

VOLUME 11 ISSUE 1 2025

ISSN 2454 – 3055



**INTERNATIONAL
JOURNAL OF
ZOOLOGICAL
INVESTIGATIONS**

***Forum for Biological and
Environmental Sciences***

Published by Saran Publications, India



International Journal of Zoological Investigations

Contents available at Journals Home Page: www.ijzi.net

Editor-in-Chief: Prof. Ajai Kumar Srivastav

Published by: Saran Publications, Gorakhpur, India



ISSN: 2454-3055

Zooplankton Abundance and Diversity of Nizamsagar Reservoir, Kamareddy District, Telangana State, India

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Received: 22nd February, 2024; **Accepted:** 7th August, 2024; **Published online:** 28th January, 2025

<https://doi.org/10.33745/ijzi.2025.v11i01.016>

Abstract: Zooplankton diversity of the Nizamsagar reservoir was studied during June 2021 to May 2022. Plankton samples were collected monthly by using plankton net (mesh size 50 μ m). Total number of zooplankton recorded were 5748 individuals per litter, of which Rotifers were 3518 (61%), Copepods were 848 (15%), Cladocerans were 1311(23%) and Ostracods were 71(1%). The taxa found in the lake were Rotifera 14 species, Copepoda 5 species, Cladocera 6 species and Ostracoda 3 species. High number of zooplankton was recorded in summer season and low number in rainy season. Fluctuations in diversity indices observed in each group's abundance may be influenced by seasonal changes, environmental factors, and intergroup interactions.

Keywords: Diversity indices, Nizamsagar Reservoir, Zooplankton, Seasonal variation

Citation: Srinivas Reddy G. and Venugopala Swamy T.: Zooplankton abundance and diversity of Nizamsagar reservoir, Kamareddy District, Telangana State, India. Intern. J. Zool. Invest. 11(1): 155-161, 2025.

<https://doi.org/10.33745/ijzi.2025.v11i01.016>



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Introduction

Zooplankton are tiny, drifting organisms that make up a significant portion of the planktonic community in fresh and marine water environments. Zooplankton are diverse in their shapes, sizes, and ecology. They can range in size from less than a millimeter to several centimeters and are found in all aquatic ecosystems from shallow freshwater ponds to the deep ocean. They can be broadly classified into two groups: holoplankton, which spends their entire lives as

plankton, and meroplankton, which spend only a portion of their life cycle as planktonic organisms.

Zooplankton are an important link in the marine and freshwater food chain, serving as a critical food source for many larger organisms. They also play an important role in nutrient cycling, as they consume phytoplankton and other organic matter, and are in turn consumed by larger organisms. Additionally, changes in the abundance, diversity, and community structure of

zooplankton can be used as indicators of environmental change and can help scientists monitor the health of aquatic ecosystems.

Several researchers have reported the diversity of zooplankton from various parts of the world. Toruan (2021) examined the zooplankton diversity at Lake Tondano, Celebas islands-Indonesia, aiming to understand how local environmental factors and habitat heterogeneity influence the zooplankton community. Melina *et al.* (2022) studied the zooplankton abundance in lake Ghodaghodi, Nepal, observing a total of 58 individuals of zooplankton and 85 individuals of phytoplankton during their study period.

Zooplankton diversity in freshwater bodies in India has been studied in various locations by various researchers. In Valankulam Lake, Coimbatore, a total of 34 species of zooplankton were recorded, including Rotifera, Cladocera, Copepoda, and Ostracoda (Mohan *et al.*, 2022). Perumal Lake in Cuddalore District had 15 species of zooplankton, and the diversity was influenced by hydrographical factors such as temperature, turbidity, and dissolved oxygen (Aravinth *et al.*, 2023). A comparative study of two ponds in Patna, Bihar, showed that the unmanaged pond had higher diversity and richness of zooplankton compared to the disturbed pond (Rani, 2023). In five freshwater ponds in Cuddalore district, Rotifers were the dominant species of zooplankton, followed by Cladocera (Barskar K and Jawalkar, 2022). Bisnoor Pachdhar reservoir had a sequence of dominant groups including Rotifera, Copepoda, Protozoa, Cladocera, and Ostracoda (Talati *et al.*, 2023). Reddy *et al.* (2015) studied the physico-chemical parameters and ichthyofaunal diversity of Nizamsagar reservoir. They reported that the reservoir water was within the permissible limits of APHA, WHO and the reservoir water is suitable for fishing and irrigation. These studies highlight the importance of monitoring zooplankton diversity in freshwater ecosystems to assess the health of the lakes and understand the impact of environmental factors on plankton communities. The present study

aimed to assess the zooplankton community, including their diversity and seasonal variation during June 2021 to May 2022 in Nizamsagar Reservoir, Kamareddy District, Telangana State, India.

Materials and Methods

Nizamsagar Reservoir, situated in the Indian state of Telangana, is the oldest man-made reservoir. It is located at 18°19' (N) latitude and 76°56' (E) longitude, built over the Manjira River, a tributary of the Godavari River, within the newly formed Kamareddy district of Telangana state. The reservoir's construction commenced in 1923 and was completed in 1931 during the rule of Hyderabad's last Nizam, Mir Osman Ali Khan. The Nizamsagar Reservoir serves as a source of water for irrigation and drinking purposes in this region.

Zooplankton sample collection is important to understand their distribution, abundance, and diversity, which can provide valuable information for ecological research and monitoring. Zooplankton samples were collected randomly in different locations of the reservoir between 7-9 am for a period of one year from June 2021 to May 2022 and such samples were pooled together to consider a final sample for analysis. Zooplankton samples collections were made by using a modified Haron- Trantor net (mesh size 50 µm).

The quantitative analysis was done by the Sedgwick-Rafter counting cell and the results were expressed in individuals per liter. The identification of Zooplankton was done with the help of standard texts and literature (Michael and Sharma 1988; Batish, 1992; Dhanapathi, 2000; Sharma and Sharma 2008). The diverse indices of Shannon, Simpson, Margalef diversity indices, Evenness and Richness were calculated by using biodiversity calculators.

Results and Discussion

During the study period, a total of 24 different species (Table 1) of zooplankton were identified. Out of them 14 species belong to Rotifera group, 6 species belong to Cladocera group, 5 species

Table 1: Monthly population dynamics of zooplankton at Nizamsagar Reservoir

Months		Jun_21	Jul_21	Aug_21	Sep_21	Oct_21	Nov_21	Dec_21	Jan_22	Feb_22	Mar_22	Apr_22	May_22	Grand Total
Season		South West Monsoon				North East Monsoon				Summer				
	ROTIFERA													
1	<i>Brachionous calyciflorus</i>	25	36	62	76	98	116	138	196	144	102	74	48	1115
2	<i>B. Plicatilis</i>	0	0	2	0	4	4	0	6	0	6	10	6	38
3	<i>B. caudatus</i>	10	14	10	10	24	22	32	28	18	10	8	8	194
4	<i>B.Urceolaris</i>	2	0	6	6	8	12	14	18	14	10	8	2	100
5	<i>B. Diversicornis</i>	0	2	0	2	0	4	4	3	1	0	0	1	17
6	<i>B. Quadridentatus</i>	1	0	2	1	0	4	0	6	6	2	4	2	28
7	<i>B. falcatus</i>	32	28	24	22	46	52	50	52	40	22	23	12	403
8	<i>B. Rubens</i>	2	2	1	0	4	4	2	1	1	0	1	1	19
9	<i>B. Rotundiformis</i>	2	1	4	2	10	10	8	12	6	4	4	2	65
10	<i>K. tropica</i>	28	40	40	36	56	52	60	64	42	26	20	24	488
11	<i>K. cochlearis</i>	10	8	22	26	30	32	40	48	42	36	28	30	352
12	<i>Asplancha brightwelli</i>	2	2	4	4	8	8	10	4	2	0	1	1	46
13	<i>Filinia longiseta</i>	2	4	4	10	8	10	16	16	10	4	2	2	88
14	<i>Cephalodella gibba</i>	35	36	38	36	62	58	70	74	58	42	34	22	565
	Total	151	173	219	231	358	388	444	528	384	264	217	161	3518
	COPEPODA													
1	<i>Mesocyclops leukarti</i>	26	32	24	30	42	56	62	68	50	42	36	34	502
2	<i>M. Hyalinus</i>	10	6	4	2	10	14	10	4	4	6	10	10	90
3	<i>Parcyclos fimbriatus</i>	4	6	2	10	14	12	10	16	4	6	8	6	98
4	<i>Heliodiaptomus pulcher</i>	2	4	0	4	4	4	6	8	2	0	0	2	36
5	<i>Tropocyclops prasinus prasinus</i>	4	8	8	12	14	16	22	20	4	6	6	2	122
	Total	46	56	38	58	84	102	110	116	64	60	60	54	848
	CLADOCERA													
1	<i>Alona rectangula</i>	1	0	0	0	1	0	0	0	2	1	4	2	11
2	<i>Diapstosoma sarsi</i>	22	4	6	10	22	43	38	52	64	68	66	58	453
3	<i>Ceriodaphnia coronata</i>	42	1	1	2	32	36	45	55	89	93	96	110	602
4	<i>Moina macrocopa</i>	4	4	2	0	2	8	6	10	12	14	15	20	97
5	<i>Moina branchiata</i>	2	6	8	6	4	2	2	2	8	10	12	12	74
6	<i>Bosmina longirastries</i>	6	4	0	2	2	8	6	6	8	10	12	10	74

	Total	77	19	17	20	63	97	97	125	183	196	205	212	1311
	OSTRACODA													
1	<i>Stenocypris simulans</i>	2	2	4	2	2	4	6	1	4	4	6	2	39
2	<i>Heterocypris salina</i>	4	2	2	0	2	2	2	2	2	4	4	2	28
3	<i>Lyprinotus cingalensis</i>	1	0	0	0	0	0	1	0	1	0	0	1	4
	Total	7	4	6	2	4	6	9	3	7	8	10	5	71
	Grand Total	281	252	280	311	509	593	660	772	638	528	492	432	5748

Table 2: Population dynamics of zooplankton at Nizamsagar Reservoir during the year 2021-22

	Jun_21	Jul_21	Aug_21	Sep_21	Oct_21	Nov_21	Dec_21	Jan_22	Feb_22	Mar_22	Apr_22	May_22	Total
Rotifera	151	173	219	231	358	388	444	528	384	264	217	161	3518
Copepoda	46	56	38	58	84	102	110	116	64	60	60	54	848
Cladocera	77	19	17	20	63	97	97	125	183	196	205	212	1311
Ostracoda	7	4	6	2	4	6	9	3	7	8	10	5	71
Total	281	252	280	311	509	593	660	772	638	528	492	432	5748

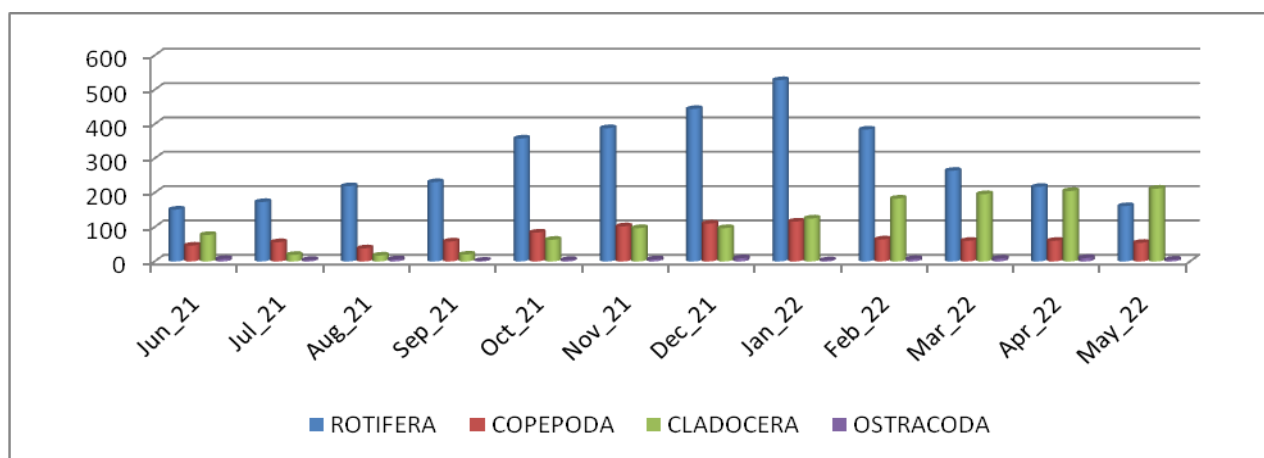


Fig. 1: Population dynamics of zooplankton at Nizamsagar Reservoir during the year 2021-22.

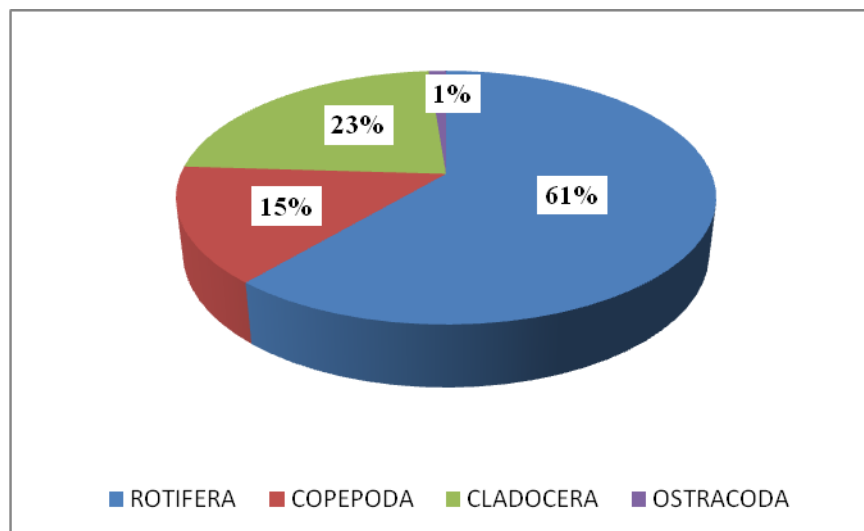


Fig. 2: Percentage of various zooplankton at Nizamsagar Reservoir during the year 2021-22.

belong to Copepoda group and 3 species belong to Ostracoda group. Rotifera group is dominant with 61 % of the total species, followed by Cladocera (23%), Copepoda (15%), and Ostracoda (1%). Highest zooplankton density found in winter (772 I/L) and lowest in Southwest monsoon period (252 I/L). Similar observations were made by Sadhasivan *et al.* (2019); Singh *et al.* (2021); Dutta (2021) and Reddy *et al.* (2023).

In the present study Rotifera exhibit a varying abundance throughout the monitoring period. The highest abundance is observed in January 2022 (528), while the lowest is in June 2021 (151). The Shannon (H) diversity indices values of Rotifera group are ranged from 1.860 - 2.120. The highest diversity is observed in November 2021 (2.12), while the lowest is in March 2022 (1.86). The Simpson diversity index fluctuates between 0.157 and 0.209. The highest dominance is noted in March 2022 (0.209), while the lowest is in October 2021 (0.157). Simpson's index suggests variations in species dominance, with higher values indicating lower diversity. The Margalef diversity index varies from 1.793 to 2.23. Maximum diversity is observed in May 2022 (2.23) and minimum in March 2022 (1.793). Evenness ranges from 0.748 to 0.827. October 2021 exhibits the highest evenness (0.827), while February 2022 has the lowest (0.748). Evenness indicates the

equitability of species abundance, with higher values suggesting a more balanced community structure.

Copepoda also displays fluctuating abundance over the months. The highest abundance is noted in January 2022 (116), while the lowest is in August 2021 (38). The Shannon diversity index for Copepoda ranges from 0.82 to 1.34. The highest diversity is observed in October 2021 (1.34), while the lowest is in February 2022 (0.82). Fluctuations in Shannon index indicate changes in the composition and abundance of Copepoda species over time. Simpson's diversity index varies from 0.03 to 0.607. The highest dominance is noted in February 2022 (0.607), while the lowest is in March 2022 (0.03). Simpson's index suggests variations in the dominance of Copepoda species, with lower values indicating higher diversity. The Margalef diversity index fluctuates from 0.732 to 1.044. Maximum diversity is observed in June 2021 (1.044) and minimum in March and April 2022 (0.732). Evenness ranges from 0.51 to 0.833. The highest evenness is observed in October 2021 (0.833), while the lowest is in February 2022 (0.51).

Cladocera shows variations in abundance, with peaks in May 2022 (212). The lowest abundance is observed in August 2021 (17). The Shannon diversity index for Cladocera ranges from 1.14 to

Table 3: Zooplankton Diversity indices of Nizamsagar Reservoir during the year 2021-22

	Jun_ 21	Jul_ 21	Aug_ 21	Sep_ 21	Oct_ 21	Nov_ 21	Dec_ 21	Jan_ 22	Feb_ 22	Mar_ 22	Apr_ 22	May_ 22
Rotifera												
Shannon (H)	1.96	1.9	2.01	1.99	2.06	2.12	2.03	1.99	1.92	1.86	2	2.01
Simpson (D)	0.163	0.17	0.665	0.176	0.157	0.158	0.166	0.194	0.2	0.209	0.178	0.168
Margalef (D mg)	2.192	1.94	2.226	2.201	1.87	2.18	1.804	2.073	2.016	1.793	2.23	2.23
Evenness (E)	0.787	0.794	0.785	0.775	0.827	0.802	0.817	0.753	0.748	0.777	0.781	0.781
Richness (R)	12	11	13	13	12	14	12	14	13	11	13	13
Copepoda												
Shannon (H)	1.22	1.26	1.01	1.27	1.34	1.27	1.24	1.19	0.82	0.94	1.1	1.09
Simpson (D)	0.362	0.357	0.431	0.328	0.31	0.35	0.368	0.389	0.607	0.03	0.399	0.427
Margalef (D mg)	1.044	0.997	0.824	0.985	0.902	0.864	0.851	0.841	0.961	0.732	0.732	1.002
Evenness (E)	0.755	0.785	0.728	0.789	0.833	0.789	0.77	0.739	0.51	0.678	0.796	0.678
Richness (R)	5	5	4	5	5	5	5	5	5	4	4	5
Cladocera												
Shannon (H)	1.19	1.5	1.14	1.17	1.17	1.22	1.15	1.14	1.22	1.24	1.32	1.27
Simpson (D)	0.375	0.183	0.305	0.31	0.37	0.338	0.366	0.367	0.361	0.35	0.33	0.353
Margalef (D mg)	1.151	1.358	1.058	1.001	1.206	0.874	0.874	0.828	0.959	0.947	0.939	0.933
Evenness (E)	0.665	0.933	0.822	0.842	0.653	0.758	0.713	0.708	0.68	0.692	0.737	0.707
Richness (R)	6	5	4	4	6	5	5	5	6	6	6	6
Ostracoda												
Shannon (H)	0.96	0.69	0.64	0	0.69	0.64	0.56	0.64	0.96	0.69	0.67	1.05
Simpson (D)	0.291	0.266	0.4	0.667	0.266	0.4	0.507	0.25	0.291	0.381	0.381	0.166
Margalef (D mg)	1.027	0.721	0.558	0	0.721	0.558	0.48	0.912	1.027	0.48	0.48	1.24
Evenness (E)	0.869	1	0.918	0	1	0.918	0.811	0.918	0.869	1	0.971	0.96
Richness (R)	3	2	2	1	2	2	2	2	3	2	2	3

1.5. The highest diversity is observed in July 2021 (1.5), while the lowest is in August 2021 and January 2022 (1.14). Simpson's diversity index varies from 0.183 to 0.375. The highest dominance is noted in June 2021 (0.375), while the lowest is in July 2021 (0.183). The Margalef diversity index fluctuates from 0.828 to 1.358. Maximum diversity is observed in July 2021 (1.358), and minimum in January 2022 (0.828). Evenness ranges from 0.653 to 0.933. The highest evenness is observed in July 2021 (0.933), while the lowest is in October 2021 (0.653).

Ostracoda exhibit a relatively low abundance

compared to other groups. The highest abundance is observed in April 2022 (10), while the lowest is in September 2021 (2). The Shannon diversity index for Ostracoda ranges from 0 to 1.05. The highest diversity is observed in May 2022 (1.05), while December 2021 exhibit lower diversity (0.56). Simpson's diversity index varies from 0.166 to 0.667. The highest dominance is noted in May 2022 (0.166), while the lowest is in September 2021 (0.667). The Margalef diversity index fluctuates from 0 to 1.24. Maximum diversity is observed in May 2022 (1.24), while some months, like September 2021, exhibit zero values, indicating potential absence or very low

abundance of Ostracoda during those periods. Evenness ranges from 0.811 to 1. The highest evenness is observed in July, October 2021 and March 2022 (1), while lower evenness is noted in December 2021 (0.811).

Conclusion

The data provides valuable insights into the temporal dynamics of zooplankton abundance in Nizamsagar Reservoir, Kamareddy district, Telangana, India. The fluctuations observed in each group's abundance may be influenced by seasonal changes, environmental factors, and intergroup interactions. Continuous monitoring and further investigations are crucial to understanding the factors driving these variations and their implications for the reservoir's ecosystem. The presented information serves as a baseline for future studies on zooplankton population dynamics in Nizamsagar Reservoir.

Acknowledgements

The authors would like to express their gratitude to the Principal, Girraj Government College (A), Nizamabad, Telangana and Government Degree College, Armur, Telangana for extending their support.

Conflict of Interest

The authors declare no conflicts of interest.

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