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Seasonal Zooplankton Community of Shatiya Wetland in Gopalganj District of North Bihar

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ABSTRACT

Zooplankton community is cosmopolitan in nature and they inhabit all freshwater habitats of the world. These species are not only useful as bio-indicators, but are also helpful for ameliorating polluted waters. Hence qualitative and quantitative studies of zooplankton diversity are of great importance. In the present study, monthly changes in diversity and density of zooplankton assemblages had been recorded during July 2021 to March 2022 at two selected sites of Shatiya wetland in Gopalganj district of Bihar (India). The population abundance is appropriate in this wetland during the study period which might be able for sufficient fish productivity.

Keywords: Zooplankton, Tropical wetland, Diversity and Density

INTRODUCTION

Wetlands are the most productive ecosystem of the world comparable to coral reefs and rainforests. However, human activities like leaching of noxious liquids from solid waste deposits or untreated waste discharge reach a climax which has undesirable effects on aquatic environment (Chapman, 1996). The wetlands are cradles of biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival (Prakash, 2020). They support high concentration of mammal, bird, reptile, amphibian, fish and invertebrate species.

Wetlands and water bodies are important components of watersheds and provide many valuable functions to the environment and society (Verma and Prakash, 2018). In addition, aquatic ecosystems are severely affected by anthropogenic activities. The use of various ecological methods is important to know the health status of an aquatic ecosystem. Further, the water quality influences the species composition, abundance, productivity and physiological conditions of the aquatic community and water quality is indicated by the structure and composition of these aquatic communities.

Biodiversity is the 'foundation of human life' on earth because each organism plays an important role and helps in producing more productive and stable ecosystem which has the ability to survive in stress conditions. Environmental conditions play a key role in defining the function and distribution of organisms, in combination with other factors.

Environmental changes have had enormous impacts on biodiversity patterns in the past and will remain one of the major drivers of biodiversity patterns in the future (Prakash and Srivastava, 2019). The climate change has a huge impact on biodiversity (Prakash and Srivastava, 2019) and farmers' practices (Mandal and Singh, 2020). The biodiversity loss has ecological impact (Kumar and Verma, 2017).

Zooplankton is a diverse group of heterotrophic organisms that consume phytoplankton, regenerates via their metabolism, and transfer energy to higher trophic levels. They play an important role in recycling nutrients as well as cycling energy within their respective environment (Kar and Kar, 2016). They invariably form an integral component for fresh water communities and contribute to biological productivity (Ramachandra *et al*., 2017). Further, these are also good indicator of the changes in water quality because they are strongly affected by environmental conditions and respond quickly.

Population density and diversity of plankton in a water body are of great importance in imposing sustainable management policies as they vary from location to location and aquatic systems within the same location. The inadequate knowledge of plankton and their dynamics is a major drawback for the better understanding of the life process of fresh water bodies. Thre is scarcity of literature upon zooplankton community analysis except Verma (2020) and Sugumaran *et al.,* (2020). So, the present study was an attempt for reporting Zooplankton abundance in Shatiya wetland sites of Gopalganj district in Bihar.

MATERIALS AND METHODS

The plankton were collected with the help of a plankton net made up of bolting silk (No. 25) by the hauling method. The plankton from the shallower zone were collected by filtering water through plankton net with the help of a 1 litre capacity beaker as in these areas it was difficult to apply hauling method. The volume of water filtered was calculated. The above collected sample was preserved in 5% formalin.

The Qualitative analysis of plankton was done under a compound microscope with the help of available monograph and literature (Needham and Needham, 1966 and Sehgal, 1983)**.** Lackey drop micro-transect method subsequently modified by Edmondson (1974) was used to enumerate plankton density quantitatively. This method involves the plankton enumeration in one drop of the concentrated sample taken on a slide. The zooplanktons were counted while moving the slide with the help of a movable stage to other edge. The slide was shifted to the next field and the above process was repeated on the path parallel to the earlier one in the reverse direction. Number of transects were counted. Five drops of concentrated sample were examined to get average plankton density.

Hill's diversity numbers in order to represent number of abundant species in samples and also to represent species maximum in abundance Hill's diversity numbers were used. In equation form, Hill's diversity numbers are $H_\alpha = (\sum p_i^\alpha)^{1/(1-\alpha)}$ where pi is the proportion of individuals belonging to ith species. Hill shows that the 0th, 1st and 2nd order of these diversity numbers (i.e., A=0, 1 and 2) coincide with three of the most important measures of diversity. Hills diversity numbers are Number 0: N_0=S, where S is the total number of species, so, N_0 is the number of all species in the sample regardless of their abundance, Number 1: N_1=eH, where H is the Shannon's index and $_{N1}$ is the measure of number of abundant species in the sample. N_1 will always be intermediate betweenN_0 and N_2, and Number 2: N_2=1/λ, where λ is Simpson's index and N_2 is the number of species maximum in abundance in a sample.

Calculation: Organisms/drop=(Area of cover slip/ Area of transect) x Individuals count recorded per transect: Where; Area of cover slip= (for round cover slip); Area of transect was measured with the help of stage and ocular micrometer; Total organisms/ml = Total no. of organisms / drop x No. of drops/ml. Also, Density (organism/l) = (a x V)/L: Where; a =number of organisms, V = volume of concentrates and L = water filtered in litre.

RESULTS

The percent composition of phytoplanktons and Zooplanktons in both the Sites has been summarized in Table -1.

Table 1: Percent composition of planktons in two Sites of Satiya wetland

Site No.	Plankton type	Jul 2021	Aug	Sep	Oct	Nov	Dec	Jan 2022	Feb	Mar
1	Phytoplankton	83.33	95.88	91.90	92.95	86.86	98.45	99.34	86.34	95.68
	Zooplankton	16.06	4.11	8.09	7.04	13.13	1.54	0.62	13.65	4.32
2	Phytoplankton	25.38	76.06	99.79	44.61	78.60	67.75	90.74	91.00	99.74
	Zooplankton	74.61	23.97	0.20	55.38	21.39	32.04	9.36	9.00	0.26

This Table indicating that phytoplankton: Zooplankton percentage ranged from 83.33- 99.34: 0.62-16.06 in Site No. 1 and 25.38-99.79: 0.20-74.61 in Site No. 2. The seasonal variation of zooplanktons is given in Table 2 and 3.

Table 2: Seasonal variation in the abundance of Zooplanktons in Site 1 of Satiya wetland

Zooplankton	Jul 2021	Aug	Sep	Oct	Nov	Dec	Jan 2022	Feb	Mar
Crustacean larva	14	10	12	10	125	92	2	1062	324
Daphnia	8	6	17	76	267	295	-	78	11
Ceriodaphnia	-	-	-	-	12	-	-	8	18
Moina	5	13	21	64	96	12	2	8	2
Cyclopus	2	12	25	32	316	103	4	32	6
Diaptomus	-	-	2	4	27	-	-	90	7
Mesocyclops	4	8	12	-	-	-	2	4	32

Brachionus	12	15	26	7	2	-	-	18	40
Filinia	3	-	4	26	42	4	8	37	-
Keratella	6	12	12	15	29	38	-	125	22
Euglena	2	6	7	12	92	8	-	18	7
Ceratium	2	4	6	6	7	3	2	3	2

Table 3: Seasonal variation in the abundance of Zooplanktons in Site 2 of Satiya wetland

Zooplankton	Jul 2021	Aug	Sep	Oct	Nov	Dec	Jan 2022	Feb	Mar
Brachionus	12	43	20	18	21	86	8	310	12
Polyarthra	48	27	2	6	8	47	86	102	10
Filinia	14	12	5	128	2	-	12	16	-
Asplanchna	8	-	-	-	-	12	-	-	-
Keratella	18	11	-	162	-	67	9	148	20
Crustacean larva	80	207	10	4	32	1	98	73	3
Cyclops	37	60	3	2	14	1	15	12	1
Daphnia	27	6	17	148	7	100	7	192	18
Eubranchinus	-	3	2	46	10	67	9	148	21
Euglena	-	4	1	-	27	90	4	86	8

The zooplankton of this wetland showed both temporal and spatial variation as evidenced by density in months of investigation in Figure 1. The density of site 1 have lower value than site 2 except in July when surprisingly density of zooplanktons are higher in site1.

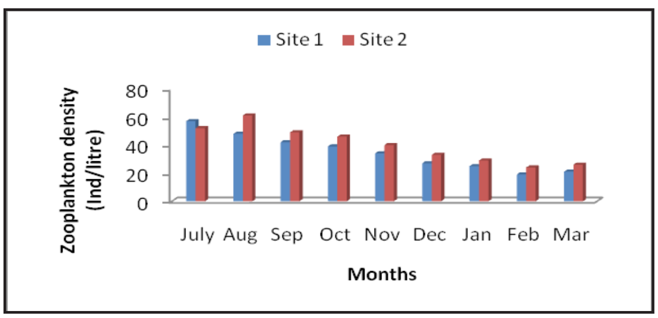

Figure 1: Zoopankton density in Shatiya wetland sites

There zooplankton abundance also showed similar pattern as density variation in this wetland evidenced in Figure 2, where high abundance observed in site 2 except in July when abundance was high in site 1 during the investigation period.

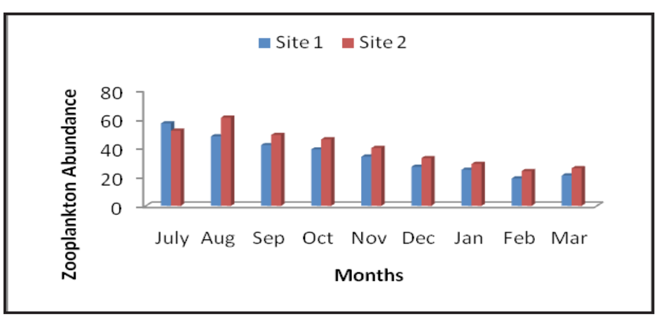

Figure 2:Zoopankton Abundance in Shatiya wetland sites

The wetland consist different groups of zooplanktons at both sites with variation in their percentage contribution in the community participating in energy allocation to tertiary organisms as a part of trophic system. There is more rotifer existence at site 2 rather than 1 due to eutrophic and shallow nature with maximum anthropogenic disturbances during the study period and forever (Figure 3).

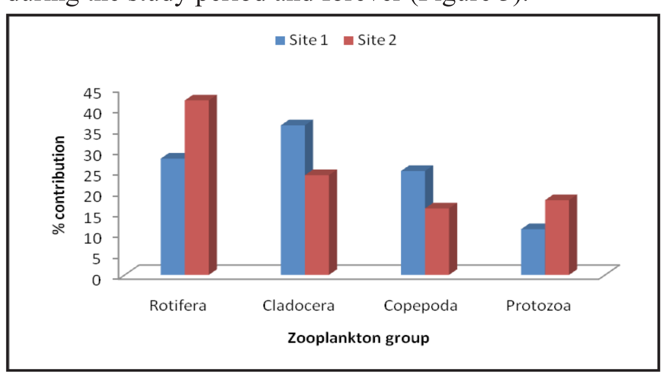

Figure 3: Zoopankton groups in Shatiya wetland sites

Amongst *Rotifers-Filinia, Keratella* and *Brachinus,* amongst *Cladocera, Daphnia, Ceriodaphnia, Moina* and amongst *Copepods, Cyclops* and *mesocyclops* were dominant species. Amongst *Protozoa Euglena* and *Ceratium* were the dominant zooplanktons.

DISCUSSION

In the present study rotifera dominated the zooplankton assemblage for a major part of the year. The cladocerans dominated during the winter season. The rotifers showed overall optimum density and they were most abundant during the rainy and summer season at different sites.

In a majority of wetlands studied in the tropics, Rotifera is the most abundant group (Yousuf 1989). Also, Tarnot and Bhatnagar (1988) reported dominance of copepods over rotifers in the Upper Lake in Bhopal, Madlhya Pradesh. The optimum density of rotifers could be attributed to a variety of reasons. Copepods including copepodite stages of cyclopo1ds and diaptomids prey upon rotifers (Williamson 1987). The low rotifer density during the winter season could be due to competition with increased cladocerans for the same resource base.

The relative contribution of different groups has also been shown to be influenced by the trophic level of the water. Nutrient enrichment leads to phytoplankton blooms, change in predator abundances and other physic chemical changes. The total zooplankton biomass increases with increase in lake productivity and is accompanied both by species and group replacements within the macro-zooplankton and there is an increase in micro-zooplankton population consisting of rotifers and ciliate protozoa (Bays & Crisman 1983). Rotifers are indicators of higher trophic levels (Saxena 1987). Waters with abundance of copepods are said to be at a lower trophic stage (Yousuf 1989).

In this study the cladoceran assemblage during the rainy season consisted of species capable of feeding on both detritus and algae (Fryer 1985) and could possibly switch from one mode to the other. *Daphnia lhuamholtzi* was the most abundant cladoceran during the winter season at all the sites. This species with pronounced helmets and long tail spines could avoid predation by larger invertebrates and young fish. Lewis and Maki (1981) have found a direct relationship between increased hardness of water and daphinid productivity. The total hardness of water during winters was found to be quite high in the present study. *Moina micrura* was the dominant species during the early summer season. Similar peaks in the density of *Moina micrura* have been observed from other Indian studies also (Murugan 1989).

In the present study Diaptomus and Cyclops alternate in being the major part of the copepod community. Also, large amount of detritus was available during the rainy season when Diaptomus sp. was the dominant copepod. Cyclops species was dominant during the post-rainy, winter and summer season. They seem to be adapted to high fluctuations in environmental conditions like the quality and quantity of food and low dissolved oxygen levels (Rao, 1994).

The rotifers were present in low densities during the entire wet phase in this study. Members of the family Brachionidae were dominant during the rainy season. The temperature and ionic concentrations determine suitable habitats for Brachionus species. Its influence may be indirect, intensifying or delay in development and cooperating to other biotic and abiotic factors (Pejler, 1977).

The seasonal succession among zooplankton species has also been related with a difference in their temperature adaptation and the nature of the available food which influences their growth and reproduction (Vijverberg. 1976). The Zooplanktons prefer green algae over blue green filamentous algae (Lampert 1982). Size selective predation by a variety of vertebrate and invertebrate predators also plays an important role in the organization and dynamics of Zooplankton communities. However, these aspects were not the subject of the present study.

CONCLUSIONS

The importance of the zooplankton is well recognized as these have vital part in food chain and play a key role in cycling of organic matter in the aquatic ecosystem. The present study on Shatiya wetland exhibits rich density and diversified zooplankton particularly rotifers reveals that this wetland is very much suitable for aquaculture as rotifers are known to be the best food for the fish larvae. This study revealed that the rotifers were found to predominant group which are the indicators of eutrophication. Therefore, measures must be taken to minimize the water pollution by regulating human activities in watershed areas.

REFERENCES

Chapman D (1996): Water quality assessments- A guide to use of Biota, Sediments and Water in Environmental Monitoring, Second Edition.

Fryer G (1985): Crustacean diversity in relation to the sìze of water bodies: some facts and problems. *Freshwater Biol*, 15: 347-36l.

Kar S and Kar D (2016): Zoolpankton diversity in a freshwater lake of Cachar, Assam. *IJABPT*, 7(1):301-305.

Kumar, Ajay and Verma AK (2017): Biodiversity loss and its Ecological impact in India. *International Journal on Biological Sciences*, 8(2): 156-160.

Lampert W (1982): Further studies on the inhibitory effects of the toxic blue-green *Microcystis aeruginosa* on the filtering rate of zooplankton. *Arch Hydrobiol*, 95: 207-220.

Lewis MA and Maki AW (1981): Effect of water hardness and diet on the productivity of *Daphnin magna* in laboratory culture. *Hydrobiologia*, 85; 175-179.

Mandal AC and Singh OP (2020): Climate Change and Practices of Farmers' to maintain rice yield: A case study. *International Journal of Biological Innovations*, 2(1): 42-51. Murugan N (1989): Dynamics of population of *Ceriodaphnia carinata* from a seasonal pond in Madurai. *Proc Indian Acad Sci*, 98: 211-222.

Needham JJ and Needham PR (1962): A Guide to the study of freshwater Biology, Charles Cthomas Publisher,USA.

Needham JE and Needham PR (1972): A guide to the study of fresh water biology. Holden Day Inc. San francisco. California.

Pejler B (1977): On the global distribution of the family Brachionidae (Rotatoria). *Arch Hydrobiol Suppl*, 53: 255-306.

Prakash S and Srivastava S (2019): Impact of Climate change on Biodiversity: An Overview. *International Journal of Biological Innovations*, 1(2):60-65.

Prakash S (2020): Conservation status of fishes reported from SemaraTaal of District Siddharthnagar (UP). India. *International Journal of Fauna and Biological Studies*, 7(3): 21-24.

Ramachandra RR, Manjulatha C and Raju DVSN (2017): Zooplankton diversity in Madduvalasa reservoir, India. *Int J Life Sci Scienti Res* 3 (1): P771-778.

Ray MB (1994): Zooplankton population in Ramsar wetland. *Advances in Freshwater Biology*, 13:27-31.

Roy U, Shaha BK, Mazhabuddin KH, Haque MF and Sarower MG (2010): Study on the Diversity and Seasonal Variation of Zooplankton in a Brood Pond, Bangladesh. *Marine. Res. Aqua*. **1** (1):30-37.

Saxena DN (1987): Rotífers as indicators of water quality. *Acta Hydrochem Hydrobiol*, 15: 481-485.

Sehgal KL (1983): Studies on Indian freshwater Copepoda I1. On Calanoid Copepods occuring in freshwater ponds of Orissa. *J Zool Soc India*, 12: 243- 249.

Shannon CE and Weaver W (1949): The Mathematical Theory of Communication. University of Illinois Press, Urbana, USA.

Simpson EM (1949): Measurement of diversity. *Nature*, **163**: 688.

Singh SP, Pathak D and Singh R (2002): Hydrobiological studies of two ponds of Satna (MP), India. *Eco Environ Cons*, **8**: 289-292.

Sugumaran, E., Shabeen, B. and Radhakrishnan, M.V. (2020): Zooplankton Diversity in Sathanur Reservoir of Thiruvannamalai (Tamilnadu), India. *International Journal of Biological Innovations*, 2 (2): 95-101.

Tarnot P and Bhatnagar GP (1988): Limnobiological studies of Upper Lake, Bhopal. Proc Nat Symp Past, Present and Future of Bhopal Lakes: 67-76.

Verma, A.K. and Prakash, S. (2018): Qualitative and quantitative analysis of macro-benthos of Baghel Taal, a wetland of U.P. *Indian Journal of Biology*, 5 (2): 127-130.

Verma, A.K. (2020): Limnological Studies of Muntjibpur pond of Prayagraj (U.P.) in relation to planktons. *International Journal of Fauna and Biological Studies*, 7 (4): 27-30. Vijverberg J. (1976): Effect of temperature of laboratory studies on development and growth of Cladocera and Copepoda from Tjeukemeer. *The Netherlands Freshwater Biology*, 10, 317-340.

Williams R, Conway DVP and Collins NR (1987): Vertical distributions of eggs, nauplii and copepodites of *Calanus helgolandicus* (Copepoda: Crustacea) in Baltic Sea. *Mar Biol*, 96: 247-252.

Yousuf AR (1989): Zooplankton studies in India with special reference to North India: A critical review. (In: Agarwal VP, Desai BN and Abidi SAH). Management of Aquatic ecosystem: 309-324.