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ASSESSMENT OF WATER QUALITY AND SEASONAL FLUCTUATION OF ZOOPLANKTON POPULATION IN THE DORA BEEL ECOSYSTEM OF KAMRUP DISTRICT, ASSAM

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ABSTRACT

The present investigation deals with the seasonal variations in physico-chemical characteristics and abundance of zooplankton population in Dora Beel, Kamrup District of Assam. The survey was undertaken from March, 2022 - February, 2023 and done in four different seasons viz. Monsoon, Pre-monsoon, winter and Post-monsoon. The physico-chemical studies include the seasonal study of water temperatures, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), pH and Free Carbon dioxide (CO_2). The result of water analysis reveals that in winter season water temperature and free CO_2were minimum but dissolved oxygen was maximum. In the monsoon season water temperature and BOD were maximum but DO was in minimum level. Free carbon dioxide was maximum but BOD was minimum in post-monsoon. The pH level was minimum in pre-monsoon season and maximum in post-monsoon. A total 24 numbers of zooplankton species were recorded belonging to five different planktonic groups such as Protozoa, Rotifera, Cladocera, Ostracoda and Copepoda. The post-monsoon season observe as peak abundance season for all the zooplanktons and pre-monsoon as low abundance season. Protozoa is the dominant group (based on abundance) followed by Rotifera, Cladocera and Copepoda. But the number of species was highest in Rotifera group. The Copepoda and Ostracoda were the lowest abundant group.

KEY WORDS: Dora Beel, Zooplankton, Physico-chemical characteristics.

INTRODUCTION

In an aquatic system, all the life processes are dependent directly or indirectly upon the various physico-chemical factors. The frequent rise and fall of these factors affect the biota, altering the survival and distribution. In other words, the growth, reproduction and development of biota are influenced by the physico-chemical factors. Biological production in any aquatic body gives direct correlation with its physico-chemical status which could be used as trophic status and fisheries resources potential (Jhingran *et al.*, 1969). Physico-chemical parameters of water bodies of an aquatic system undergo variations because of human intervention or by natural processes. These variations influence growth, sexual maturity, biological productivity and metabolic activities of aquatic life. So, the life in aquatic environment is largely influenced by physico-chemical characteristics as well as their stability. These characteristics have enabled biota to develop many adaptations that improve sustained productivity and regulate Lake Metabolism. The physico-chemical study of a lake enables in drawing out vital conclusions regarding the eutrophic status of the water bodies (Prescott, 1984). Limnologist have always considered that the study of physico-chemical status of a given lake water is an indispensable component that would specify the relationships, interdependencies as well as interaction functioning in the ecosystems with respect to the a-biotic factors. It is noteworthy to mention that in Lake ecosystem, there is significant

direct and inverse relationship between the physico-chemical parameters, and it further influences the plankton fluctuation in water (Kalita, 2017).

The term plankton has been used to describe free floating and weakly swimming marine and fresh-water organisms. The term "plankton", coined by Hensen (1887) and it was more precisely defined by Haeckel (1891). The plankton comprises of those entire aquatic organisms which are free-floating, freely swimming, drifting, and mostly microscopic and have relatively small power of locomotion or none at all. The planktons are carried away by the water current from one place to another. Presently the plankton could be defined as free floating organisms, which have the intrinsic power of locomotion, if present, is so feeble that they remain almost at the mercy of water currents and waves. Qualitatively plankton could broadly be classified as phytoplankton and zooplankton. Phytoplankton includes the chlorophyll bearing organisms capable of photosynthesis and non-photosynthetic plant or sapro-plankton against the plankton of animal origin termed as zooplankton.

Planktonic animals (zooplanktons) must necessarily have the capacity to remain a float and hence the exhibit wonderful adaptations. The zooplanktons unlike phytoplankton are patchily distributed horizontally and vertically in an ecosystem. They also undergo diurnal vertical distribution and migration. The number of zooplankton in water bodies is usually much lower than phytoplankton. Many zooplankton feed on algae and bacteria and in turn are fed by numerous invertebrates and fishes. The zooplanktons occupy a central position between the autotrophs and other heterotrophs and form an important link in aquatic food webs. Zooplanktons considered as good indicators of environmental status, water quality and aquatic productivity. Presence and dominance of zooplankton species play a vital role in functioning of freshwater ecosystems and the seasonal changes in zooplankton species are clearly related to the water quality and biological regime of the aquatic environment (Chandrasekhar and Rao, 2010). Zooplanktons also play significant role in conversion of plant protein to animal protein. In fish culture, pond zooplankton has considerable importance as they serve as live feed for the fish juveniles.

In waterbodies, seasonal fluctuation occurs in plankton communities and their density varies according to the nature of water (Kumar and Khare, 2015). The Plankton community characteristics are usually determined by a-biotic factors such as temperature, pH etc and nutrients (Jonah *et al*., 2020; Yue *et. al,* 2022). Several researchers have conducted studies on water quality parameters in relation to plankton diversity in different wetlands in India. Plankton population in relation to physico-chemical parameters of water with reference to its periodicity and abundance were done by many workers time to time. Among them some good workswere of Singh (2000); Dutta and Patra, 2013; Parveen and Mola (2013), Dhanasekaran *et al.* (2016), Karthika *et al.,* 2017; Kumar *et al.,* 2020; Singh *et al.,* 2021; Panpatil and Deshmukh (2021), Darvekar and Rout, 2022; Rajani, 2023; Vaghela *et al.,* (2023); Sangeetha *et al.,* 2024 etc.

Though the Dora beel is one of the prominent wetland of South Kamrup District, Assam with rich in bio-diversity but till now no remarkable work on this wetland is available therefore present investigation was undertaken to study the seasonal variation in zooplankton population along the physico-chemical parameters of the beelwith following aim and objectives-

1) Study of the seasonal variation of Zooplankton population of the Dora beelwater body.
2) Identification of Zooplankton by using standard methodology.
3) Study of the seasonal variation in physico-chemical parameters of the beel water.

MATERIALS AND METHODS

Study Area

The present study was conducted in the floodplain wetland Dora beel of Kamrup District of Assam during the period from February, 2022 to March, 2023. The study site (Dora beel) is a natural lake situated at Rampur village under the Palashbari revenue circle in the Kamrup district of Assam, located approximately 26°052 19.93N latitude and 91°27231.93E longitude. According to the Survey of India, 1971 the total area of the Beel was 297.96 acres which has shrunk to 278.41 acres according to Land sat imagery 2005 (Das, 2015).The Beel is surrounded by following villages- Rajapukhuri, Nahira, Bhakatpara, Tezpur, Rampur, Majpara, Kuldung, Dhantola, Bortari and Khidirpukhuri.In the monsoon period the beel is connected to the Kulsi River. River *Kulsi*is a tributary of the Brahmaputra and it originates from West Khasi Hills of Meghalaya.

Climatic condition

The climate of the district shows heavy summer rainfall, winter drought, high humidity and relatively low temperature in a given year. The climate of the districts of North Eastern India normally experiences four climatic seasons (Barthakur, 1986), which are Pre-monsoon (March - May), Monsoon (June – August), Post –monsoon (September - November) and Winter (December - February).

Physico-chemical Analysis of Water

Collection of water samples

Water samples were collected from the surface level of water body in different climatic seasons - Pre-monsoon, Monsoon, Post-monsoon and Winter from five different collection spots of the Beel. At least five water sample(s) were collected from each collection site (Kalita, 2017). The samples were collected between 7 to 10 am in sterilized plastic bottles.

Analysis of water for different physico-chemical parameters

The collected water sample were then taken into laboratory and was analyzed for a number of physico-chemical characteristics employing standard method (APHA, 2022; Trivedy and Goel, 1986). The physico-chemical parameter study included – water temperatures, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), pH and Free Carbon dioxide (CO_2).

Estimation of Plankton Diversity

Collection of Plankton samples

Sample collections were done by filtering a volume of 50-liter surface water through a plankton net No. 25 of bolting silk with mesh size 40 micron and were preserved in 5% formalin in 100 ml sterilized bottles following Goswami, (2004); Sharma and Sharma, 2013. The samplings were done in all the four climatic seasons from different sampling stations. At least five samples were collected from each collection site for each analysis. The sample collections were done between 8 am to 10 am. For microscopic analysis samples were brought to the laboratory and were thoroughly mixed before the examination.

Microscopic analysis of Zooplankton

In Laboratory the microscopic analysis of zooplankton species was done following Hosmani and Bharathi (1980), Goswami (2004). The zooplankton species observed under research binocular microscope and identified following the works of Tonapi (1980), Needham and Needham (1986), Battish (1992) and Sharma and Sharma (2008, 2013).

Statistical analysis

The correlation coefficient analysis has been carried out to find out correlation between any two tested physico-chemical parameters of water. The correlation coefficient between zooplanktonic groups and some physico-chemical parameters were done. The significance of correlationswas also tested by using t-test.

RESULTS AND DISCUSSION

The result of seasonal analysis of physico-chemical parameters of the Beel water are represented in tabular form (Table 1). Here the pH values fluctuated between 5.9 to 7.3. Maximum pH value lies in post-monsoon and minimum in Pre-monsoon. The water temperature was ranged from 18.02°C to 33.04 °C during the study period. DO content varies from 4.9 to 7.4 mg./l. The BOD and free CO_2 vary from 6.5 to 8.0 mg /l. and 1.5 to 3.4 mg/l respectively.

The zooplanktons that were recorded from the study period were listed in Table and figure (Table 2 & Fig.1). There are 24 species representing five classes of zooplankton namely Protozoa (4 species),

Table 1. Seasonal variation in Physico-chemical Characteristics of the Beel water

Parameters	Pre-monsoon		Monsoon		Post-monsoon		Winter	
	Mean	S.D	Mean	SD	Mean	S.D	Mean	S.D.
Water Temp (° C)	24.42	0.449	33.04	0.270	23.90	0.777	18.02	0.130
p^H	5.90	0.158	6.72	0.138	7.32	0.083	6.36	0.114
DO (mg./l)	5.68	0.178	4.94	0.054	6.48	0.319	7.48	0.192
BOD (mg./l)	7.42	0.204	8.02	0.178	6.54	0.288	6.66	0.270
Free CO_2 (mg./l)	2.1	0.122	3.04	0.181	3.48	0.204	1.55	0.766

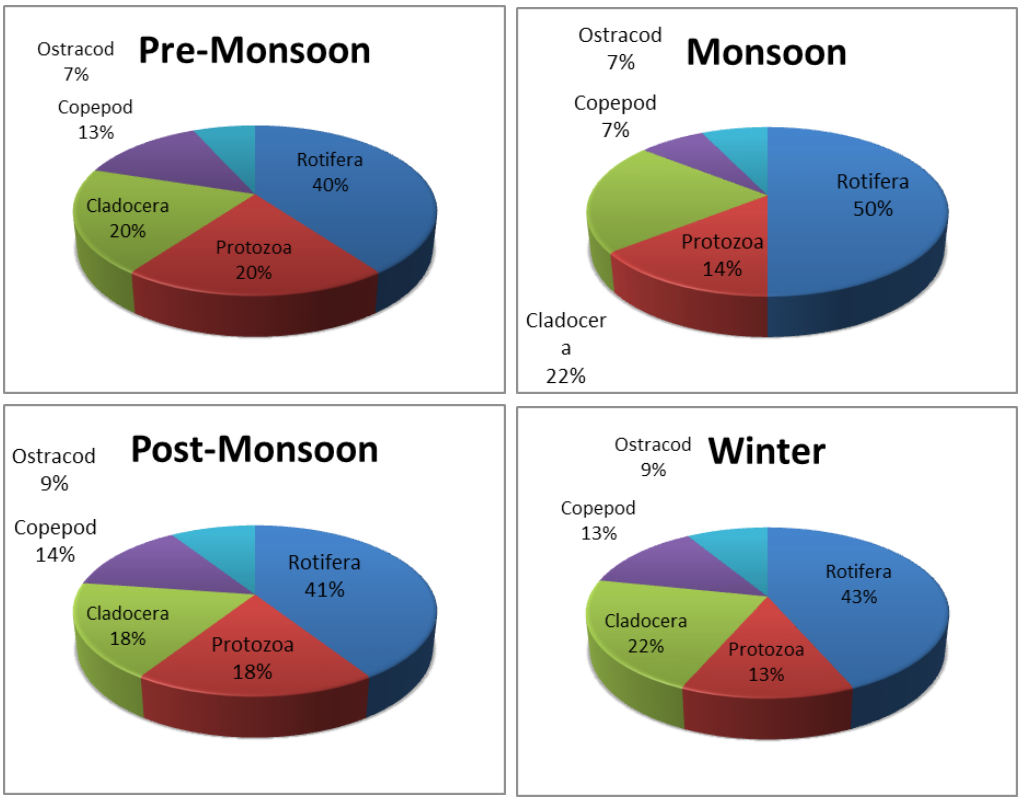

Fig. 1. Composition of different groups of zooplankton of DoraBeel atdifferent seasons

Table 2. Seasonal variations in zooplankton population of Dora Beel

S. No.	Name of the Group	Name of Species	Present or absent in different seasons			
			PR MON	MON	PO MON	WIN
1	Rotifera	*Brachionus angularis*	+	+	+	+
2	-do-	*Brachionus calyciflorus*	-	-	+	+
3	-do-	*Asplanchna priodonta*	+	+	+	+
4	-do-	*Filinia logiseta*	+	-	+	+
5	-do-	*Keratella tropica*	+	+	+	+
6	-do-	*Keratella valga*	+	+	+	+
7	-do-	*Lacane luna*	-	-	+	+
8	-do-	*Testudinella patina*	+	+	+	+
9	-do-	*Trichocera similis*	-	+	-	+
10	-do-	*Platyias patula*	-	+	+	+
11	Protozoa	*Paramacium* sp.	+	-	+	+
12	-do-	*Arcella discoides*	+	+	+	+
13	-do-	*Arcella Vulgaris*	-	-	+	+
14	-do-	*Vorticella* sp.	+	+	+	-
15	Cladocera	*Monia brachiata*	+	-	+	+
26	-do-	*Daphnia carinata*	+	+	+	+
17	-do-	*Bosmina longirostris*	+	-	-	+
18	-do-	*Bosmina corigoni*	-	+	+	+
19	-do-	*Acroperus* sp.	-	+	+	+
20	Copepoda	*Cyclops virides*	-	-	+	+
21	-do-	*Nauplius lavae*	+	-	+	+
22	-do-	*Diaptomus* sp.	+	+	+	+
23	Ostracoda	*Centrocypris* sp.	+	+	+	+
24	-do-	*Heterocypris* sp.	-	-	+	+

PR MON = Pre-monsoon; MON = Monsoon; PO MON = Post-monsoon; WIN = Winter
+= Present; - = Absent

Rotifera (10 species), Cladocera (5 species), Ostracoda (2 species) and Copepoda (3 species). The availability of zooplankton community follows the following sequences:

Rotifera : Winter > post-monsoon > monsoon >pre-monsoon
Protozoa: Post-monsoon > winter > pre-monsoon > monsoon
Cledocera: Winter > post-monsoon > monsoon > pre-monsoon
Copepoda: Post-monsoon > winter > pre-monsoon > monsoon
Ostracoda: Winter > post-monsoon > monsoon> pre-monsoon

Statistical Analysis

Correlation co-efficient of physico-chemical parameters

Pre-monsoon: Out of 10 correlations found between two parameters 7 were found to have significant at 5% level (r>0.649). **Monsoon**: - Out of 10 correlations 5 were found to have significant at 5% level (r>0.649). The negative (inverse) correlations were found in 6 cases between pH and water temperature (r= - 0.879), pH and BOD (r = - 0.986), water temperature and DO (r = -0.641), water temperature and free CO_2 (r = -0.550), DO and BOD (r = - 0.867) and BOD and free CO_2 (r = - 0.338).

Post-monsoon: Out of 10 correlations 5 were found to have significant at 5% level (r > 0.649). The negative (inverse) correlations were found in 4 cases between pH and BOD (r = - 0.352), Water Temperature and BOD (r = - 0.669), DO and BOD (r = - 0.994) and BOD and Free CO_2 (- 0.364).

Winter: Out of 10 correlations 6 were found to have significant at 5% level(r>0.649). The negative (inverse) correlations were found in 4 cases between pH and Water Temperature (r= - 0.269), Water Temperature and DO(r=-0.777), Water Temperature and BOD (r=0.255) and Water Temperature and Free CO_2 (-0.773).

Some of the highly significant correlation were discernible between Temperature and DO (r = 0.939), DO and BOD (r = 0.968) and DO and Free CO_2 (r = 0.912) in pre-monsoon; p^H and DO(r = 0.910) in monsoon; DO and BOD(r = 0.994) in post

Table 3.1. Correlation coefficient matrix for water parameters during Pre-monsoon season

Parameters	pH	Water Temp.	DO	BOD	Free CO_2
pH	1.000	0.598	0.883*	0.154	0.516
Water Temp.		1.000	0.939*	0.863*	0.802*
DO			1.000	0.968*	0.912*
BOD				1.000	0.796*
Free CO_2					1.000

*Significance at 5 % level, r>0.649

Table 3.2. Correlation coefficient matrix for water parameters during Monsoon season

Parameters	pH	Water Temp.	DO	BOD	Free CO_2
pH	1.000	-0.879*	0.910*	0.986*	0.379
Water Temp.		1.000	-0.641	0.910*	- 0.550
DO			1.000	-0.867*	- 0.050
BOD				1.000	0.338
Free CO_2					1.000

*Significance at 5 % level, r>0.649

Table 3.3 Correlation coefficient matrix for water parameters during Post-monsoon season

Parameters	pH	Water Temp.	DO	BOD	Free CO_2
pH	1.000	0.729*	0.392	- 0.352	0.466
Water Temp.		1.000	0.704*	- 0.669*	0.752*
DO			1.000	- 0.994*	0.450
BOD				1.000	- 0.364
Free CO_2					1.000

*Significance at 5 % level, r>0.649

Table 3.4. Correlation coefficient matrix for water parameters during Winter season

Parameters	pH	Water Temp.	DO	BOD	Free CO_2
pH	1.000	-0.269	0.524	0.665*	0.807*
Water Temp.		1.000	- 0.777*	- 0.255	- 0.773*
DO			1.000	0.173	0.752*
BOD				1.000	0.665*
Free CO_2					1.000

*Significance at 5 % level, r>0.649

monsoon season. BOD did not show any significant correlation with free CO_2 at monsoon and post-monsoon season.

Correlation co-efficient between zooplankton and physico-chemical parameters

The correlation co-efficient was evident that a positive correlation existed between Rotifers with water temperatures, DO and pH in pre-monsoon season while the negative correlation occurred between Rotifers with Temperature, DO and pH in monsoon. The negative correlation existed between Protozoa with water temperature, DO and pH in monsoon. The positive correlation existed between Cladocera with water temperature, DO and pH in pre-monsoon and post-monsoon. The negative correlation occurred between Copepoda with water temperature, DO and pH in post-monsoon season. The positive correlation existed between Ostracoda and water temperature at pre-monsoon and winter season. The negative correlation occurred between Ostracoda and DO in pre-monsoon. The positive correlation existed between Ostracoda and pH at pre-monsoon and monsoon season.

DISCUSSION

In this investigation water temperature is higher in monsoon, lower in winter and medium in post monsoon season (Table 1). Generally, the temperature is the most important factor for planktonic growth and variation which is supported by the findings of Rao *et al*.(1996), Kumar(1995). Our observation is in conformity with the above where we find a positive correlation between the dominant group Rotifer and Cladocera with water temperature (Table 4). Dissolved Oxygen (DO) is very essential for the respiratory metabolism of most of the aquatic organisms. Oxygen distribution in water bodies is important as it is the direct need of many aquatic organisms and it favours the solubility and availability of many nutrients of the organisms in turn increased the productivity of the aquatic ecosystem (Wetzel, 1975). In this investigation DO value was recorded to be the higher in winter season and post-monsoon season and the lower in monsoon and pre-monsoon season (Table 2.9). Identical

Table 4. The correlation coefficient between Zooplankton and physico-chemical parameters of Dora Beel at different seasons.

Characteristic	Pre-monsoon	Monsoon	Post-monsoon	Winter
Rotifers v/s water Temperature	0.6499*	- 0.2331	0.6468	-0.8400*
Rotifers v/s DO	0.4082	- 0.6123	- 0.0350	0.8067*
Rotifers v/s pH	0.8067*	- 0.3429	0.6864*	0.3220
Protozoa v/s water Temperature	- 0.1624	- 0.4024	0.2347	-0.3429
Protozoa v/s DO	- 0.3572	- 0.6123	- 0.0571	0.8137
Protozoa v/s pH	0.5694	- 0.3429	0.7205*	0.2941
Cladocerav/s water Temperature	0.6499*	- 0.3699	0.8802*	-0.5601
Cladocera v/s DO	0.4082	- 0.1666	0.6574*	0.1423
Cladocera v/s pH	0.8067*	- 0.2100	0.7205	0.0800
Copepoda v/s water Temperature	- 0.4726	0.9989*	- 0.5868	-0.5600
Copepoda v/s DO	- 0.3750	- 0.6123	- 0.6288	0.1423
Copepoda v/s pH	0.0581	- 0.7717	- 0.8807*	0.8000
Ostracoda v/s water Temperature	0.2736	- 0.2861	- 0.5868	0.7844
Ostracoda v/s DO	- 0.0625	0.4082	0.6574*	0.2324
Ostracoda v/s pH	0.6393	0.5144	- 0.4893	-0.3429

*Significance at 5 % level, r>0.649

findings had also been reported from various wetlands and fish ponds of Assam (Hazarika and Dutta, 1994; Sarma *et al.,* 2013, Kalita, 2017)

Here the population of Rotifers and Cladocera were found higher in winter season. Similar findings were also observed by Sinha and Sinha (1993), Kalita *et al.* (2013). Similar to our findings the dominance of Rotifer was also reported by Sawar and Parveen (1996). They observed the superiority of Rotifers over Cladocera and Copepoda.

CONCLUSION

The zooplankton diversity plays very significant role in the functioning of freshwater ecosystem. Zooplankton diversity in water bodies provided significant information about the available sources for supporting life for fishery development.In this study the BOD level is found high which might be due to the decomposition of organic matter and decay of vegetation in beel which mixed with river water during rainy season and it is come into light that the beel is impacted unfavorably by some natural and anthropogenic factors. The major anthropogenic activities that influence the beel ecosystem are agricultural activities, throwing of wastes, overgrazing, settlement, growing of brick industries, construction of roads and over exploitation of biota etc., which cause deterioration of the wetland environment.

The beel plays an important role in maintaining the environmental quality of the areas and its vicinity and therefore proper conservation measures should be taken for sustainable livelihood and existence of this wetland.

Conflict of interest - None

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