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Effect of seasons and water quality on abundance of protozooplankton in coastal water of Barisal, Bangladesh

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ABSTRACT

The present research was carried out to investigate the seasonal abundance of zooplankton especially protozoa in selected coastal ponds of Bakergonj, Barisal, Bangladesh during April 2006 to March 2007. The physicochemical parameters of the water such as pH, DO (Dissolved Oxygen), air, temperature in the study areas were also recorded during the study period. A total of 4 protozooplankton species were identified from the seven ponds and a river of Bakergonj upazila. Among zooplankton the occurrence of protozoa were 1.12%. The abundance of zooplankton community was highest in summer (2862 indiv/L) and the lowest in winter (1059 indiv/L). Whereas the abundance of protozoa was highest in monsoon and lowest in summer. From the accumulated data in a year the monthly abundance of zooplankton varied from 497 indiv/L in March to 4933 indiv/L in May with an average of 1781 indiv/L. The mean composition of protozoa in the ponds was about 20 indiv/L with *Difflugia* sp 75.64 %, *Glaucoma* sp 20.19 %, *Arcella vulgaris* 2.56 % and *Centropyxis* sp 1.60 %. The water quality parameters were either positively or negatively related to the abundance of the zooplankton. Protozoa was positively related to the water quality of ponds. The river did not appear to be rich in zooplankton community as well as protozoa. The zooplankton community as well as protozoa was comparatively higher in pristine and culture ponds than the river.

Key words: zooplankton, protozoa, Barishal, Bangladesh

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INTRODUCTION

Zooplankton organisms occupy a central position in the food webs of aquatic ecosystem. They do not only form an integral part of the lentic community but also contribute significantly, the biological productivity of the fresh water ecosystem (Wetzel 2001). The importance of the zooplankton is well recognized as these have vital part in food chain and play a key role in cycling of organic matter in an aquatic ecosystem. The zooplankton community of rivers and different kinds of ponds has received relatively considerable attention for a long time in different parts of the world including Bangladesh but very few in coastal regions. Protozoa are an important component of both the nano- and microplankton in marine and freshwater environments and are preyed upon by zooplankton. Since protozoa causes a variety of diseases in human and animal the researcher all over the world has given special attention on it. Proper identification and detection of seasonal variation are invaluable component for understanding the epidemiology and transmission dynamics of the protozoa. Moreover, investigating the zooplankton may identify the changes in aquatic ecosystems. Although very few works have been done with micro zooplankton (Kim and Joo, 2000; Maria-Heleni et al, 2000; Zimmermann-Timm et al., 2007) protozoa are reported very few in number in these studies (Ali, 1980). It is an established fact that maintenance of healthy aquatic ecosystem is dependent on the physico-chemical properties of water and biological diversity. The present study primarily aims to document the seasonal variability and

effect of physico-chemical parameters of water on abundance of zooplankton species especially protozoa in some selected costal of areas of Bangladesh.

MATERIALS AND METHODS

Collection of samples

This study was conducted at Bakergonj upazila of Barisal district of Bangladesh located about 68 Km far from the Bay of Bengal. The zooplankton area was between the junction of costal and freshwater flood plain. The geographical location of the study area was between 22°-29´ N to 22°-30´ N and 90°-22´ E. Samplings were done at eight different sites which include seven ponds (5 pristine and 2 culture ponds) and one river. Samplings were done several times at these sites. The work was carried out during the period of April 2006 to March 2007. The whole year of the study period was divided into three seasons namely winter (November to February), summer (March to June) and monsoon (July to October).

Sampling sites

Site-1: Bakerganj Helipad Govt. pond (pristine pond)
Site-2: Bharpasa Mukherji Bari pond (pristine pond)
Site-3: Bharpasa Jam-E-Mosque pond (pristine pond)
Site-4: Upazila health complex mosque pond (pristine pond)
Site-5: Tulatuli river side
Site-6: Harun Dakua's pond (culture pond)
Site-7: Bara Aulia's Mazar pond (pristine pond)
Site-8: Bairam Kha's lake (culture pond)

Isolation and identification of zooplankton

Zooplankton was collected in each sampling site through plankton net of 64 µm mesh size by passing 100 liter of water through it. Fifty milliliter (ml) of condensed zooplankton sample was preserved by formalin. Part of the sample (10 ml) was supplied to the Department of Zoology, University of Dhaka for zooplankton analysis in cooperation with ICDDR,B, Mohakhali, Dhaka.

The supplied sample was usually examined under microscope (X 160) using S-R counting cell to enumerate the zooplankton. The Following formula was used for the total counting of the zooplankton:

$$Z_L = \frac{Z_C}{W}\left(\frac{S\ X\ B}{s\ XS_b}\right)$$

Where,
ZL = Zooplankton/Liter.
ZC = Total number of organism counted in 3 ml sample
S = Volume of sample in ml
B = Volume of bucket sample in ml
s = Volume of examined sample in ml
Sb = Volume of sub-sample (part of sample examined) in ml.

Statistical Analysis

The relationship between the physico-chemical and biological parameters was observed by using the standard formula of Karl Pearson's co-efficient of correlation (r). T test was used to measure the level of significance of relationship between the different parameters.

RESULTS AND DISCUSSION

Zooplankton abundance

In the present study the qualitative and quantitative observations were made at one month intervals on the zooplankton community of seven ponds and the river site of the study area during the study period. From the accumulated data it was observed that the monthly abundance of zooplankton varied from 497 indiv/L in March to 4933 indiv/L in May with an average of 1781 indiv/L (figure 1). In general, the abundances of zooplankton community were highest in summer (2862 indiv/L) and the lowest in winter (1059 indiv/L) (figure2). Among zooplankton the occurrence of protozoa are 1.12%.

Protozoa

The monthly abundance of protozoa in the study area was recorded. Protozoan population was not

found in all the months (figure 3). The highest abundance of protozoa was recorded in the monsoon which was 1280 indiv/L and the lowest number of protozoa was recorded in the summer (120 indiv/L) (figure 4).

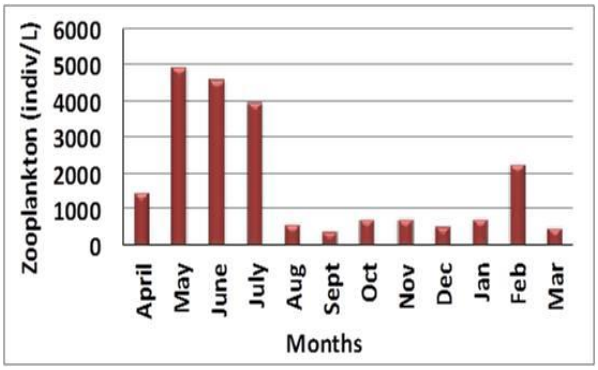

Figure1
Monthly variation of total zooplankton during the study period

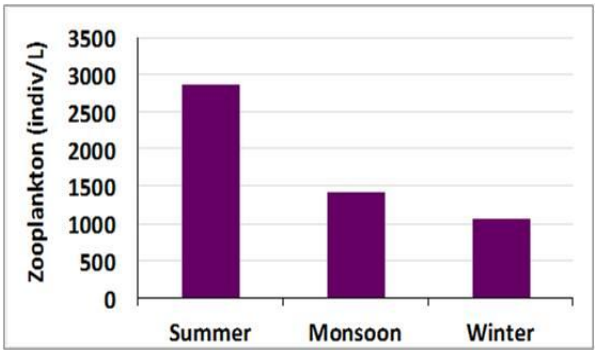

Figure 2
Seasonal variation of zooplankton during the study period

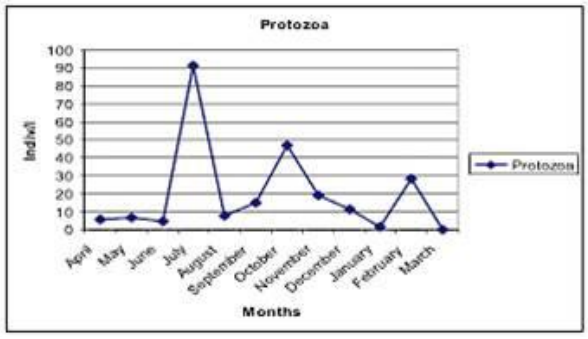

Figure 3
Monthly variation of protozoa in the study period

The protozoan population varied considerably in different sampling sites. In site-1 protozoa was totally absent in summer and the highest number was found in winter (table 1). In site-2 protozoa was observed in all most all the seasons but the highest number was observed in winter (144 indiv/L). In site 3 protozoa were available in monsoon and winter. The highest number was found in winter (660 indiv/L). In Site-4 it was found only in June and September. In site-5 it was observed only in winter. In site-6 it was recorded in monsoon and part of winter. In Site-7 it was found only in monsoon (740 indiv/L). In site-8 no protozoa was found in winter but the highest number was found in monsoon (348 indiv/L). Among the sites the highest abundance of average protozooplankton (61.75 indiv/L) was observed in site-7 (Bara Aulia's Mazar pond) and it was lowest (4.25 indiv/L) in site-4 (Upazila health complex mosque pond). The average protozooplankton was 0 indv/L in January and highest (91.12 indv/L) in July (table 1). Such variations in population may be due to variation in nutrient and other favorable conditions of water during plankton production.

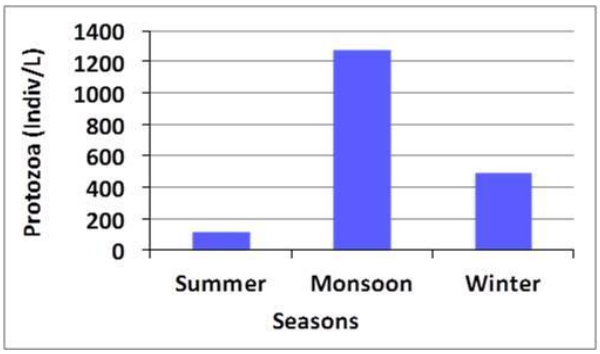

Figure 4
Seasonal variation of protozoa during the study period

Arcella vulgaris, Centropyxis sp, Difflugia sp, Glaucoma sp species were identified as protozooplackton (table 2) from the selected sites. Among the protozooplankton *Difflugia* sp was in highest abundant followed by *Glaucoma* sp, *Arcella vulgaris* and *Centropyxis* sp (table 2). The abundance of protozoan species is given below:

***Difflugia* sp**

Among the protozoa, *Difflugia* was the most dominant genus. It contributed 75.64% of the total

protozoa. It was found in all the sites with monthly average 118 indiv/L.

***Glaucoma* sp**

Glaucoma was the 2nd dominant genus. It was 20.19% of the total protozoa. It was not found in site-4 and site-5 with monthly average 37.5% indiv/L.

***Arcella* sp**

It was 2.56% of the total protozoa. Only one species of this genus was found viz- *Arcella vulgaris*. It was found in site-1, site-5, and site-7 with monthly average 4 indiv/L.

***Centropyxis* sp**

It was 1.60% of the total protozoa. It was found only in site-1, site-6, and site-7 with monthly average 2.5 indiv/L.

Table 1
Site wise monthly variations in the abundance (indiv/L) of protozoa in Bakergonj

Sites	2006									2007			Monthly average
	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Site-1	0	0	0	0	0	0	27	25	30	0	21	0	8.58
Site-2	27	0	0	0	3	0	0	0	12	6	18	0	6.25
Site-3	0	0	0	27	3	0	6	111	48	6	0	0	16.75
Site-4	0	0	36	0	0	15	0	0	0	0	0	0	4.25
Site-5	0	0	0	0	0	0	0	15	0	0	150	0	13.78
Site-6	0	0	0	0	54	51	0	0	0	0	39	0	12
Site-7	0	0	0	693	0	21	27	0	0	0	0	0	61.75
Site-8	18	54	0	0	0	33	315	0	0	0	0	0	35
Average	5.62	6.75	4.5	91.12	7.5	15	46.87	18.87	11.25	1.5	28.5	0	19.79

Table 2
Abundance of different protozoan (indiv/L) fauna

Sites	*Arcella vulgaris*	*Difflugia sp*	*Glaucoma sp*	*Centropyxis sp*
Site-1	6	402	6	12
Site-2	0	693	48	0
Site-3	0	84	60	0
Site-4	0	165	0	0
Site-5	36	30	0	0
Site-6	0	15	177	9
Site-7	6	18	15	9
Site-8	0	9	72	0
Total	48	1416	378	30
Monthly average	4	118	37.5	2.5

Table 3
Co-efficient of correlation (r) between physico-chemical parameters, and protozoa

Relationship	Correlation "r"	Calculated "t"	Tabulated "t" at 5% level of significance
Protozoa and water temperature	+0.1098	0.3493	
Protozoa and pH	+0.0807	0.2560	1.812
Protozoa and DO	+0.1395	0.4455	
Protozoa and air temperature	+0.06057	0.1918	

Relationship of physico-chemical parameters with the abundance of protozooplankton

Air and water temperature

The average air highest temperature (35.2°C) was recorded in April and lowest temperature (24°C) in January (figure 5). Whereas the water temperature was found to be variable throughout the study period. The maximum was found as 33.33°C in October and minimum was 20.17°C in January (figure 6). The protozooplankton was found to be lowest (1.5 indiv/L) in January might be due to lower temperature and higher population (46.87 indiv/L) was observed in October might be due to higher water temperature in this month. A positive correlation was observed between the protozooplankton and water temperature in the study area (table 3).

Figure 5
Monthly variation of average air temperature

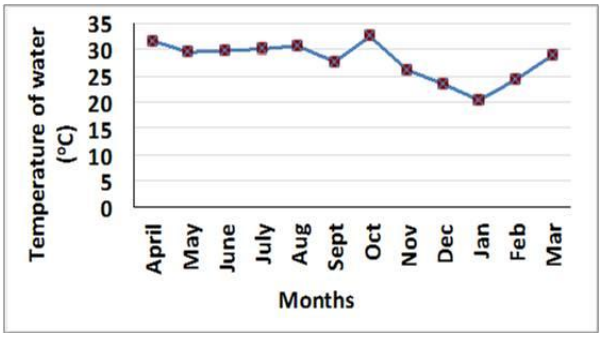

Figure 6
Monthly variation of average water temperature

pH of the water

The pH value of the ponds showed to be alkaline in nature during the study period with some variation (figure 7). The alkalinity was increased in winter and decreased in summer. The positive correlation was observed between the pH of water and the abundance of protozooplankton in the selected areas.

Dissolved oxygen (DO)

The average minimum and maximum value of DO of eight sights was 6.13 mg/L in September and 7.91 mg/L in November respectively (figure 8). Positive correlation between DO and abundance of protozoa was observed in this study.

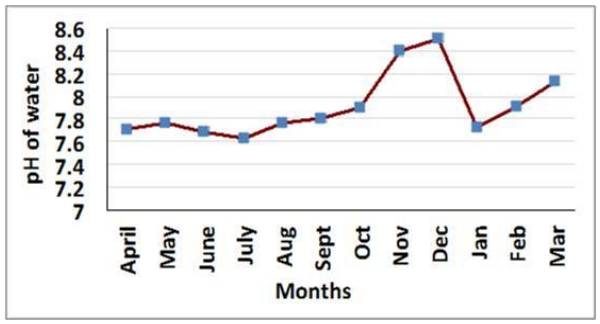

Figure 7
Monthly variation of pH in water sample

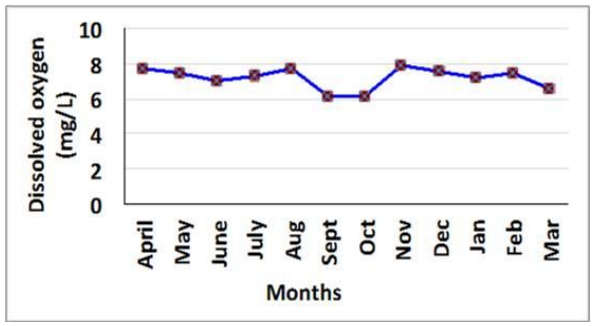

Figure 8:
Monthly variation of dissolved oxygen

The zooplankton individuals increased their abundance during summer, probably corresponding to the water quality, decaying vegetation, increased levels of nutrient in the sediment and higher abundance of bacteria in the pond during this time (Jacoby and Greenwood 1989; Srivastava et al., 1990). In contrast, the abundance of zooplankton species decreased in

winter, probably corresponding to low water temperature and high alkalinity (Chattopadhyay Banerjee, 2007). On the other hand, increased in abundance of protozoa during Monsoon, probably due to the precipitation, and water temperature that were higher in this period. The lower abundance of protozoan population in summer, probably due to decreased in alkalinity of water.

During the year, precipitation in the summer probably produced inputs of nutrients and suspended solids in the system and the winds in the winter increased water turbulence, causing an enhancement of DO concentration and homogenization of the water column. Moreover, the concentration of DO in the winter is probably also related to the higher solubility of oxygen as a consequence of the lower water temperatures.

The protozooplankton community showed seasonal variations with higher densities and species diversity in the monsoon (rainy season) in comparison with the dry season. Similar protozoan seasonality patterns were found by Gomes and Godinho (2003) and Araújo and Costa (2007). These higher values in the monsoon were probably due to the precipitation that may have caused the sediment resuspension carrying some benthic protozoans to the water column and the entrance of soil protozoa coming from the drainage basin along with protozoans originated from rivers whose water volume increases at this season. Protozoan density could also be affected by temperature, a fact confirmed by the high positive correlation between these variables. The increasing protozoan density with temperature could be related to the enhancement of their reproductive rates due to the higher metabolic rates; and prey and predator populations that normally are also positively affected by temperature. From the study it can be mimicked that there is a close relationship among these factors with the abundance of zooplankton as well as protozoa in different regions and seasons of the year. However, further studies are needed to determined and understand the influence of the possible factors that affect the zooplankton population dynamics in Bangladesh

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