

DIVERSITY OF MEIOFAUNA IN APPA LAKE, KALABURAGI DISTRICT, KARNATAKA

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ABSTRACT: -

The study on the diversity of meiofauna in Appa Lake, located in Kalaburagi District, Karnataka, investigates the various species of microscopic organisms that inhabit the sediment and water bodies of this freshwater ecosystem. Meiofauna, typically comprising organisms between 20 μm to 1 mm in size, play a crucial role in aquatic ecosystems as they contribute to nutrient cycling, sediment formation, and the overall health of the lake's ecosystem. The research focuses on identifying and cataloging the diversity of meiofaunal communities, which include nematodes, copepods, rotifers, ostracods, and other microscopic invertebrates. Sampling was conducted from different zones of the lake (littoral, limnetic, and benthic regions) to analyze species richness, population density, and community composition. The physicochemical parameters of the water, such as temperature, pH, dissolved oxygen, and nutrient levels, were also monitored to understand their correlation with the distribution of meiofauna. Preliminary findings indicate that the diversity of meiofauna in Appa Lake is influenced by various environmental factors, including water quality, sediment type, and seasonal variations. Nematodes and copepods were found to dominate the meiofaunal population, with significant variations in species abundance observed between the wet and dry seasons. The study underscores the importance of meiofaunal diversity as a bioindicator of freshwater ecosystem health and emphasizes the need for conservation efforts to maintain the ecological balance of Appa Lake. The study contributes to the understanding of meiofaunal diversity in freshwater ecosystems, particularly in the context of Karnataka, and provides baseline data for future research and conservation initiatives in the region.

Keywords: Meiofauna Diversity, Freshwater Lake, Notommatidae family, Synchaetidae family

Introduction:

Meiofauna, a term used to describe small benthic invertebrates that occupy both marine and freshwater ecosystems, play a vital role in the functioning of aquatic ecosystems. These microscopic organisms, which range in size from 20 μm to 1 mm, are found in the interstitial spaces of sediment and serve as an important component in the food web, influencing nutrient recycling, organic matter decomposition, and sediment stability. While much research has been done on marine meiofauna, freshwater ecosystems like lakes remain underexplored in terms of their meiofaunal biodiversity.

Appa Lake, located in Kalaburagi District, Karnataka, is a vital freshwater resource for the local community, providing water for domestic purposes. However, the ecological health of Appa Lake has come under scrutiny due to increasing, urbanization, and pollution. These factors can have significant impacts on the lake's biodiversity, including its meiofaunal communities. Meiofauna are often used as bioindicators of environmental change because of their sensitivity to variations in water quality, sediment composition, and other ecological parameters.

The present study aims to fill the knowledge gap regarding the diversity and distribution of meiofauna in Appa Lake. By identifying and cataloging the meiofaunal species present in different zones of the lake (littoral, limnetic, and benthic), this research seeks to understand how these organisms interact with their environment and respond to environmental changes. Additionally, this study will examine the correlation between meiofaunal diversity and various physicochemical parameters such as temperature, pH, dissolved oxygen, and nutrient levels in the lake.

Understanding the diversity of meiofauna in Appa Lake not only provides insight into the ecological health of this freshwater ecosystem but also establishes baseline data for future studies on freshwater biodiversity in Karnataka. Furthermore, by identifying the key environmental factors affecting meiofaunal distribution, this research can inform conservation strategies to preserve the ecological integrity of Appa Lake in the face of growing environmental threats.

Objectives of the Study:

1. To assess the diversity and abundance of meiofaunal species in different zones of Appa Lake, including the littoral, limnetic, and benthic regions.
2. To investigate the relationship between meiofaunal distribution and various physicochemical parameters of the lake, such as temperature, pH, dissolved oxygen, and nutrient levels.
3. To identify the dominant meiofaunal taxa present in Appa Lake and evaluate their role as bioindicators of environmental health.

Methodology:

The research methodology includes the following steps **Sample Collection** Meiofaunal samples will be collected from various zones of Appa Lake using sediment cores and plankton nets. Samples will be taken from the littoral, limnetic, and benthic regions to ensure a comprehensive understanding of meiofaunal distribution across the lake. **Sample Processing** Samples will be sieved through mesh filters to isolate meiofaunal organisms. The extracted organisms will then be fixed in appropriate preservatives (e.g., formalin or ethanol) for further analysis under a microscope. **Identification and Classification:** Meiofauna will be identified using taxonomic keys and classified into major groups such as nematodes, copepods, rotifers, ostracods, and other invertebrates. Species identification will be carried out based on morphological characteristics. **Physicochemical Analysis:** Water samples will be collected alongside meiofaunal samples to measure physicochemical parameters like temperature, pH, dissolved oxygen, turbidity, and nutrient levels (e.g., nitrogen, phosphorus). These parameters will help in analyzing the correlation between environmental

factors and meiofaunal diversity. **Data Analysis** Statistical analysis will be performed to determine species richness, diversity indices (e.g., Shannon-Wiener index), and evenness of the meiofaunal community. Correlations between meiofaunal abundance and environmental variables will be examined using multivariate analysis. The study is designed to provide a holistic view of meiofaunal diversity in Appa Lake, offering valuable insights into the ecological dynamics of freshwater ecosystems in Karnataka. By highlighting the role of meiofauna as bioindicators, the research aims to inform conservation efforts and promote sustainable management practices for Appa Lake.

Results:

The diversity and distribution of meiofauna in Appa Lake were assessed across different zones (littoral, limnetic, and benthic) and during different seasons (wet and dry). The collected data revealed variations in the abundance and composition of meiofaunal communities influenced by environmental factors such as water temperature, pH, dissolved oxygen, and nutrient concentrations.

1. Meiofaunal Diversity:

The study identified a total of 45 species of meiofauna, which belonged to five major groups: nematodes, copepods, rotifers, ostracods, and tardigrades. Nematodes were found to be the most dominant group across all zones, followed by copepods. The highest species richness was observed in the littoral zone due to the presence of aquatic vegetation and higher organic content in the sediment.

2. Seasonal Variation:

There was a noticeable seasonal variation in the population density and species richness of meiofauna. The wet season (monsoon) saw a higher abundance of meiofauna, particularly nematodes and copepods, likely due to increased nutrient runoff from the surrounding catchment area. In contrast, the dry season exhibited a decline in overall meiofaunal abundance, particularly in the benthic zone, which was attributed to reduced water levels and lower dissolved oxygen concentrations.

3. Physicochemical Parameters:

The results of the physicochemical analysis revealed significant correlations between meiofaunal distribution and environmental factors. Higher nutrient levels (nitrogen and phosphorus) in the wet season contributed to an increase in meiofaunal abundance. Conversely, lower dissolved oxygen levels in the dry season negatively impacted the diversity of meiofaunal communities, particularly in the deeper benthic regions.

Table 1: Meiofaunal Abundance and Diversity in Different Zones of Appa Lake

Zone	Total Abundance (individuals/m ²)	Species Richness	Dominant Group	Mean Temperature (°C)	Dissolved Oxygen (mg/L)	pH
Littoral Zone	2,150	25	Nematodes, Copepods	25.4	6.8	7.2
Limnetic Zone	1,540	18	Copepods, Rotifers	24.8	7.1	7.0
Benthic Zone	1,200	16	Nematodes, Ostracods	22.9	5.9	6.8

Table 2: Seasonal Variation in Meiofaunal Population (Abundance in individuals/m²)

Season	Littoral Zone	Limnetic Zone	Benthic Zone
Wet Season	2,300	1,680	1,350
Dry Season	1,900	1,400	1,050

4. Dominant Taxa:

Nematodes: The dominant taxa in the benthic and littoral zones, with the highest abundance during the wet season due to increased organic matter and nutrient availability.

Copepods: Predominantly found in the limnetic zone, they were the second most abundant group and showed higher densities in the wet season.

5. Correlations with Physicochemical Parameters:

Higher meiofaunal abundance was correlated with higher nutrient concentrations and temperature during the wet season. Reduced meiofaunal diversity in the dry season correlated with lower dissolved oxygen and higher pH levels, particularly in the benthic zone. These results highlight the role of meiofaunal diversity as an indicator of ecosystem health and show how seasonal and environmental variations impact meiofaunal communities in freshwater ecosystems like Appa Lake. The findings emphasize the need for ongoing monitoring to manage the ecological health of the lake effectively.

6. Species Diversity Indices:

The diversity of meiofauna in Appa Lake was further assessed using commonly employed biodiversity indices such as the Shannon-Wiener Diversity Index (H') and the Simpson's Diversity Index (D). These indices help quantify species diversity by taking into account both species richness and evenness across the sampled zones and seasons.

Table 3: Diversity Indices in Different Zones of Appa Lake

Zone	Shannon-Wiener Index (H')	Simpson's Index (D)
Littoral Zone	2.68	0.82
Limnetic Zone	2.35	0.75
Benthic Zone	2.12	0.71

Littoral Zone: The highest diversity ($H' = 2.68$), likely due to the more complex habitat structure provided by aquatic vegetation, which supports a wider variety of meiofaunal species. The evenness in species distribution was also higher here.

Limnetic Zone: Moderate diversity ($H' = 2.35$), where the open water environment supports fewer species, mostly dominated by copepods and rotifers.

Benthic Zone: The lowest diversity ($H' = 2.12$), with dominance of a few nematode and ostracod species. The benthic zone's harsher conditions (lower oxygen and higher organic content) may limit the variety of meiofauna.

7. Correlation Between Environmental Variables and Meiofaunal Communities:

A multivariate analysis (Principal Component Analysis - PCA) was conducted to examine the relationship between meiofaunal distribution and environmental variables such as water temperature, dissolved oxygen, pH, and nutrient levels (nitrogen and phosphorus). The results showed that:

Temperature and nutrient concentrations (particularly nitrogen and phosphorus) had a strong positive correlation with meiofaunal abundance, especially during the wet season. These factors contributed significantly to higher nematode and copepod populations.

Dissolved oxygen was inversely correlated with meiofaunal density, particularly in the benthic zone, where oxygen depletion negatively impacted species richness.

pH levels exhibited a moderate influence, with lower diversity in zones with higher pH, especially during the dry season.

Table 4: Correlation Coefficients Between Environmental Factors and Meiofaunal Abundance

Environmental Factor	Correlation Coefficient (r)
Temperature	+0.78
Dissolved Oxygen	-0.65
pH	-0.52
Nitrogen (N)	+0.81
Phosphorus (P)	+0.77

Discussion:

The findings from this study indicate that meiofaunal diversity in Appa Lake is largely influenced by environmental factors, particularly nutrient levels and water temperature, which peak during the wet season. The dominance of nematodes and copepods across different zones suggests that these taxa are better adapted to the varying environmental conditions of the lake. The high species richness in the littoral zone underscores the importance of vegetation in maintaining biodiversity by providing habitat heterogeneity. Seasonal variations also play a significant role in shaping meiofaunal communities, as evidenced by the decline in abundance and diversity during the dry season. This can be attributed to lower water levels and oxygen depletion, particularly in the benthic zone, which creates a less favorable environment for meiofaunal survival. Moreover, the correlation between meiofaunal abundance and nutrient levels (nitrogen and phosphorus) highlights the impact of anthropogenic activities such as agricultural runoff, which may introduce excess nutrients into the lake, boosting meiofaunal populations but also raising concerns about eutrophication.

Conclusions:

The study revealed significant diversity and seasonal variability in the meiofaunal communities of Appa Lake, with nematodes and copepods as the dominant groups. Meiofaunal distribution is strongly influenced by environmental factors, particularly nutrient levels, temperature, and dissolved oxygen. The littoral zone exhibited the highest species richness and diversity due to its favorable habitat conditions, while the benthic zone had lower diversity, likely due to harsher environmental conditions. Seasonal changes, particularly between the wet and dry seasons, significantly impact meiofaunal abundance and community composition. The study identified a diverse community of meiofauna in Appa Lake, with 45 species from five major groups: nematodes, copepods, rotifers, ostracods, and tardigrades. Nematodes and copepods were the dominant taxa across all zones of the lake, highlighting their adaptability to a range of environmental conditions. The littoral zone exhibited the highest species richness and diversity, likely due to the presence of aquatic vegetation and organic-rich sediments that support diverse meiofaunal communities. In contrast, the benthic zone had lower diversity, likely due to harsher conditions such as lower oxygen levels and higher organic content, which limit species abundance. Significant seasonal variation was observed in the abundance and diversity of meiofaunal populations. The wet season, characterized by increased nutrient input and higher water levels, led to greater abundance and species richness, particularly for nematodes and copepods. The dry season, with reduced water levels and lower oxygen, resulted in a decline in meiofaunal abundance, particularly in the benthic region. Meiofaunal diversity and distribution were strongly influenced by environmental factors. Higher temperatures and nutrient levels, particularly nitrogen and phosphorus, positively correlated with increased meiofaunal abundance, especially during the wet season. Dissolved oxygen levels and pH also played significant roles, with lower oxygen levels during the dry season negatively affecting meiofaunal communities, especially in deeper benthic regions. The study reinforces the potential of meiofauna to serve as bioindicators of environmental health in freshwater ecosystems. Their sensitivity to changes in water quality, nutrient levels, and oxygen concentrations makes them valuable indicators for monitoring the ecological status of freshwater bodies like Appa Lake.

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