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Research Article

ZOOPLANKTON COMMUNITY OF FRESHWATER PONDS IN PURULIA AT WEST BENGAL

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ABSTRACT

Studies were conducted in the zooplankton and water quality from the freshwater ponds of importance on fish culturing at Purulia. Among various groups of zooplanktonic organisms viz., rotifera, copepoda and cladocera were recorded from the study area. The present investigation was conducted in 12 fishery ponds commonly called as bandhs. Water samples were collected and the following physico-chemical parameters viz., pH, Temperature, Dissolved oxygen, Alkalinity, Electrical conductivity, Hardness, Total dissolved solids, dissolved carbondioxide, nitrate, nitrite, phosphate- total and silicate were analysed. Zooplankton samples were collected to investigate on their diversity and abundance. The results revealed about 14 species of rotifera belongs to 4 families, 2 classes; 12 species of cladocera belongs to 4 families and 3 species of copepod belongs to 1 family, 1 order respectively. 3 species of rotifera namely *B. rubens*, *B. calyciflorus*, *B. ahlstromi* and 1 species Moina *micrura* of cladocera along with nauplii and copepodites stages belonging to cyclopoid copepods. This preliminary finding would act as baseline information for future research in Purulia.

Keywords: Zooplankton, Rotifera, Copepoda, Cladocera, Water quality.

INTRODUCTION

Zooplankton are heterotrophic, microscopic, aquatic organisms and the larval stages of other life forms of invertebrates (Chakraborty and Mallick, 2020). Their population changes in the aquatic environment are often attributed to anthropogenic disturbances and environmental factors. Due to their higher sensitivity to pollution, they were important bioindicators of aquatic ecosystem (Yakubu *et al.*, 2000; Dudgeon *et al.*, 2006; Contreras *et al.*, 2009; Ravikumar *et al.*, 2011 and Krupa *et al.*, 2020). The changes in hydrologic cycle and influences of various environmental factors to the waterbody always implicits the alteration in food web dynamics in the population of plants, microorganisms, invertebrates and vertebrates. Zooplankton constitutes an important food source for many aquatic organisms (Guy, 1992). They act as primary consumers to several invertebrates and vertebrates (Forro *et al.*, 2008; Chatterjee *et al.*, 2014). The present investigations were carried out on few ponds at Purulia to reveal the zooplankton diversity and the assessment on the water quality in the ponds reflects the suitability to pisciculture.

MATERIALS AND METHODS

Purulia district in West Bengal, forms the lowest step of the Chotanagpur Plateau, north of the Kansabati river in India. About 12 locations were the selected sites for the study viz., Location -S1 (Bhata Bandh - 23° 33239'N; 86° 35456'E); Location – S2 (Bhutgoria Bandh - 23° 31661'N; 86° 37293'E); Location – S3 (Bibir Bandh - 23° 31967'N

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and 86° 35846'E); Location – S4 (Buchaa Bandh - 23° 32693'N; 86°37653'E); Location – S5 (Dulmi Bandh - 23° 31202'N; 86° 36240'E); Location – S6 (Kamala Bandh - 23° 32100'N; 86° 36343'E); Location – S7 (Mahato Bandh - 23° 32549'N; 86°35547'E); Location – S8 (Moyra Bandh - 23° 33350'N; 86° 34702'E); Location – S9 (Poka Bandh - 23° 33188'N; 86° 37131E); Location – S10 (Punya bandh - 23° 32287'N; 86° 35770'E); Location – S11 (Ram Bandh - 23° 31202'N; 86°36240'E) ; Location – S12 (Saheb Bandh - 23° 33566'N; 86° 36251'E). The collections were carried out during March 2021(Figure1).

Surface water samples were collected from above mentioned 12 localities from 7 am to 9 am in poly propylene containers and were analysed water quality parameters viz., pH, Temperature, Dissolved oxygen, Alkalinity, Electrical conductivity, Hardness, Total dissolved solids, dissolved carbondioxide, nitrate, nitrite, phosphate- total and silicate (APHA, 2005). Zooplankton samples were collected in polypropylene containers of 100ml capacity using plankton net of mesh size 63 microns. 100 litres of surface water were filtered through plankton net and the zooplankton samples were preserved 4 % formaldehyde for the the quantitative analysis. The preserved samples were screened using sedgewick rafter counting chamber to investigate the abundance (ind/m^3). The plankton samples were sorted groupwise on protozoa, rotifera, copepoda and cladocera were identified following literatures (Sharma, 1998; Michael & Sharma, 1988; Venkataraman, 1999; Roy, 1999). The process of identification and counting were done with the leica DM 1000 microscope.

RESULTS AND DISCUSSION

Rotifera included 5 families Asplanchnidae (1 species; 1 genus), Brachionidae (10 species; 2 genera) lecanidae (1 species; 1 genera), testudinellidae (1 species; 1 genera), bdelloidea (1 species; 1 genus) of two orders monogononta and bdelloidea respectively. Of these 5 families brachionidae exhibited higher number of species and the species diversity of the rotifers (14 species) were recorded from the fresh water ponds at Purulia. Among Brachionidae, *B. rubens* in S1, S2 and S7; *Brachionus calyciflorus* at S3, *Brachionus ahlstromi* and *B. forficula* at S7were found to be abundant. The protozoa were represented by amoebozoan with only one species *Centropyxis ecornis* were recorded at S11. The species richness of rotifers was found in location S3 and at S4. Cladocera holds four families viz., Sididae (1 species; 1 genera), Daphnidae (7 species; 3 genera), Moinidae (2 species; 2 genera) and Chydoridae (2 species; 2 genera) along with the cladoceran neonates, 12 species belong to 8 genera, 4 families were recorded. Cladocerans were higher in diversity at S1 and S8. The copepod shown the record of 3 species of cyclopidae. Among copepoda cyclopoid nauplii and copepodites were occurs in all the locations and cyclopoid nauplii dominated in S5 during the study. *Mesocylops leuckarti* population were higher in S4 and S9. *M. hyalinus* occurs at S12 and *Microcyclops varicans* in S4. In overall the zooplankton diversity were higher in S8 followed in S1 and S4. *Lecane papuana*, *Philodina* sp. of rotifera, *C. ecornis* of amoebozoa, *M. macleayi, C. sphaericus, A. verrucosa, Diaphanosoma Senegal, C. laticaudata, D. similis* and *S. serrulatus* of cladocera; *M. hyalinus* and *M. varicans* of copepoda were found to rare in the study (Table. 1).

The zooplankton abundance was investigated in the few groups viz., rotifer, cladocera and copepoda. Among rotifera, the highest peak was observed in S1 by *B. rubens* (2,240 ind/m^3) followed by *B. ahlstromi* (1,800 ind/m^3) at S7 and *B. forficula* (1,620 ind/m^3) at S7 and *B. calyciflorus* (1,380 ind/m^3) at S3 and *B. rubens* (2,240 ind/m3) at S1. These mentioned four species were dominating the waters (Fig. 2). Other rotifers were registered moderate abundance. In cladoceran population, cladoceran neonates showed moderate abundance and occurred in all localities. Higher abundance of cladoceran were noticed at S3 by *Moina micrura* (860 ind/m^3) followed by M. macleayi (760 ind/m^3) at S10, cladoceran neonates occupied maximum representation (550 ind/m^3) at S1. *Moina micrura* found in majority of the localities S3, S4, S5, S8, S9, S10 and S12 with moderate abundance (Fig. 3). Among the copepods, cyclopoid nauplii (1,140 ind/m^3) hold the maximum representation at S4and *M. leuckarti* (990 ind/m^3) at S4 and their abundance were moderate in most of the localities (Figure 4).

Surface water temperature (21° C to 28° C) showed the marked variation where the higher temperature was noticed at S10 and S11 whereas lower temperature at S4. The concentration pH was between 4.8 to 8.5 (Conc.), most of the locations were alkaline in state where the lower level of pH measured at s12. The water transparency revealed the maximum values at S2 followed by S1, S12 and S10. The electrical conductivity also recorded in the surface water showed wide variation between 273 to 716 values. The dissolved oxygen was ranged between 2.04 mg/L to 5.77 mg/L with wide variations whereas lower values were recorded at S12 and S4 and elevated levels were noticed in the values of free carbon dioxide in same station. Alkalinity was almost higher in all the locations except S4 and S12. And the higher values 256 mg/L of hardness recorded at S5. The total dissolved solids were also higher in concentration in water ranging from 0.12 gm/L to 1.6 gm/L. The nutrients viz., phosphate (1.2 to 1.5 mg/L), nitrate (0.02 to 1.8 mg/L), nitrite 0.02 to 5 mg/L) and ammonia (2 to 12.5 mg/L) and silicate (0 to 10mg/L) were recorded with wide fluctuations where higher concentration of nitrate, nitrite, todal dissolved solid, hardness at S5 (Figure 5-17).

Table. 1. List of Zooplankton diversity in 12 (S1-S12) localities at Purulia.

	Taxa	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**
	Phylum Rotifera Class Monogonontas Order Ploima Family Asplanchnidae												
1	*Asplanchna brightwellii* Gosse, 1850	-	-	+	-	+	-	-	-	-	-	-	-
	Family Brachionidae												
2	*Brachionus ahlstromi* Lindeman, 1939	-	-	+	-	-	+	+++	+	-	-	+	+
3	*B.angularis* Gosse, 1851	+	+		+	+	-	-	-	-	-	+	-
4	*B.bidentatus* Anderson, 1889	-	-	+	-	-	-	-	-	-	-	-	-
5	*B. calyciflorus f.dorcas* Gosse, 1851	-	-	-	-	+	-	++	-	-	-	-	-
6	*B. calyciflorus* Pallas 1766	-	-	+++	-	+	++	+	++	-	-	-	-
7	*B. diversicornis* Daday, 1883	-	-	-	-	-	++	-	-	-	+	-	-
8	*B.forficula* Wierzejski, 1891	-	-	-	-	-	-	+++	+	-	-	-	+
9	*B. quadridentatus* Hermann 1783	+	-	-	+	-	-	-	-	-	-	+	-
10	*B. rubens* Ehrenberg, 1838	+++	+++	+	+	-	+	+++	-	+	++	-	+
11	*Keratella tropica*Apstein, 1907	-	-	+	+	-	-	++	+	-	-	-	-
	Family Lecanidae												
12	*Lecane papuana* Murray, 1913	-	-	-	-	-	-	-	-	-	-	+	-
	Family Testudinellidae												
13	*Testudinella parva* Ternetz, 1892	-	-	-	+	-	-	-	-	-	+	-	-
14	Cyst	+	-	-	-	-	-	-	-	-	-	-	-
	Class Bdelloidea												
15	Phillodina sp	-	-	-	+	-	-	-	-	-	-	-	-
16	Phylum Protozoa – Amoebozoa Family Centropyxidae												
17	*Centropyxis ecornis* (Ehrenberg, 1841) Leidy, 1879	-	-	-	-	-	-	-	-	-	-	+	-
	Cladocera Order Ctenopoda Family Sididae												
18	*Diaphanosoma senegal* Gauthier, 1951	+	-	-	-	-	-	-	-	-	-	-	-
	Order Anomopoda												

	Family Daphnidae												
19	*Ceriodaphnia cornuta* (Sars,1885)	++	+++	-	-	-	-	+	+	-	-	-	-
20	*C. laticaudata* Muller, 1867	-	-	-	-	-	-	-	+	-	-	-	-
21	*C. quadrangula* O F Muller, 1785	+	-	-	-	-	-	-	-	-	-	-	-
22	*C. reticulata* Jurine, 1820	+	-	-	+	-	-	-	+	-	-	-	+
23	*Daphnia similis* Claus 1876	+	+	-	-	+	-	-	-	-	-	-	-
24	*Simocephalus serrulatus* (Koch, 1841)	-	-	-	-	-	-	-	++	-	-	-	-
25	*S.expinosus* (Koch, 1841)	-	-	-	-	-	-	-	-	-	-	+	+
	Family Moinidae												
26	*Moina micrura* (Kurz, 1874)	-	-	+++	+	+	-	-	+	+	+	-	+
27	*Moinodaphnia macleayi* King, 1853	-	-	-	-	-	-	-	-	-	++	-	-
	Family Chydoridae												
28	*Alona verrucosa* Sars, 1901	-	-	-	-	-	-	-	+	-	-	-	-
29	*Chydorus sphaericus* (O.F. Muller, 1776)	-	-	-	-	-	-	-	-	-	-	+	-
30	Cladocera neonates	+	+	-	+	+	-	-	+	-	-	--	+
	Class Copepoda Order Cyclopoida Family Cyclopidae Sub family: Cyclopinae												
31	Cyclopoid copepodites	++	-	+	+	+	-	-	+	++	+	+	+
32	Cyclopoid nauplii	++	+	+	+++	+	++	+	++	+	++	+	+
33	*Mesocyclops hyalinus* (Rehberg, 1880)	-	-	-	-	-	-	-	-	-	-	-	+
34	*Mesocyclops leuckarti* (Claus,1857)	+	+	-	++	+	-	-	+	++	+	-	-
35	*Microcyclops varicans* (Sars G.O., 1863)	-	-	-	+	-	-	-	-	-	-	-	-

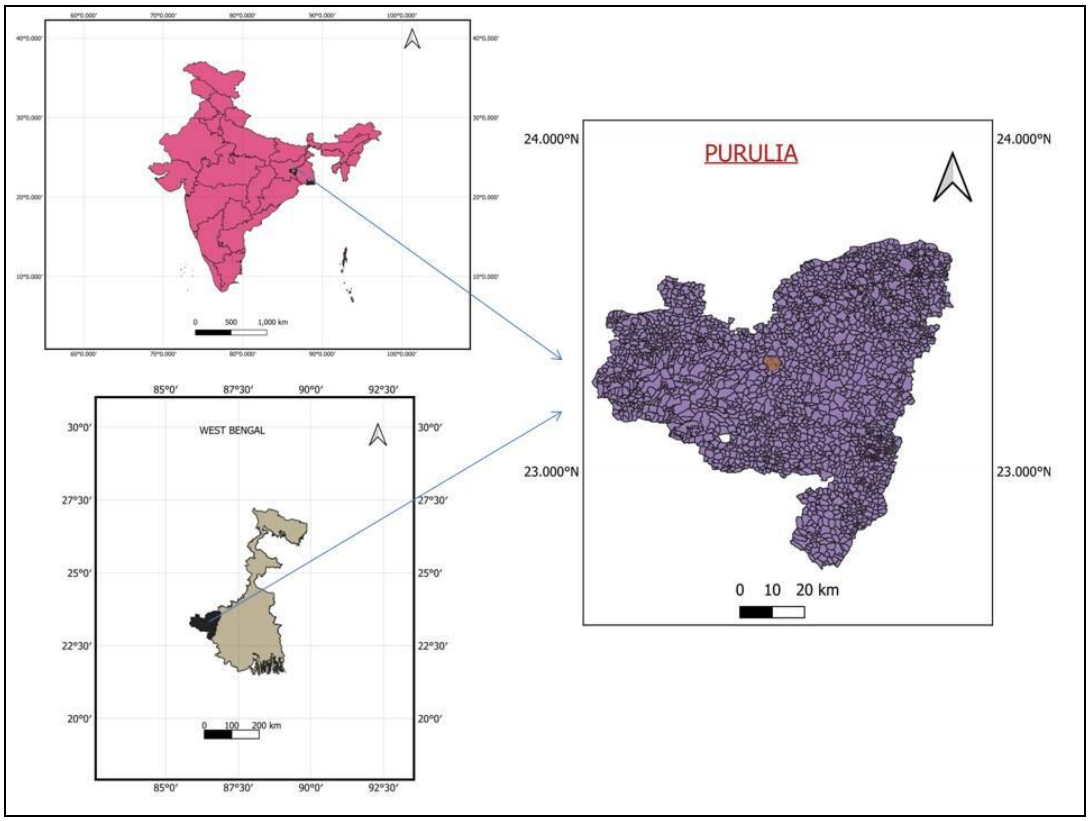

Figure 1. Study Area in Purulia district at West Bengal.

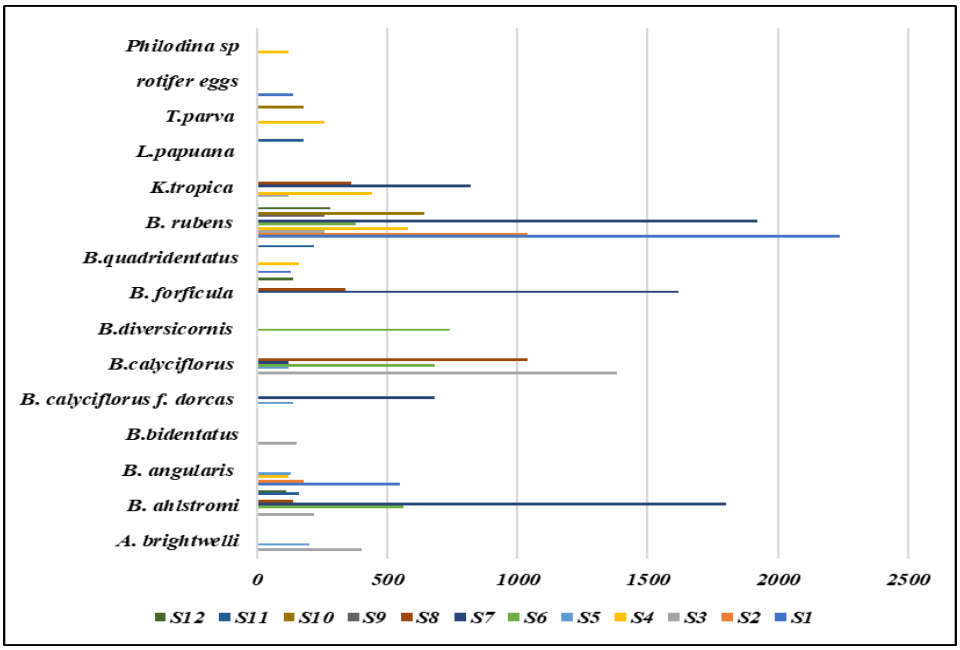

Figure 2. Rotifer abundance in the freshwater ponds at Purulia.

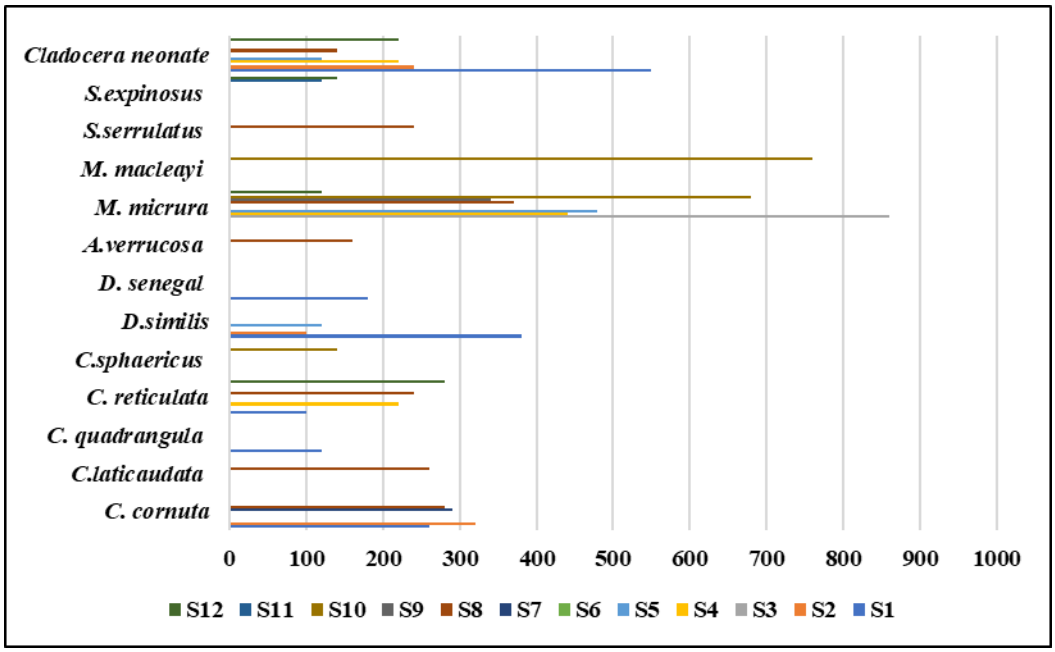

Figure 3. Cladocera abundance in the freshwater ponds at Purulia.

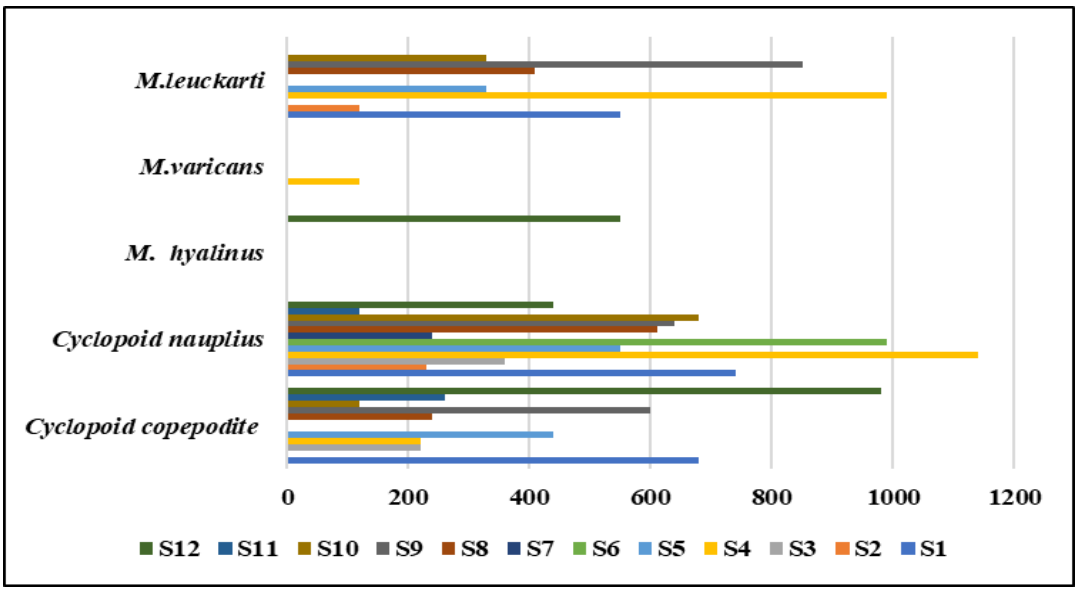

Figure 4. Copepoda abundance in the freshwater ponds at Purulia.

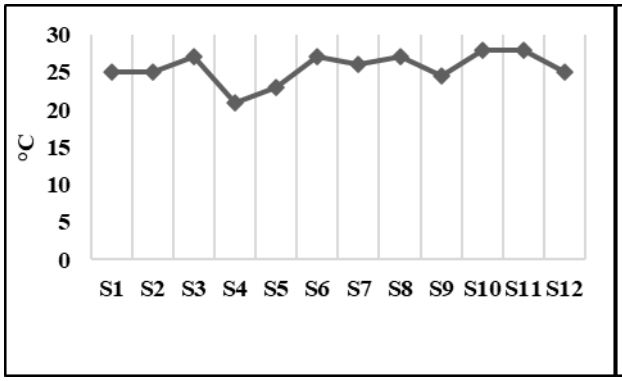

Figure 5. Temperature

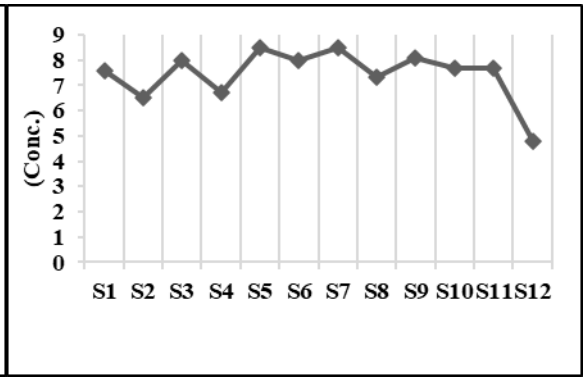

Figure 6. pH

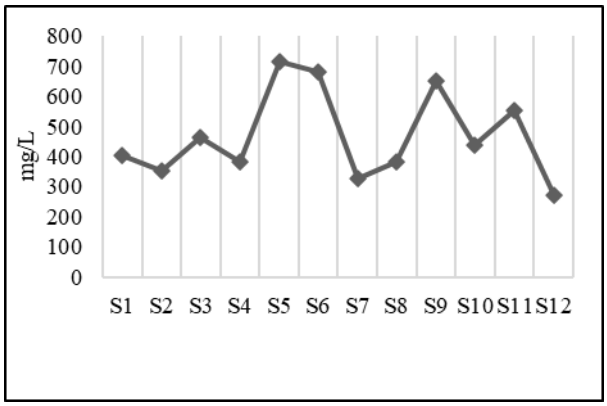

Figure 7. Electrical conductivity.

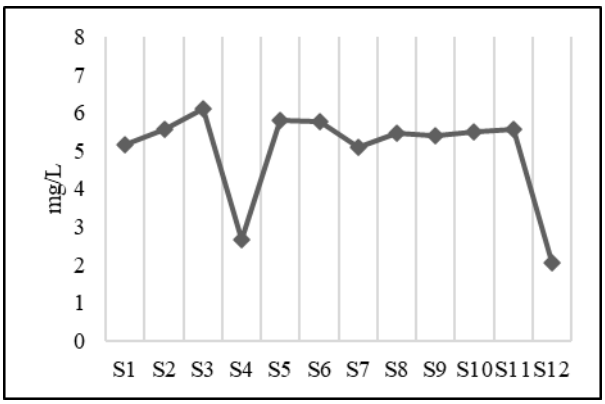

Figure 8. Dissolved Oxygen.

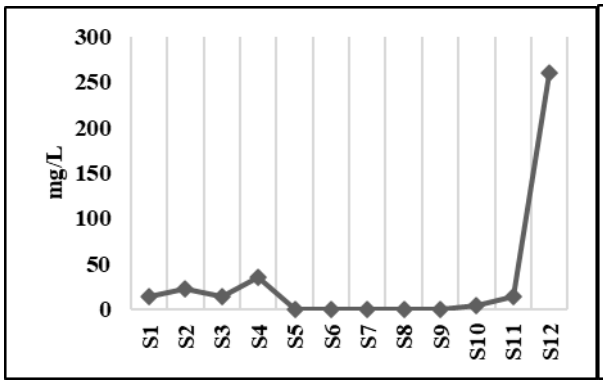

Figure 9. Free carbondioxide

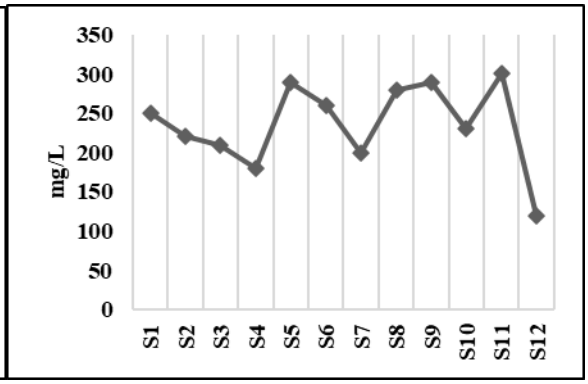

Figure 10. Alkalinity

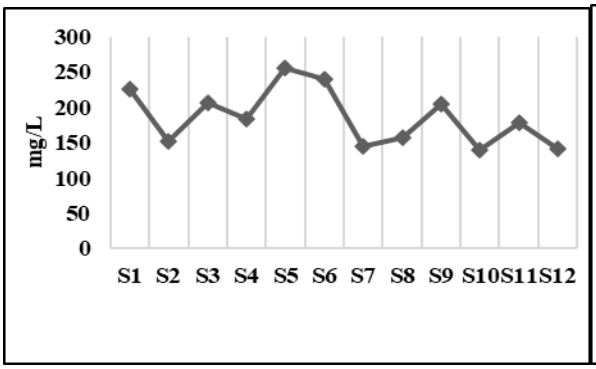

Figure 11. Hardness

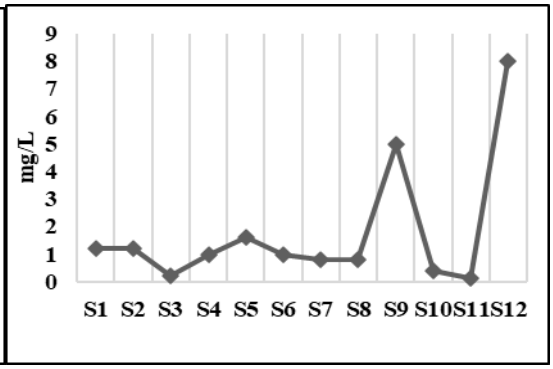

Figure 12. Total Dissolved Solids

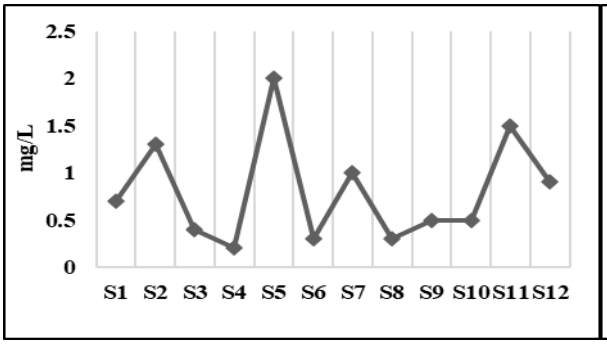

Figure 13. Phosphate

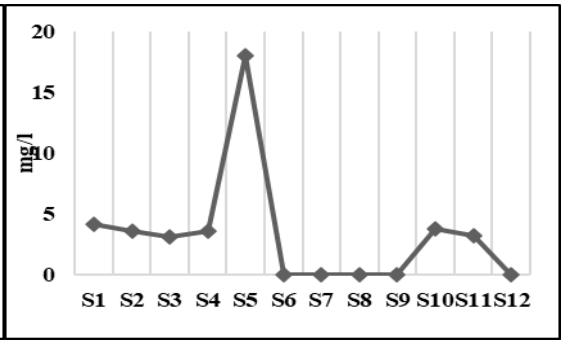

Figure 14. Nitrate

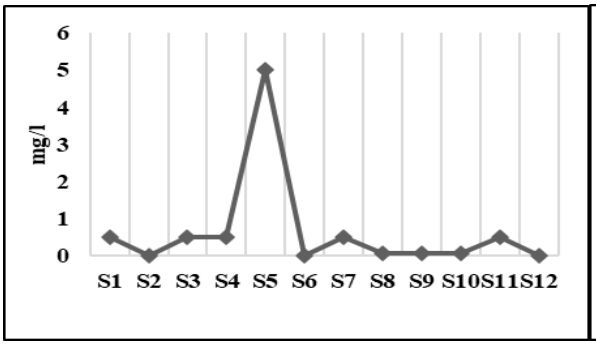

Figure 15. Nitrite

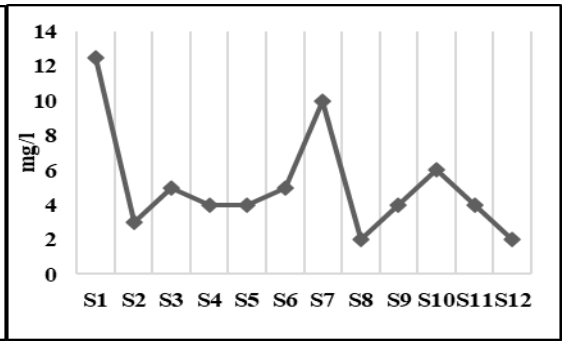

Figure 16. Ammonia

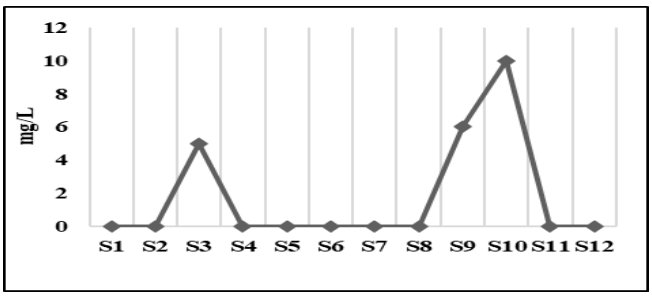

Figure 17. Silicate

The zooplankton and water quality of 12 ponds at Purulia comprised of rotifera, copepoda, cladocera and protozoans. The fish cultured ponds (study sites) were with noticeable variations in nutrient loading with higher concentrations of Silicate (S1), ammonia (S1 and S7) nitrate, nitrate and phosphate, total dissolved solids (S9 and S12). Similar studies with fluctuating levels of nutrients in ponds of West Bengal (Ghosh & Mandal, 2020; Chattopadhyay & Panda 2022). Reports on higher organic load indicates the nutrient availability and values of the dissolved solid interlink with the higher level of pH, alkalinity and hardness level including electrical conductivity (Lin, 1986). And also, the higher concentration of nutrients may be due to external source of wash offs, detergent, pesticides, fisheries etc., substantiates the zooplankton value of potential survivorship in fluctuating environment (Bhakta *et al*., 2015; Datta, 1999).

In the present study, 12 localities showed distinct differences in the diversity and species wise abundance. The species richness was remarkably higher in S1, S4 and S8 whereas the diversity showed good registry of rotifers, copepods and cladoceran community among zooplankton. The population abundance was also noticed in rotifera copepoda and cladocera. Similarly, Pradhan & Bandyopadhyay, (2018) reported the zooplankton diversity and water quality parameters from few water bodies at Purulia during the studies in the year 2014-2015 revealed few groups of zooplankton viz., rotifer, copepod, protozoa, ostracoda and cladocera at the level of genera. Chatterjee *et al.* 2014 stated from the three sites at Saheb bandh during 2007 – 2012, 10 species of rotifers, 2 species of cyclopoid copepods 5 species of cladocera and 3 species of ostracoda were recorded at Saheb Bandh at Purulia. Similar to the present observations, Brachionus species were reported in large population in the ponds at Purulia. The species diversity, zooplankton population abundance fluctuations depend on the prey, climatic factors, macrophytes, anthropogenic influences, physico chemical factors and seasonal impacts as stated in several studies (Segers, 2003).

CONCLUSION

Ponds/Bandhs are utilized in fisheries widely in rural areas where the water quality and zooplankton are the factors influencing major factor. In present scenario, most of the waterbodies are polluted due to source of factors through algal blooming, pesticides, fertilizers, industrial runoff, climatic factors and human activities. Majority of the studies on zooplankton observation in terms of diversity and population were still unclear with meager identification details upto species level and the gap areas in monitoring freshwater systems. Freshwater systems are to be conserved by the public due to human livelihood depends on their huge resources. The zooplankton available in freshwaters acts as indicators of pollution as well their successful survivorship in extreme fluctuating climate conditions. Long term monitoring on freshwaters seasonally will impact fresh water conservation.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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