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Study On Zooplankton Diversity Of Tighra Reservoir District, Gwalior, Madhya Pradesh

Tiwari Nidhi, *Mahor R.K

Research Scholar of Zoology, P.K. University, Shivpuri, M.P

*Associate Professor of Zoology, Govt. K.R.G. P.G. (Auto) College, Gwalior

ABSTRACT

The present investigation focuses on the diversity of Zooplankton in Tighra Reservoir, District Gwalior. The study was conducted across five sampling stations from January 2023 to December 2024. Zooplankton samples were collected from the surface waters using a plankton net made of nylon cloth with a 20 µm mesh size. These samples were preserved for laboratory analysis and identified using standard reference materials. A total of 29 zooplankton species were recorded, classified into five major groups: Protozoa (3 species), Rotifera (12 species), Copepoda (5 species), Ostracoda (4 species), and Cladocera (5 species). Among these, rotifers were found to be the most dominant group throughout the study period. The highest zooplankton population density was observed during the summer season, while the lowest was recorded in winter. Seasonal variations in zooplankton diversity appeared to be influenced by changing environmental conditions of the reservoir.

Keywords: Zooplankton, Tighra Reservoir.

INTRODUCTION

Plankton serve as a natural food source for many aquatic organisms. Almost all fish rely on it during their larval stages, with some species depending exclusively on zooplankton. As an integral component of freshwater ecosystems, plankton contributes significantly to biological productivity. Zooplankton, the heterotrophic segment of the plankton community, drift freely in aquatic environments. They play a crucial role by incorporating primary producers into their biomass, making them accessible to higher trophic levels (Michale, 1973).

Zooplankton are essential indicators of species distribution within reservoirs and occupy a central position in aquatic food chains (Donar & Reddy, 2012). Acting as a vital link between primary producers and higher trophic levels, they feed on phytoplankton and serve as the primary food source for larvae of carnivorous and omnivorous fish, as well as other aquatic organisms (Dutta et al., 2017). These microscopic, free-floating organisms are found in nearly all natural water bodies and are a key energy source between phytoplankton and larger aquatic fauna (Khandayat & Singh, 2019).

Due to their high population density, short life span, mobility, species diversity, and sensitivity to environmental stressors, zooplankton are widely used as bioindicators of physical, chemical, and biological processes in aquatic ecosystems (Gadekar, 2020). Their abundance and composition vary across sites even under seemingly similar ecological conditions (Boyd, 1982). Particularly, rotifer populations are strongly influenced by both abiotic and biotic environmental factors (Karuthapandi et al., 2013).

Understanding zooplankton diversity is essential for evaluating the ecological health and pollution levels of freshwater bodies, making their study increasingly important in the context of modern environmental management (Rao et al., 2017).

STUDY AREA

The Tighra Freshwater Reservoir is situated at 26°12′0″ N latitude and 78°30′0″ E longitude, approximately 20 km west of Gwalior city in Madhya Pradesh, near the Saga Magnet City, at an elevation of 218.58 meters above sea level. Constructed on the Sank River, the reservoir is encircled on three sides by hills, a feature that inspired its name. Formerly known as Madhav Jalashay, the reservoir was reconstructed in 1910 by the late Maharaja Madhava Rao Scindia.

The Sank River enters the reservoir through a gorge located at the southwestern end. Additionally, several small streams (nallahs) from the surrounding hill slopes contribute inflow to the reservoir. The northeastern boundary is marked by a concrete masonry wall.

Tighra Reservoir has an irregular shape, characterized by multiple shallow embayments along its periphery. It extends 5.8 km along the southwest–northeast axis and reaches a maximum width of 3.8 km. The reservoir has a maximum depth of 18 meters. Its gross storage capacity is 130.80 million cubic meters (4622 million cubic feet), with a live storage capacity of 124.23 million cubic meters (4390 million cubic feet). The dead storage capacity, below the lowest still level (L.S.L.), is 6.56 million cubic meters (232 million cubic feet).

Satellite image of Tighra reservoir

MATERIAL METHOD

Zooplankton samples were collected seasonally with a plankton net (Bolting silk mesh Size 25µ from January 2023 to December 2024 between 8:00 to 10:00 am. 100 liters of surface water were sieved through the plankton net and transferred to plastic containers and preserved by using 0.5 ml of formalin, examined under a microscope, and Systematic identification was done by taking the help of Edmondson (1992), Battish (1992), and Dhanapati (2000). Zooplankton were counted using Lackey's drop method (Adoni *et al.*, 1985). The total number of zooplankton present in a litre of water sample is calculated by using the following formula:

$$N = n*v/ V$$

Whereas,
N: Total no. of organisms/liter of water filtered.
N: Number of organisms counted in 1 ml of sample
V volume of concentrate plankton sample (ml)
V Volume of total water filtered through (L)

RESULT AND DISCUSSION

The zooplankton observed in this investigation are summarized in Table 1. Diverse taxonomic groups were documented in Tighra Reservoir, including representatives of Protozoa, Rotifera, Copepoda, Ostracoda, and Cladocera. A total of 30 species belonging to 13 families and 7 orders were recorded during the study period. This includes 3 species of protozoans from 3 families within a single order; 12 species of rotifers spanning 4 families and 2 orders; 5 copepod species from 2 families and 2 orders; 4 ostracod species belonging to 1 family and 1 order; and 5 cladoceran species representing 4 families and 2 orders.

A similar investigation by Mourya et al. (2024) reported 24 zooplankton species in Ramoua Dam, also highlighting Rotifera as the dominant group throughout the study in Gwalior district, Madhya Pradesh.

In the present study, Rotifera contributed the highest percentage of the zooplankton population at 39.98%, followed by Protozoa at 18.86%, Copepoda at 16.03%, Ostracoda at 14.84%, and Cladocera at 10.89%. For comparison, Sayasrao and Rambhau (2020) recorded a total of 15,058 zooplanktons in the Sukhana Dam, comprising 23.83% Rotifera, 28.52% Cladocera, 44.48% Copepoda, and 3.17% Ostracoda.

Among the recorded zooplankton in the current study, the order *Ploima* was most dominant (33%), followed by *Diplostraca* (20%), *Podocopida* (13%), *Arcellinida* and *Cyclopoida* (10% each), and both *Calanoida* and *Flosculariaceae* (7% each). At the family level, *Brachionidae* showed the highest representation with 6 species (20%), followed by *Cyprididae* with 4 species (13.33%). Families such as *Lecanidae*, *Cyclopidae*, and *Daphniidae* each contributed 3 species (10%), while *Trochosphaeridae* and *Diaptomidae* contributed 2 species each (6.66%). Other families—*Arcellidae*, *Centropyxidae*, *Difflugiidae*, *Synchaetidae*, and *Macrothricidae*—were represented by a single species each (3.33%)

Seasonal variations in zooplankton population density are presented in Tables 2 and 3. A total of 10,026 organisms were counted across all zooplankton groups during the study period. The summer season recorded the highest population density in both years of observation. Among the groups, *Rotifera* were the most abundant, with 2017 individuals in 2023 and 1584 in 2024.

Verma et al. (2013) also observed monthly fluctuations in zooplankton abundance in a freshwater body, Futera Anthropogenic Pond, Damoh District. Similarly, Manickam et al. (2014) reported seasonal changes in zooplankton diversity in a perennial reservoir at Thoppaiyar, Dharmapuri District, South India. These findings align with the current study, where species diversity index values of the major zooplankton groups showed monthly and seasonal variations.

The composition and abundance of zooplankton varied in response to limnological parameters, with a density peak during summer (April and May) and a decline in winter January. According to Prajapati (2017), zooplankton populations reached their highest peak in May and August, while the lowest peak counts were observed in January. This trend underscores the influence of seasonal environmental changes on zooplankton dynamics.

Table No. 1

S. No.	Group	Order	Family	species
1	Protozoa	Arcellinida	Arcellidae	Arcella discoides
2			Centropyxidae	Centropyxis ecornis
3			Difflugiidae	Difflugia lebes
4	Rotifera	Ploima	Brachionidae	Brachionus angularis
5				Brachionus budapestinensis
6				Brachionus calyciflorus
7				Brachionus caudatus
8				Brachionus diversicornis
9				Keratella tropica
10			Lecanidae	Lecane luna
11				Lecane (M) bulla
12				Lecane (L) papuana
13			Synchaetidae	Polyarthra vulgaris
14		Floscullariaceae	Trochosphaeridae	Filinia longiseta
15				Filinia opoliensis
16	Copepoda	Cyclopoida	Cyclopidae	Mesocyclops hyalinus
17				M. thermocyclops
18				Thermocyclops crassus
19		Calanoida	Diaptomidae	Diaptomus sp.
20				Cyclops spp.
21	Ostracoda	Podocopida	Cyprididae	Cypris sp.
22				Cypris dravidensis
23				Cprinotus gunning
24				Syprinotus spp.
25	Cladocera	Diplostraca	Daphniidae	Semocephalus expinosus
26				Simocephalus vetulus
27				Daphnia pulex
28			Moinidae	Moina brachiata
29				Moina micrura

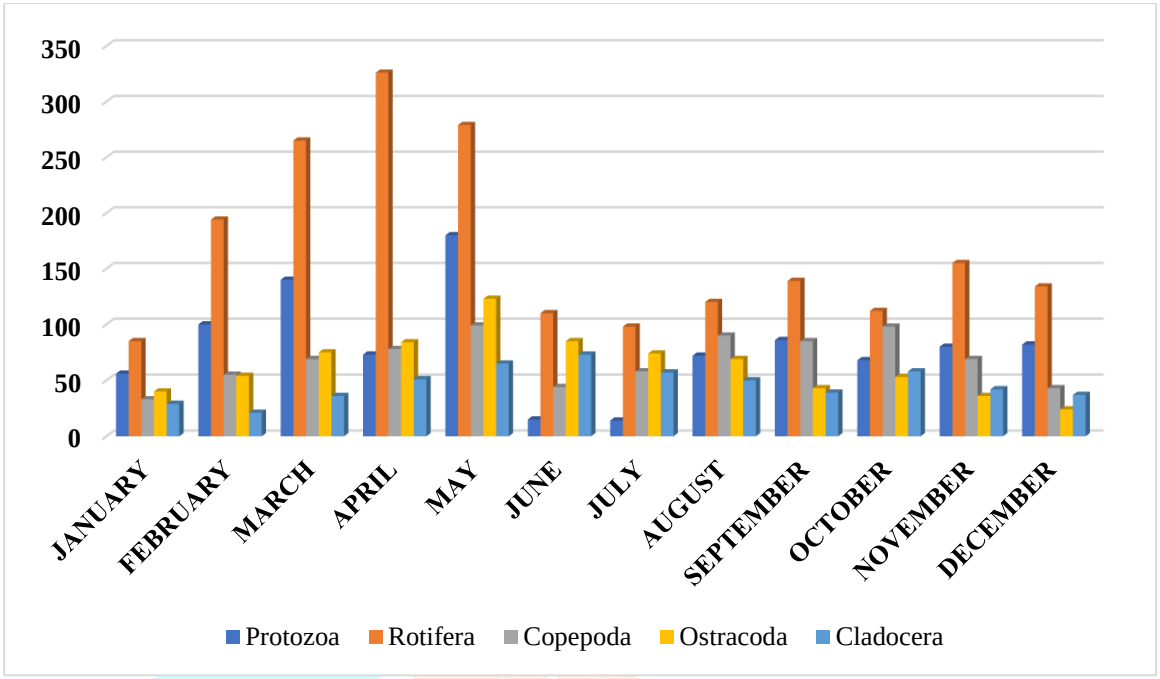
Table No. 2 Data of Various Groups of Zooplankton (unit /L) at Tighra Reservoir, Gwalior (January to December 2023)

Month	Protozoa		Rotifera		Copepoda		Ostracoda		Cladocera		Total
	n/l	%	n/l	%	n/l	%	n/l	%	n/l	%	n/l
January	74	29.36	91	36.11	43	17.06	29	11.5	15	5.95	252
February	110	30.72	104	29.05	63	17.59	57	15.92	24	6.7	358
March	121	24.49	186	37.65	78	15.78	76	15.38	33	6.68	494
April	143	25.13	215	37.78	69	12.12	93	16.34	49	8.61	569
May	160	25.07	213	33.38	95	14.89	98	15.36	72	11.28	638
June	163	25.42	154	24.02	56	8.73	84	13.10	63	9.82	641
July	124	30.84	79	19.65	68	16.91	77	19.15	54	13.43	402
August	85	23.67	92	25.62	74	20.61	65	18.1	43	11.97	359
September	92	24.79	118	31.8	76	20.48	53	14.28	32	8.62	371
October	74	20	127	34.32	65	17.56	56	15.13	48	12.97	370
November	59	20.27	109	37.45	59	20.27	43	14.77	21	7.21	291
December	65	23.21	96	34.28	54	19.28	39	13.92	26	9.28	280
TOTAL	1270	25.9	1584	32.3	800	16.31	770	15.7	480	9.79	4904

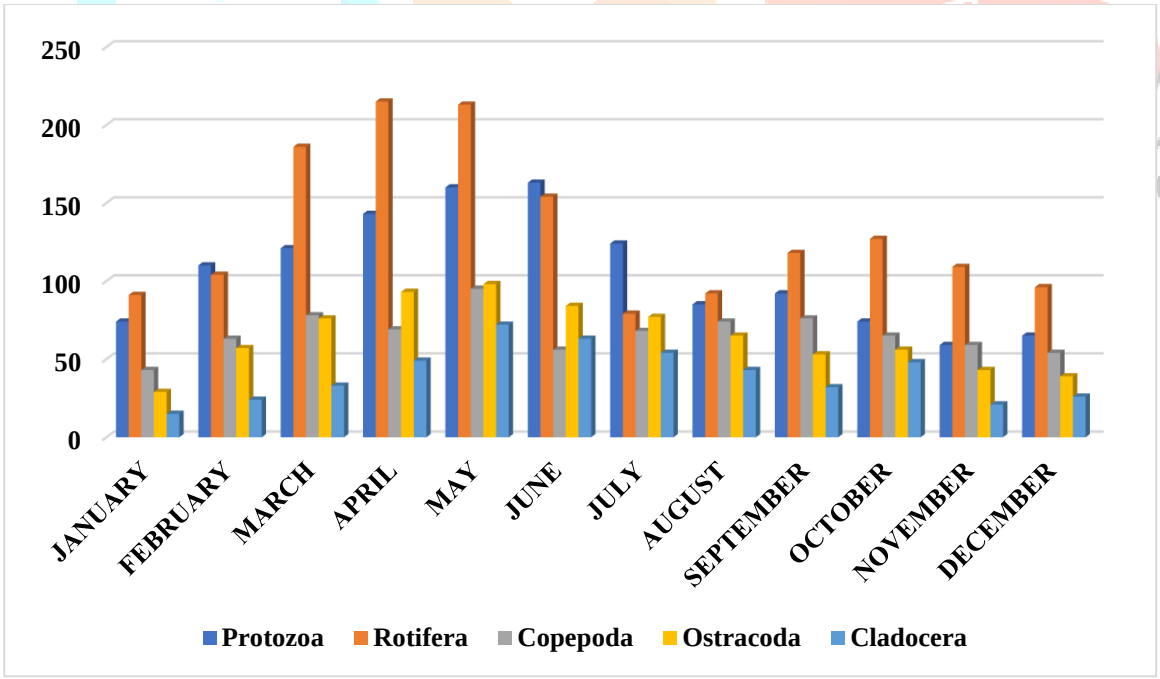
Table No. 3 Data of Various Groups of Zooplankton (unit /L) at Tighra Reservoir, Gwalior (January to December 2024)

Month	Protozoa		Rotifera		Copepoda		Ostracoda		Cladocera		Total
	n/l	%	n/l	%	n/l	%	n/l	%	n/l	%	n/l
January	56	23.04	85	34.97	33	13.58	40	16.46	29	11.93	243
February	100	23.58	194	45.75	55	12.97	54	12.73	21	4.95	424
March	140	23.93	265	45.29	69	11.79	75	12.82	36	6.15	585
April	73	11.92	326	53.26	78	12.74	84	13.72	51	8.33	612
May	180	24.12	279	37.39	99	13.27	123	16.48	65	8.71	746
June	15	4.58	110	33.63	44	13.45	85	25.99	73	22.32	327
July	14	4.65	98	32.55	58	19.26	74	24.58	57	18.93	301
August	72	17.95	120	29.92	90	22.44	69	17.20	50	12.46	401
September	86	21.93	139	35.45	85	21.68	43	10.96	39	9.94	392
October	68	17.48	112	28.79	98	25.19	53	13.62	58	14.91	389
November	80	20.94	155	40.57	69	18.06	36	9.42	42	10.99	382
December	82	25.62	134	41.87	43	13.43	24	7.5	37	11.56	320
TOTAL	966	18.86	2017	39.98	821	16.03	760	14.84	558	10.89	5122

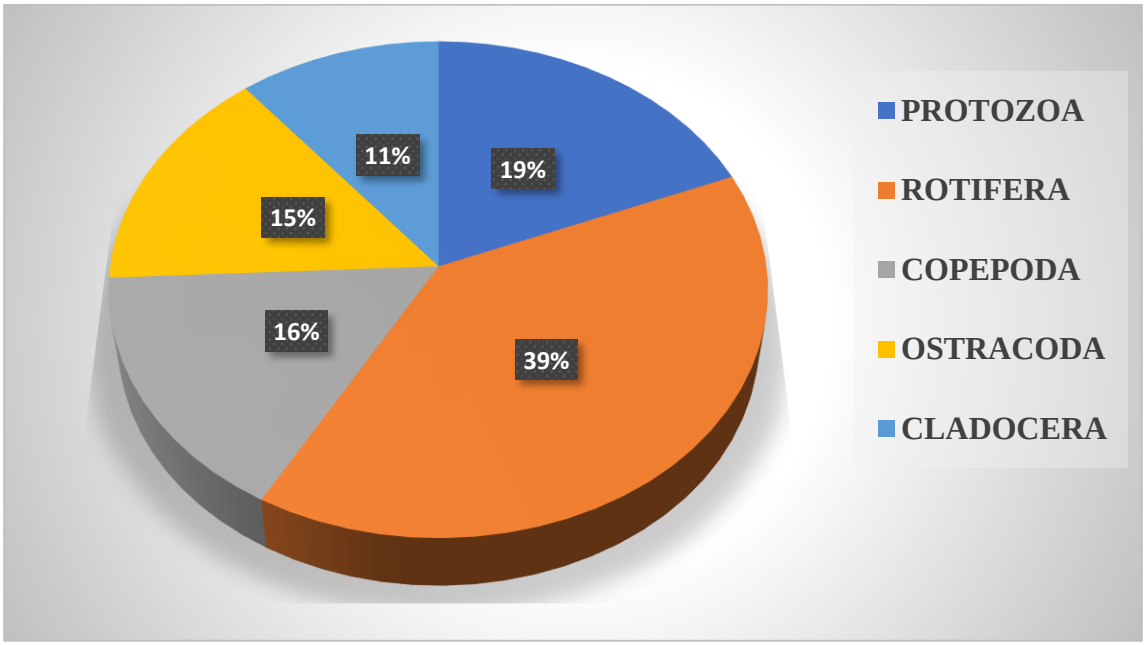
Monthly compositions of various groups of Zooplankton at Tighra Reservoir, Gwalior (January to December 2023)



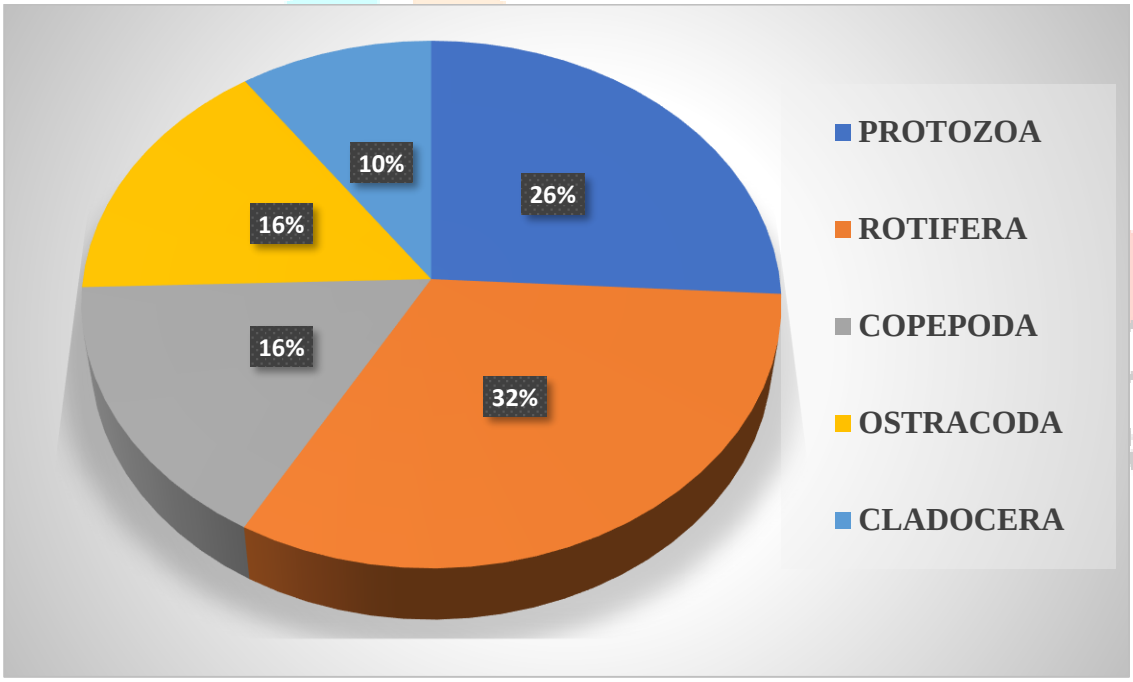
Monthly compositions of various groups of Zooplankton at Tighra Reservoir, Gwalior (January to December 2024)



Group-wise Zooplankton diversity January 2023 to December 2023



Group-wise Zooplankton diversity January 2024 to December 2024



CONCLUSION

Rotifers play a crucial role in freshwater ecosystems as an important group of zooplankton. Their community structure serves as a reliable bio-indicator for assessing water quality, and monitoring long-term changes in their populations is essential. The abundance of rotifers is closely linked to the trophic status of aquatic environments. Current data on the zooplankton composition and seasonal variation in the Tighra Reservoir provide valuable insight for future research on invertebrate diversity and conservation. This information also promotes awareness of water pollution and supports the sustainable management of aquatic ecosystems.

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