta Pachono Shamuk	Rams Horn Snail	*Indoplanorbis* sp.
4	Jhinuk	Freshwater Mussel	*Mercenaria* sp.
5	Bara shamuk	Apple Snail	*Pila* sp.
6	Guli Shamuk	River Snail	*Bellamya* sp.
7	Taj Shamuk	Lineate Nerite	*Septaria* sp.
8	Dara Shamuk	Zebra Snail	*Neritina* sp.
9	Poka	Sewage worm	*Tubifex* sp.
10	Kacho	Earth Worm	*Pheretima* sp.
11	Joke	Leech	*Hirudo* sp.
12	Kakra	Small Crab	*Liocarcinus* sp.
13	Poka	Isopod larvae	*Lirceus* sp.
14	Poka	Dragon fly larvae	*Libellula* sp.
15	Poka	Midge (larvae)	*Chironomus* sp.

The total 15 species could be classifies into three major groups/ Phylum, like: Mollusk, Annelid and Arthropod.

Mollusk was the most dominant group found all the months (July to December). The amounts of mollusks become larger in fresh water zone relative to polluted zone. In this study, two groups of freshwater mollusks were found from Rupsha River namely snails (Gastropods) and mussels (Bivalves). Between two groups Gastropod occupied greater number than Bivalves. *Pila* sp. and *Neritina* sp. were most common gastropods found abundantly from the study. *Mercenaria* sp. was common mussels (Bivalves). Others mollusks were: *Anodonta* sp., *Indoplanorbis* sp., *Bellamya* sp., *Septaria* sp., *Melanoides* sp. From July to December, the number of benthos were become decreased.

July to August the amount of Annelids was larger amount into polluted zone than fresh zone. But next three months (September, October and November) the amount of Annelids in the fresh zone and polluted zone was remain same. In the month of December, it was not found in the polluted area. But in the fresh vs. polluted area the Annelids are dominant than the mollusk and arthropods. In the Annelids group earth worm (*Pheretima* sp.), Sludge worm (*Tubifex* sp.) and Leech (*Hirudo* sp.) are commonly found. Earthworm was found on the fresh area in a great number but Sludge worm or Sewage worm (*Tubifex* sp.) was found more in number in the polluted area comparing to the fresh area. The reason might be the physiology of Sewage worm (*Tubifex* sp.) was suitable in the polluted environment.

The amount of Arthropods species was relatively high in the fresh area than the polluted area as like as the mollusk but the quantity was relatively low than the mollusks. In the case of Arthropods, they were generally found in the fresh area, they were low in the polluted area. In this phylum Small crab (*Liocarcinus* sp.) was very common. Others species were: Sowbug (*Lirceus* sp.) and Midge larvae (*Chironomus* sp.), Dragon fly larvae (*Libellula* sp.).

From the figure 2, 3 and 4 it is found that abundance distribution is rapidly decreases from month of July to December and in August both F/mean as well as P/mean are near about same that indicates the good environment for living of benthos.

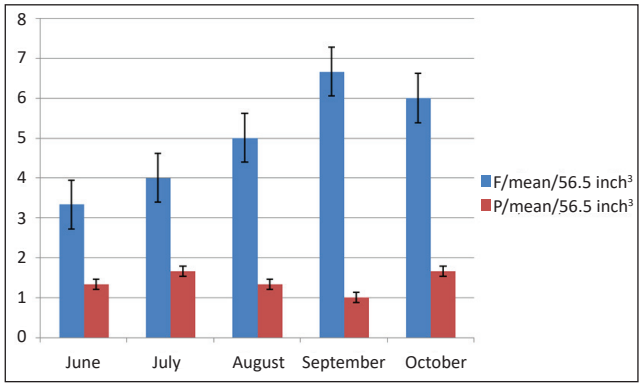

Figure 2: Graphically representation of Mollusks (abundance-distribution)

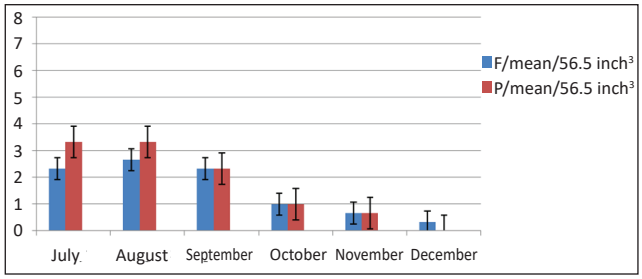

Figure 3: Graphically representation of Annelids (abundance-distribution)

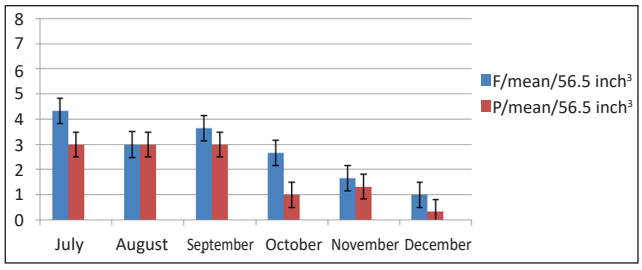

Figure 4: Graphically representation of Arthropods (abundance-distribution)

Effects of Salinity and Alkalinity on pH of Water to Enhance of Fishery Cultivation

If alkalinity and pH are directly related, their effectiveness influences on living environment of fish. Alkalinity controls water's ability to refuse to go along with changes the level of pH in water. pH ranges at 6.5-9.0, creates good environment and control the quality of water which control the benthos lives. Velez *et al.* (2016) observed that 30 psu salinity with 8 pH is good for benthos as well as fresh water fish. pH enhances with salinity until $CaCO_3$ infiltration is reached. Calcite impetuous, the carbonate-alkalinity of water becomes low. If pH is greater than 9.5 or lower than 4.5 is not good for living most of the aquatic organisms. Little fish and little immature insects are faced problems even at 5 may die at that stage. At 9-14 pH range, fish as well as benthos are damaged. Lower pH range is the measurement of acidity in water. Fish and insects are unable to live below pH level 4 and above pH level 11 for vast periods. The better pH level for insects, benthos as well as fish is 6.5-9 propounded by Berezina (2001).

As the study area was selected in two different places (fresh area and polluted area) in Rupsha River, Benthos is present in both places. So, it can be said that benthos can survive in different environmental condition. But their Species composition and abundance can be varied in these aspects.

Conclusion

Benthos should be prevented to maintain the ecological balance by maintaining the hazardous condition of the environment. From the investigation it is clear that Mollusk is the most dominate among the other groups (Annelids, Insects) thought there is a majority of annelids in the industrial area. The findings have also seen the seasonal variation of benthos in two different places. As the study was concluded for several months, annual or seasonal variation could not be fully determined. Long more studied are much more essential to know the exact condition of the benthic community. The Mollusks distribution increases up to 77% from June to October in Fresh area but at Polluted area, it reduces 28% than fresh area. Annelid at June-September and October is same but on July-August it's become higher at both type of water. Arthropods reduce 33.3% from June to October in Fresh area but in polluted area it is very rare presence. The result indicates that there has an effective impact on the benthos on their natural life cycle. Living benthos leads to live of fishing as well as water pH level with salinity level creates the proper environment of cultivation of fish.

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