https://doi.org/10.48047/AFJBS.6.15.2024.5556-5568

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Studies on Zooplankton Diversity with The Influence of Some Physicochemical Parameters of Surface Water of Manar Reservoir

Pedewad SH[1] and Solunke KR[2]

[1]Research Student, in Environmental Science, School of Earth Sciences, S.R.T.M. University, Nanded-431606, Maharashtra, India

[2]Associate Professor in the Department of Environmental Science, Indira Gandhi Senior College CIDCO, Nanded-431603, Maharashtra, India[2]

Email: kedarsolunke2008@gmail.com

Volume 6, Issue 15, Sep 2024

Received: 15 July 2024

Accepted: 25 Aug 2024

Published: 05 Sep 2024

doi: 10.48047/AFJBS.6.15.2024.5556-5568

Abstract

In aquatic ecosystems, plankton serve as the fundamental food source, sustaining fish and other water-dwelling organisms. The diversity of zooplankton is a critical environmental metric for evaluating water quality. Due to their high sensitivity to environmental conditions and rapid response to habitat alterations, zooplankton diversity functions as an excellent indicator of changes in water quality. This sensitivity makes them essential for monitoring and comprehending the health of aquatic ecosystems. From January 2019 to December 2019, a study was conducted to evaluate the connection and impact between specific water quality parameters and seasonal abundance. The study focused on parameters such as temperature, dissolved oxygen, and pH. The research identified a total of 10 zooplankton species, comprising 4 species from Rotifera, 2 from Copepoda, 2 from Cladocera, and 2 from Protozoa.

Keywords: Zooplankton diversity, Physicochemical parameter, Manar reservoir.

Introduction

The health of aquatic ecosystems is influenced by numerous physical, chemical, and biological components in water, which are crucial for the development and longevity of water-dwelling organisms. The interplay between water conditions and aquatic life is symbiotic, making the connection between water quality and the productivity of aquatic environments vital for long-term growth and output (Bisht *et al.,* 2013). Minute drifting organisms known as zooplankton are crucial components in the nutritional chain of water-based environments (Kadam *et al.,* 2014). As consumers in the ecosystem, zooplankton play a crucial role in the food chain by connecting primary producers to organisms at higher trophic levels (Sharma and Singh, 2012). Zooplankton diversity may be affected by temperature (Manickam *et al.,* 2018). Environmental factors and physicochemical parameters influence the variety of zooplankton species present in an ecosystem (Kumar and Rakhi, 2018). The assessment of water quality significantly relies on the variety of zooplankton present (Jadhav *et al.,* 2012). Freshwater ecosystems rely heavily on the existence and quantity of zooplankton species for their proper functioning and overall health (Rokade, 2021). Siddaram *et al.,* (2016), emphasizes that zooplankton studies are crucial for various fields, including fisheries, aquaculture and paleolimnology. This study's primary objective is to assess the diversity and seasonal abundance of zooplankton, as well as calculate its diversity index. This focus aligns with a key priority in zooplankton conservation efforts, which involves monitoring their populations and diversity indices to ensure their long-term survival.

Study Area

Lower Manar Dam has been chosen as the focus area for zooplankton research. This dam, situated in Maharashtra's Nanded district, was constructed on the Manar River in Varwant village, Kandahar taluka, between 1959 and 1968. The Manar Reservoir boasts a diverse ecosystem of plankton and fish species. Year-round, the reservoir's water is utilized for irrigation, enhancing the fertility of agricultural lands, as well as supporting small-scale fishing and other activities by local residents. Three locations, designated as S1, S2, and S3, have been identified for the current investigation.

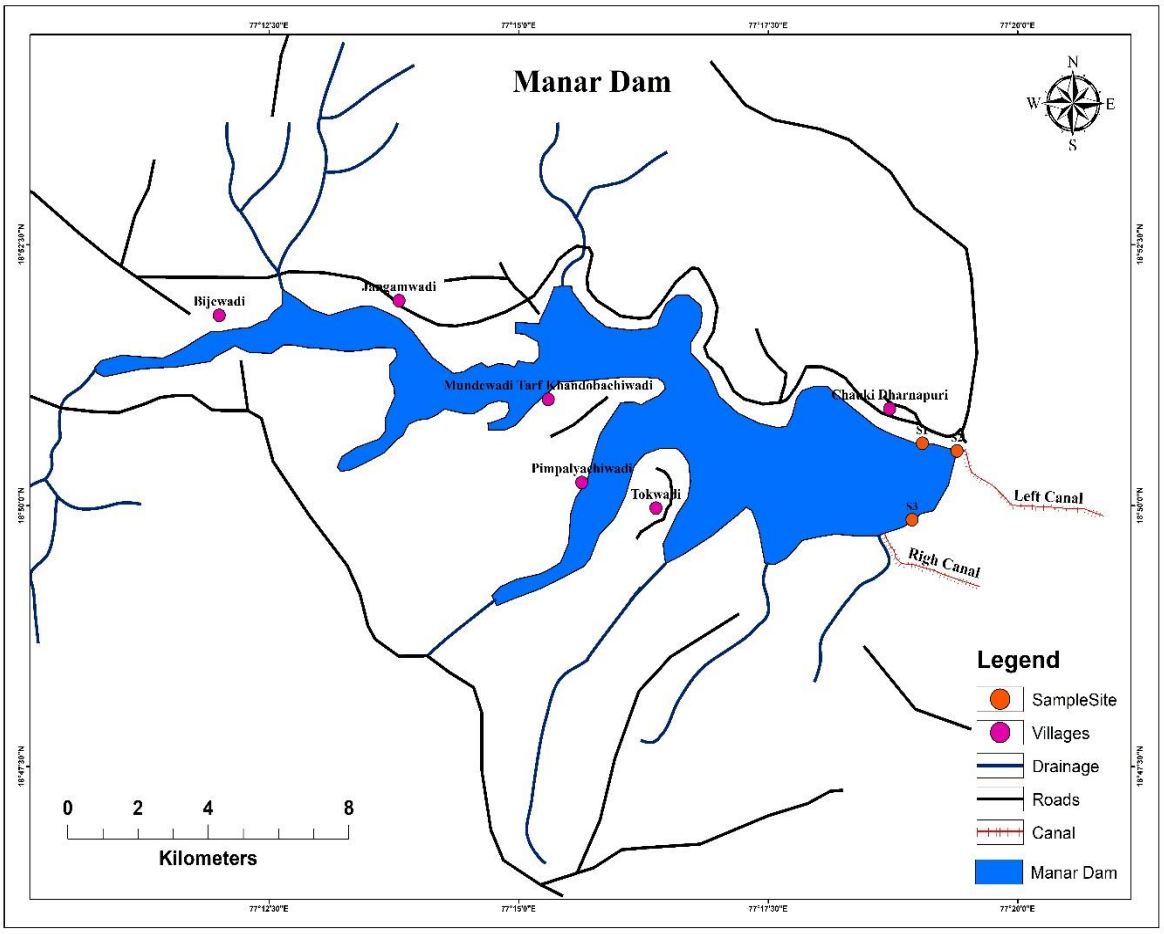

Figure No. 1: Location map of the study area with three different sites selected

Material and Methods

For the present study, several physicochemical parameters were analyzed that are closely associated with plankton growth. Water samples were collected once a month during morning hours. Samples were obtained in standard containers and transferred into pre-cleaned sampling bottles from designated sites. From January 2019 to December 2019, water samples were collected and subsequently analyzed in the laboratory.

Parameters such as temperature and dissolved oxygen were measured utilizing the procedure described by Dewan *et al*., (2006). pH was determined using the electronic pH meter method prescribed by Maiti (2004). Zooplankton identification and quantitative methods were conducted according to Adoni *et al*., (1985). The Shannon and Weaver index (1949) formula was

employed to measure plankton diversity, as recommended by Ludwig and Reynolds (1988). Furthermore, Wilham and Dorrick (1968) proposed an index for assessing the pollution level of a water body.

Results and Discussion

Table No. 1: Temperature, pH and dissolved oxygen levels in water samples from three locations of Manar Dam from January 2019 to December 2019.

2019 Seasonal study period months		S1			S2			S3		
		Temp °C	**pH**	**DO (mg/L)**	**Temp °C**	**pH**	**DO (mg/L)**	**Temp °C**	**pH**	**DO (mg/L)**
Summer	February	22	8.4	3.50	22	8.4	3.71	24	8.4	3.64
	March	24	8.3	3.43	26	8.4	3.78	26	8.4	3.57
	April	**27**	**8.6**	**3.29**	27	**8.6**	**3.64**	**28**	**8.6**	**3.50**
	May	**27**	**8.6**	3.57	**28**	**8.6**	3.85	27	**8.6**	3.71
Monsoon	June	26	8.3	3.64	26	8.3	3.99	26	8.4	3.85
	July	23	8.0	3.78	23	8.1	4.06	24	8.1	4.13
	August	22	**7.8**	4.06	22	**8.0**	4.2	23	**8.0**	4.41
	September	23	8.0	4.13	22	8.1	4.41	23	8.2	4.48
Winter	October	21	8.2	4.34	23	8.2	4.48	22	8.2	4.55
	November	19	8.3	4.41	**19**	8.3	4.55	19	8.3	4.62
	December	**18**	8.3	4.62	20	8.3	**4.76**	**18**	8.3	**5.04**
	January	20	8.2	**4.76**	21	8.3	4.69	20	8.4	4.76

Table No.2. Seasonal abundance (no/L) of different groups of Zooplankton study at S1 of Manar reservoir from January 2019 to December 2019

Group wise name of the zooplankton species 2019	**Number of organisms /L Location of S_1**											
	Summer				**Monsoon**				**Winter**			
	Feb	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Rotifera												
Keratella tropic	37.5	50	**75**	62.5	50	25	**12.5**	37.5	37.5	50	62.5	50
Brachionus falcatus	**12.5**	25	**62.5**	50	50	37.5	25	25	25	37.5	**62.5**	50
Filinia	37.5	50	**75**	50	50	37.5	**25**	37.5	**25**	**25**	50	37.5
Trichotria	**12.5**	37.5	**62.5**	50	37.5	37.5	**12.5**	25	**12.5**	25	50	37.5
Copepoda												
Diaptomus	37.5	50	**75**	62.5	50	25	**12.5**	25	37.5	50	62.5	50
Cyclops	25	50	**75**	62.5	37.5	37.5	**12.5**	25	25	37.5	50	50
Cladocera												
Moina	37.5	**62.5**	**62.5**	50	37.5	37.5	**12.5**	25	25	37.5	50	37.5
Daphnia	37.5	50	**75**	50	37.5	25	**12.5**	25	25	37.5	62.5	50
Protozoa												
Paramecium sp.	25	50	**62.5**	**62.5**	37.5	25	**12.5**	**12.5**	25	37.5	50	**62.5**
Vorticella sp.	37.5	62.5	**75**	50	50	37.5	**25**	37.5	37.5	37.5	62.5	50

Table No.3. Seasonal abundance (no/L) of different groups of Zooplankton study at S2 of Manar reservoir from January 2019 to December 2019

Group wise name of the zooplankton species 2019	**Number of organisms /L** **Location of S_2**											
	Summer				**Monsoon**				**Winter**			
	Feb	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Rotifera												
Keratella tropic	37.5	50	**75**	62.5	50	37.5	**12.5**	37.5	37.5	62.5	**75**	62.5
Brachionus falcatus	**25**	37.5	**62.5**	50	50	37.5	**25**	37.5	**25**	37.5	**62.5**	**62.5**
Filinia	**25**	50	**75**	50	62.5	50	**25**	37.5	50	37.5	**75**	62.5
Trichotria	37.5	50	**62.5**	50	50	37.5	**25**	37.5	**25**	37.5	**62.5**	50
Copepoda												
Diaptomus	50	62.5	**75**	62.5	50	37.5	**12.5**	25	37.5	50	62.5	62.5
Cyclops	37.5	50	**87.5**	62.5	50	50	37.5	**25**	37.5	50	50	62.5
Cladocera												
Moina	37.5	50	**87.5**	75	50	25	**12.5**	37.5	25	50	75	62.5
Daphnia	50	62.5	**75**	**75**	50	50	**25**	37.5	37.5	50	62.5	50
Protozoa												
Paramecium sp.	50	62.5	**75**	62.5	62.5	50	**37.5**	50	**37.5**	50	**75**	62.5
Vorticella sp.	50	50	**75**	62.5	62.5	50	**25**	37.5	**25**	37.5	62.5	50

Table No.4. Seasonal abundance (no/L) of different groups of Zooplankton study at S3 of Manar reservoir from January 2019 to December 2019

Group wise name of the zooplankton species 2019	Number of organisms /L Location of S3											
	Summer				Monsoon				Winter			
	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan
Rotifera												
Keratella tropic	62.5	75	**87.5**	75	62.5	50	**37.5**	50	50	62.5	75	62.5
Brachionus falcatus	**25**	37.5	**62.5**	**62.5**	37.5	50	**25**	37.5	37.5	50	**62.5**	50
Filinia	50	62.5	**87.5**	75	62.5	50	**37.5**	62.5	50	62.5	75	62.5
Trichotria	37.5	50	**75**	62.5	62.5	50	**25**	37.5	37.5	50	62.5	62.5
Copepoda												
Diaptomus	62.5	75	**87.5**	75	50	37.5	**25**	37.5	37.5	62.5	75	62.5
Cyclops	50	62.5	**75**	62.5	62.5	50	**25**	37.5	50	50	**75**	62.5
Cladocera												
Moina	50	62.5	**75**	**75**	50	37.5	**25**	37.5	37.5	50	62.5	50
Daphnia	62.5	75	**87.5**	75	62.5	50	**37.5**	50	**37.5**	50	75	62.5
Protozoa												
Paramecium sp.	50	75	**87.5**	62.5	75	50	**37.5**	62.5	50	62.5	75	62.5
Vorticella sp.	62.5	75	**87.5**	75	62.5	50	**37.5**	50	**37.5**	50	75	75

In the present study, 10 species belonging to 4 zooplankton groups were identified in Manar Reservoir. Specifically, 4 species of the Rotifera group, 2 species of Copepoda, 2 species of Cladocera, and 2 species of Protozoa were recorded. The four Rotifera species identified were

Keratella tropica, Brachionus falcatus, Filinia sp., and *Trichotria sp*. The two Copepoda species observed were *Diaptomus sp.* and *Cyclops sp*. The Cladocera species identified were *Moina sp*. and *Daphnia sp*., while the Protozoa species recorded were *Paramecium sp*. and *Vorticella sp*. The seasonal abundance of the different zooplankton groups was determined, and the detailed results are presented in Tables No. 2 to 4.

The minimum and maximum temperature ranges, considering all sites of the Manar dam from January 2019 to December 2019, were 18°C in December at sites one and three, and 28°C in May at site 2. Additionally, 28°C was recorded at site three in April. The seasonal variation of physicochemical parameters is presented in Table No. 1. This table demonstrates that all three locations within the study area exhibited the highest temperatures in summer, intermediate temperatures in the rainy season, and the lowest temperatures in winter. A water quality assessment using physicochemical parameters was performed by Simpi *et al.*, (2011) at Hosahalli Tank in Karnataka's Shimoga District, India. The research spanned from January to December 2007. Their findings revealed that the highest temperature reached 27°C in May, while the lowest temperature of 20°C was observed in December. According to Das *et al*., (1997), variations in atmospheric temperature can lead to changes in water temperature. The chemical reactions in water and the biological processes of aquatic organisms are significantly influenced by temperature, which in turn affects biological communities (Balai, *et al*., 2016).

This thermal factor is essential in shaping aquatic ecosystems. Upon analysis of the pH values across all sites of Manar Dam from January 2019 to December 2019, it was determined that the minimum and maximum pH levels were 7.8 in August at site one, and 8.6 in April and May at all sites, respectively. In Manar Reservoir, elevated pH levels were observed during the summer, low levels during the monsoon period, and moderate in winter. A study by Sreeja and Pillai (2012) investigated the physicochemical characteristics of the Kodyar River in Kerala over one year, from June 2010 to June 2011. Their findings revealed that the water's pH level in the Kodyar River fluctuated between 7.01 and 7.40. Shukla and Singaracharya (2018) suggest that the elevated pH levels detected during summer may be attributed to enhanced decomposition processes.

In comparison to all sites of Manar Dam from January 2019 to December 2019, the minimum and maximum levels of dissolved oxygen were 3.29 mg/L at site one in April and 5.04 mg/L at site three in December, respectively. Furthermore, dissolved oxygen concentrations were observed to be highest in winter, followed by monsoon, and lowest in summer. A study conducted by Pattan and Sunkad, (2017) assessed the water quality of the Belagavi Kangrali water body. Their findings revealed that the dissolved oxygen (DO) concentrations varied between 5.8 mg/L and 8.2 mg/L. Mishra and Singh (2020) suggest that the peak levels of dissolved oxygen observed in winter could be attributed to colder temperatures, while the minimum levels seen in summer might result from increased metabolic activity of organisms.

Table No.5. Diversity Index Level of Zooplankton in Water Samples of Manar

.3..Reservoir (January 2019 to December 2019)

Months		Zooplankton diversity index		
		2019		
		S_1	**S_2**	**S_3**
Summer	February	**2.239**	2.274	**2.273**
	March	2.278	2.292	2.283
	April	**2.299**	2.297	2.297
	May	2.296	2.292	**2.299**
Monsoon	June	2.292	2.297	2.288
	July	2.284	2.282	2.297
	August	2.245	**2.233**	2.282
	September	2.264	2.285	2.281
Winter	October	2.264	2.275	2.292
	November	2.280	2.288	2.296
	December	2.296	2.295	**2.299**
	January	2.290	**2.298**	2.296
Average		2.277	2.284	2.290

A.C.	2.284		
Minimum	**2.239**	**2.233**	**2.273**
Maximum	**2.299**	**2.298**	**2.299**

Whereas, A.C. = average concentration

Table No.6. Classification of Pollution Levels as per Wilham and Dorris Based on the Shannon and Weaver Index

Shannon and Weaver Index	**Pollution level by Wilham and Dorris**
> 3 (greater than 3)	Clean water
1 to 3	Moderate pollution
<1 (Less than 1)	Heavy pollution

Conclusion

Research has shown that several physicochemical factors, such as pH, temperature, dissolved oxygen (DO), and environmental conditions, affect zooplankton composition and diversity. In addition, this study also highlighted the zooplankton population in the reservoir and its important function in the aquatic food web.

Acknowledgement

The first author would like to express his gratitude to the Indian Council of Social Science Research (ICSSR), New Delhi for financial support for this research. The authors are also thankful to the Director of the School of Earth Sciences at Swami Ramanand Teerth Marathwada University in Nanded, Maharashtra, India, for providing access to laboratory and library facilities.

References

1. Bisht, A. S., Ali, G., Rawat, D. S., & Pandey, N. N. (2013). Physico-chemical Behaviour of Three Different Water Bodies of Sub–Tropical Himalayan Region of India. *Journal of Ecology and the Natural Environment*, Vol. 5(12), pp 387-395.

2. Kadam, C. P., Dandolia, H. S., Kausik, S., Saksena, D. N., & Shrotriy, V. P. (2014). Biodiversity of Zooplankton in Pillowa Reservoir District Morena Madhya Pradesh, India. *International Journal of Life Sciences*, Vol. 2(3), pp 263-267.

3. Sharma, D. K., & Singh, R. P. (2012). Seasonal Variation in Zooplankton Diversity in Tighra Reservoir, Gwalior (Madhya Pradesh). *Indian Journal of Scientific Research*, Vol. 3(2), pp 155-161.

4. Manickam, N., Bhavan, P. S., Santhanam, P., Bhuvaneswari, R., Muralisankar, T., Srinivasan, V., Asaikkutti A., Rajkumar G., Udayasuriyan R., and Karthik, M. (2018). Impact of Seasonal Changes in Zooplankton Biodiversity in Ukkadam Lake, Coimbatore, Tamil Nadu, India, and Potential Future Implications of Climate Change. *The Journal of Basic and Applied Zoology*, Vol. 79(15), pp 1-10.

5. Kumar, S. D., & Rakhi, U. (2018). A Study of Seasonal Variations in Zooplankton Diversity of Pagara Dam of Morena District, Madhya Pradesh, India. *International Journal of Life Sciences*, Vol. 6 (2), pp 409-414.

6. Jadhav, S., Borde, S., Jadhav, D., & Humbe, A. (2012). Seasonal Variations of Zooplankton Community in Sina Kolegoan Dam Osmanabad District, Maharashtra, India. *Journal of Experimental Sciences*, Vol. 3(5) pp 19-22.

7. Rokade, A. U. (2021). Biodiversity of Zooplankton at Shidheshwar Lake, Solapur, Maharashtra, India. Research Directions, pp 127-141.

8. Siddaram. L., Reddy. R. B., Reddy N., and Vijayakumar K. (2016). Diversity and Abundance of Zooplankton in Hattikuni Reservoir, Yadgir District, Karnataka,*Indian Streams Research Journal*, Vol. 6(5), pp 1-11.

9. Irrigation Status Report (ISR) (2018-19), Report from Executive Engineering, Nanded Irrigation Division (S), Nanded. Maharashtra State, India.

10. Diwan A. D., Misra S M., Dhanpati M.V.S.S.S., Murugan N., Thirumalai G., Altaff K. and Sakhre V.B. (2006), Methodology for Water Analysis, (Physico- chemical, Biological and Microbiological) Indian Association of Aquatic Biologists (IAAB), Publication No.2.

11. Maiti, S.K. (2004). Handbook of Methods in Environmental Studies, (Vol.1) Water and Waste Water Analysis, 2nd Edition, ABD Publisher, Jaipur, India, pp 1-307.

12. Adoni, A.D. Joshi G., Ghosh K., Chaurasia S.K., Vaishya A.K., Yadav M. and Verma H. G. (1985). Workbook on Limnology. Pratibha Publishers C-10, Gour Nagar, Sagar - 470003, India.

13. Shannon C.E. and W. Weaver (1949). The Mathematical Theory of Communication. University Illinois Press, Urbana, IL.

14. Ludwig, J. A., and Reynolds, J. F. (1988). Statistical ecology: A Primer in Methods and Computing, John Wiley & Sons, Vol. 1, pp 1-377.

15. Wilhm, J. L., and Dorris, T. C. (1968). Biological Parameters for Water QualityCriteria. Bioscience, 477-481.

16. Simpi, B., Hiremath, S. M., Murthy, K. N. S., Chandrashekarappa, K. N., Patel, A. N., and Puttiah, E. T., (2011). Analysis of Water Quality Using Physico-Chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India. *Global Journal of Science Frontier Research*, Vol. 11(3), pp 31-34.

17. Das, J., Das, S. N., & Sahoo, R. K. (1997). Semidiurnal Variation of Some Physico-Chemical Parameters in The Mahanadi Estuary, East Coast of India. *Indian Journal of Marine Sciences,*Vol. 26(3), pp 323-326.

18. Balai, V. K., Sharma, L. L., and Ujjania, N. C., (2016). Limnological Study of Jaisamand Lake (India) and its Suitability for Aquaculture and Fisheries. *International Journal of Applied and Pure Science and Agriculture*, Vol. 2(1), pp 25-30.

19. Sreeja, V., and Pillai, A. R., (2012). Assessment on The Characteristics of River Kodayar With Reference to Physico-Chemical Parameters. IOSR *Journal of Applied Chemistry*, Vol. 2(1), pp 5-8.

20. Shukla, S., and Singaracharya, M. A., (2018).Assessment of Water Quality Status of Godavari River Around Process Industries at Manuguru, Telangana State, *International Journal of Trend in Scientific Research and Development*, Vol.2 (3), pp 159-165.

21. Pattan K.I., and Sunkad B.N., (2017). Water Quality Assessment of Kangrali Water Body of Belagavi, *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 6(3), pp 3303-3309.

22. Mishra, D. B., and Singh, P., (2020). Limnological Studies of Balapur Pond of Prayagraj Uttar Pradesh, India.*International Journal of Fauna and Biological Studies*, Vol. 7(4), pp 1-5.