

Seasonal Dynamics of Zooplankton Species Richness in Barur Lake, Krishnagiri District, Tamil Nadu, India

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Abstract

Zooplankton communities are widely recognized as sensitive indicators of ecological conditions in freshwater environments and play a significant role in assessing aquatic biodiversity. Among the available biodiversity indices, Margalef's Species Richness Index (Dmg) provides an effective measure of species richness relative to the total number of individuals recorded. The present investigation examined the seasonal variation in zooplankton diversity in Barur Lake, located in Krishnagiri District, Tamil Nadu, India, over a one-year period from January to December 2024. Monthly observations documented forty-nine zooplankton species comprising 19 species of Rotifera, 11 Cladocera, 12 Copepoda, and 7 Ostracoda. Rotifers remained the dominant group throughout the study. Species richness reached its highest level during the summer season, whereas relatively lower richness was observed during the monsoon, likely because of increased water volume, dilution effects, and turbidity. Seasonal changes in Margalef's Species Richness Index effectively reflected variations in zooplankton diversity and indicated that Barur Lake supports a moderately stable freshwater ecosystem capable of sustaining diverse aquatic communities. Continuous biodiversity monitoring using species richness indices can provide valuable scientific information for the conservation and sustainable management of freshwater ecosystems.

Keywords: Margalef's Species Richness Index, Zooplankton Diversity, Freshwater Ecosystem, Seasonal Variation, Barur Lake, Krishnagiri District.

Introduction

Freshwater ecosystems represent biologically productive habitats that sustain a wide variety of aquatic organisms and contribute substantially to ecological balance and ecosystem functioning. Within these ecosystems, zooplankton occupy an important ecological position by transferring energy from phytoplankton to higher trophic levels while responding rapidly to environmental changes. Consequently, their community structure and composition are frequently employed as reliable indicators of water quality, trophic status, and overall ecosystem health (Wetzel, 2001; Edmondson, 1959).

Seasonal fluctuations in zooplankton assemblages are largely governed by changes in physicochemical characteristics such as water temperature, dissolved oxygen, nutrient availability, pH, and other environmental variables. These seasonal responses provide valuable insights into ecological processes occurring within freshwater habitats and assist in evaluating environmental quality (APHA, 2017). The year-long investigation conducted in Barur Lake revealed the occurrence of diverse zooplankton

communities distributed among four major taxonomic groups, demonstrating considerable seasonal variation throughout the study period.

Species richness is one of the most fundamental measures used to evaluate biological diversity in ecological investigations. Among several biodiversity indices, Margalef's Species Richness Index has gained wide acceptance because it estimates species richness by relating the number of species to the total number of individuals sampled (Margalef, 1958). Unlike the Shannon–Wiener Diversity Index, which incorporates both species richness and evenness (Shannon & Weaver, 1949), Margalef's index specifically emphasizes richness, making it particularly suitable for comparing biodiversity among freshwater ecosystems and for detecting seasonal changes in aquatic communities.

The present study was therefore undertaken to evaluate seasonal variation in zooplankton species richness in Barur Lake using Margalef's Species Richness Index. The findings provide useful information on the ecological status of the lake and contribute to the understanding of freshwater biodiversity for conservation and sustainable management.

Materials and Methods

Barur Lake is a perennial freshwater water body situated in Krishnagiri District, Tamil Nadu, India. Monthly sampling was carried out from January to December 2024 to assess seasonal variations in zooplankton diversity. Approximately 100 litres of surface water were filtered through a plankton net with a mesh size of 150 µm, and the collected samples were preserved in 4% formalin for subsequent laboratory examination.

Physicochemical parameters including water temperature, pH, dissolved oxygen, electrical conductivity, and total dissolved solids were determined following standard procedures recommended by APHA (2017). Zooplankton specimens were identified using standard taxonomic keys. Biodiversity was evaluated using commonly accepted ecological indices, namely the Shannon–Wiener Diversity Index, Simpson's Dominance Index, Pielou's Evenness Index, and Margalef's Species Richness Index, to assess seasonal variation in community structure and species richness.

Results and Discussion

The physicochemical characteristics of Barur Lake exhibited noticeable seasonal fluctuations throughout the investigation period, reflecting the influence of changing climatic conditions on the aquatic environment. Water temperature reached its highest values during the summer months and declined considerably during the monsoon season. The pH remained consistently within the slightly alkaline range, indicating favourable conditions for the survival of freshwater organisms. Dissolved oxygen concentrations were comparatively higher during winter and lower in summer, suggesting seasonal variation in water quality associated with temperature and biological activity.

A total of forty-nine zooplankton species were recorded during the study, comprising nineteen species of Rotifera, eleven Cladocera, twelve Copepoda, and seven Ostracoda. Among these groups, rotifers were consistently the most abundant throughout the sampling period, indicating their adaptability to the prevailing environmental conditions of Barur Lake. The continuous occurrence of representatives from all four major zooplankton groups demonstrates that the lake supports a moderately diverse and ecologically functional freshwater community.

Seasonal analysis using Margalef's Species Richness Index revealed distinct temporal variation in zooplankton diversity. The highest species richness was observed during the summer season, which may

be attributed to favourable environmental conditions, including elevated water temperature and enhanced primary productivity that promote zooplankton growth and reproduction. In contrast, species richness declined during the monsoon period, possibly because increased inflow, dilution of nutrients, and higher turbidity altered habitat conditions and reduced the suitability of the environment for several zooplankton species. Similar seasonal trends have been reported from other tropical freshwater ecosystems, where maximum zooplankton richness generally occurs during the pre-monsoon or summer period.

Unlike diversity indices that simultaneously consider both species richness and evenness, Margalef's Species Richness Index specifically measures the number of species relative to the total number of individuals, making it particularly useful for evaluating seasonal changes in biodiversity. The observed variation in the index effectively reflected changes in zooplankton assemblages across different seasons. Furthermore, the year-round persistence of Rotifera, Cladocera, Copepoda, and Ostracoda suggests that Barur Lake maintains ecological continuity despite seasonal environmental fluctuations.

Overall, the present findings indicate that Barur Lake possesses moderate ecological integrity and provides favourable conditions for sustaining freshwater biodiversity. Seasonal changes in environmental variables influenced the composition and richness of zooplankton communities, yet the ecosystem continued to support diverse aquatic fauna. These observations emphasize the ecological significance of the lake and underline the importance of regular biodiversity monitoring for assessing ecosystem health and supporting sustainable freshwater resource management.

Conclusion

The present investigation demonstrated that Margalef's Species Richness Index is an effective ecological indicator for assessing seasonal variation in zooplankton biodiversity in Barur Lake. The index successfully reflected fluctuations in species richness throughout the study period, with the highest values recorded during summer and comparatively lower values during the monsoon season. These seasonal differences highlight the influence of hydrological and environmental conditions on the structure of freshwater zooplankton communities.

The occurrence of forty-nine zooplankton species representing four major taxonomic groups indicates that Barur Lake supports a moderately diverse and ecologically stable freshwater ecosystem. The predominance of rotifers throughout the investigation further suggests favourable ecological conditions for maintaining aquatic biological productivity. Collectively, these findings demonstrate that Margalef's Species Richness Index is a practical and reliable tool for evaluating freshwater biodiversity and detecting seasonal ecological changes.

Long-term ecological monitoring that integrates biodiversity indices with physicochemical parameters will provide a more comprehensive understanding of ecosystem dynamics and facilitate evidence-based conservation and management strategies for freshwater lakes. Such approaches will contribute to the sustainable utilization and protection of aquatic resources while preserving biological diversity in freshwater ecosystems.