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ABUNDANCE AND SEASONAL DIVERSITY OF ZOOPLANKTON IN COASTAL AQUATIC ENVIRONMENTS OF MATHBARIA, BANGLADESH*

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Abstract

Monthly seasonal diversity and abundance of zooplankton species at three ponds of Mathbaria were investigated from surface water column during January 2008 to December 2008. Thirty-six species of zooplankton were identified from the ponds. Among these, 25 belonged to rotifer, six were of protozoan, three were copepods and one each from cladocera and ostracoda. Nauplii (copepods) were the most abundant (39.09% in site 1, 36.81% in site 2, and 33.06% in site 3) group, while the ostracoda were the least abundant (0.1% in site 2) group. The relative abundance was maximum (39.09%) for nauplii and minimum (4.56%) for cladocera in site 1; maximum (36.81%) for nauplii and minimum (0.1%) for ostracoda in site 2; maximum (33.15%) for rotifer and minimum (1.17%) for Cladocera in site 3. The species of frequent occurrence (100%) were *Cyclops* sp. and copepoda nauplius. In Bangladesh, cholera outbreaks have two major peaks, one between March to May and other between August to October. This study shows that, seasonal diversity and abundance of zooplankton species varied with seasons, the zooplankton peaks coincide to the reported peak outbreak of cholera at the area.

Introduction

In freshwater ecosystem, zooplanktonic organisms which comprise of the second level of the food chain, are important food sources of many invertebrate animals and fish. Some of the zooplankton like rotifers were reported as primary consumers that feed on various phytoplankton while others were reported as raptorial predators that feed on bacteria and detritus matters.[1, 2] The main food of major carps like rui, catla and their hybrids were found to be plankton in origin.[3] Besides zooplankton plays an important role in the water quality, eutrophication status and productivity of a lake.[4] The zooplankton in a freshwater pond are those which are caught in a fine-meshed net towed slowly through the water column, and consist mainly of protozoan, rotifers, cladocerans,

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copepods and a great variety of immature larval forms of insects and crustacean[5]. Zooplanktons pass a short life-cycle, and thus multicellular zooplankters inhabiting a shallow freshwater body respond quickly to environmental changes, and hence their species composition and frequency of seasons; abundance fluctuate according to the changing environmental status. [6] Zooplankton play an important role as a reservoir of *V. cholerae* which is responsible for seasonal cholera and zooplankton also plays a major role in the multiplication , survival and potential transmission of cholera in coastal water body of Mathbaria.[7] Mathbaria is a cholera prone area and the inhabitants of that area use pond water for drinking, washing, cooking and other social purposes as the salinity of underground water is beyond acceptable level. Thus, in order to find out relationships between zooplankton abundance and cholera disease, it is necessary to observe seasonal diversity and abundance of zooplankton species. The present investigation is an attempt to examine the abundance, seasonal diversity and composition of zooplankton of selected ponds of Mathbaria, Bangladesh.

Materials and Methods

Mathbaria of Pirozpur district is located adjacent to the Bay of Bengal, approximately 400 Km southwest of Dhaka. The river, Baleshwar, flows along the western boundary of Mathbaria, on its other side a tropical mangrove forest of the Sundarbans is located. In the current study, water samples were collected monthly from three excavated ponds that are exclusively used only water sources for drinking and other restricted domestic uses. No anthropogenic contamination was allowed in the ponds except flood water.

Water samples were collected from three ponds used socially in three different localities of Mathbaria, between January, 2008 to December, 2008. For zooplankton sample collection, 100 liters of water was filtered successively through 64 μm mesh nylon nets (Millipore Corp., Bedford, MA), and 50 ml of the concentrates was collected initially as a crude measure of zooplankton. The collected zooplankton samples were fixed in 4% buffer formaldehyde solution and were identified at the Advanced Fisheries Research Laboratory of Department of Zoology, University of Dhaka.

For qualitative and quantitative study, zooplankton samples were examined under a compound microscope (Axioskop 40, Japan) in a Sedgeweak-Rafter cell. The specimens were identified up to genera or species level. The zooplankton species were identified using various text books.[8-12]

Results and Discussion

Zooplankton collected from the three sites of Mathbaria across seasons were identified. They belong to 36 species (Table 1). Among these, 25 belonged to rotifera, six were of protozoans, three were copepods and one each from cladocera and ostracoda. Nauplii (copepods) were the most abundant (39.09% in site 1, 36.81% in site 2, and

33.06% in site 3) group, while the Ostracoda were the least abundant (0.1% in site 2) group. The qualitative zooplankton analysis in Bakerganj showed the presence of 47 taxa from five groups: Protozoa (four taxa), Rotifera (31 taxa), Copepoda (five taxa), Cladocera (five taxa) and Ostracoda (two taxa).[13]

In site 1, the relative abundance was maximum (33.33%) for *Difflugia* sp. and minimum (0.12%) for *Arcella* sp., *Centropyxis* sp. in Protozoa; maximum (5.25%) for *Polyarthra vulgaris* and minimum (0.12%) for *Brachionus* sp., *B. forficula*, *Colurella* sp., *Horaella brehmi* and *Lecane luna* in Rotifera; maximum (5.52%) for *Diaptomus* sp. and minimum (2.04%) for *D. gracilis* in Copeoda (Table 1).

Furthermore, the frequency of occurrence was maximum (58.33%) for *Difflugia* sp. and minimum (8.33%) for *Arcella* sp., *Glaucoma* sp. and *Centropyxis* sp. In Protozoa; maximum (33.33%) for *Polyarthra vulgaris* and minimum (8.33%) for *Brachionus* sp., *B. angularis*, *B. forficula, Colurella* sp., *Filinia longiseta, Horaella brehmi* and *Lecane luna* in Rotifera; maximum (83.33%) for *Cyclops* sp. and minimum (58.3%) for *D. gracilis* in Copepoda. Nevertheless, the frequency of occurrence in Cladocera was 58.33% (Table 1).

In site 2, the relative abundance was maximum (11.66%) for *Difflugia* sp. and minimum (0.1%) for *Glaucoma* sp., *Centropyxis* sp., in Protozoa; maximum (8.01%) for *Pompholyx sulcata* and minimum (0.1%) for *Manfredium* sp., *Monostyla bula,* and *Trichocerca* sp. in Rotifera; maximum (10.65%) for *Cyclops* sp. and minimum (2.64%) for *Diaptomus sp.* in Copeoda (Table 1).

Furthermore, the frequency of occurrence was maximum (58.33%) for *Difflugia* sp. and minimum (8.33%) for *Glaucoma* sp. and *Centropyxis* sp. in Protozoa; maximum (41.67%) for *Polyarthra vulgaris, Horaella brehmi* and minimum (8.33%) for *Filinia terminalis, Keratella tropica, Manfredium* sp., *Monostyla bula*, *Trichocerca* sp., and *Testudinella patina* in Rotifera; maximum (100%) for *Cyclops* sp. and minimum (25%) for *D. gracilis* in Copepoda. Nevertheless, the frequency of occurrence in Cladocera was 50% and Ostracoda was 8.33% (Table 1).

In site 3, the relative abundance was maximum (18.73%) for *Difflugia* sp. and minimum (0.17%) for *Glaucoma* sp. in Protozoa; maximum (8.58%) for *Polyarthra vulgaris* and minimum (0.08%) for *Brachionus* angularis, *B. diversicornis*, *B. quadridentatus*, *Filinia terminalis*, *Manfredium* sp. and *Monostyla bula* in Rotifera; maximum (6.41%) for *Cyclops* sp. and minimum (0.5%) for *D. gracilis* and *Diaptomus* sp. in Copeoda (Table 1).

Furthermore, the frequency of occurrence was maximum (66.67%) for *Difflugia* sp., *Phacus* sp. and minimum (8.33%) for *Glaucoma* sp. and *Centropyxis* sp. in Protozoa; maximum (41.67%) for *Brachionus falcatus, Horaella brehmi* and minimum (8.33%) for *B. angularis*, *B. diversicornis, B. quadridentatus, Filinia terminalis, Keratella tropica, Manfredium* sp., *Monostyla bula, Pompholyx sulcata* and *Rotaria neptunia* in Rotifera; maximum (91.67%) for *Cyclops* sp. and minimum (8.33%) for *D. gracilis* in Copepoda. Nevertheless, the frequency of occurrence in Cladocera was 25% (Table 1).

Table 1. Zooplankton species recorded from the surface water of three sites of Mathbaria over January2008 to December 2008 (% by number = contribution of each species to the total number of zooplankton recorded over seasons, % frequency of occurrence = percentage of plankton net in which the species was recorded).

Mathbaria		Site - 1 (South Mithakhali)		Site - 2 (kachisori)		Site - 3 (Mathbaria bazaar)	
Group	Species	Relative abundance (% by number)	Frequency of occurrence (%)	Relative abundance (% by number)	Frequency of occurrence (%)	Relative abundance (% by number)	Frequency of occurrence (%)
Protozoa		**33.81**		**22**		**25.24**	
	Arcella sp.	0.12	8.33				
	Difflugia sp.	33.33	58.33	11.66	58.33	18.73	66.67
	Glaucoma sp.	0.24	8.33	0.1	8.33	0.17	8.33
	Centropyxis sp.	0.12	8.33	0.1	8.33	0.67	8.33
	Phacus sp.			4.97	66.67	5.5	66.67
	Pareuglypha sp.			5.17	25		
	Unidentified					0.17	16.67
Rotifera		**11.28**		**18.69**		**33.15**	
	Asplanchna priodonta					8.33	25
	Brachionus sp.	0.12	8.33				
	Brachionus angularis	0.96	8.33	0.41	33.33	0.08	8.33
	Brachionus caudatus					1.75	25
	Brachionus diversicornis					0.08	8.33
	Brachionus falcatus					6.16	41.67
	Brachionus forficula	0.12	8.33			1.5	25
	Brachionus quadridentatus					0.08	8.33
	Colurella sp.	0.12	8.33				
	Filinia longiseta	3.48	8.33	1.42	25	0.67	25
	Filinia terminalis			0.2	8.33	0.08	8.33
	Filinia opolinesis			0.2	16.67	0.18	

(Contd.)

(Contd.)

Group	Mathbaria Species	Site - 1 (South Mithakhali)		Site - 2 (Kachisori)		Site - 3 (Mathbaria bazaar)	
		Relative abundance (% by number)	Frequency of occurrence (%)	Relative abundance (% by number)	Frequency of occurrence (%)	Relative abundance (% by number)	Frequency of occurrence (%)
	Hexarthra intermedia			0.2	16.67	2.66	25
	Horaella brehmi	0.12	8.33	0.71	41.67	0.75	41.67
	Keratella cochlearis			0.51	16.67		
	Keratella tropica	0.36	16.67	0.41	8.33	0.75	8.33
	Lepadella sp.					0.25	16.67
	Lecane luna	0.12	8.33				
	Manfredium sp.			0.1	8.33	0.08	8.33
	Monostyla bula			0.1	8.33	0.08	8.33
	Polyarthra vulgaris	5.52	33.33	5.1	41.67	8.58	50
	Pompholyx sulcata			8.01	25	0.17	8.33
	Rotaria neptunia			0.41	25	0.09	8.33
	Trichocerca spp.			0.1	8.33	0.33	25
	Testudinella patina			0.2	8.33	0.17	16.67
	Unidentified	0.36	16.67	0.61	25	0.33	8.33
Nauplii		**39.09**		**36.81**		**33.06**	
	Nauplius	30.58	100	3022		28.23	100
	Metanauplius	8.51	66.67	6.59		4.83	91.67
Copepoda		**11.28**		**18.39**		**7.41**	
	Cyclops sp.	3.72	83.33	10.65	100	6.41	91.67
	Diaptomus gracilis	2.04	58.33	5.1	25	0.5	8.33
	Diaptomus sp.	5.52	66.67	2.64	33.33	0.5	25
Cladocera		**4.56**		**4.1**		**1.17**	
	Diaphanosoma sp.	4.56	58.33	4.1	50	1.17	25
Ostracoda				**0.1**			
	Heterocypris sp.			0.1	8.33		

In site 1, the seasonal assemblages of zooplankton species were maximum in August for Protozoa, December for Rotifera, September for copepoda and April for Cladocera (Fig. 1). In contrast, the seasonal assemblages of zooplankton species were minimum in April for Protozoa, August for Rotifera, February, July and August for Copepoda and February for Cladocera. Furthermore, the sum of the assemblages of the zooplankton species was maximum (645 ind/l) in August and minimum (42 ind/l) in March, 2008.

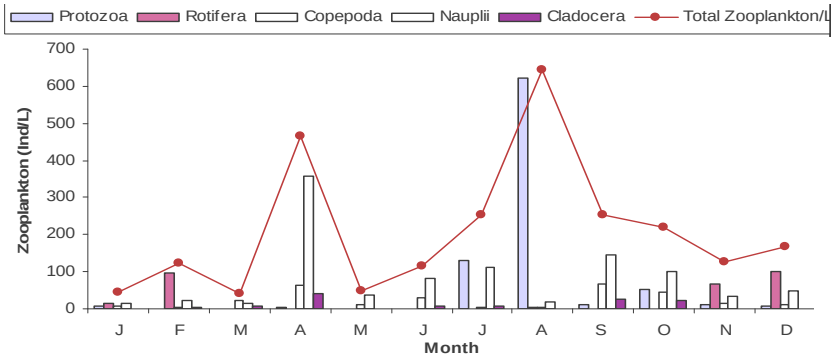

Fig. 1. The zooplankton groups across seasons in surface water of site-1 of Mathbaria.

In site 2, the seasonal assemblages of zooplankton species were maximum in September for Protozoa, February for Rotifera , April for copepoda and April for Cladocera (Fig. 2). In contrast, the seasonal assemblages of zooplankton species were minimum in January for Protozoa, May and August for Rotifera, January, June and July for Copepoda, and November, December for Cladocera. Furthermore, the sum of the assemblages of the zooplankton species was maximum (813 ind/l) in April and minimum (18 ind/l) in January, 2008.

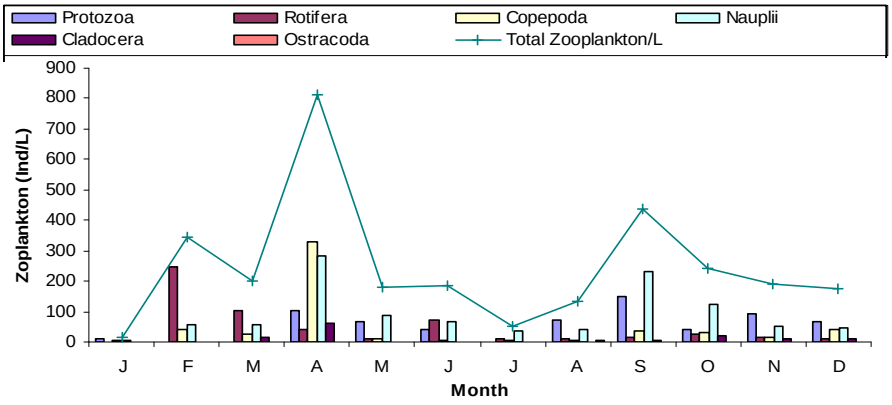

Fig. 2. The zooplankton groups across seasons in surface water of site-2 of Mathbaria.

In site 3, the seasonal assemblages of zooplankton species were maximum in April for Protozoa, January for Rotifera, Copepoda and Cladocera (Fig. 3). In contrast, the seasonal assemblages of zooplankton species were minimum in March and May for Protozoa, May for Rotifera, September for Copepoda, and April, December for Cladocera. Furthermore, the sum of the assemblages of the zooplankton species was maximum (744 Ind/l) in April and minimum (21 ind/l) in March 2008.

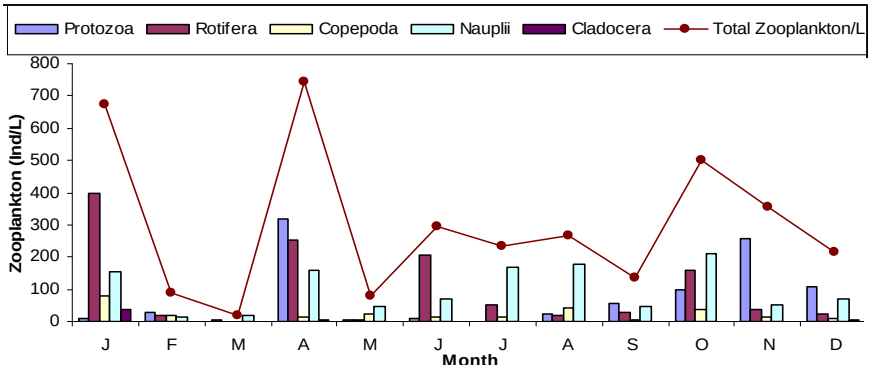

Fig. 3. The zooplankton groups across seasons in surface water of site-3 of Mathbaria.

The protozoa, rotifera, copepoda, cladocera, nauplii and ostracoda mainly constituted the zooplankton groups of studied coastal ponds. The zooplankton species increased their abundance during summer (April-May), 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.[14,15] In contrast, the abundance of zooplankton species decreased in winter (November-January), probably corresponding to low water temperature and high alkalinity (pH 7.6 - 9.8).[16]

The Protozoan populations were fewer in the studied pond surface water. The rotifer populations, however, were more abundant than other zooplankton groups in the all three pond sites of Mathbaria, and this was probably because of their ability to withstand and survive in varying limnological conditions prevailing at different seasons.

Some species (e.g., *Cyclops* sp., *Diaptomus* sp., *D. gracilis*, nauplius larva, metanauplius larva *Difflugia* sp., *Phacus* sp., *Polyarthra vulgaris, Brachionus angularis, Horaella brehmi, Brachionus falcatus*) were more abundant than other zooplankton species, and consequently their frequency of occurrence reached the maximum (30 - 100%)

Results of the present investigation demonstrated that the seasonal zooplankton diversity decreased in November and December for all three sites. In contrast, the zooplankton diversity reached the peak in April for all sites and August, September and October for all sites. This could influence the abundance of *Vibrio cholerae* in the aquatic system.

In Bangladesh, cholera outbreaks have two major peaks, one between March and May and other between August and October.[17] This study shows that, seasonal diversity and abundance of zooplankton species varied with seasons and that the zooplankton peak coinside to the outbreak of cholera in the area.

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