Uttar Pradesh Journal of Zoology

Volume 45, Issue 18, Page 470-479, 2024; Article no.UPJOZ.4058
ISSN: 0256-971X (P)

Comparative Zooplankton Diversity in Two Freshwater Lakes of Belagavi City, Karnataka, India

Prateek Angadi [a*], Prajyoti C. Kalakundrikar [a], Pragati Pramod Joshi [a], Swapna Katageri [a] and Pooja D. Mathad [a]

[a] Department of studies in Zoology, Rani Channamma University, Belagavi, Karnataka, - 591156, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/upjoz/2024/v45i184464

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/4058

Original Research Article

Received: 08/07/2024
Accepted: 10/09/2024
Published: 14/09/2024

ABSTRACT

Zooplankton are used as bioindicators to assess the pollution status of lakes but diversity studies related to different trophic levels of lakes are few. Therefore, the present study was undertaken to assess the comparative zooplankton diversity of a eutrophic Kanbargi lake and an oligotrophic Khadarwadi lake in Belagavi city. During the study period, a total of 23 species of zooplankton were identified. In Kanbargi lake, Rotifera showed maximum diversity and abundance, followed by Copepoda, Ostracoda and Cladocera while in Khadarwadi lake, Rotifera were most abundant followed by Cladocera, Copepoda and Ostracoda. Rich diversity and abundance of Rotifera were observed in Kanbargi lake compared to Khadarwadi lake, while Cladocera abundance was higher in

**Corresponding author: Email: pratikangadi@gmail.com;*

Cite as: *Angadi, Prateek, Prajyoti C. Kalakundrikar, Pragati Pramod Joshi, Swapna Katageri, and Pooja D. Mathad. 2024. "Comparative Zooplankton Diversity in Two Freshwater Lakes of Belagavi City, Karnataka, India". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (18):470-79. https://doi.org/10.56557/upjoz/2024/v45i184464.*

Khadarwadi lake. Least abundance was shown by Ostracoda in both lakes. Seasonal variation was also observed between the two lakes, with Rotifera dominating the summer season, while Copepoda and Cladocera abundance increased during the monsoon season. Hierarchical Cluster Analysis (HCA) reveals different clusters occupied by zooplankton in both lakes. These results suggest that there exists a difference in zooplankton diversity and community structure between the two lakes. The current study highlights the potential implications for broader aquatic ecosystem and importance of monitoring the freshwater bodies to maintain ecological balance.

Keywords: Zooplankton; lake diversity; Rotifera; seasonal variation; eutrophication.

1. INTRODUCTION

Zooplankton are cosmopolitan organisms inhabiting all aquatic habitats in the world. They are essential bioindicators in aquatic ecosystem as they occupy an intermediate position in the food chain and significantly contribute to secondary production in freshwater, estuarine, and marine ecosystems [1]. By occupying a vital position in the food web, they transfer energy from lower trophic levels to higher tropic levels, such as the larval stages of fish, which helps in sustaining life at higher trophic levels. The rich diversity and abundance of zooplankton in lakes or aquatic ecosystems can be used to determine the health and trophic status of waterbodies [2,3]. A 10 years long study in reservoirs at Ebro river in Spain revealed that eutrophic and low water quality correspond to higher Rotifera species belonging to Brachionus and Keratella genera, suggesting that zooplankton species are valuable tools to determine the water quality status [4].

Zooplankton are composed of four major groups: Rotifera, Cladocera, Copepoda and Ostracoda, each being sensitive to different environmental variations and responding quickly due to their short life cycle [3]. Fluctuations in environmental physical conditions can alter zooplankton abundance, species diversity and community structure [1]. Freshwater bodies experience degradation due to domestic discharge, industrial, and agricultural fertilizer wastes such as nitrogen and phosphates, which leach into nearby aquatic bodies [5]. These anthropogenic pollutants can also affect zooplankton diversity and composition in ponds or lakes, thereby reducing productivity. Several studies have been conducted to understand role of environmental variation and zooplankton composition in lakes. In Dal–Nigeen lake, Srinagar, Rotifera were dominant group followed by Copepoda and Cladocerans in summer and autumn, indicating a moderate level of zooplankton diversity in the lake due to impact of organic pollution [6]. Studies on lakes in Telangana have reported rich diversity of Rotifera, Copepoda, Cladocera and Ostracoda with highest diversity observed during summer [7, 8]. In Kukkarhalli lake of Mysore district, the absence of free CO_2, due to lake harbouring abundant algal blooms, indicates higher eutrophication, which affect the abundance and diversity of zooplankton [9]. Rotifera are known to inhabit polluted and eutrophic lakes and are highly tolerant to fluctuation of limnological parameters [10].

Comparative studies between different trophic lakes help us understand the role of different zooplankton species, and their presence or absence helps to identify the trophic status. A comparative zooplankton study in lakes of Mysore demonstrated that Kalale lake is less polluted than Alanahalli and Dalvoy lakes due to the lesser abundance of Rotifers [3]. In Belagavi District, several studies on zooplankton have been reported. In Fort lake of Belagavi city, Rotifera accounted for the highest abundance followed by Copepoda, Cladocera, and Ostracoda due to high levels of phosphates [11]. Similarly, Rotifera were highly abundant in Sogal pond due to anthropogenic activities [12]. Seasonal variation studies conducted in irrigation tanks of Belagavi District reported higher abundance of zooplankton in summer and the lowest in post-monsoon season, with the presence of eutrophic rotifer species suggesting eutrophication of water tanks [13, 14]. Water physio-chemical studies have reported majority of the lakes in Belagavi city are eutrophic, with only a few classified as oligotrophic [15, 16]. Anthropogenic activities and urbanization can accelerate eutrophication of numerous lakes. Comparative studies between lakes of different trophic level can help identify trophic specific zooplankton as these lakes could have different diversity of zooplankton. Therefore, the present study aimed to understand the zooplankton diversity and composition in eutrophic and oligotrophic lakes in Belagavi city.

2. MATERIALS AND METHODS

2.1 Study Area

Belagavi city is located at 15.87°N latitude and 74.50°E longitude with an elevation of 747.47 m above sea level. The average rainfall is over 1500 mm [15]. Based on earlier reports on water quality assessment in Belagavi city, two lakes were chosen: one representing the North Belagavi city – Kanbargi lake, and the other from South Belagavi city- Khadarwadi lake [15, 16]. The above-cited reports have described Kanbargi lake as eutrophic, while Khadarwadi lake is oligotrophic. Kanbargi lake is situated at 15°53'28"N 74°33'13"E and Khaderwadi lake is situated at 15°48'29"N 74°28'19"E (Fig. 1).

2.2 Sample Collection and Identification

Zooplankton sampling was conducted twice a month in both lakes during the early morning hours from March to July, for a period of 5 months. Zooplankton were collected using a plankton net with a mesh size of 100 microns and concentrated for 200ml. The collected zooplankton samples were preserved using 4% formalin. Observation and counting were done using a compound microscope. For species identification, standard keys were followed [17, 18, 19, 20] and were identified to the lowest possible taxon.

2.3 Data Analysis

Standard Diversity Indices, such as Abundance, Shannon, Simpson indices were used. The graphs and tables were created using Microsoft Excel 2016. Two-way Hierarchical Cluster Analysis (HCA) with Bray-Curtis Similarity Index, was performed using PAST 4.17 (Palaeontological Statistics) to establish the relationship between two lakes during different seasons.

3. RESULTS AND DISCUSSION

In aquatic ecosystems, zooplankton play a crucial role as intermediate food sources to higher trophic animals and act as bioindicators for accessing the health of water bodies such as lakes. In the present study, a total of 23 species of zooplankton were identified of which 19 species were present in Kanbargi lake and 16 species were present in Khadarwadi lake. A total of 13 Rotifera species, 1 Cladocera species, 2 Copepoda species and 2 Ostracoda species were observed in Kanbargi lake. In Khadarwadi lake, 7 species of Rotifera, 2 species of Cladocera, 3 species of Copepoda and 2 species of Ostracoda were observed (Table 1). The order of zooplankton groups relative abundance is Rotifera > Copepoda > Ostracoda > Cladocera for Kanbargi lake and Rotifera > Cladocera > Copepoda > Ostracoda for Khadarwadi lake (Fig. 2). Throughout the study period, Rotifera showed the highest abundance, and dominance in both lakes but Kanbargi lake showed higher abundance than Khadarwadi lake (Table 2). Species such as *Brachionus calyciflorus, Brachionus ureolaris, Keratella cochlearis, Lecane bulla, Asplanchna brightwelli*, and *Filinia longiseta* were observed frequently in Kanbargi lake throughout the study period suggesting the lake is eutrophic. Such Rotifera species are known to inhabit eutrophic and polluted water bodies due algal bloom, organic waste and other domestic waste [1, 13, 14, 21]. *Brachionus calyciflorus* and *Filinia longiseta* have been reported to thrive in polluted water and are considered indicators of eutrophication [1].

Fig. 1. Satellite map of Kanbargi lake and Khadarwadi lake, Belagavi city, India

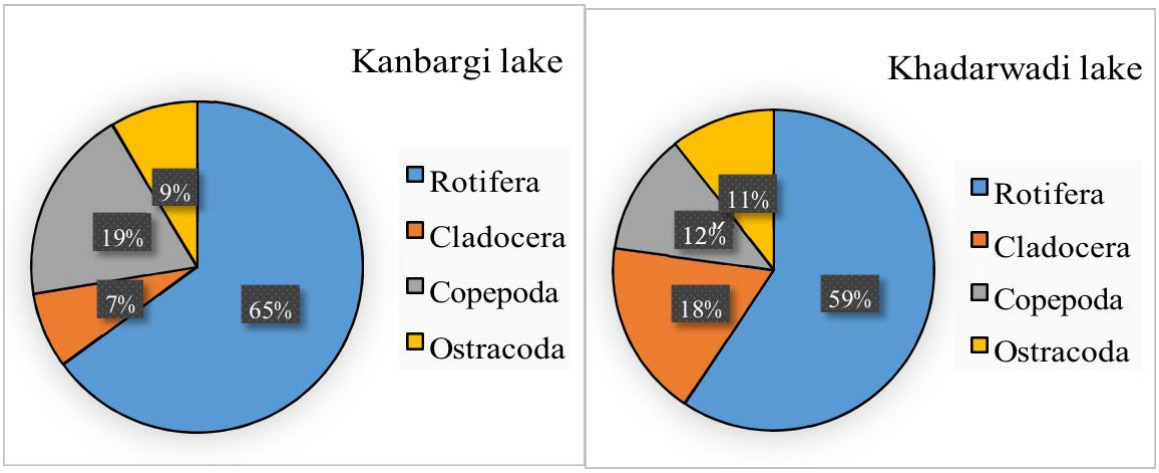

Fig. 2. Abundance of zooplankton groups in Kanbargi and Khadarwadi lake during the study period

Though Rotifera displayed the highest relative abundance in Khadarwadi lake, the diversity was lower compared to Kanbargi lake and eutrophic inhabiting species were absent during our study period (Table 1). In contrast, the Cladoceran relative abundance is found to be 18% in Khadarwadi which is higher than that of Kanbargi lake. Cladocerans prefer cleaner waters for growth as they are highly sensitive to pollutant and eutrophication [22, 23]. Species like *Ceriodaphnia cornuta* are reported to be present only in oligotrophic lakes [24]. Considering lower diversity of rotifers and higher abundance of Cladocera, it can be said that Khadarwadi lake is cleaner and less polluted than Kanbargi lake. Among Cladocera, only *Moinodaphnia macleayi* is found in Kanbargi lake and this species has been recorded in eutrophic lakes [1].

In Copepoda, *Mesocyclops leuckarti* and *Thermocyclops hyalinus* were observed in Kanbargi lake. The absence of calanoid copepoda suggest the lake could be eutrophic. Copepoda occupy 19% of the relative abundance, second to Rotifera, in Kanbargi lake, suggest that abundance of phytoplankton such as diatoms and blue-green algae was high, as they are important food sources for cyclopoid Copepods developmental stages [1]. Copepoda are also known to prey on Rotifers and Cladocerans [25]. In the present study, the highest abundance of Copepoda and decreased abundance of Rotifera suggest they hunt and feed on Rotifera. In comparison to Kanbargi lake, lower abundance of Copepoda is seen in Khadarwadi lake with *Mesocyclops hyalinus*, *Mesocyclops leuckarti* and *Thermocyclops hyalinus* species observed. The lower abundance could be due to the lack of phytoplankton such as diatoms and blue-green algae required for their development. Ostracoda were represented by only two species, *Strandesia elongata* and *Eucypris bispinosa* and occupied the least relative abundance among all zooplankton groups. Lower Ostracoda diversity and abundance are correlated with increased pollution levels [3]. Similarly, lower diversity and abundance of Ostracoda have been reported in different lakes [3, 13, 26].

The Diversity indices values are shown in Table 2. For Kanbargi lake, the Simpson_1-D diversity index reveals that Rotifera have the highest diversity value of 0.802, followed by Copepoda (0.794), Ostracoda (0.790), and Cladocera (0.786). Similarly, the Shannon (H) values showed that Rotifera were more diverse (1.609), followed by Copepoda (1.60), Ostracoda (1.591), and Cladocera (1.574). However, for Khadarwadi lake the Simpson_1-D diversity index reveals that Rotifera have highest diversity value of 0.792 followed by Cladocera (0.788), Copepoda (0.783), and Ostracoda (0.767). Similarly, the Shannon (H) values showed that Rotifera were more diverse (1.595) followed by Cladocera (1.579), Copepoda (1.562) and Ostracoda (1.308).

Zooplankton are reported to show seasonal variation in their abundance due to changing temperature and rainfall. Seasonal variation in the composition of zooplankton groups in Kanbargi and Khadarwadi lakes is displayed in Fig. 3. During summer highest abundance is shown by Rotifera in both lakes. However,

Kanbargi lake had a higher individual count per litre of Rotifera compared to Khadarwadi lake. Such a rich population of Rotifers in the summer season could be due to the presence of a higher population of bacteria and decaying organic matter [27]. Rotifers are known to favour warmer temperatures and they increase their abundance in such favourable environmental conditions [28]. The two-way Hierarchical Cluster Analysis (HCA) with Bray-Curtis similarity index displayed in Fig. 4 for the summer season reveals that Rotifera show dissimilarity between both lakes. Cladocera show slight dissimilarity but both Ostracoda and Copepoda display similarity between the two lakes. HCA also reveal that Rotifera occupy separate cluster whereas Cladocera and Ostracoda occupy the same cluster and Copepoda occupy the last cluster. Higher temperatures favours Rotifera reproduction and they flourish during summer in both lakes, therefore, they occupy a separate hierarchical cluster. The dissimilarity observed between the lakes for rotifers could be due to differences in their abundance and the eutrophic and oligotrophic nature of Kanbargi and Khadarwadi lakes respectively [16, 17]. From the above results, it can be said that Rotifera have established a dominance over the remaining three groups during the summer season.

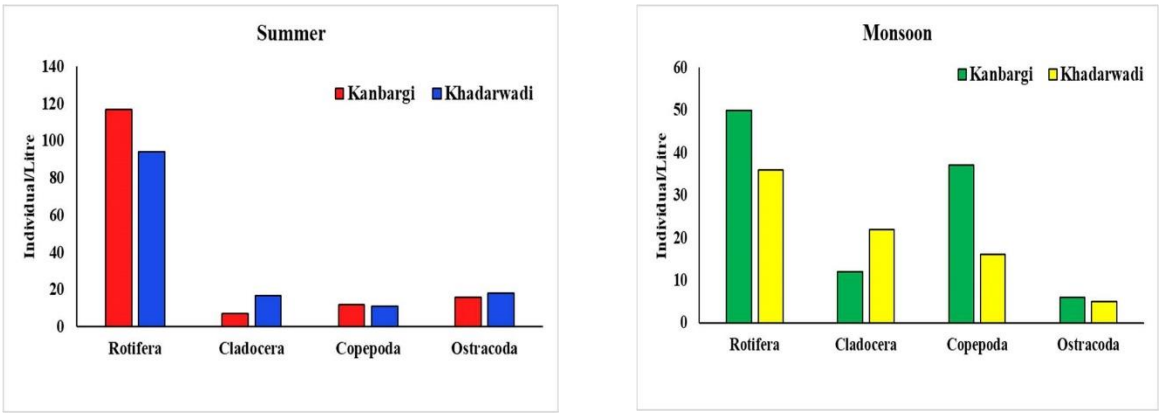

Fig. 3. Seasonal variation of Zooplankton groups abundance in Kanbargi and Khadarwadi lake

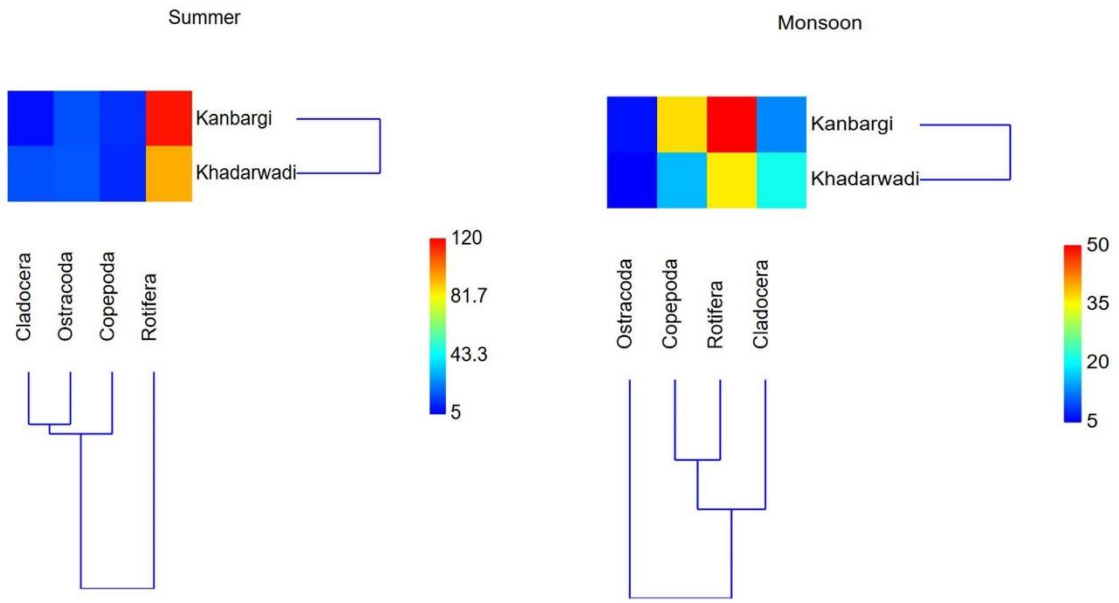

Fig. 4. Hierarchical Cluster Analysis (HCA) with Bray-Curtis Similarity Index of Kanbargi and Khadarwadi lakes during the summer and monsoon

During monsoon, Rotifera abundance reduced compared to the summer season in both lakes. Since Rotifers require warmer temperatures for their growth and reproduction, the lowered temperature might affect their population. Cladocera species like *Ceriodaphnia cornuta* increase their population in rainy season and decrease during summer [5]. The increased abundance of Cladocera observed in the monsoon season may be due to the availability of food. An inverse population relationship between Rotifera and Cladocera is mainly observed to avoid competition between them [29]. The Hierarchical Cluster Analysis (HCA) with Bray-Curtis similarity for the monsoon (Fig. 4) reveals both Rotifera and Copepoda display higher dissimilarity and occupy the same hierarchy cluster. The Cladocera cluster is separate and shows dissimilarity between the two lakes. However, the dissimilarity and clustering of Cladocera have an inverse relation to that of Rotifera and Copepoda in the two lakes. That is, Cladocera are more abundant in Khadarwadi lake than in Kanbargi lake, but the abundance trend is opposite with Rotifera and Copepoda in these lakes. This suggests that lower temperatures and increased rainfall can favour the population of Cladocera and Copepoda groups. Ostracoda show higher similarity in both lakes and perhaps lower temperatures and higher rainfall do not favour the Ostracoda growth and reproduction, hence, occupy separate cluster. Zooplankton are important factor for fish recruitment and occupy a crucial position in food web. Zooplankton diversity reflects on fish population due to their prey-predator relationship [30]. Zooplankton such as Cladocera and Rotifera are food sources for fish and the abundance of fish species depend on these zooplankton during different seasons in Dhir lake, Assam [31]. Therefore, zooplankton serve both as bioindicators and assure fish recruitment by acting as food sources. This closely connected relationship can be disrupted due to eutrophication which can impact the overall biodiversity of lakes.

Table 1. List of zooplankton species identified in Kanbargi and Khadarwadi lake during the study period

Group	Genus	Species	Kanbargi	Khadarwadi
		Brachionus caudatus	+	+
		Brachionus rubens	+	-
		Brachionus forficula	+	-
	Brachionus	*Brachionus diversicornis*	+	-
		Brachionus ureolaris	+	+
		Brachionus calyciflorus	+	+
Rotifera	Keratella	*Keratella tropica*	+	+
		Keratella cochlearis	+	+
	Lecane	*Lecane bulla*	+	+
	Polyarthra	*Polyarthra vulgaris*	+	+
	Asplanchna	*Asplanchna intermedia*	+	-
		Asplanchna brightwelli	+	-
	Filinia	*Filinia longiseta*	+	-
	Moinodaphnia	*Moinodaphnia macleayi*	+	-
	Macrothrix	*Macrothrix goeldii*	-	+
Cladocera	Ceriodaphnia	*Ceriodaphnia cornuta*	-	+
	Daphnia	*Daphnia carinata*	-	+
	Mesocyclops	*Mesocyclops leuckarti*	+	+
Copepoda		*Mesocyclops hyalinus*	-	+
	Thermocyclops	*Thermocyclops hyalinus*	+	+
		Naupiius	+	+
Ostracoda	Strandesia	*Strandesia elongata*	+	+
	Eucypris	*Eucypris bispinosa*	+	+

Table 2. Abundance and Diversity indices of zooplankton groups in two lakes

	Kanbargi lake				Khadarwadi lake			
	Rotifera	**Cladocera**	**Copepoda**	**Ostracoda**	**Rotifera**	**Cladocera**	**Copepoda**	**Ostracoda**
Abundance (Ind/L)	167	19	49	22	130	39	27	23
Simpson_1-D	0.802	0.786	0.794	0.790	0.792	0.788	0.783	0.767
Shannon_H	1.609	1.574	1.60	1.591	1.595	1.579	1.562	1.308

4. CONCLUSION

The comparative study between eutrophic and oligotrophic lakes demonstrates a difference in zooplankton diversity and composition. A higher abundance of pollutant-tolerant Rotifera, with a low abundance of other zooplankton groups, suggest eutrophic conditions in Kanbargi lake. In contrast, the higher abundance of Cladocera in Khadarwadi lake, suggests that it is cleaner and less polluted than Kanbargi lake. During summer, we observed a higher abundance of Rotifers in both lakes, while Cladocera and Copepoda abundance increased during the monsoon. Hierarchical Cluster Analysis (HCA) during summer reveal that Rotifera occupy a separate cluster and show dissimilarity between two lakes while other groups show similarity between both lakes. These results indicate that there is a difference in zooplankton diversity between the two lakes. The closely connected relationship between zooplankton and fish recruitment can be disrupted due to pollution and eutrophication of lakes. This can impact the overall health of freshwater lakes and there is a need for strategies and proper management to maintain ecological balance of the freshwater ecosystem.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. Vaibhav P. Ugare for his guidance and support and to Dr. Vidyasagar C.C, Co-ordinator of Department of studies in Zoology, RCUB, for providing laboratory facilities for the said work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dhanasekaran M, Bhavan PS, Manickam N, Kalpana R. Physicochemical characteristics and zooplankton diversity in a perennial lake at Dharmapuri (Tamil Nadu, India). Journal of Entomology and Zoology Studies. 2017;5(1):285-292.
2. Dharma Guru Prasad MP. Assessment of physico-chemical properties with zooplankton of Marehalli lake, Mandya, Karnataka, India. Uttar Pradesh Journal of Zoology. 2021;42(24):97-109.
3. Savitha N, Yamakanamardi SM. Studies on abundance of zooplanktons in lakes of Mysore, India. Journal of Environmental Biology. 2012;33(6):1079-1082.
4. Muñoz-Colmenares ME, Soria JM, Vicente E. Can zooplankton species be used as indicators of trophic status and ecological potential of reservoirs?. Aquatic Ecology. 2021;55(4):1143-1156.
5. Revankar N, Kadadevaru GG. Physico-chemical parameters and zooplankton community at sangave pond in Uttara Kannada District, Karnataka, India. Environmental Sciences. 2021;9(12):998-1003.
6. Meshram D, Catherine D, Badhe N, Khedkar S, Vijay R, Nandy T. Zooplankton diversity as indicators of pollution in warm monomictic Dal–Nigeen lake. Sustainable Water Resources Management. 2018;4:897-904.
7. Kumar PA, Balakrishna D, Jangir OP. Studies of physicochemical parameters and zooplankton diversity in Takerial lake of Kamareddy district, Telangana. Uttar Pradesh journal of zoology. 2020; 41(22):100–107.
8. Kalpana B, Rani VS, Jyothilaxmi A, Reddy TR. Diversity of zooplankton in three major lakes of husnabad surrounding area, Telangana state, India. Uttar Pradesh journal of Zoology. 2021;41(23):47–51.
9. Joseph B, Yamakanamardi SM. Monthly changes in the abundance and biomass of zooplankton and water quality parameters in Kukkarahalli Lake of Mysore, India. Journal of Environmental Biology. 2011;32(5):551.
10. Sarkar R, Ghosh AR, Mondal NK. Comparative study on physicochemical status and diversity of macrophytes and zooplanktons of two urban ponds of Chandannagar, WB, India. Applied Water Science. 2020;10:1-8.
11. Sunkad BN, Patil HS. Water quality assessment of Fort lake of Belgaum

(Karnataka) with special reference to zooplankton. Journal of Environmental Biology. 2004;25(1):99-102.

12. Abbai SS, Sunkad BN. Effect of anthropogenic activities on zooplankton population of Sogal pond, Belgaum District, Karnataka, India. Research Journal of Recent Sciences; 2013.
13. Neelgund HD, Kadadevaru GG. A study on seasonal variation in zooplankton abundance in kadasgatti minor irrigation tank of Bailhongal Taluk, Belagavi District, Karnataka State, India. Indian Journal of Science and Technology. 2021;14(27):2238-2249.
14. Neelgund HD, Kadadevaru GG. A study on zooplankton community with respect to abundance, diversity, trophic status and variations in physicochemical factors at Bidi minor irrigation tank of Khanapur taluk, Belagavi District, Karnataka, INDIA. International Journal of Ecology and Environmental Sciences. 2022;48(1):85-101.
15. Muchandi SS, Raikar RV, Virupakshi AS, Pharalad P. Assessment of lake water quality using factor analysis: A case study of North Belgaum City, India. Asian Journal of Chemistry. 2017;29(1): 213.
16. Lavanya HD, Arjun S Virupakshi, Eutrophication status and water quality index of lakes at South Belgaum, International Journal of Innovative Research in Science, Engineering and Technology. 2017;6(6):10541 – 10548.
17. Battish SK. Freshwater zooplankton of India. Oxford & IBH Publishing Company., New Delhi; 1992.
18. Sharma BK. Freshwater rotifers (*Rotifera*: Eurotatoria), Fauna of West Bengal, state fauna series. 1998;3(11):341-461.
19. Manickam N, Santhanam P, Saravana Bhavan P. Techniques in the collection, preservation and morphological identification of freshwater zooplankton. Basic and applied zooplankton biology. 2019;139-195.
20. Kumar A. Freshwater plankton and macrophytes of India. Astral International Pvt. Limited., New Delhi; 2020.
21. Karra T, Sayantan D. Seasonal variability and diversity of zooplanktons in three treated sewage water fed ponds in CHRIST (Deemed to be University), Bengaluru, Karnataka, India. Journal of Survey in Fisheries Sciences. 2023;518-535.
22. Rajashekhar M, Vijaykumar K, Parveen Z. Zooplankton diversity of three freshwater lakes with relation to trophic status, Gulbarga district, North-East Karnataka, South India. International journal of systems Biology. 2009;1(2):32.
23. Devi P, Bhatnagar A. Zooplankton diversity in eight lentic water bodies of Haryana, India: a multilocation study. Environment and Ecology. 2021;39(4): 828—836.
24. Bhavan PS, Selvi A, Manickam N, Srinivasan V, Santhanam P, Vijayan P. Diversity of zooplankton in a perennial Lake at Sulur, Coimbatore, India. International Journal of Educational Research. 2015;5:31-44.
25. Brandl Z. Freshwater copepods and rotifers: predators and their prey. In *Rotifera* X: Rotifer Research: Trends, New Tools and Recent Advances, Proceedings of the Xth International Rotifer Symposium, held in Illmitz, Austria, 7–13 June 2003 (pp. 475-489). Springer Netherlands; 2005.
26. Padmanabha B, Belagali SL. Ostracods as indicators of pollution in the lakes of Mysore. Journal of Environmental Biology. 2008;29(3):415.
27. Majagi S, Vijaykumar K. Ecology and abundance of zooplankton in Karanja reservoir. Environmental monitoring and assessment. 2009;152:451-458.
28. Pawar RT. Zooplankton diversity and seasonal variation of Majalgaon reservoir, Maharashtra state, India. International journal of environmental sciences. 2016;6(5):859-866.
29. Prakash S, Verma AK, Prakash S. Seasonal variation of Zooplankton and zoobenthos population in Alwara lake of district Kaushambi Uttar Pradesh India. The Journal of Zoology Studies. 2015;2(5):13-16.
30. Lomartire S, Marques JC, Gonçalves AM. The key role of zooplankton in ecosystem services: A perspective of interaction between zooplankton and fish recruitment. Ecological Indicators. 2021;129: 107867.

31. Das AN, Sharma DK. Analysis of planktonic abundance and its correlation to fish diversity in Dhir beel (Oxbow Lake), Assam, India. Egyptian Journal of Aquatic Biology and Fisheries. 2022;26(3):725-743.

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/4058