ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 07 | July - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STUDY OF ZOOPLANKTONS DIVERSITY AS BIOINDICATOR OF WATER QUALITY IN NAVALPUR RESERVOIR M.P.

Zoology

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ABSTRACT

The diversity of plankton serves as an important biological indicator of the health of an environment, reflecting its overall ecological well-being. For the present study, the Navalpur Reservoir (Hardi Reservoir) was specifically chosen as the focal point. Zooplankton, which are vital components of fresh-water ecosystems, play a crucial role in the intricate aquatic food -chains. The primary objective of this study was to comprehensively evaluate the diversity, composition, and abundance of zooplankton in the Navalpur Reservoir located in M.P. Monthly sampling was conducted at selected sites within the reservoir to gather data. Zoo-plankton samples were methodically collected using a plankton-net and then preserved in 4% formalin for subsequent laboratory analysis. A total of 25 species, categorized into four major groups - Rotifera, Branchiopoda, Copepoda, and Ostracoda, were identified through the study. Among these groups, Copepoda was found to be the dominant one, followed by Rotifera, Branchiopoda, Cladocera, and Ostracoda. The species diversity exhibited a peak during the post-monsoon season and was at its lowest during the summer months. This study provides evidence that the Navalpur Reservoir sustains a diverse and abundant zooplankton community, indicating a moderate to good ecological health status.

KEYWORDS

Zooplankton, Diversity, Reservoir, Rotifera, May-fly Nymph, Cladocera, Bio-indicator, Navalpur.

INTRODUCTION

Plankton communities serve as important indicators of the overall health of freshwater aquatic ecosystems. Inland freshwater bodies, such as ponds, lakes, tanks, pools, puddles, and swamps, play a crucial role in providing resources and habitats for both aquatic and terrestrial animals. Plankton are highly vulnerable to the effects of water pollution, as supported by various studies (Zelalem 2015, Kumar et al. 2015, 2020). Plankton are categorized based on their size, including mega-plankton (larger than 3 mm), macroplankton (less than 3 mm), microplankton (less than 1 mm), and nanoplankton (less than 60μ). They form the primary food source for herbivorous and omnivorous fish species, including Indian Major Carps (IMC) and all commercial fishes in riverine ecosystems, as evidenced by multiple research studies (Alam et al. 2015, Dwivedi et al. 2019, Dwivedi & Mishra 2023). Additionally, plankton also serve as a crucial food source for zooplankton, as indicated by research findings (Islam et al. 2020, 2022). The populations of plankton are influenced by various factors such as nutrient availability, temperature, sunlight, and water currents, making them integral components of ecosystems.

Freshwater eco-systems are home to a diverse range of biological communities that play a crucial role in maintaining ecological balance and promoting aquatic productivity. Within these communities, zoo-plankton are particularly important as primary consumers, forming a vital link between phyto-plankton and higher trophic levels, such as fishes. Zoo-plankton are highly sensitive to changes in their environment, making them effective bioindicators of water quality. The species composition, abundance, and diversity of zoo-plankton reflect the trophic status and overall ecological condition of aquatic ecosystems. Changes in physicochemical parameters directly impact zooplankton communities, providing valuable insights into pollution, eutrophication, and habitat degradation. Navalpur Reservoir (Hardi Reservoir), located in the Shahdol District of M.P. , serves important functions such as irrigation, fisheries, and domestic use. Despite its ecological significance, there is limited available information on the relationship between zooplankton diversity and water quality in Navalpur Reservoir. Therefore, the current study aims to assess zooplankton diversity and its potential as a bioindicator of water quality in Navalpur Reservoir.

Zooplankton as Bio-indicators of Water Quality

Zooplankton serve as effective biological indicators for monitoring aquatic health and contamination levels due to their vulnerability to environmental variations. These organisms play a vital ecological role as a bridge between primary producers and fish populations, and their short lifespans make them highly responsive to changes in pollutant loads or water characteristics. Zoo-plankton communities exhibit immediate sensitivity to physical and chemical changes in water, including nutrient enrichment (eutrophication), heavy metal influx, and organic pollution from domestic sewage, making them valuable indicators of anthropogenic stress. In pristine conditions, zooplankton communities maintain a balanced distribution among major groups such as Rotifera, Cladocera, and Copepoda. However, in polluted or degraded waters, the community structure shifts, with pollution-tolerant species like certain Brachionus species proliferating rapidly, signaling ecological imbalance.

Objectives

1. The primary objective is to identify and document the various species of zooplankton found in Navalpur Reservoir.
2. An important aspect of this study is to assess the diversity and abundance of zooplankton communities within the reservoir.
3. To evaluate the relationship between zooplankton diversity and water quality.
4. To determine the ecological status of the reservoir by utilizing zooplankton as bio-indicators

MATERIALS AND METHODS :-

- Description of the study area.
- Identification of Zooplankton.
- Collection of Zooplankton.

DESCRIPTION OF THE STUDY AREA

The study was carried out at Navalpur Reservoir, located in Shahdol District, Madhya Pradesh. Navalpur Reservoir, also known as Hardi Reservoir, is situated in the Nawalpur, Dhurwar area of Shahdol and serves as a crucial irrigation source for local farmers. This reservoir, situated on Dhurwar and Nawalpur Road under Sohagpur district of Shahdol district, has the primary goal of providing water for agricultural and irrigation purposes. In addition to its role in irrigation, the reservoir is conducive to reservoir fish culture, supporting the cultivation of various types of fishes and aquatic animals. It is replenished by the local topography and natural rainwater flow, which aids in maintaining the groundwater level in the surrounding area. The presence of the Son River near Navalpur Reservoir, along with the nearby Sarfa Dam, significantly contributes to the water supply, including drinking water for Shahdol City. The area is well connected to the Nawalpur main road and the surrounding areas of Dhurwar, Jamui, and Hardi.

COLLECTION OF ZOOPLANKTONS

Hroughout the study period, water samples were collected on a monthly basis. Roughly 50 liters of water underwent filtration using a plankton net with a mesh size of 64 μm. The Zoo-plankton samples obtained were preserved in a 4% formalin solution and then transported to the laboratory for identification. The sampling took place in the morning from 7:00 to 8:00 and in the evening from 17:00 to 18:00, specifically chosen to avoid high water temperatures that can affect the behavior of Zoo-plankton, which are known to be sensitive to temperature changes.

IDENTIFICATION OF ZOOPLANKTONS

Identification of Zooplankton was made easier through the use of taxonomic keys obtained from different sources. These sources

include the Work book of Limnology by A.D. Adoni Pennak (1978), Sehgal (1983), Needham, Edmondson (1959), Battish (1992), Needham (1962), Tonapi (1980), and the American Public Health Association (APHA) (1980). The taxonomic keys provided systematic guidance for distinguishing different species of zoo-plankton based on their morphological characteristics and other defining features.

RESULTS

The results of our study revealed that Copepoda and Rotifera were the dominant groups of zooplankton, followed by Branchipoda, Ostracoda, and Cladocerans. Despite being a minor phylum, rotifers are both qualitatively and quantitatively the most abundant plankton in inland waters, and they are widely distributed worldwide. The presence of a high number and abundance of Rotifers indicates a better quality of the reservoir from a limnological perspective. Rotifers play a crucial role in the aquatic food chain, serving as a significant link between nano-plankton and carnivorous zoo-plankton, and they contribute to the cycling of organic material while forming a substantial component of the diet of larval fish. Their diet includes algae, dinoflagellates, bacteria, and diatoms. Previous studies have also underscored the significance of rotifers, highlighting their quantitative dominance in many Indian reservoirs (Somani, 2002).

Copepod species were also found to be the most abundant, indicating their dominant status in the lake. Due to their predatory roles, copepods help in controlling the population of large phyto-plankton and releasing small phyto-plankton from grazing pressure by protozoans and other competitors (Sommer and Sommer, 2006).

Zooplankton Composition

A total 32 Zoo-plankton sp. were recorded.

Table No.1-Showing percentage of Zooplanktons

S.N	CLASS	SPECIES	PERCENTAGE
1	Copepoda	10	33.33
2	Rotifera	07	23.33
3	Beanchiopoda	07	23.33
4	Ostracoda	05	13.33
5	Cladocera	03	6.67

Copepoda, Rotifera was the most dominant group followed by Beanchiopoda and Ostracoda.

Common Species Recorded

- Brachionus calyciflorus
- Brachionus angularis
- Keratella cochlearis
- Asplanchna sp.
- Daphnia pulex
- Ceriodaphnia sp.
- Moina micrura
- Cyclops sp.
- Mesocyclops sp.
- Cypris sp.
- May-fly nymphs

During my study at the Navalpur Reservoir, I observed that apart from Rotifera, Daphnia, Moina, Cypris, Copepoda, and other Zooplanktons, the May-fly Nymph was also present in large numbers. May-fly Nymph is a water indicator and is highly sensitive to polluted water. If its quantity is present in any water reservoir, then the water there will be pure. And the oxygen level will be higher, which is a very good thing for fish culture.

The presence of May-fly nymphs in a pond or body of water generally signifies that the water is clean, devoid of pollution, and possesses high levels of oxygen. In the field of limnology, these May-fly nymphs are regarded as bio-indicators.
In addition to water quality, they also signify the following:

Excellent Water Quality: Mayfly nymphs are unable to survive in polluted waters (such as those contaminated with heavy metals or acidic substances). A significant population of these nymphs indicates a thriving pond ecosystem.

High Dissolved Oxygen: These organisms respire through delicate gills situated near their abdomen, which necessitate sufficient oxygen for proper functioning.

Sufficient food and habitat: They consume algae, detritus, and aquatic plants found at the pond's bottom. Their presence reflects a well-functioning aquatic food web within the pond.

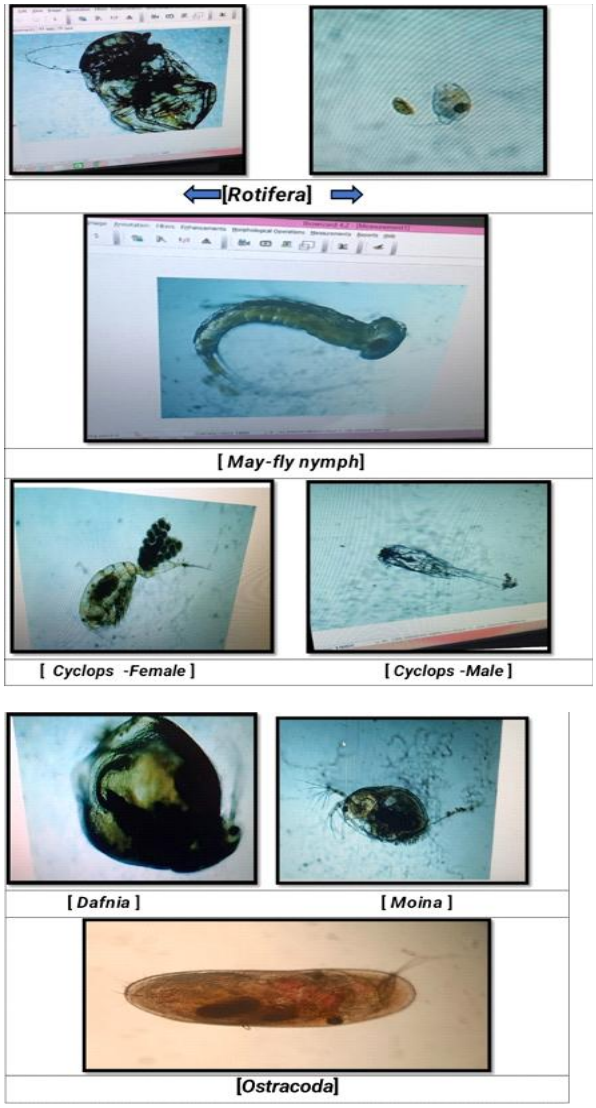

Image No. 01: Some Identified Zooplankton species

Diversity Indices

- Shannon-Wiener Index (H'): 2.45–3.12
- Simpson Diversity Index: 0.82–0.91
- Species Richness; Moderate to High

The highest diversity was recorded during the post-monsoon season, while the lowest diversity occurred during summer.

DISCUSSION

The study's findings of Copepoda and Rotifera dominance suggest that the reservoir is nutrient-enriched. Eutrophic environments are commonly indicated by species like Beanchiopoda, Ostracoda, and Cladocera. Nonetheless, the presence of Copepoda and Cladocera in considerable quantities indicates that the reservoir continues to preserve a sound biological balance. The favorable environmental conditions for aquatic creatures are indicated by the positive correlation between zooplankton diversity and dissolved oxygen. Temperature, nutrient availability, and phytoplankton productivity all had an impact on seasonal variations in zooplankton abundance.

When a pond or body of water has an abundance of mayfly nymphs, it is a strong indicator that the water quality is excellent, as these aquatic insects are highly sensitive to pollution and can only thrive in clean, oxygen-rich water. The presence of a large number of mayfly nymphs in a body of water signifies that the water is free from pollution, as these organisms cannot tolerate impurities such as acidity or

chemicals, indicating chemical-free water. Mayfly nymphs require clean and high levels of dissolved oxygen in the water to breathe, emphasizing the importance of adequate oxygen for their survival. The presence of mayfly nymphs contributes to an improved ecosystem, as they primarily feed on algae and organic waste, serving as a vital food source for smaller fish and contributing to a healthy food web. Environmentalists and scientists view may-fly nymphs as significant bioindicators for measuring the overall health of water bodies, recognizing their role in assessing water quality.

CONCLUSION

The present investigation revealed rich zooplankton diversity in Navalpur Reservoir. Copepoda and Rotifera was the dominant zooplankton group, followed by Beanchiopoda and Ostracoda, Cladocera. The diversity and composition of zooplankton were closely associated with water quality parameters, demonstrating their importance as biological indicators.

The study concludes that Navalpur Reservoir exhibits to good ecological health and that zooplankton communities can serve as effective bioindicators for monitoring water quality and ecosystem status.

In the aquatic ecosystem, phyto-plankton and zoo-plankton play a crucial role as primary organisms in the food chain, making it essential to understand their significance. Zooplankton depend heavily on phytoplankton for survival and serve as key components in the formation of the aquatic food web. A recent study has revealed an abundance of plankton in the area, indicating the presence of clean water due to minimal anthropogenic activities, making it an ideal environment for fish culture. Among the plankton, May-fly nymphs are commonly used as bio-indicators of water quality due to their inability to survive in polluted water, while also serving as a vital food source for fish and other aquatic organisms. The diversity of plankton in Navalpur Bandha, Shahdol District effectively reflects the water quality, indicating signs of nutrient enrichment in the reservoir.

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