*Indian J. Applied & Pure Bio.* Special Volume 35-39 (2021).
**Environment & Sustainable Development : Problems, Prospects & Mitigation Date : 25th-27th November, 2021**

**ISSN: 0970-2091**
**A web of Science Journal**

# Freshwater Zooplankton as Potential Biological Indicators: A Review

**[1]Shashikant Trimbak Hon* and [2]Sandesh P Jagdale**

[1]P.G. & Research Centre, Zoology
[1]Sanjivani Arts, Commerce and Science College, Kopargaon. Ahmednagar-423603 (India)
[2]Dapoli Urban Bank Senior Science College, Dapoli, Ratnagiri-415712 (India)
Correspond*: trimbakrah@gmail.com, https://orcid.org/**0000-0002-1596-5855**

**Abstract**

The freshwater ecosystems are detoured by anthropogenic activities and Industrialization,which resulted in a dramatic increase in the pollution level of aquatic ecosystems *over the past decade*. One of the cheapest ways to assistthe health of the aquatic ecosystem is bymonitoring theorganisms present in them and such organisms are the 'Biological indicators' In the present review c65cxwe tried to sum up the studies on freshwater zooplanktons as a biological indicator. They quickly responses to the changes that occurred in their environment and hence they are the efficient model for water quality assessment. Pollution limited the presence of some species, while others were discovered to be accepting the same, as a result, researchers can implement them as a promising tool for studying the health of the aquatic environment. Hence the objective of this study is to furnish the knowledge of freshwater zooplanktons asbiological indicators forwater quality studies.Further will contribute to developing the appropriate framework for environmental analysis to policy makers.

The aquatic ecosystems are at high risk due to increasing human greed to exploit natural resources. The overpopulation, industrialization, deforestation has adversely affected the environment and result in the serious issue like global warming, alternation of seasonal durations, *etc.* and ultimately the adverse effects are seen on the biota as well as socioeconomic of the globe.It initiated the development of promising tools to monitor the health of aquatic ecosystems. Now a day, biological indicators are more preferred than that of the chemical method for assisting the health of an aquatic ecosystem, as it has the following advantages[22].

- They can be easily sampled
- Biological effects can be calculated.
- To assess the beneficial and adverse effects of multiple contaminants on the life forms.
- Because of their abundance, they can be conveniently recorded.
- It is many a time cost-effective option in contrast to other specific realistic analysis methods.
- Provide details of the lengthy consequences of stress on the flora and fauna of the

[1]Assistant Professor, [2]Principal.

particular habitat.

- It gives the initialphase of diagnosis including the negative impacts of pollutants on biota.

The zooplanktons are microscopic creaturesthatfloat on the water surface and move along with the currents, as have very low power of locomotion. They can be used as biological indicators[9,13,32] as they quickly respond to changesthat occur in their environment, different groups of zooplankton react differently to various pollution present in their ecosystem. According to Bellinger & Sigee27[5] the ability of a freshwater organism to show the environmental changes was first reported by Kolenati (1848) and Cohn (1853). Phytoplan-ktons are the base of an aquatic food web; thus, the productivity of any aquatic body depends upon the quality and quantity of the phytoplanktons and zooplanktons present in it.

Abiotic factors influence the water quality as well as the abundance and distribution of phytoplanktons and zooplanktons[30]. One of the most important abiotic factors is the temperature[15], it controls all the activities of the water bodies. Productivity of aquatic ecosystem changes with seasonal variations. Excess phosphate contains and temperature can result in algal bloom[3,17,25,28]. It affects the light penetration and results in low production of phytoplankton and zooplanktons[2]. Density and abundance of Phytoplanktons and zooplanktons is directlyproportional to the abiotic factors, like dissolved oxygen, total dissolved solids, carbon dioxide concentration, biological oxygen demand, chemical oxygen demand, pH, alkalinity, phosphate and nitrate concertation[10] Gss & Eilham[10] report some higher members of Chlorophyceae present due to high pH, alkalinity, DO, TDS and BOD, therefore, can be the indicators of the trophic state of the water body.[8] Studied two reservoirsJaguari and Jacarei, Brazil for the effect of abiotic and biotic factors on zooplanktons distribution and abundance. Further by using the K- dominance curve and Calanoida/Cyclopoida ratio they depict the tropic state of the reservoirs.

Ismail & Adnan[14] observed Harapan and Aman Lakes for zooplankton community in correlation with physical parameters and chlorophyll-a content. They noted that the presence of three zooplanktonic species namely are *Brachionus forficula, Brachionus nilsoni, and Trichocerca* were observed in both the eutrophic lakes; ultimately, they are the indicators of the eutrophic state of the freshwater ecosystem Wadjikar *et al.*,[31] monitored the water quality of ten zones of Nagpur city (Maharashtra, India) Using zooplankton organisms as Bioindicators and conclude that out of 10 zones 8 were badly affected by sewage drainage, and anthropogenic activities affecting the diversity and abundance of zooplanktons. Further by using a one-way ANOVA test, they state that in polluted zones the abundance of protozoa was more than that of the rotifer. Biological Indices were used to assess the water quality[23]. Rasheed *et al.*,[23] studied the zooplankton bio-indicators in the Tigris River at the city of Baghdad to monitor the water quality. They concluded that though the chemical analysis does not shows the significant difference between the three water bodies but biological indices have some noticeable differences and therefore the biological

indicators are more superior to that of chemical analysis.

Almeida *et al.*,[1] sampled the four reservoirs in northern Portugal (Paradela, Alto Cávado, Alto Rabagão and Venda Nova) to study the contribution of zooplankton as a biological element in assessing reservoir water quality.They noted that these water bodies have potential good ecology, according to WFD (Water Framework Directive) reference values for physical and chemical parameters and phytoplankton communities, with occasional to moderately decreasing ecological potential due to variations in dissolved $O_2$ and total phosphorus values. But the zooplankton groups show the variation in taxonomic level as well as in functional perspective due to slight change in the water parameters. Hence reported that "metrics proposed by WFD to evaluate water quality in reservoirs seem to be insufficient to report all the alterations that occur in these aquatic ecosystems".

Xiong *et al.*,[33] reviewed the current methods used to monitor zooplankton biodiversity for the continued management of disturbed freshwater ecosystems. They further comment on advancements in some regularly used methods of identification such as Flow CAM automated system, ZOOSCAN, Scanning Electron Microscopy (SEM) and metabarcoding and real-time quantitative PCR. with their advantages and disadvantages. At last, they say that metabarcoding is a possible solution to existing technical problems to improve the accuracy and efficiency of DNA-based biodiversity monitoring.

A review was carried out by Lomartire *et al.*,[20] to examine the role of zooplankton in marine systems, showing how their presence is critical for the functioning of ecosystems and fishery industries.

Barka *et al.*,[4] reported that the zooplanktons of Bir Mcherga dam, (Tunisia) are under continuous steers of various pollutants in it. They calculated the genotoxicity, neurotoxicity and oxidative stress of two Cladocera's species *Acanthocyclops robustus* and *Diaphanosoma mongolianum.* Parmar *et al.*,[22] explored the concept of biological indicators and enlisted their advantages, according to them the zooplanktons are the best indications of water pollution as they react very quickly to the environmental changes. Zooplanktons are an efficient tool for assisting the water quality. Saha *et al.*,[24] examined pesticide contamination and the pathways through which they enter the environment. Insecticide contamination can affect body size and ultimately reduce the energy flow in the food chain[11]. Duelli & Obrist[6] put forth different communities of biological indicators for effective assessment of the ecology. Karpowicz *et al.*,[16] measured the body size of *Daphnia cucullate* for assessing the tropic status of 104 lakes from northern Poland. They observed the large body size of *D. cucullate* were absent in highly eutrophic conditions; hence concluded it as the biological indicator of the freshwater ecosystem. The total phosphate concentration can noticeably affect the biodiversity as well as the body size of zooplanktons.[19,34] *Trichotria tetrat, Alona guttata, Mescyclops edex, Cyclips, and Aheyella* are the species found in the phosphorus-rich environment hence can be pollution indicators of a phosphorus-rich aquatic ecosystem.

Singh *et al*.,[27] reviewed the potentiality of phytoplankton and zooplankton as bioindicators of water quality. According to them, the plankton community is a chipset, the easiest and reliable way to monitor aquatic ecosystems. Kulas *et al*., [18] reported the ciliates from krka river are potential bioindicators of different environmental pollution of freshwater ecosystem. Munoz-Colmenares[21] evaluated the zooplankton species from Ebro River watershed, the largest basin in Spain and enlisted the eutrophic status indicating species of freshwater ecosystem. The species that indicate the low water quality are *Acantho-cyclops americanus, Ceriodaphnia spp., Daphnia cucullata, Daphnia pa´rvula, Diaphanosoma brachyurum, Brachionus angularis, Keratella cochlearis and Phom-polyx sulcata*. The species that indicatesthe moderate quality was *Bosmina longirostris,* and *Daphnia longispina, Ascomorpha ovalis and Ascomorpha saltans* are the species of good water quality.

This review studyprovide a brief overview of the applications of biological indicators forthe aquatic ecosystem. Biological indicators are an environmentally friendly tool for evaluating water quality, and many documents show their advantages over thechemical assessment of environmental health. Hence by monitoring the water body biological indicators aid in the detection of anthropogenic and natural stress on the flora and fauna of the aquatic ecosystem.

Most records show the association of zooplanktons and phytoplanktons with abiotic and biotic factors as well as their role in the assessment of the water quality.As only one species is unable to detect the various pollutants present in the aquatic environment, a community of several biological indicators can be implemented for assessing the pollutants such as agricultural runoff, untreated sewage, industrial effluent, etc. Monitoring water bodies on a regular basis can provide an early warning of a deteriorating environment.Forretortion of the freshwater ecosystem, it is essential to employ the biomonitoring programs by the government as well as NGOs. with the public involvement. It will be helpful toframe out policy for the conservation of the aquatic ecosystem.

References :


1. Almeida, R., I. Sousa Pinto and S. C. Antunes (2020). *Limnetica, 39*(1): 245–261.
2. Ariyadej, C., R. Tansakul, P. Tansakul and S. Angsupanich, (2004) *Songklanakarin J. Sci. Technol., 26*(5): 595–607.
3. Barbieri, A., M. Veronesi, M. Simona, S. Malusardi and V. Straškrabová (1999). *Journal of Limnology*, *58*(2): 179.
4. Barka, S., I. Gdara, Z. Ouanes-Ben Othmen, S. Mouelhi, M. El Bour and A. Hamza-Chaffai (2020) *Environmental Science and Pollution Research*, *27*(6): 5670–5680.
5. Bellinger E. G. and D. C. Sigee (2010). Freshwater Algae: Identification and Use as Bioindicators: Wiley-Blackwell, Chichester, West Sussex, UK.
6. Duelli, P. and M. K. Obrist (2003). *Agriculture, Ecosystems & Environment*, *98*(1–3): 87–98.
7. Ferdous, Z. and A. K. M. Muktadir (2009) *American Journal of Applied Sciences*, *6*(10): 1815–1819.

8. Gazonato Neto, A. J., L. C. Silva, A. A. da, Saggio and O. Rocha (2014) *Biota Neotropica, 14*(4).
9. Gerhardt, A. (2002). *Environmental monitoring, 1*: 77–123.
10. Gsss, F. and P. Eilham (193AD). *Revue d'hydrobiologie tropicale, 16*(1): 3–34.
11. Gurav, M. N. and M. K. Pejaver (n.d.). *Online International Interdisciplinary Research Journal, 7*(1): 47–53.
12. Hanazato, T. (1998). *Environmental Pollution, 101*(3): 361–373.
13. Holt, E. and S. Miller (2010). *Nature Education Knowledge, 3*(10): 8.
14. Ismail, A. H. and A. A. Mohd Adnan (2016). *Tropical Life Sciences Research, 27*(3): 31–38.
15. Jakhar, P. (2013). A Review. *International Journal of Innovative Research and Studies, 2*(12): 13.
16. Karpowicz, M., Ł. Sługocki, J. Kozłowska, A. Ochocka and C. López (2020) *Ecological Indicators, 117:* 106585.
17. Khatri, N. and S. Tyagi (2015). *Frontiers in Life Science, 8*(1): 23–39.
18. Kulaš, A., V. Gulin, R. Matoničkin Kepčija, P. Žutinić, M. Sertić Perić, S. Orlić and M. Gligora Udovič (2021) *Ecological Indicators, 124:* 107430.
19. Li, Y. and F. Chen (2020). *Ecological Indicators, 113:* 106167.
20. Lomartire, S., J.C. Marques and A.M.M. Gonçalves (2021). *Ecological Indicators, 129*: 107867.
21. Muñoz-Colmenares, M. E., J. M. Soria and E. Vicente (2021). *Aquatic Ecology, 55:* 1143–1156.
22. Parmar, T.K., D. Rawtani and Y. Agrawal (2016) *Frontiers in life science, 9*(2): 110–118.
23. Rasheed, K. A., H. A. Flayyh and Dawood A. T. (2016) *International Journal of Environment, Agriculture and Biotechnology, 2*(1): 138–148.
24. Saha, A., R.K. Ghosh, P.K. Jesna and P.P. Choudhury (2021). *Sustainable Agriculture Reviews 48*: 185–231.
25. Senapati, T., S. Ghosh and T. Mandal (2011). *International Journal of Current Research, 3*(7): 053–055.
26. Singh, S. and R. C. Sharma (2020). Zooplankton diversity and potential indicator species for assessment water quality of high altitude wetland, Dodi Tal of Garhwal Himalaya, India. *Academia Arena, 12*(5): 1–16.
27. Singh, U. B., A. S. Ahluwalia, C. Sharma, R. Jindal and R. Thakur (2013). *Environment and Conservation, 19*(3): 793–800.
28. Stomp, M., J. Huisman, G. G. Mittelbach, E. Litchman and C. A. Klausmeier (2011). *Ecology, 92*(11): 2096–2107.
29. Thirugnanamoorthy, K. and M. Selvaraju (2009). *Recent Research in Science and Technology, 1*(5): 235–238.
30. Vaidya, S.R. (2017). A review. *International Journal of Biology Research, 2*(1): 14–15.
31. Wadjikar, B., A. Masram, M. M. Rai and A. Darvekar (2017) *International Journal Of Researches In Biosciences, Agriculture And Technology, 5*(2): 9.
32. Walsh, G. (1978) *Principles of Ecotoxicology. John Wiley & Sons, Inc., New York, 44*(127): 257–274.
33. Xiong, W., X. Huang, Y. Chen, R. Fu, X. Du, X. Chen and A. Zhan (2020). *Environmental Science and Ecotechnology, 1*: 100008.
34. Zaghloul, A., M. Saber, S. Gadow and F. Awad (2020). *Bulletin of the National Research Centre, 44*(1): 1–11.