Short communication

Seasonal dynamics of rotifer community in relation to water quality at Pravara-Godavari river confluence (Ahmednagar, MS, India)

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ABSTRACT. This study reports the diversity, abundance, and seasonal dynamics of the rotifer community in the Pravara-Godavari river confluence, Ahmednagar, throughout a year, from November 2024 to October 2025. Seasonal sampling was conducted to assess rotifer species composition and density, and to measure key physicochemical water parameters, including temperature, pH, dissolved oxygen, turbidity, alkalinity, hardness, and chloride. A total of 19 rotifer species, representing 4 genera and 3 families, were recorded in the study area. Strong temporal variation in population structure was indicated by the rotifer community's noticeable seasonal variations in both species richness and density. The summer period recorded the highest rotifer diversity and abundance. At the same time, the monsoon season had the lowest values, perhaps due to a dilution effect, increased water turbulence, and altered habitat stability. Furthermore, correlation analysis showed that important physicochemical parameters such as pH, water temperature, turbidity, alkalinity, total hardness, chloride concentration, and dissolved oxygen had a significant impact on rotifer species richness. These results demonstrate that even small changes in water quality can significantly impact the composition of rotifer communities. Overall, the study highlights rotifers' sensitivity to environmental factors and underscores their value as reliable bioindicators for evaluating freshwater ecosystems.

Keywords: species diversity, bioindicator, rotifer abundance, water quality, freshwater ecosystem

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1. Introduction

Rotifers (Phylum Rotifera) are among the oldest metazoan groups (Barnes, 1993) and dominate zooplankton assemblages in freshwater ecosystems. They exhibit distinct seasonal dynamics closely regulated by physicochemical parameters, confirming their ecological sensitivity and reliability as bioindicators for assessing freshwater quality and environmental change (Arora and Mehra, 2003). A rotifer taxon of considerable diversity is frequently found in various types of stabilization ponds, polluted rivers, and lentic ecosystems such as village ponds (Sládeček, 1983). Rotifer species composition and abundance are suggested to be strongly associated with ecosystem health status, and individual species may reflect the level of eutrophication (Rogozin, 2021). In tropical and subtropical regions such as India, seasonal variations, including the Monsoon, Post-Monsoon, Winter, and Summer, play a pivotal role in shaping aquatic environments. The present study aims to investigate seasonal variation in rotifer diversity and abundance at the Pravara-Godavari river confluence in Ahmednagar (Ahilyanagar) district, Maharashtra, India. We also analyze the influence of key physicochemical parameters on their distribution. River confluences create dynamic environmental gradients that strongly influence the distribution, diversity, and metabolic activity of microorganisms, making these zones critical for understanding microbial ecology and river health (Hui et al., 2022). By examining these interactions across different seasons, the study provides important baseline data. It enhances our understanding of how environmental variability shapes zooplankton communities in freshwater ecosystems.

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The study of the Godavari River at Kaygaon Toka and Kopargaon revealed significant seasonal and spatial variations in water quality, with several parameters at Kopargaon exceeding drinking water standards, indicating localized pollution impacts (Rathod and Shinde, 2011). The study by Thitame et al. (2010) examines seasonal variations in physicochemical parameters and irrigation suitability of water from the Pravara River at Sangamner, Ahmednagar district. Overall, research on the seasonal dynamics of rotifer communities, particularly at the Pravara–Godavari river confluence, is limited. Most available studies are either broader zooplankton surveys, general diversity assessments, or seasonal studies in other freshwater bodies and water quality contexts. The Pravara–Godavari river confluence is an ecologically significant zone where seasonal runoff, hydrological mixing, and watershed activities influence water quality and biological communities. Despite its importance, detailed studies on rotifer dynamics remain limited. Assessing seasonal variations of rotifers in relation to physicochemical parameters provides essential baseline data for understanding community responses, evaluating water quality, and supporting sustainable management under increasing anthropogenic pressure.

Ahmednagar (Ahilyanagar) is the largest district in terms of area. It is situated in the middle of western Maharashtra, India. The district has a total area of 17196 sq. km, making it the largest district in Maharashtra. The Pravara-Godavari river confluence is located at Pravaranagar in Ahmednagar district, Maharashtra, where the Pravara and Godavari rivers meet. The Pravara River is about 200-208 km long in Ahmednagar, flowing eastward and gathering tributaries such as the Mula and Mahalungi before meeting the Godavari at Pravara Sangam. The region falls within the semi-arid zone and experiences a tropical monsoon climate, characterized by three major seasons: the Monsoon (July to November) Winter (December to February) and Summer (March to June).

2. Materials and Methods

2.1. Study area

The study was conducted at the Pravara–Godavari river confluence in Ahmednagar (Ahilyanagar) district, Maharashtra, India. Two sampling sites were selected at the confluence zone: site 1 (latitude 19.621814° N; longitude 75.018419° E) and site 2 (latitude 19.622778° N; longitude 75.015309° E). The geographic locations were recorded using GPS, and a site map was prepared to depict the sampling stations.

2.2. Sample collection and analysis

Rotifer samples were collected seasonally from both sites. Sampling was carried out using a standard plankton net with a 40 μm mesh size over the period of one year (October 2024 to September 2025). The plankton net was pulled horizontally at ~1 m below the water surface and towed for a distance of 10 m. The collected samples were transferred to clean polyethene bottles and preserved in 4% formalin for laboratory analysis. Physicochemical parameters were analysed according to standard methods. Water temperature and pH were measured on-site using portable field instruments. Dissolved oxygen (DO) was measured in situ and later determined in the laboratory using Winkler's method. Turbidity was measured using a Secchi disc. Other chemical parameters, such as alkalinity, hardness, and chloride, were analysed using standard titrimetric and laboratory procedures.

All zooplankton were left to settle at the bottom. The concentrated sample was examined using a LABOMED Lx 300 binocular microscope. Microphotographs were taken using a digital camera attached to the microscope. A micrometre was used to measure the organism's size. All rotifers were identified based on external morphological characters. The latest standard taxonomic keys and relevant literature were used for identification, including Sharma (1987; 2005), Dhanapathi (2000), Koste (1987), and Segers (2007). For quantitative estimation, counting was performed using the Sedgwick-Rafter method. Rotifer community structure was evaluated using standard ecological indices such as the Shannon–Wiener Diversity Index (H'), Simpson's Diversity Index (D), and Evenness Index (E). Statistical analysis was performed using Microsoft Excel. The association between physicochemical parameters and rotifer abundance was evaluated through direct seasonal comparison of measured values, and the relationships were interpreted based on concurrent fluctuations.

3. Results

In 2024–2025, a total of 19 rotifer species from four genera and three families were identified in the present research from the Pravara-Godavari river confluence. With nine species, Brachionidae was the most prevalent family. Lecanidae and *Trichocercidae* followed with four and two species, respectively. About the genus-wise seasonal distribution, Brachionus had the most significant number of species in every season (six in the Monsoon, eight in the Winter, and six in the Summer). In contrast, *Keratella* had between one and two species, *Lecane* had between one and four species, and *Trichocerca* was only found in the Winter and Summer. The number of species increased from nine during the Monsoon to thirteen during the Summer (Table 1).

Summer had the highest diversity, followed by Monsoon and Winter, according to the Shannon-Wiener diversity index (H') values. At the same time, Pielou's Evenness (E) was highest in Summer, indicating a more uniform distribution of species, and lowest in Winter. Simpson's index (D) revealed the lowest dominance in Summer and higher dominance in Monsoon and Winter (Table 2).

Rotifer population density also varied seasonally in the water sample analysis. Summer showed the highest abundance (1760 ind./L), followed by Winter (1520 ind./L) and Monsoon (1120 ind./L) (Fig. 1).

The pH value ranged from 7.5 to 7.9, the water temperature peaked in the Summer (29°C), the turbidity

Table 1. Rotifer species recorded from the water samples of the Pravara-Godavari river confluence (November 2024-October 2025).

No.	Family	Species	Monsoon	Winter	Summer
1.	Brachionidae	*Brachionus diversicornis* Daday, 1883	+	+	+
2.		*Brachionus plicatilis plicatilis* Müller, 1786	+	–	–
3.		*Brachionus quadridentatus melhemi* Barrois & Daday, 1894	–	+	+
4.		*Brachionus calyciflorus* Pallas, 1766	+	+	+
5.		*Brachionus falcatus* Zacharias, 1898	+	+	+
6.		*Brachionus variabilis* Hempel, 1896	–	+	–
7.		*Brachionus forficula* Wierzejski, 1891	+	–	–
8.		*Brachionus caudatus* Barrois & Daday, 1894	+	+	+
9.		*Brachionus angularis* Gosse, 1851	–	+	+
10.		*Keratella tropica* Apstein, 1907	–	+	+
11.		*Keratella valga* Ehrenberg, 1834	–	+	–
12.		*Keratella procurva* Thorpe, 1891	–	+	–
13.		*Keratella cochlearis* Gosse, 1851	–	–	+
14.	Lecanidae	*Lecane physalis* Wulfert, 1939	–	–	+
15.		*Lecane leontina* Turner, 1892	+	–	+
16.		*Lecane lunaris* Ehrenberg, 1832	+	–	+
17.		*Lecane bulla bulla* Gosse, 1851	–	+	+
18.	Trichocercidae	*Trichocerca siamensis* Segers & Pholpunthin, 1997	–	–	+
19.		*Trichocerca tigris* Müller, 1786	–	+	–

ranged from 1.5 to 1.8 NTU, and the dissolved oxygen slightly dropped in the Summer (7.3 mg/L) compared to the Monsoon (8.8 mg/L). These physicochemical parameters showed minor seasonal variations. Higher rotifer abundance was associated with increases in hardness, alkalinity, and chloride concentrations from Monsoon to Summer (Table 3, Fig. 2).

Table 2. Diversity indices of rotifer abundance at the Pravara-Godavari river confluence.

No.	Season	Shannon H'	Simpson D	Evenness E
1.	Monsoon	0.932	0.444	0.673
2.	Winter	0.918	0.439	0.662
3.	Summer	1.190	0.282	0.859

4. Discussion

At the Pravara-Godavari river confluence, seasonal variation had a significant impact on rotifer diversity and abundance. The Summer period recorded the highest levels of species richness, diversity, and evenness. At the same time, the Monsoon season showed the lowest levels. Increased temperature also improved feeding efficiency and nutrient assimilation, leading to rapid population turnover. In addition, relatively stable hydrological conditions during Summer increased water residence time, allowing plankton communities to establish and proliferate. The Monsoon season exhibited reduced diversity and abundance due to hydrological disturbance. Heavy rainfall increased turbidity and reduced light penetration, thereby indirectly limiting phytoplankton availability. Monsoonal runoff also diluted nutrients. These combined stressors explain the observed decline in richness and community stability. A lower Simpson's dominance in the Summer further indicated a more uniform distribution of species.

Perhaps as a result of lower temperatures and different dissolved oxygen levels, Winter supported moderate diversity but lower evenness, indicating

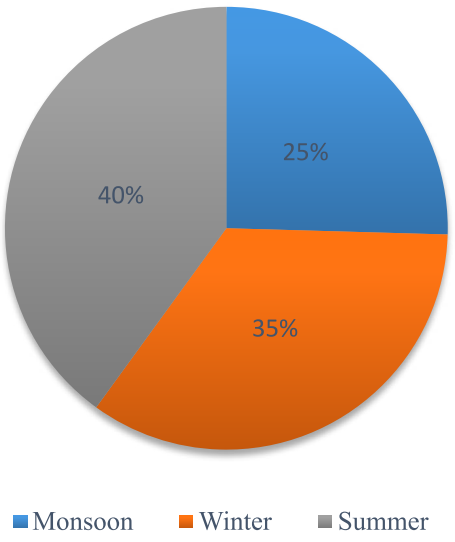

Fig.1. Seasonal percent contribution of rotifer density (ind./L) in the Pravara-Godavari river confluence.

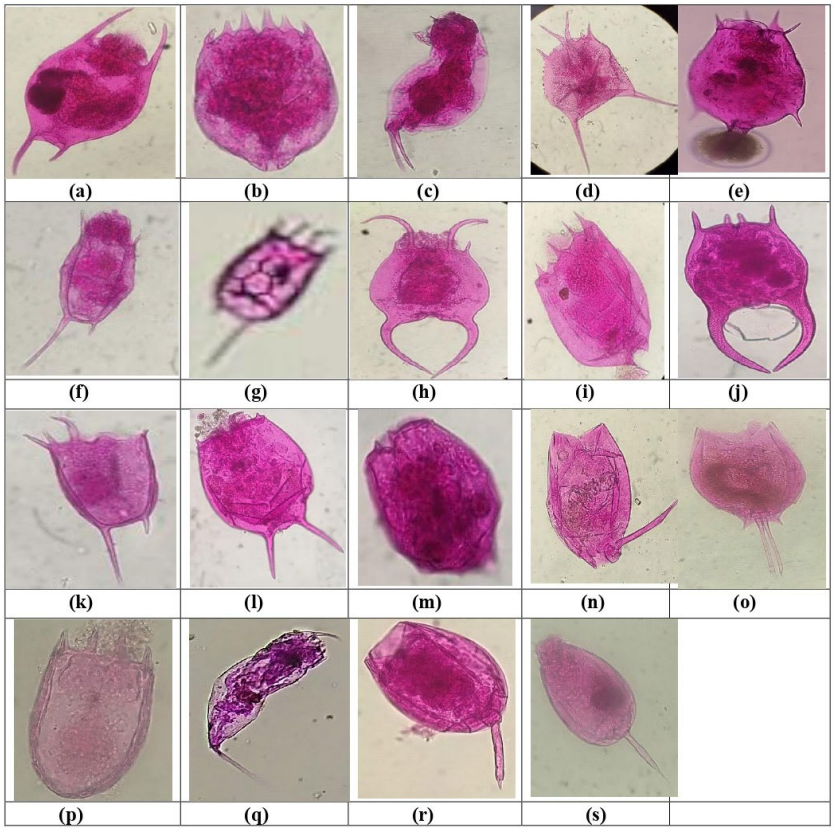

Fig.2. a) *B. diversicornis*; b) *B. plicatilis plicatilis*; c) *Trichocerca tigris*; d) *B. quadridentatus melhemi*; e) *B. calyciflorus*; f) *K. tropica*; g) *K. procurva*; h) *B. falcatus*; i) *B. variabilis*; j) *B. forficula*; k) *K. valga*; l) *B. caudatus*, 1894; m) *B. angularis*; n) *L. physalis*; o) *L. leontina*; p) *K. cochlearis*; q) *Trichocerca siamensis*; r) *L. lunaris*; and s) *L. bulla bulla*.

dominance by fewer genera. Perennial dominance of Brachionus species demonstrates their ecological adaptability across a range of physicochemical conditions. The ecological success of *Brachionus* in semi-arid freshwater ecosystems is attributed to its high reproductive rate, broad tolerance to environmental variations, and ability to utilize nutrient-rich conditions. Many species thrive in alkaline, moderately eutrophic waters, which are common in reservoirs and river systems in Maharashtra. Consequently, the consistent dominance of *Brachionus* indicates its role as a bioindicator of productive and nutrient-enriched freshwater habitats. The seasonal pattern observed in the Pravara–Godavari river confluence, where rotifer diversity and abundance peaked during Summer and declined during the Monsoon, is consistent with observations from other freshwater bodies of Maharashtra, such as Shanoor Dam (Gadhikar and Sawale, 2016), Dnyaneshwar Sagar (Kawade and Pandarkar, 2014), and Visapur Dam (Bhalsing and Pokale, 2023). Thus, the similarity between the present findings and previous studies indicates that seasonal hydrological dynamics play a crucial role in structuring rotifer communities in freshwater ecosystems of Maharashtra. Rotifers are sensitive to environmental changes, as indicated by correlations between rotifer community structure and physicochemical parameters such as temperature, dissolved oxygen, turbidity, alkalinity, hardness, and chloride. These results support the application of rotifers as useful bioindicators of ecological status and water quality in semi-arid freshwater ecosystems.

5. Conclusion

According to the study, rotifer diversity in the Pravara-Godavari river confluence is seasonal, with the highest levels of species richness, diversity, and evenness occurring in the Summer. The dominant family, Brachionidae, demonstrates the ecological adaptability of certain rotifers to changing environmental conditions. Continuous monitoring of rotifer populations and water quality assessments may contribute to ecological management and provide essential baseline data for research on freshwater biodiversity. These findings contribute to our understanding of the dynamics of planktonic communities in the freshwater ecosystems of Ahmednagar, Maharashtra. They can serve as a guide for future ecological and conservation research.

Table 3. Physicochemical profile of the Pravara-Godavari river confluence.

No.	Season	pH	Water Temp (°C)	Turbidity (NTU)	DO (mg/L)	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L)	Chloride (mg/L)
1.	Monsoon	7.5	27	1.8	8.8	204	124	84.57
2.	Winter	7.7	25	1.5	8.4	255	135	95.32
3.	Summer	7.9	29	1.6	7.3	276	168	102.84

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Conflict of interest

The author declares no conflicts of interest.

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