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Zooplankton Community and their Variation : A Case Study in Few Rivers Across Nadia and North 24 Parganas, West Bengal

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ABSTRACT

This study conducted to investigate the plankton diversity and abundance from the rivers at Nadia and North 24 Parganas to reveal the status. Samples were collected from seven sites of rivers Hooghly, Churni, Jalangi, Mathabhanga Bhagirathi, Ichamathi of West Bengal were carried out during March to May 2021. Enormous loads of wastes received from anthropogenic activities influences the living planktonic organisms which play the major role in food web dynamics in riverine ecosystem. pH, temperature, dissolved oxygen, dissolved carbon di-oxide, transparency, hardness, alkalinity, total dissolved solids, nitrate, nitrite, silicate and ammonia were analysed. 21 speciesof zooplankton including protozoa (2 species, 2 genera, 2 families, 1 order), rotifers (11 species, 6 genera, 4 families, 2 suborders), copepods (2 species, 2 genera, 2 families, 1 suborder), and Cladocera (5 species, 5 genera, 4 families, 1 sub-order) and the variation in abundance were noticed from the study. The maximum representation of the zooplankton species belonging to rotifera (Family: Brachionidae) and copepodites and naupliar stages of cyclopoid copepods were found to be abundant.

Keywords Rivers, Water Quality, Zooplankton, Abundance and Diversity.

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INTRODUCTION

Riverine ecosystems are complex and dynamic in nature. The rivers have loaded nutrients, organic matters involve biogeochemical process which influences the zooplankton population abundance and diversity (Nasser *et al.* 1998, Sikkou-Frangou *et al.* 1998, Agarwal *et al*. 2009). Zooplankton, an important and play significant role in food web in the changing climatic conditions, human influences and anthropogenic activities (Zhikharev *et al.* 2023). Enormous studies in the hydrobiological investigation, zooplankton diversity and their population were also recorded from the rivers of India (Chakrabarty *et al.* 1959, Roy *et al*. 2013, Das and Dutta 2011, Basu *et al*. 2013, Mathivanan *et al.* 2007, Sarawade and Kamble 2014, Patel and Singh 2014, Das *et al.* 2016,

Sarkar and Pal 2017, 2021) but majority of the studies on zooplankton were reported with record of genera level identification and data were scattered.

Mohanty *et al.* (2022) reported on the 43 species of zooplankton from 20 localities covers major states viz., Uttarakhand, Uttar Pradesh, Jharkhand, Bihar and West Bengal of river Ganga. Most of the small rivers and streams always face challenges on various threats dealt with the effects on the living resources and abiotic factors which were still unexplored (Nielsen and Watson 2008). Maximum representation of plankton and water quality of freshwater systems with rotifers, copepods, cladoceran were reported from lentic water system in West Bengal. Exclusive studies on cladoceran diversity from West Bengal were reported by Venkataraman (1999) as the prime data. The present study aims to explore the zooplankton fauna from the selected rivers runs across Nadia and North 24 parganas which would act as baseline information for future research.

MATERIALS AND METHODS

Seven sampling sites were chosen from the riverine areas flowing across Nadia and North 24 Parganas covering Kalyani, Kalinarayanpur, Nabadweep, Majhdiha, Kisnaganj, Naihati were few villages of respective riverine ghats were covered in the study during March to May 2021. Majherchar ghat of Hooghly river - S1, Station Ghat of Churni river- S2, Swarupganj FerryGhat of Hooghly river- S3, Hulor Ghat of Jalangi river – S4, Kisnaganj Bridge Ghat of Mathabhanga river – S5, Mechubajar ferry ghat of Hooghly river – S6, Purbopara ghat of Ichamati river – S7 were the selected sites (Fig. 1). All the sites were influenced by domestic activities like washing, fishing, boating.

Surface water samples were collected from the physico-chemical parameters, plankton samples were collected by filtering the river water in plankton net of mesh size 100 microns and preserved in 4% formaldehyde. The quantitative analysis was carried out by filtering 100 liters of surface water in plankton net and examined using Sedgewick rafter cell counter. The water quality parameters viz., pH, temperature, dissolved oxygen, dissolved carbon dioxide, salinity, hardness, alkalinity, total dissolved solids, transparency, nitrate, nitrite, ammonia and silicate were

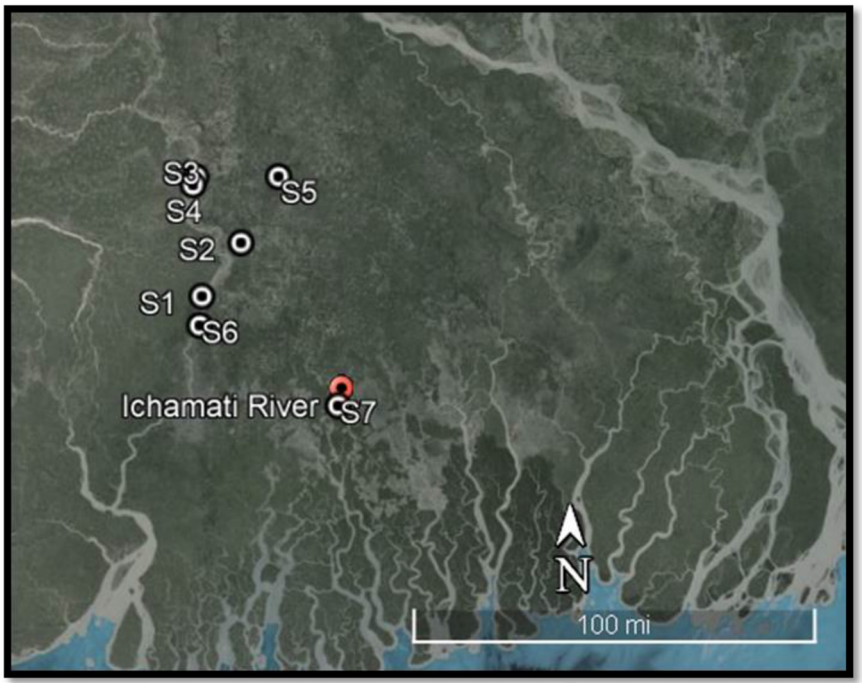


Fig. 1. Map showing the locations S1 – S7 of rivers across Nadia and North 24 Parganas at West Bengal.

analyzed following APHA (2005). The multivariate cluster analysis were performed on species abundance of zooplankton and their diversity by Past statistical software - version 4.10 (Hammer and Harper 2024).

RESULTS AND DISCUSSION

Zooplankton diversity

The study revealed 21 zooplankton species, including protozoa (2 species, 2 genera, 2 families, 1 order), rotifers (11 species, 6 genera, 4 families, 2 suborders), copepods (2 species, 2 genera, 2 families, 1 suborder), and cladocera (5 species, 5 genera, 4 families, 1 suborder). Their distribution were more diverse in Swarupganj ferryghat of Hooghly river (S3), but less diverse in Mechubajar ferry ghat of Hooghly river (S6). During the study period, the most common zooplanktonic species were *Brachinus ahlstromi* from

Table 1. Zooplankton encountered in the study sites selected in rivers at Nadia and North 24.

Sl. No.		S1	S2	S3	S4	S5	S6	S7
	Protozoa							
1	*Galeripora discoides* (Ehrenberg 1871), Gonzalez-Miguens *et al.* 2021,	++	+		+			
2	*Centropyxis spinosa* (Cash & Hopinson 1905), Deflandre 1929,	++		+				
	Rotifera							
	Family: Brachionidae							
3	*Brachionus ahlstromi* (Lindeman 1939)	+++	++	+	+		+	
4	*Brachionus angularis* (Gosse 1851)			++	+			+
5	*Brachionus falcatus* (Zacharias 1893)			+				
6	*Brachionus forficula* (Wierzejski 189)1			+++				
7	*Brachionus rubens* (Ehrenberg 1838)						+	
8	*Keratella quadrata* (Muller 1786)			+				
9	*Keratella tropica* (Apstein 1907)	++	+	++				+
10	*Plationus patulus* Muller 1776		+					
	Family Lecanidae							
11	*Lecane papuana* (Murray 1913)						+	
	Suborder Floscullariacea Remane 1933							
	Family Testudinellidae							
12	*Testudinella patina* (Hermann, 1783)	+				+		
	Family Filinidae							
13	*Filiniav opoliensi*s (Zacharias 1898)			++				
	Family Asplanchnidae							
14	*Asplanchna brightwell*i (Gosse 1850)			+	++	+		
15	*Bosminopsis deiterisi* (Richard 1895)			+	+			
16	*Coronotella rectangula* (Sars 1862)			+	+			
17	*Ceriodaphnia cornuta* (Sars 1885)				+			
18	*Chydorus sphaericus* (Muller 1776)				+			
19	*Moina micrura* (Kurz 1875)			+				
20	Cladocera cyst	+	++	++				
	Copepoda							
21	Calanoid copepodite							
22	Calanoid nauplii				+++			
23	Cyclopoid copepodite	+		+++	+++		+++	
24	Cyclopoid nauplii	+		+++	+++		+++	
25	*Thremocyclops crassus crassus* (Fischer 1853) (female)				+		+	
26	*Mesocyclops (Mesocyclops) leuckarti leuckarti* (Claus 1857) (female)				+			

Table 1. Continued.

Sl. No.		S1	S2	S3	S4	S5	S6	S7
	Phytoplankton							
27	*Pediastrum duplex* (Meyen 1829)			++	+			+
28	*Coscinodiscus* sp.				+			
29	*Synedra ulna* (Ehrenberg 1832)				+			
30	*Chloropsis* sp.				+			
31	Spirogyra				+			

Majherchar ghat of Hooghly river (S1), *Brachionus forficula* from Swarupganj ferry ghat of Hooghly river (S3) of rotifera, cyclopoid copepodite and naupliar stages of copepoda were found in Swarupganj ferry ghat of Hooghly river (S3), Hulor ghat of Jalangi river (S4), and Mechubajar ferry ghat of Hooghly river (S6) were noticed. A few phytoplankton species, such as *P. duplex*, *Coscinodiscus* sp., *Synedra ulna, Chloropsis* sp. and *Spirogyra* sp., were also recorded, indicates the status of pollution (Table 1).

Zooplankton population abundance

From the investigation, zooplankton abundance recorded from 7 study sites (S1 – S7). Protozoans were contributed 3,400 individuals, rotifers (6,600 ind/m^3), cladocera (660 ind/m^3) and copepods (1,070 ind/m^3) were encountered in Majherchar ghat of Hooghly river (S1). Rotifers and cladocera were evenly dispersed in Station ghat of Churni river (S2), with 2470 ind/m^3 of rotifers and 2,100 ind/m^3 of cladocerans and copepods were absent, with record of least representation of protozoa (320 ind/m^3) were recorded. Rotifers had the largest peak of 11,780 ind/m^3, followed by a modest population of copepods (6,800 ind/m^3) and cladocera (4,400 ind/m^3). At Hulor ghat of Jalangi river (S4), the population of protozoans (680 ind/m^3), rotifers (3,200 ind/m^3), cladocera (1,930 ind/m^3) and copepods (11,690 ind/m^3) were reported (Fig. 2).

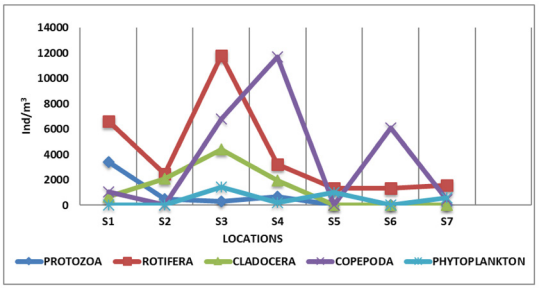


Fig. 2. Zooplankton abundance (Protozoa, Rotifera, Cladocera and Copepoda) and phytoplankton cell abundance recorded at various locations during the study period.

At Kisnaganj bridge ghat of Mathabhanga river (S5), only the rotifer (1,320 ind/m^3) population was observed. Mechubajar ferry ghat of Hooghly river (S6) only shows rotifers (1,320 ind/m^3) and copepods (6,100 ind/m^3), while Purbopara ghat of Ichamati river (S7) also reported only rotifers (1,550 ind/m^3) and copepods (440 ind/m^3). The highest peak of

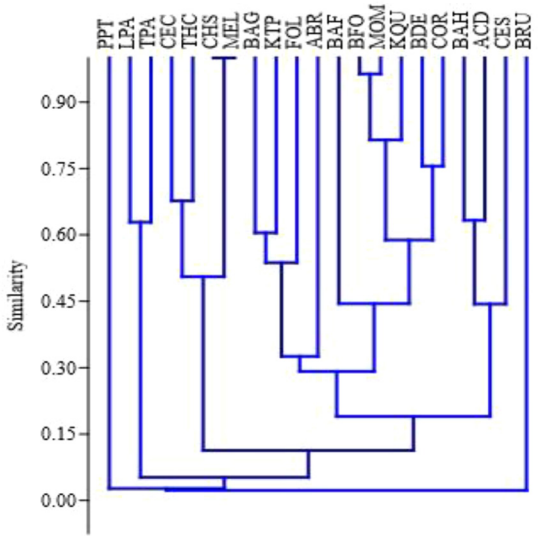
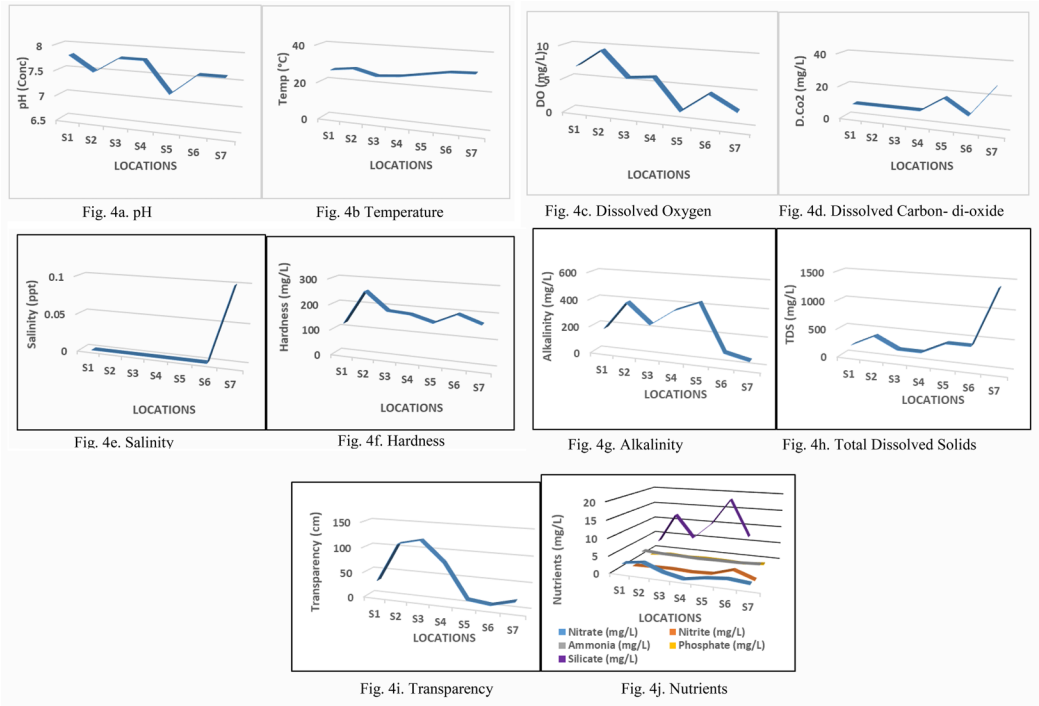


Fig. 3. Cluster analysis on zooplankton species wise abundance in all localities.
Note: ABR- *A. Brightwelli,* ADC- *A. discoides,*BAG- *B. angularis,* KTP –*K. tropica,* BAF- *B. falcatus,* LPA- *L. papuana*, CHS- *C. spinosa,* MEL- *M. leuckarti,* BRU- *B. rubens,* CEC-*C. cornuta,* THC- *T. crassus,* PPT- *P. patulus,* BFO-*B. forficula*, MOM- *M. micrura,* KQU-*K. quadrata,* BDE- *B. deiterisi,* COR- *C. rectangula,* TPA- *T. patina,* FOL- *F. opoliensis,* ABR-*A. brightwelli,* BAH- *B. ahlstromi.*



Figs. 4a-j. Water quality parameters recorded at 7 locations during the study.

protozoans was recorded at S1, rotifers and cladocerans at Swarupganj ferryghat of Hooghly river (S3), copepods at Hulor ghat of Jalangi river (S4). The phytoplankton population was measured at Swarupganj ferryghat of Hooghly river (S3), Hulor Ghat of Jalangi river (S4), Kisnaganj bridge ghat of Mathabhanga river (S5) and Purbopara ghat of Ichamati river (S7) (Fig. 2). The zooplankton abundance evidenced in variations in density due to the flushing effect in the river channel (Thorp *et al.* 1994) since the reproduction of plankton occurs in low condition (Pace 1984) and at off channel habitats (Thorp *et al.* 1994).

Zooplankton species abundance

Based on the zooplankton of all the groups present in the 7 locations, the abundance of 21 species were screened for the cluster analysis. The cluster analysis based on Bray Curtis coefficient showed the groups based on the similarity in abundance of species among zooplankton were clustered. In overall the dendrogram showed the similarity in species which were grouped where *Arcella discoides* (ADC) of protozoa, *Brachionus ahlstromi* (BAH), *Keratella tropica* (KTP) and *Brachionus angularis* (BAG) of rotifers were showed higher abundance among zooplankton (Fig. 3). Similar studies were conducted among the zooplankton genera composition across various sites (Jabeen and Barbhuiya 2018, Das *et al.* 2018).

Physico-chemical characteristics

The pH ranges between 7.2 and 7.8, with slighter variation between sites (Fig. 4a). However, temperature recorded from S1 to S7 revealed that the highest temperatures were around 30° C at S6 and Purbopara ghat of Ichamati river (S7) (Fig. 4b). The concentration of dissolved oxygen ranged from 1.63 mg/L at S5 to 9.47 mg/L at Station ghat of Churni river (S2) (Fig. 4c). Kisnaganj Bridge ghat of Mathabhanga river (S5) and Purbopara ghat of Ichamati river (S7) influenced by dissolved carbondioxide ranged from 8.8 mg/L to 26.4 mg/L (Fig. 4d). Despite the presence of freshwater at these locations, only Purbopara ghat of Ichamati river (S7) had a salinity of 0.1 ppt (Fig. 4e). Station ghat of Churni river (S2) was recorded on

highest reported value for both alkalinity and hardness (Figs. 4f–4g). Total dissolved solid concentrations were similarly greater in Station Ghat of Churni river (S2), Kisnaganj Bridge Ghat of Mathabhanga river (S5), and S6 (Fig.4h). Less transparency was seen at Kisnaganj Bridge Ghat of Mathabhanga river (S5) and Mechubajar ferry Ghat of Hooghly river (S6), where transparency was also evaluated with significant differentiation (Fig. 4i). The lesser transparency is mainly due to increased turbulence (Shiel *et al.* 1982). The nutrients nitrate (0.02 mg/L to 3.4 mg/L), nitrite (0.03 mg/L to 2.1 mg/L), ammonia (2.1 mg/L, 2.8 mg/L), silicate (3.8 mg/L, 5.9 mg/L), and total phosphate (0.1 mg/L, 0.7 mg/L) recorded at various sites did not exhibit any change (Fig.4j).

In the present study the fluctuation noticed in zooplankton population and nutrient content due to overload of pollution, silt, freshwater influx and habitat similar to the studies by Mohanty *et al*. (2022) stated that the lower contribution of zooplankton in the lower stretch of river ganga lying in West Bengal whereas the richness of zooplankton availability in middle stretch of the river due to habitat, higher flow of water and high nutrient content in water. Similar observation was recorded in the upper stretch of Hooghly river represented by copepod population (Sarkar *et al.* 1986). The sediment loading in estuaries with pollution influences the enrichment of nutrients and further phytoplankton and zooplankton richness has been witnessed in many rivers of India (David and Roy 1966, Pace 1984, Subramanian1993, Sharma *et al*. 2011, Hafiz *et al*. 2014).

CONCLUSION

The studies in few rivers at West Bengal revealed the maximum diversity of zooplankton was recorded in Swarupganj ferryghat of Hooghly river (S3) when compared to other riverine sites. The changes in water quality and the plankton composition due to anthropogenic activities and influences of climate changes. Further long-term monitoring the riverine systems on the impact on pollution load to regulate the conservation and ecosystem. This data would be brought the clarity on zooplankton diversity as the baseline information.

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