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ASSESSMENT OF ZOOPLANKTON DIVERSITY IN THE MALLAPURA LAKE, CHITRADURGA DISTRICT, KARNATAKA

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Zooplankton plays a critical role in the aquatic food chain for aquatic organisms. The current study focused on a zooplankton population at Mallapura Lake in Chitradurga, Karnataka. Water samples were collected once a month for one year, from October 2022 to September 2023. There are 20 species of zooplankton known to science, classified into four groups: rotifers (14 species), copepoda (3 species), and cladocera (3 species). Based on the findings of the current study, we can conclude that the Rotifera are the most numerous of the zooplankton groups identified throughout the survey.

Keywords: Zooplankton, Cladocera, Copepoda; Mallapura lake; Rotifera;

I. INTRODUCTION

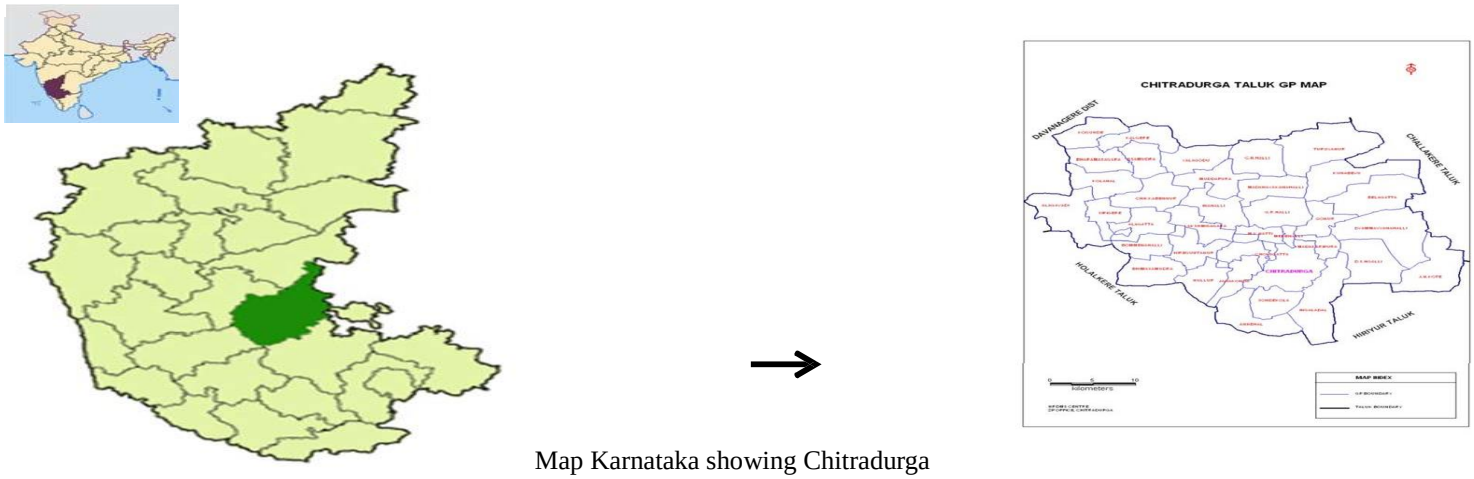
Zooplankton are small, mostly microscopic, and frequently floating aquatic creatures that play a vital role in many aquatic ecosystems (Goswami, 2004). They are important components of the aquatic food chain, transporting energy from primary producers like phytoplankton to larger aquatic animals like fish and other higher trophic levels (Polis & Strong, 1996). Zooplankton are excellent indicators of water quality changes, responding quickly to environmental conditions (Parmar et al., 2016). In freshwater ecosystems, they play a crucial role in aquatic food webs and significantly boost aquatic production (Goswami, 2004).Furthermore, zooplankton have an essential function and operate as bioindicators, making them a useful tool for measuring water pollution levels (Parmar et al., 2016). They are sensitive to changes in aquatic water bodies, and deviations in their composition can significantly impact the aquatic system's ambient conditions (Zhou et al., 2020). Studying zooplankton is a good approach for measuring biotic potential and estimating the overall economic potential and fundamental properties of water bodies (Bakhtiyar et al., 2020; Caroni & Irvine, 2010).Several studies have used zooplankton groups to estimate the tropical condition of aquatic environments (Fernando, 1994; Fernández-Álamo & Färber-Lorda, 2006; Colloquium, 2001). Notable scientists who have thoroughly studied various aspects of zooplankton include Johnson and Allen (2012), Domis et al. (2013), and de Senerpont Domis et al. (2013). However, there is little information available regarding the zooplankton in Mallapura Lake, Chitradurga District. Thus, the fundamental purpose of this study is to examine the Zooplankton community in Mallapura Lake, Chitradurga District, Karnataka.

II. MATERIALS AND METHODS:

2.1. Study area

Mallapura Lake is located in the north-east corner of Chitradurga and has a total size of approximately 100 acres with a depth of 3-4 metres. The lake water is used for cultivation by locals. The lake's geographic coordinates are 14.23' N latitude, 76.4' E longitude, and its mean sea level height is 735 meters (Fig. 1).

Location of the study area:
Map of INDIA Showing Karnataka



Map Karnataka showing Chitradurga

Figure 1: Map showing the location of the study area

2.2. Collection and Identification of Zooplankton

Water samples were collected monthly from Mallapura Lake for a one-year period, from October 2022 to September 2023. Zooplankton were captured using a nylon bolting silk plankton net (No. 25, mesh size 50 µ) that functioned as a filter (Needham, 1962). The net was dragged for ten meters. Samples were collected and placed in vial bottles labeled with 4% formalin. The volume of filtered water was calculated by multiplying the net's mouth area by the depth of the reservoir.Following sedimentation, 100 milliliters of the material were centrifuged for 20 minutes at 1,500 rpm for future research (Needham, 1962). Zooplankton identification was conducted using standard keys from Pennak (1957) and Tonapi (1980). Protocols provided by the American Public Health Association (APHA) were followed (Clesceri, 1998). Both qualitative and quantitative analyses of plankton were performed using a Sedgwick Rafter Cell. The identification was authenticated by the Zoological Survey of India (ZSI) Kolkata.

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III. RESULTS AND DISCUSSION

The current study's findings led to the identification of twenty zooplankton species. These species are divided into three groups: Rotifera, Cladocera, and Copepods. Rotifera was the most prevalent of the three categories. The results are displayed in Table No. 1, 2 and 3 Figure No. 2, 3 and 4.

Table 1: Details of sampling locations

Sl. No	Details of sampling locations	Longitude	Latitude
1	Mallapura Lake North S1	76.393971°	14.253796°
2	Mallapura Lake South S2	76.399963°	14.252131°
3	Mallapura Lake East S3	76.404751°	14.250715°
4	Mallapura Lake West S4	76.389631°	14.253439°

Table 2: Group wise variation in Zooplankton species in in Mallapura lake, Chitradurga District, Karnataka.

Sl NO	Zooplankton Groups	Zooplankton species	Sampling station			
A	**Rotifera**	**Total 14 species**	**S1**	**S2**	**S3**	**S4**
1		*Asplanchna brightwelli*	**2**	**1**		
2		*Brachionus angularis*	**2**	**3**		**1**
3		*B. bidentata*	**1**			
4		*B. calyciflorus*	**3**	**1**	**3**	**3**
5		*B. ahlstromi*	**1**	**2**	**1**	**1**
6		*B. forficula*	**1**	**2**		
7		*Brachionus urceolaris*	**1**		**1**	
8		*Filinia pejleri*			**1**	
9		*Keratella tropica*		**1**		
10		*Keratella quadrata*			**1**	
11		*Lepadella cristata*		**1**		
12		*Pompholyx sulcata*	**1**			
13		*Rotaria neptunia*		**1**		
14		Bdelloid rotifer	**1**			
B	**Copepoda**	**Total 03 species**				
15		Copepoda Nauplii		**1**		
16		Cyclopoid copepodite	**1**			
17		*Mesocyclops leuckarti*	**1**	**3**	**3**	**2**
C	**Cladocera**	**Total 03 species**				
18		Cladocera neonate			**1**	
19		*Ceriodaphnia cornuta*	**1**			
20		*Moina micrura*	**3**	**1**	**2**	**1**
		TOTAL	**19**	**17**	**13**	**8**

Table 3: Seasonal Variation of different Groups of Zooplankton

Sl. No	Zooplankton Group	Pre-Monsoon	Monsoon	Post Monsoon	Total
1	Rotifera (No per Ltr)	575	395	275	1245
2	Cladocera (No per Ltr)	365	275	185	825
3	Copepoda (No per Ltr)	425	290	175	890
4	Total Zooplankton (No per Ltr)	1365	960	635	2960

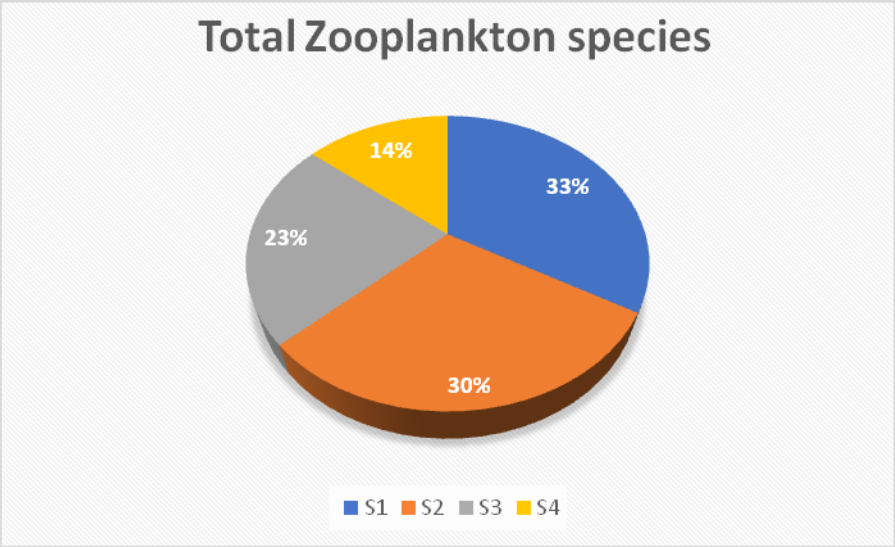

Fig 2: No of Zooplankton species reported at different sampling sites Mallapura Lake North S1, Mallapura Lake South S2, Mallapura Lake East S3, Mallapura Lake West S4

Rotifera includes 14 species: *Asplanchna brightwelli*, *Brachionus angularis*, *B. bidentata*, *B. calyciflorus*, *B. ahlstromi*, *B. forficula*, *Brachionus urceolaris*, *Filinia pejleri*, *Keratella tropica Keratella*, *Lepadella cristataPompholyx sulcata*, *Rotaria neptunia*, and Bdelloid rotifer. Among these, *Brachionus calyciflorus* is prevalent at all sites. Seasonally, the number was highest in the premonsoon (575/L), followed by the monsoon (395/L), and lowest in the post monsoon (275/L).

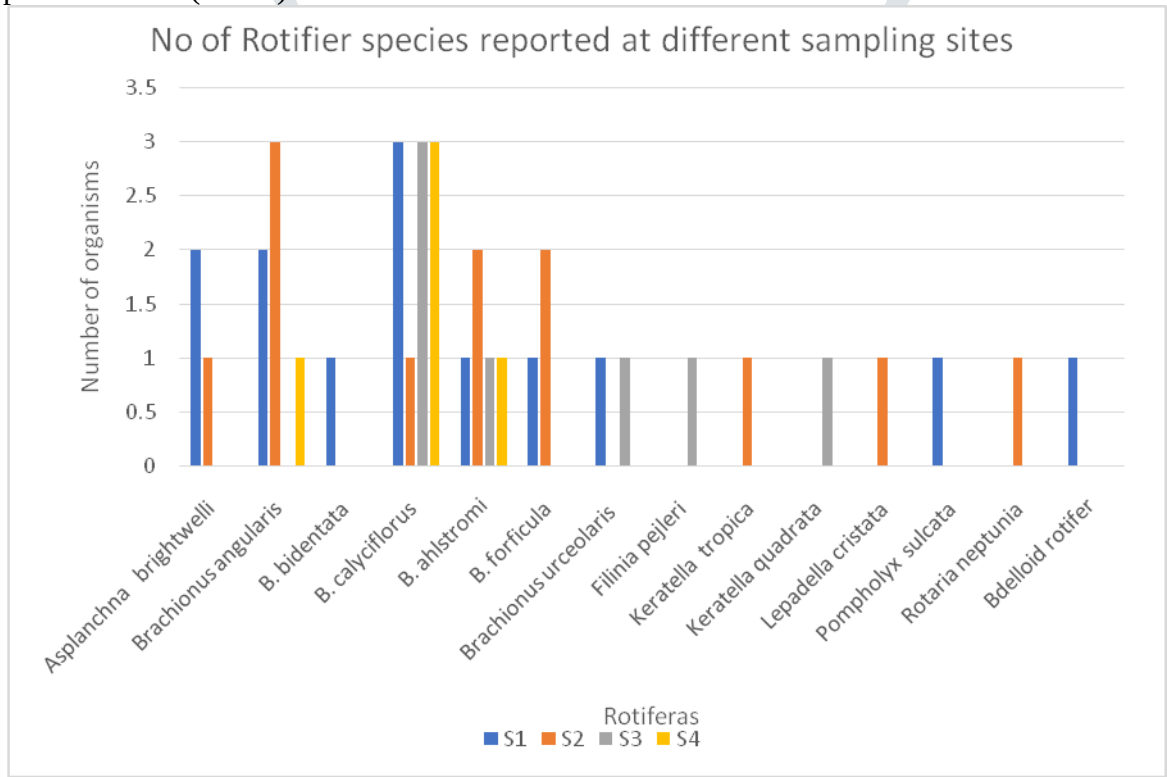

Fig 3: No of Rotifer species reported at different sampling sites Mallapura Lake North S1, Mallapura Lake South S2, Mallapura Lake East S3, Mallapura Lake West S4

Cladocera consists of three species: *Cladocera neonate*, *Ceriodaphnia cornuta* and *Moina micrura*. According to our observations, the *Moina micrura* species is prevalent.

Seasonally, the number was highest before the monsoon (365/L), followed by the monsoon (275/L), and lowest after the monsoon (185/L).

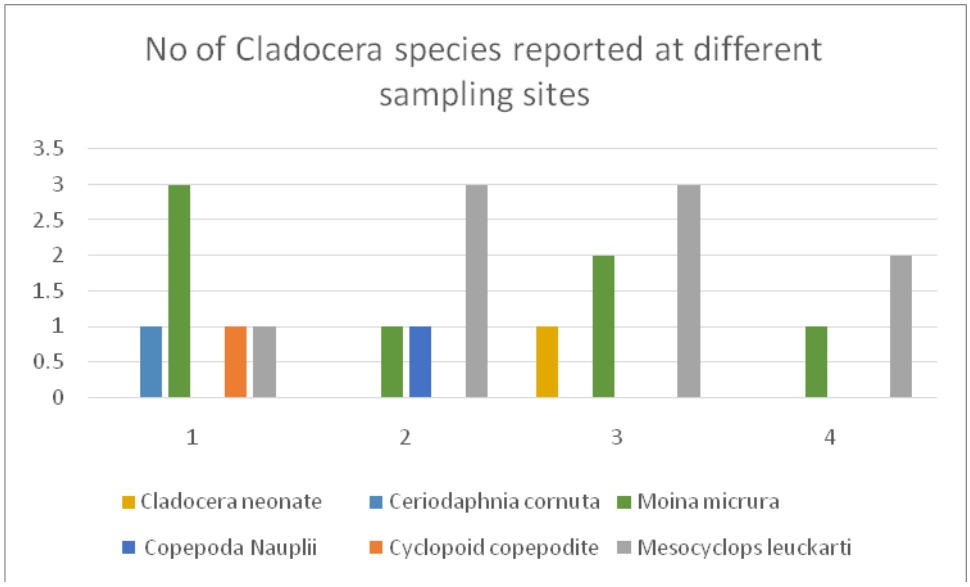

Fig 4: No of Cladocera species reported at different sampling sites Mallapura Lake North S1, Mallapura Lake South S2, Mallapura Lake East S3, Mallapura Lake West S4

Copepoda consists of three species: *Copepoda Nauplii*, *Cyclopoid copepodite*, and *Mesocyclops leuckarti*. *Mesocyclops leukarti* species are frequently encountered during investigations. Seasonally, the number was highest before the monsoon (425/L), followed by the monsoon (290/L), and lowest after the monsoon (175/L).

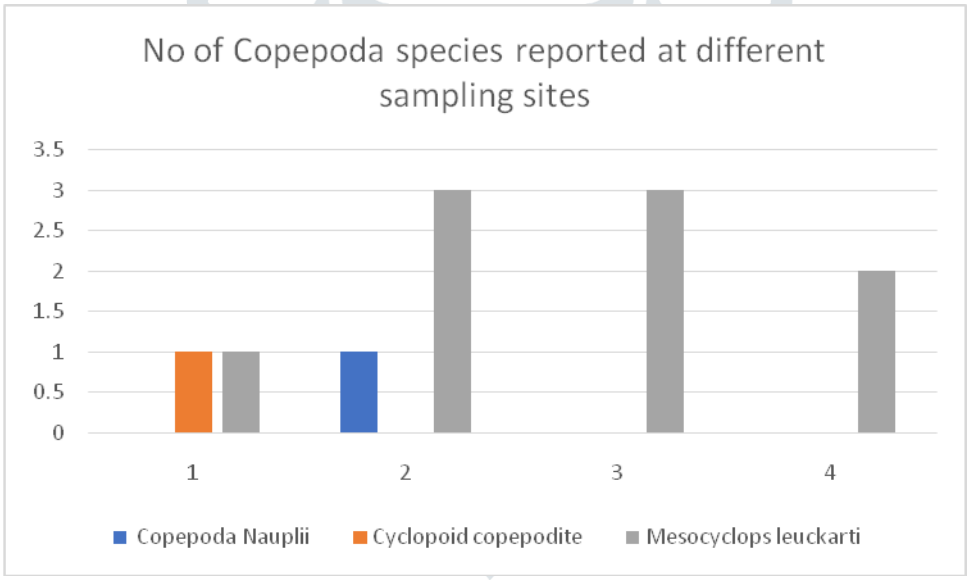

Fig 5: No of Copepoda species reported at different sampling sites Mallapura Lake North S1, Mallapura Lake South S2, Mallapura Lake East S3, Mallapura Lake West S4

IV. DISCUSSION

Rotifera

The current investigation revealed fourteen species of rotifers, which emerged as the dominant group (Table 1). Rotifers' small size, rapid reproduction, adaptability, resilience to unfavorable conditions, and diverse feeding habits make them well-suited to dominate in this freshwater body (Pourriot et al., 1982; Wallace et al., 2006). Moreover, rotifer supremacy has been linked to the presence of algae in the pond, which provides a food source and shelter (Scheffer, 1998).Rotifers play critical roles in nutrient cycling and food web dynamics in freshwater habitats (Gilbert, 2016; Wallace et al., 2006). Seasonal variation revealed that rotifer abundance was highest in the pre-monsoon period, likely due to the presence of phytoplankton and favorable environmental conditions (Reynolds, 2006), and lowest in the winter, possibly due to high turbidity and insufficient light (Lewis, 2010).These findings are consistent with previous research, which reported similar seasonal patterns in rotifer abundance (Dumont et al., 2002; Nandini et al., 2011).

Cladocera

The current analysis revealed three Cladocera species. Seasonal variation showed that their abundance was highest pre-monsoon and lowest during winter (Table 2). This pattern is attributed to temperature, a crucial abiotic factor influencing zooplankton distribution and abundance (Branstrator, 2005). Cladocerans are also impacted by food supply and water turbidity (Gliwicz, 2003).Previous studies have reported similar findings, highlighting the significance of temperature, food availability, and water clarity in shaping Cladocera populations (Kamalam et al., 2012; Nandini et al., 2011; Saha et al., 2012; Sinev, 2006; Tanaka, 2007).

Copepoda

The current investigation revealed three copepod species. Seasonal variation showed that their abundance was highest pre-monsoon and lowest during winter (Table 3). This pattern can be attributed to high temperatures and increased water evaporation, resulting in a concentrated density of producers, thereby providing more food for zooplankton (Reynolds, 2006).Temperature, turbidity, rate of reproduction, and wind are significant factors influencing the distribution and variation of copepod populations (Kamalam et al., 2012; Sinev, 2006; Tanaka, 2007). Similar observations have been reported by previous researchers, highlighting the importance of these environmental factors in shaping copepod dynamics (Nandini et al., 2011; Saha et al., 2012).

V. Conclusion

The study's findings underscore the vital role of zooplankton diversity in maintaining the health of freshwater ecosystems. The investigation identified 20 zooplankton species in Mallapura Lake, comprising 14 Rotifera, 3 Cladocera, and 3 Copepoda species. Notably, seasonal analysis revealed highest concentrations pre-monsoon, moderate during monsoon, and lowest post-monsoon. The dominance of rotifer diversity throughout the year, followed by Copepoda and Cladocera, suggests severe eutrophication in the water body.Furthermore, the aquatic zooplankton population provided critical information regarding available food sources for fisheries development. However, pollution and human activities pose significant threats to biodiversity, emphasizing the need for current knowledge of aquatic species richness to inform effective conservation strategies.In conclusion, this study highlights the importance of conserving zooplankton diversity and aquatic ecosystems, informing future research and conservation efforts to protect these vital ecosystems.

VI. ACKNOWLEDGMENT

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VII. REFERENCES:

[1]. Achary, M. S., Panigrahi, S., Satpathy, K. K., Sahu, G., Mohanty, A. K., Selvanayagam, M., &Panigrahy, R. C. (2014). Nutrient dynamics and seasonal variation of phytoplankton assemblages in the coastal waters of southwest Bay of Bengal. *Environmental monitoring and assessment*, *186*, 5681-5695.

[2]. Bakhtiyar, Y., Arafat, M. Y., Andrabi, S., & Tak, H. I. (2020). Zooplankton: the significant ecosystem service provider in aquatic environment. *Bioremediation and Biotechnology, Vol 3: Persistent and Recalcitrant Toxic Substances*, 227-244.

[3]. Bharathi, M. D., Patra, S., Sundaramoorthy, S., Madeswaran, P., Chandrasekar, D., &Sundaramanickam, A. (2018). Seasonal variability in plankton food web composition in Tuticorin coastal waters, south east coast of India. *Marine pollution bulletin*, *137*, 408-417.

[4]. Branstrator, D. K. (2005). Effects of temperature on zooplankton community structure. Journal of Plankton Research, 27(11), 1107-1115.

[5]. Caroni, R., & Irvine, K. (2010). The potential of zooplankton communities for ecological assessment of lakes: redundant concept or political oversight? In *Biology and Environment: Proceedings of the Royal Irish Academy* (Vol. 110, No. 1, pp. 35-53). Royal Irish Academy.

[6]. Choudhury, A. K., Das, M., Philip, P., &Bhadury, P. (2015). An assessment of the implications of seasonal precipitation and anthropogenic influences on a mangrove ecosystem using phytoplankton as proxies. *Estuaries and Coasts*, *38*, 854-872.

[7]. Clesceri, L. S. (1998). Standard methods for examination of water and wastewater. American public health association, 9.

[8]. Colloquium, M. Z. (2001). Future marine zooplankton research a perspective. *Marine Ecology Progress Series*, *222*, 297-308.

[9]. Cottenie, K., Nuytten, N., Michels, E., & De Meester, L. (2001). Zooplankton community structure and environmental conditions in a set of interconnected ponds. *Hydrobiologia*, *442*, 339-350.

[10]. de SenerpontDomis, L. N., Elser, J. J., Gsell, A. S., Huszar, V. L., Ibelings, B. W., Jeppesen, E., ... &Lürling, M. (2013). Plankton dynamics under different climatic conditions in space and time. *Freshwater Biology*, *58*(3), 463-482.
[11]. Domis, D. S., LISETTE, N., Elser, J. J., Gsell, A. S., Huszar, V. L., IBELINGS, B., ... & DONK, V. (2013). Plankton dynamics under different climatic conditions in space and time. *Freshwater Biology*, *58*(3), 463-482.
[12]. Dumont, H. J., et al. (2002). Ecology of rotifers. In Encyclopedia of life sciences (pp. 1-8).
[13]. Fernández-Álamo, M. A., & Färber-Lorda, J. (2006). Zooplankton and the oceanography of the eastern tropical Pacific: A review. *Progress in Oceanography*, *69*(2-4), 318-359.
[14]. Fernando, C. H. (1994). Zooplankton, fish and fisheries in tropical freshwaters. *Studies on the Ecology of Tropical Zooplankton*, 105-123.
[15]. Gilbert, J. J. (2016). Rotifers in freshwater ecosystems. Journal of Plankton Research, 38(3), 439-453.
[16]. Gillooly, J. F., & Dodson, S. I. (2000). Latitudinal patterns in the size distribution and seasonal dynamics of new world, freshwater cladocerans. *Limnology and Oceanography*, *45*(1), 22-30.
[17]. Gliwicz, Z. M. (2003). Between hazards of starvation and predation: the ecology of offspring size in zooplankton. Ecology, 84(11), 2834-2844.
[18]. Goswami, S. C. (2004). Zooplankton methodology, collection & identyification-A field manual.
[19]. Johnson, W. S., & Allen, D. M. (2012). *Zooplankton of the Atlantic and Gulf coasts: a guide to their identification and ecology*. JHU Press.
[20]. Kamalam, B., et al. (2012). Seasonal variations in Cladocera population in a tropical lake. Journal of Environmental Biology, 33(5), 851-856.
[21]. Lewis, W. M. (2010). Seasonal patterns in phytoplankton and zooplankton communities in a tropical lake. Journal of Plankton Research, 32(11), 1441-1453.
[22]. Michael, R. G. (1968). Studies on the zooplankton of a tropical fish pond. *Hydrobiologia*, *32*, 47-68.
[23]. Nandini, S., et al. (2011). Seasonal variations in rotifer and cladoceran populations in a tropical lake. Journal of Environmental Biology, 32(5), 631-638.
[24]. Needham JG, Needham PR. A guide to the study of Fresh Water Biology Holden day Ins. San-Francisco, USA. 1962; 108.
[25]. Padhye, S. M. (2020). Seasonal variation in functional composition and diversity of cladoceran zooplankton of a lotic eutrophic habitat from India. In *Annales de Limnologie-International Journal of Limnology* (Vol. 56, p. 11). EDP Sciences.
[26]. Parmar, T. K., Rawtani, D., & Agrawal, Y. K. (2016). Bioindicators: the natural indicator of environmental pollution. *Frontiers in life science*, *9*(2), 110-118.
[27]. Pennak RW. Species Composition of Limnetic Zooplankton Communities 1. Limnology and Oceanography. 1957 Jul;2(3):222-32.
[28]. Polis, G. A., & Strong, D. R. (1996). Food web complexity and community dynamics. *The American Naturalist*, *147*(5), 813-846.
[29]. Pourriot, R., et al. (1982). Rotifers and their role in freshwater ecosystems. Developments in Hydrobiology, 10, 147-155.
[30]. Rahim, S. A., Radhika, R., & Mathew, S. (2022). A review on the effect of seasons and pollution on plankton diversity in Indian freshwaters. *Uttar Pradesh J. Zool*, *43*(11), 58-67.
[31]. Reju, J., Thampiraj, & Prakash, J. W. (2019). Seasonal variations of zooplanktons in the selected ponds of Venganoor Grama Panchayath, southern western Ghats.
[32]. Reynolds, C. S. (2006). The ecology of phytoplankton. Cambridge University Press.
[33]. Roshith, C. M., Meena, D. K., Manna, R. K., Sahoo, A. K., Swain, H. S., Raman, R. K., ... & Das, B. K. (2018). Phytoplankton community structure of the Gangetic (Hooghly-Matla) estuary: Status and ecological implications in relation to eco-climatic variability. *Flora*, *240*, 133-143.
[34]. Saha, S. K., et al. (2012). Cladocera fauna of freshwater lakes of West Bengal, India. Journal of Threatened Taxa, 4(15), 3057-3066.
[35]. Scheffer, M. (1998). Ecological consequences of habitat fragmentation in lakes. In Habitat fragmentation and its consequences (pp. 123-144).
[36]. Sharma, S., Siddique, A., Singh, K., Chouhan, M., Vyas, A., Solnki, C. M., ... & Sengupta, T. (2010). Population dynamics and seasonal abundance of zooplankton community in Narmada River (India). *Researcher*, *2*(9), 1-9.
[37]. Sinev, A. Y. (2006). Ecological and morphological diversity of Cladocera (Crustacea) in freshwater ecosystems. Journal of Limnology, 65(2), 147-155.

[38]. Sinev, A. Y. (2006). Ecological and morphological diversity of Copepoda (Crustacea) in freshwater ecosystems. Journal of Limnology, 65(2), 147-155.
[39]. Srichandan, S., Baliarsingh, S. K., Prakash, S., Lotliker, A. A., Parida, C., & Sahu, K. C. (2019). Seasonal dynamics of phytoplankton in response to environmental variables in contrasting coastal ecosystems. *Environmental Science and Pollution Research*, *26*, 12025-12041.
[40]. Tanaka, H. (2007). Seasonal changes in zooplankton community structure in a shallow lake. Limnology, 8(2), 155-164.
[41]. Tonapi GT. Fresh water animals of India: An ecological approach.1980.
[42]. Unit CF. Practical guide to identifying freshwater crustacean zooplankton.2004. Cooperative Freshwater Ecology Uni.
[43]. Wallace, R. L., et al. (2006). Rotifers: Vol. 1: Biology and ecology. CABI Publishing.
[44]. Zhou, J., Qin, B., Zhu, G., Zhang, Y., & Gao, G. (2020). Long-term variation of zooplankton communities in a large, heterogenous lake: Implications for future environmental change scenarios. *Environmental research*, *187*, 109704.