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SEASONAL ABUNDANCE OF CERTAIN ZOOPLANKTON IN UPPER LAKE, BHOPAL

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AUTHORS' CONTRIBUTIONS
This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Upper Lake (Bhoj Tal or Bada talab) is a man-made reservoir. The water body of Upper lake receives domestic discharge which leads a large amount of nutrient inputs and the highest amount of nitrate and phosphate indicates that water is eutrophic in nature. The present study has been carried out to study seasonal abundance of certain zooplankton in Upper lake, Bhopal. The abundance of zooplankton was studied in pre-monsoon, monsoon and post monsoon season. In the present study zooplanktons comprised of total 5 taxonomic groups: Protozoa, Ostracoda, Rotifera, Cladocera and Copepoda. The greater abundance of zooplankton was recorded during summer season while the lowest abundance was recorded during the monsoon season.

Keywords: Seasonal abundance; zooplankton; Upper Lake; diversity.

1. INTRODUCTION

The Bada talab (Upper Lake, Bhopal) was built in 11th century by constructing an earthen dam beyond the Kolans river, with a catchment area of 361 sq.km. The area is rich in biodiversity that includes about 106 species of Macrophytes, 105 species of Zooplankton, 43 species of Fishes, 27 species of Avifauna, 98 species of Insects and more than 10 species of Reptiles and Amphibians and hence required to be protected to conserve the natural habitat of the state. Tropical wetlands play an important role for human kind in all continents [1]. Wetlands are among the most productive ecosystem in the world, comparable to rainforests and coral reefs [2]. Plankton population have a dynamic relationship in the food chain. In the last two decades much attention has been paid in tropical countries towards the study of biology, ecology and toxicology of zooplankton due to their important role in the rapidly emerging concepts in environmental management like Environmental Impact Assessment (EIA), bio indication of pollution and biological monitoring [3]. Zooplankton are microscopic floating animal-like organisms spotted either at or near the surface of waterbodies. Ovie [4] defined zooplankton as the free floating, aquatic

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invertebrates often described as microscopic because of their usual small size that ranges from a few to several micrometers and is rarely exceeding a millimeter. Plankton are the most sensitive floating group which are being the initial target of water pollution, thus any unacceptable change in aquatic ecosystems affects the diversity and biomass of this community. Due to their large density, shorter life span, drifting nature, high group or species diversity and different tolerance to stress, zooplankton are being used as an indicator group for the physical, chemical and biological process in the aquatic ecosystem [5]. Zooplankton diversity is one of the largest major ecological parameters in water quality. These are free floating organisms and play an integral role in the aquatic food chain [6]. Zooplankton play a significant role in lake ecosystems as grazers that manage algal and bacterial populations, as a food source for higher trophic levels and in the elimination of dissolved nutrients. They play an important role in recycling nutrients as well as cycling energy within their respective environment [7]. They invariably form an integral component for fresh water communities and contribute to biological productivity [8]. Zooplanktons are often an important link in the transformation of energy from producers to consumers [9]. The plankton population on which the entire aquatic life depends directly or indirectly is governed by the interaction of a number of physical, chemical and biological conditions and the tolerance capacity of the organisms to variations in one or more of these conditions. In some monitoring models, the relationship between phytoplankton and zooplankton is employed [10]. According to Rajagopal et al., [6] zooplankton play an integral role and serve as a bio-indicator and it is a well-suited tool for understanding water pollution status. Zooplanktons are essential in an environmental effect and highly responsive to change in the environment and thus indicate environmental changes. They often respond quickly to a wide variety of environmental changes or disturbances including nutrient loading because most species have a short generation time [11]. The dominance of zooplankton in shallow water bodies by rotifers, cladocera or copepods varies according to the degree of organic pollution [12] (Verma & Munshi, 1995; Rao & Durve, 1992). Zooplanktons are effective for concentrating huge amounts of heavy metals from water bodies. These metals are probably passed on and concentrated at higher trophic levels between the food chain. Therefore, it is mandatory to understand whether the mortality is due to magnifications of heavy metals or pollutants. The fishery potential is fully related to the presence of zooplankton [13]. The present study was undertaken to investigate the seasonal abundance of certain zooplankton in upper lake.

2. MATERIALS AND METHODS

2.1 Study Area

The present investigation has been executing on Upper lake of Bhopal, Madhya Pradesh. The upper lake basin constitutes a submergence area of around 31.0 sq. km and a catchment area of 361 sq. km. The upper lake disperses over longitude 77°18’00” to 77°24’00” E and latitude 23°13’00” to 23°16’00” N. The upper lake or Bada talab was established in the 11th century by buildup an earthen dam across the Kolans river. Van-Vihar National park encircles the upper lake on the south, Human settlements on the east and north and Agriculture fields on the west.

Image 1. Collection of Zooplankton from Upper Lake, Bhopal

2.2 Collection and Preservation

The samples for zooplankton examination, were collected on a seasonal basis for a phase of one year from March 2019 to February 2020 for the qualitative and quantitative analysis. Water samples have been collected in one-liter polythene canes of the surface waters by the boat from the upper lake (Image 1) between 8AM to 10AM.The plankton samples were collected using a bolting silk cloth (20 µ aperture) conical-shaped plankton net from the upper lake following standard method [14]. The plankton samples were preserved in 4% formaldehyde to examine in the laboratory. A 'Sedgwick Rafter Counting Cell' was used for the quantitative study of zooplankton. The identification of aquatic biota (zooplankton) was done following the standard works and methods [15-22].

$$\textbf{Number of Zooplankton "n"} = \frac{\text{Cx } 1000\text{mm2}}{\text{AxDxE}}$$

Where,

C = Number of organisms recorded
A = Area of field in the microscope
D = Depth of field (SRC depth) in mm
E = Number of fields counted.

Number of zooplankton/l = n x Vol. of concentrate (ml)/ Vol. (liters) of water filtered

2.3 Shannon Diversity Index

This index is an index applied to biological systems derived from a mathematical formula used in the communication area (Shannon, 1948).

$$\mathbf{H' = -\sum [(n_i / N) \times (\ln n_i / N)]}$$

H': Shannon Diversity index
N_i: Number of individuals belonging to I species
N: Total number of individuals

3. RESULTS AND DISCUSSION

The fresh water zooplankton were found to contain Protozoa, Ostracoda, Rotifera, Cladocera and Copepoda. The major systematic groups of zooplankton embrace numerous taxa, which feed on phytoplankton. Zooplankton community structure has been used as an indicator of the nutrient and pollution status of water bodies (Ogbeibu et al., 2001 and Imoobe & Adeyinka, 2010). Selective grazing by zooplankton is a major factor affecting the system of phytoplankton community. These animal components are mainly filter-feeders, sediment-feeders or raptorial predators [23]. Among them, filter-feeders generally exert the strongest effect on phytoplankton abundance in lakes. The values of the whole number of zooplankton have been recorded to vary with an increasing trend from March to May and becoming highest in the summer season and due to heavy rain, their number decreased from July to August. The predominance of protozoan and rotifer communities indicates water quality deterioration and onset of eutrophication at alarming rate [24]. Rotifera showed the greatest number of species followed by Cladocera, which in turn was followed by Copepoda, Protozoa and Ostracoda. Rotifera play a vital role in the trophic level of fresh water impoundments and serve as a living capsule of nutrition [8].

3.1 Rotifera

Rotifers play a vital role in the trophic tiers of fresh water impoundments and serve as a living capsule of nutrition [25]. In the current study, a total of 8 species were identified. The dominance of Rotifer species was due to their preference for warm waters as highlighted by Dumont [26] and Segers [27]. High abundance of rotifers in the water body indicates enrichment due to direct inflow of untreated domestic sewage from the adjacent area into the wetland, as was suggested by Arora [28]. The number of rotifers increased in summer which may be due to the higher population of bacteria organic matter of dead and decaying vegetation [29]. According to observations, the *Brachionus* species are very common in temperate and tropical waters indicating the alkaline nature of water [30].

3.2 Cladocera

Among Cladocera, genus *Bosmina* recorded to be dominant which has been considered a good indicator of trophic conditions for a long time [31]. This genus is very common in eutrophic lakes having abundant macrophytic vegetation and also found abundant in Ikeda lake [32]. The distribution of Cladocera may be due to the interaction of biotic and abiotic components of water [33]. Cladocerans are the most beneficial and nutritive group of crustaceans for higher members of fishes in the food chain. In the present investigation, a total of 6 species were identified (Table 1).

3.3 Copepoda

Copepods provide food to various fishes and take an uppermost position in ecological pyramids. Copepoda throughout the whole period was usually displayed by *Cyclops* sp. and naupli larvae. This was attributed to the enriched nature of waters. Verma et al., [34] and Ahmad et al., [35] observed that *Cyclops* sp. and naupli were sensitive to pollution and expand with an

increase in nutrients. Joshi [36] reported the dominant population of Copepoda (*Cyclops* sp.) throughout the year from Sagar Lake while Gupta [37] reported similar conditions in Gulabsagar and Ganglooan water bodies of Jodhpur. Khan [38] also reported dominance of copepod in floodplain wetlands of West Bengal.

3.4 Ostracoda

Ostracods show extremely small diversity and population density in comparison to other groups of zooplankton. In the current study only one species of Ostracoda was found (Table 1).

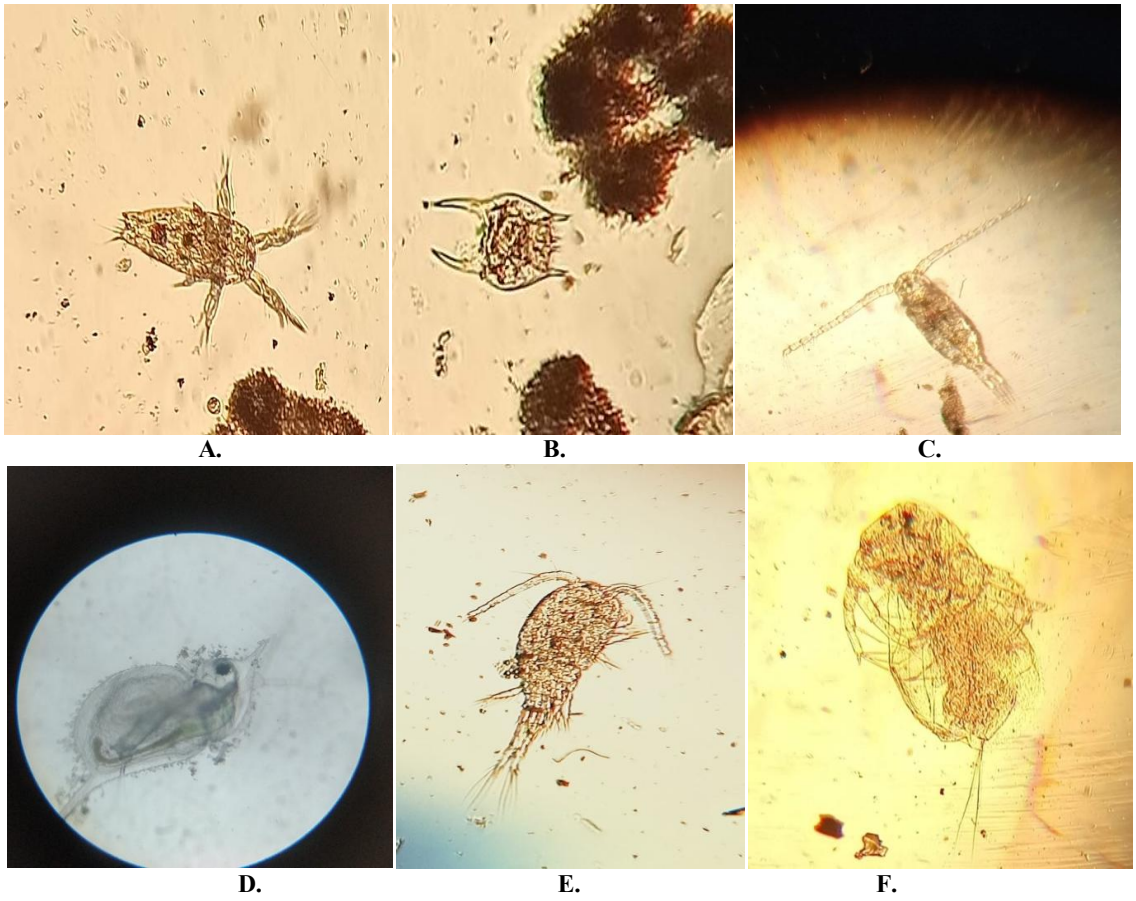

Image 2. Microscopic view of some zooplanktons in Upper Lake, Bhopal
A. Naupli B. Brachionus species C. Calanoid Copepode D. Daphnia Pulex
E. Orthocyclops F. Moina Species

Table 1. List of Zooplankton species found in Upper lake different seasons

Different Zooplankton species				
Cladocera	**Rotifera**	**Copepoda**	**Ostracoda**	**Protozoa**
Bosmina sp.	*Asplanchna* sp.	*Cyclops* sp.	*Cypris* sp.	*Centropyxix* sp.
Chydorus sp.	*Branchionus angularis*	*Naupli*		*Filnia* sp.
Daphnia sp.	*Branchionus caudatus*			*Keratella tropica*
Leydgia sp.	*Branchionus calyciflorus*			*Keratella cochlearis*
Moina sp.	*Platyias* sp.			*Verticella* sp.
Moinadaphnia sp.	*Polyarthra* sp.			
	Trichocera sp.			
	Trichocerca longiseta			

Table 2. Seasonal variation of Zooplankton in Upper lake, Bhopal

S. No.	Class	Zooplankton (%)		
		Pre-monsoon	Monsoon	Post-monsoon
1.	Cladocera	12.35±1.03	16.50±1.15	25.62±1.62
2.	Rotifera	33.53±1.62	27.84±1.13	35.76±0.63
3.	Copepoda	57.47±1.17	5.91±0.28	41.08±1.18
4.	Ostracoda	0.84±0.48	0±0	0.74±0.48
5.	Protozoa	2.13±1.22	1.83±0.55	3.09±1.22

Each value represent Mean ± SEM; n=3

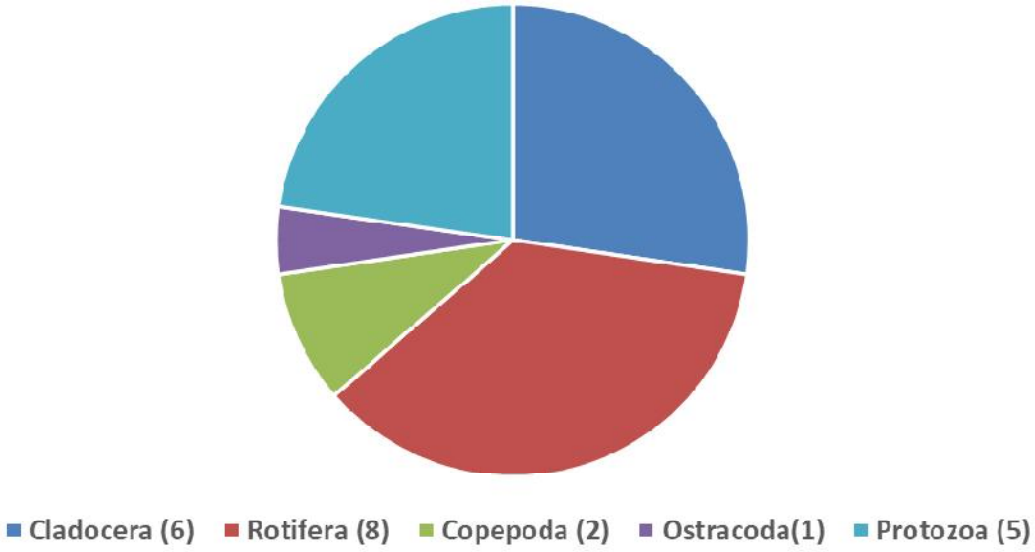

Fig. 1. Different zooplankton species (number) found in Upper Lake Bhopal

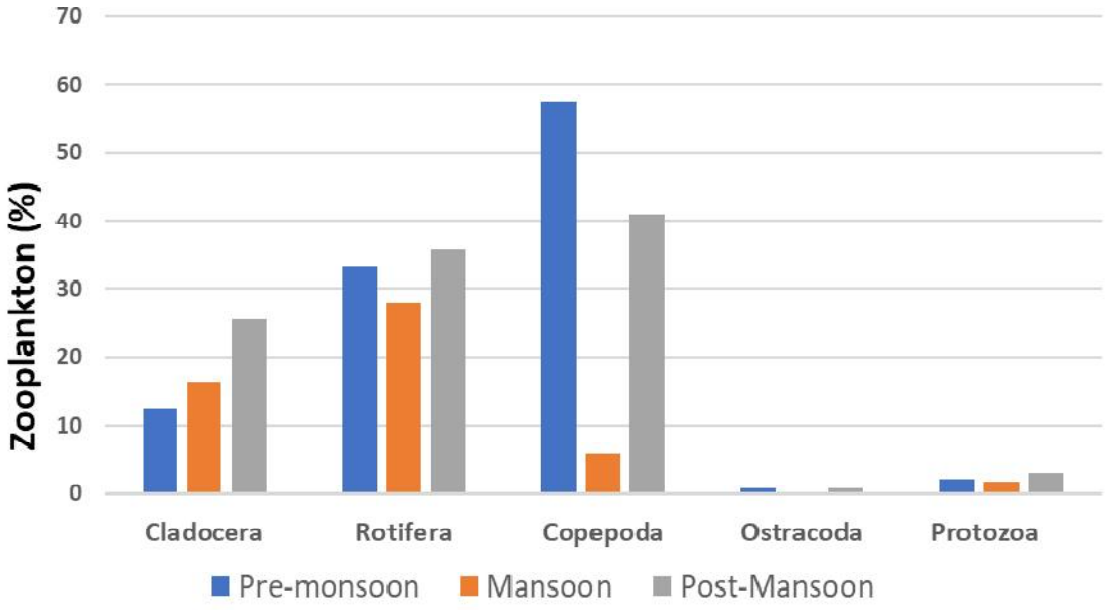

Fig. 2. Seasonal variation of zooplankton in Upper Lake, Bhopal

3.5 Protozoa

Protozoans are a very diverse group of unicellular eukaryotic organisms any of which are motile [29]. In the current analysis 5 species of protozoans were recorded (Table 1).

4. CONCLUSION

The current analysis showed the seasonal abundance of zooplankton in Upper lake, Bhopal. During the study phase, five groups of zooplankton were recorded for their abundance. The highest abundance of zooplankton was recorded during the summer season while the lowest abundance was recorded during the monsoon season, and it might be due to high temperature, longer photoperiod and intensity of light in summer, growth of phytoplankton and algae that can affect the abundance of zooplanktons in the upper lake.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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