



SEASONAL VARIATION OF WATER QUALITY PARAMETERS AND ZOOPLANKTON DIVERSITY IN WATER BODIES OF PURULIA DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

The present study was conducted to know the seasonal variation of water quality parameters and also the seasonal diversity of zooplankton in the water bodies of Purulia District, West Bengal during the period March 2014 to February 2015. Water Temperature, Alkalinity and Hardness showed the highest value in Pre-monsoon season. Transparency was highest in Post Monsoon. Dissolve oxygen, Nitrate Nitrogen, Nitrite Nitrogen and Ortho-Phosphate showed the highest value in Monsoon. Five major groups like Rotifera, Copepoda, Protozoa, Ostracoda, Cladocera represented the zooplankton population of the studied water bodies. Rotifera, Copepoda, Ostracoda, Cladocera showed higher population density in Pre-monsoon season. The highest concentration of Protozoan was observed during Post Monsoon months.

Keywords: Zooplankton population, Diversity, Water quality, Seasonal variation.

INTRODUCTION

Purulia is the western-most district of West Bengal. It has some unique characteristics of its tropical location, its shape as well as function like a funnel. The district has huge inland fishery resources in the form of pond, tank, and big water bodies mainly in the form of bandhs and reservoir. Maximum water area under Purulia district is semi derelict in nature. Most of these water bodies are good source of Aquaculture. Plankton is the most important component of trophic structure which takes parts in transfer of energy to higher trophic levels in the aquatic environment. Zooplankton transforms plant material into animal. According to Basawarajeshwari & Ramakrishna Reddy, (2015) seasonal changes in zooplankton species are related to the Physico-chemical parameters of aquatic ecosystem. Zooplanktons play an integral role and may serve as bio indicator and it is a well-suited tool for understanding water pollution status (Contreras *et al.*, 2009). Water is the key ingredient required for the survival of all organisms in the earth. Water used as a medium in most the biochemical process. A large number of aquatic organisms from microscopic plankton to large aquatic

animals dwell in Water bodies. Plankton can also act as biomarker for water quality assessment for fish production. Present study was conducted to understand the seasonal variation of physico chemical characteristics of pond water and also seasonal fluctuation of zooplankton diversity. In this study we also investigate the seasonal diversity of different zooplankton group and their co relation with different physico-chemical parameter of water body.

MATERIALS AND METHODS

For the present investigation 60 no's of randomly selected respondent (pond) has been surveyed from 12 Fishery village of 6 Administrative Blocks and three Sub Divisions of Purulia district west Bengal during March 2014 to February 2015.

Water sample collection

For water quality analysis random samples of water were collected from each selected ponds of the Purulia district in the morning of each season (Pre Monsoon, Monsoon, Post

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Monsoon and Winter) throughout the research period. Water samples were collected from 50 cm depth in each sampling station. During collection of water samples, cautions were taken so as to prevent air bubbling, which might influence water quality parameters such as dissolved oxygen.

Plankton sample

Plankton net made up of silk cloth (no. 21 with 65 meshes per centimeter square) was used to collect the plankton sample. About 50 liters of water was filtered through hand plankton net, where in the plankton concentrate used to accumulate in the specimen tube of 100 ml fitted at the tail end of the net. The filtered sample of plankton was preserved in 4% formalin solution and stored in labeled vials for subsequent quantitative and qualitative analysis (APH, 2012). Zooplankton counting was done by Sezedwick Rafter Cell counting method. The detailed study of the plankton was done by using OLYMPUS inverted stereoscopic microscope (Model MLX – B) fitted with a NIKON camera. Identification of plankton was done according to the character mentioned by different authors (Battish, 1992; Cox, 1996; Hutchinson, 1966; India & Biswas, 1915; Needham & Needham, 1938; Round, 1984; Ward & Whipple, 1918; Wetzel & Likens, 1991).

RESULTS AND DISCUSSION

The seasonal variation of physico-chemical parameter of selected water bodies of Purulia district are given below in (Table 1). Temperature is one of the most important and noteworthy phenomena of aquatic environment; it has the relationship on zooplankton variation. During the study period, the mean water temperatures varied from minimum 17.19°C in winter season and maximum 28.06°C in Pre Monsoon months (Table 1). This result has been supported by the finding of (Singh & Gupta, 2004; Sen *et al.*, 2011) and (Anukool & Shivani, 2011). The average pH value of the water bodies of the Purulia District during the study period varies from minimum 6.93 in winter season to maximum 7.45 in pre monsoon month. In the present investigation the average pH ranges between 6.93-7.45 (Table 1) shows near neutral to slightly alkaline condition of the pond water body. Higher value of pH in summer season may be due to low water level in the pond and high photosynthesis of micro and macro organism resulting in high production of carbon dioxide which make the water little alkaline (Shiddamallayya & Pratima, 2011; Trivedy, 1989).

Table 1. Seasonal variation of different water quality parameters in the ponds of Purulia district.

Season	Pre Monsoon	Monsoon	Post Monsoon	Winter
Parameter	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D
Water Temp	28.066 ± 0.974	24.813 ± 0.618	20.963 ± 2.41	17.19 ± 1.146
pH	7.45 ± 0.273	7.35 ± 0.273	7 ± 0.236	6.933 ± 0.242
Transparency (Cm)	26.693 ± 0.621	22.955 ± 3.011	34.511 ± 1.704	25.203 ± 2.06
Dissolved Oxygen (mg/l)	3.833 ± 0.30	4.5 ± 0.2	4.133 ± 0.258	4.133 ± 0.265
Alkalinity (mg/l)	65.366 ± 6.03	59.54 ± 16.222	60.235 ± 8.44	63.051 ± 14.53
Hardness (mg/l)	103.478 ± 21.09	99.2 ± 28.05	86.415 ± 15.49	90.27 ± 22.15
Nitrite Nitrogen (NO ₂ N) (mg/l)	0.0101 ± 0.006	0.0172 ± 0.02	0.0148 ± 0.018	0.0142 ± 0.018
Nitrate Nitrogen (NO ₃ N) (mg/l)	0.0154 ± 0.003	0.0350 ± 0.05	0.0134 ± 0.008	0.0108 ± 0.005
Ortho Phosphate (P ₂ O ₅) (mg/l)	0.0040 ± 0.004	0.0044 ± 0.002	0.0035 ± 0.004	0.0029 ± 0.003

According to Dutta & Patra, (2013) the average value of pH is 7.1 the pond seems to be of medium productive in nature for Zooplankton production. In the present study minimum dissolved oxygen concentration was recorded in Summer Season i.e. Pre Monsoon month 3.8 mg/l and maximum of 4.5 mg/l in Monsoon month (Table 1). During the study period the mean value of DO ranges from 3.8 to 4.5 mg/l. This may be due to difference in water temperature. Similar results were observed by Kamal *et al.* (2007). During the study period the higher values of transparency was observed during post monsoon month's i.e. 34.51 cm and lower value was observed during Monsoon Season 22.95 cm (Table 1). The result supported by the findings of (Saksena *et al.*, 2008).

In the present investigation alkalinity values varied from 59.54 – 65.36 mg/l during the four seasons, of which

maximum value was observed during pre monsoon month 65.36 mg/l and minimum value was observed during monsoon month 59.54 mg/l (Table 1). Similar result has been recorded by Elayaraj & Selvaraju, (2014). Total Hardness value ranged from 86.41 – 103.47 mg/l in different seasons of which higher value 103.47 mg/l in Pre Monsoon and lowest (86.41mg/l) in Post Monsoon season (Table 1). As the water volume decreases in the pre monsoon due to the higher rate of evaporation in high temperature, the Hardness increases. The findings are supported by Rajagopal *et al.* (2010)

During the study period the Nitrate Nitrogen Concentration of pond water of Purulia District varied from 0.0108 to 0.0350 mg/l. Maximum Nitrate nitrogen concentration was found in Monsoon Season (0.0350 mg/l) and minimum value found in Winter Season (0.0108 mg/l)

(Table 1). In present investigation high values of nitrate found in monsoon season due to influx of nutrients from the watershed areas along with runoff water in monsoon and low value in winter season, kinetics of nitrogen cycling was low due to less decomposition of organic matter and low water temperature. During the study period the available phosphate concentration of the water body of Purulia District varied from 0.0029 to 0.0044 mg/l (Table 1). The highest value of available phosphate was found during the Monsoon season and lowest value was found during winter season.

During the study period the Nitrite Nitrogen concentration of water body of Purulia District varies from 0.010 to 0.017 mg/l. The highest nitrite nitrogen concentration was found in Monsoon Season and lowest concentration was found in Pre monsoon Season (Table 1). The zooplankton study in the selected ponds of Purulia District consists of five major groups like Rotifera, Copepoda, Protozoa, Ostracoda, Cladocera represented the zooplankton population of the studied water bodies (Table 2-5). A total 6 genus of Rotifera group (*Brachionus sp*, *Asplanchna sp*, *Keratella sp*, *Synchaeta sp*, *Euchlanis sp*, *Filinia sp*) 10 genus of Copepoda (*Nauplii*, *Diaptomus sp*, *Pseudodiaptomus sp*, *Cyclops*, *Mesocyclops sp*, *Paracyclops sp*, *Microcyclops sp*, *Eucyclops*, *Acanthocyclops sp*, *Heliadiaptomus*), 3 genus of Protozoa (*Amoeba*, *Paramecium*, *Arcella*) 6 genus of Cladocerans (*Daphnia sp*, *Ceriodaphnia*, *Simocephalus*, *Bosmina*, *Moina*, *Diaphanosoma sp*) and one genus of Ostracoda (*Cypris sp*) were identified from the ponds (Table 2). Nauplius larvae were found in some ponds.

Rotifera

In the present study 6 genera of Rotifera group were identified from the water bodies of Purulia district. The recorded population density of Rotifer was varied from 44 ind /l to 19 ind/l. In the present investigation the maximum no of Rotifera was found during summer season and minimum no was observed during monsoon season due to

its preference for warm waters. Similar findings were observed by Basawarajeshwari & Ramakrishna Reddy, (2015) and (Segers, 2003).

Cladocera

The highest concentration of Cladocerans was observed during Pre Monsoon months (80 ind/l) and minimum concentration was found during Monsoon (42 ind/l) months. During summer the cladoceran population was moderate due to dense growth of rotifers and thus avoiding competition. Ramachandra Rao *et al.*, (2008) reported that cladocerans population was higher in summer season and lower in winter season.

Copepoda

During the study period the seasonal density of copepod varied from 89 ind/l to 34 ind/l (Table 3). Copepods showed higher population density in summer season (89 ind/l) and lower population density in monsoon period. This result supported by the findings of (Dar & Dar, 2009) who told that Copepod develop better in warm periods.

Ostracoda

These are represented by *Cypris sp*. In the present investigation highest concentration of Ostracoda found in 2 ind/l and lowest in 1 ind. /lt. The population density of Ostracoda was higher in Pre Monsoon and Post Monsoon season and lower during Monsoon season. Kedar (2008) also found the similar results.

Protozoa

In the present investigation only three species of Protozoa are found (*Amoeba*, *Paramecium*, *Arcella*). The population density of Protozoa was higher in post monsoon month and lower in monsoon month. Shivashankar & Venkataramana, (2013), also reported that the population density of Protozoa was also lower in Monsoon season.

Table 2. Zooplankton availability in the ponds of Purulia District.

Groupwise zooplankton availability				
Taxa				
Rotifera	Copepoda	Protozoa	Ostracoda	Cladocera
a. <i>Brachionus sp.</i>	a. <i>Nauplii</i>	a. <i>Amoeba</i>	a. <i>Cypris sp.</i>	a. <i>Daphnia sp.</i>
b. <i>Asplanchna sp</i>	b. <i>Diaptomus sp</i>	b. <i>Paramecium</i>		b. <i>Ceriodaphnia</i>
c. <i>Keratella sp.</i>	c. <i>Pseudodiaptomus sp.</i>	c. <i>Arcella</i>		c. <i>Simocephalus</i>
d. <i>Synchaeta sp.</i>	d. <i>Cyclops</i>			d. <i>Bosmina</i>
e. <i>Euchlanis sp.</i>	e. <i>Mesocyclops sp.</i>			e. <i>Moina</i>
f. <i>Filinia sp.</i>	f. <i>Paracyclops sp.</i>			f. <i>Diaphanosoma sp.</i>
	g. <i>Microcyclops sp.</i>			
	h. <i>Eucyclops</i>			
	i. <i>Acanthocyclops sp</i>			
	j. <i>Heliadiaptomus</i>			

The total no of species recorded were 584 ind./l, out of which Rotifera were 118 ind./l (20.21 %), Cladocera 221 ind./l (37.84 %), Copepoda 234 ind./l (40.07%), Ostracoda 6 ind./l (1.03 %), and Protozoa 5 ind./l (0.86 %).

In the present study the occurrence of season wise zooplankton groups was dominant in the following

increasing order. Pre Monsoon: Copepoda > Cladocera > Rotifera > Ostracoda > Protozoa, Monsoon: Copepoda > Cladocera > Rotifera > Ostracoda > Protozoa, Post Monsoon: Copepoda > Cladocera > Rotifera > Ostracoda > Protozoa, Winter: Cladocera > Copepoda > Rotifera > Protozoa > Ostracoda.

Table 3. Seasonal diversity of zooplankton group in the ponds of Purulia district.

Group	Seasonal Diversity					Diversity Index
	Rotifera	Copepoda	Protozoa	Ostracoda	Cladocera	
Season	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	
Pre Monsoon	44 $\pm$ 5	89 $\pm$ 9	1 $\pm$ 1	2 $\pm$ 0	80 $\pm$ 21	1.12
Monsoon	19 $\pm$ 2	64 $\pm$ 7	1 $\pm$ 0	1 $\pm$ 0	42 $\pm$ 14	1.07
Post Monsoon	23 $\pm$ 2	47 $\pm$ 6	2 $\pm$ 1	2 $\pm$ 0	52 $\pm$ 16	1.17
Winter	32 $\pm$ 3	34 $\pm$ 5	1 $\pm$ 0	1 $\pm$ 0	47 $\pm$ 15	1.16

Table 4. Composition (%) of different group of zooplankton availability in Purulia district.

Composition (%) of Different group of Zooplankton	
Group	Composition (%)
Rotifera	20.21
Copepoda	40.07
Protozoa	0.86
Ostracoda	1.03
Cladocera	37.84

Table 5. Seasonal Abundance (%) of different group of zooplankton in Purulia district.

Seasonal Abundance (%) of different group of Zooplankton					
Group	Rotifera	Copepoda	Protozoa	Ostracoda	Cladocera
Season	Percentage (%)	Percentage (%)	Percentage (%)	Percentage (%)	Percentage (%)
Pre Monsoon	20.37	41.20	0.46	0.93	37.04
Monsoon	14.96	50.39	0.79	0.79	33.07
Post Monsoon	18.25	37.30	1.59	1.59	41.27
Winter	27.83	29.57	0.87	0.87	40.87

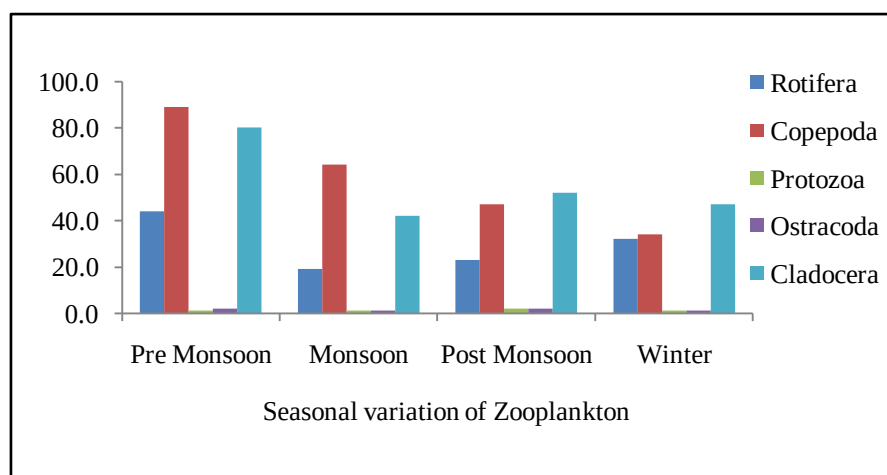


Figure 1. Graphical representation of seasonal diversity of zooplankton group in the ponds of Purulia district.

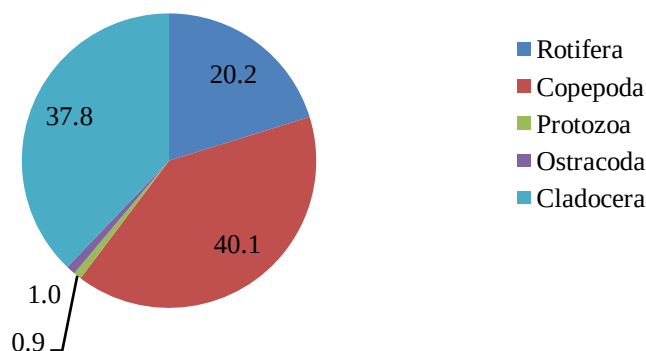


Figure 2. Composition (%) of zooplankton in the ponds of Purulia district.

CONCLUSION

In the present study it depicts that moderate no's of zooplankton group were available in Pre Monsoon and winter season. Minimum no's of zooplankton group were available in Monsoon season. This type of seasonal fluctuation may be due to the favourable climatic condition of these seasons. Among the Rotifera group the *Brachionus sp.* is more in number. It shows that the ponds are some where organically polluted and eutrophic load is more. This is because most the ponds are multi ownership in nature and pond water is used for various household work and irrigation purpose also. The desired water level must be maintained by proper desiltation of the pond and conducting awareness programme among the villagers. If we properly aware the local fishers then only we can restore our old perennial water body that enhance the rich biodiversity of flora and fauna.

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