International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 14-02-2026, Accepted: 18-03-2026, Published: 03-04-2026
Volume 11, Issue 2, 2026, Page No. 1-4

Rotifer diversity of Lauseeng Pond, Udaipur, Rajasthan in relation to selected water quality parameters

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DOI: https://doi.org/10.66856/ijer.2026.11.2.11106

Abstract
Present study was carried out at Lauseeng Pond Udaipur district Rajasthan. Water samples and rotifer samples were collected from three sites (site 1, site 2. site 3) of Lauseeng Pond from January 2023 to December 2024. Highest water temperature was found at site 3 (29.5°C) during summer season and lowest was at site 1 (17.1°C) during winter season. Similarly highest pH was at site 3 (8.3) during winter season and lowest was at site 1 (7.1) during summer season. The average levels of dissolved oxygen were highest at site 1 (7.40 mg/l) due to less pollution and lowest were at site 3 (6.17 mg/l) due to high pollution by domestic activities. Total nine species of rotifer were identified from the study area out of which only six species were present at site 1 which indicates that this site is well oxygenated and less polluted evident through absences of pollution indicator species like *Filinia sp*. Whereas in contrast all nine species were present at site 2 shows that it was in oligotrophic condition but due to proximity with the site 1 polluted water is constantly deteriorating the water quality; which is why the abundance of pollution indicator species are in lower count at site 2 and it is getting polluted and developing eutrophic conditions. Interestingly site 3 has only six species and species indicating oligotrophic condition are absent and presence of species like *Filinia sp*. in high number indicates pollution and eutrophic conditions.

Keywords: Rotifers, Lauseeng, Water quality, Pollution, Bioindicator

Introduction
Water is the most essential abiotic factor for survival of life on earth. Aquatic habitat is largest habitat which supports survival of terrestrial habitat too and it also holds about 50% of total species found on earth, hence water and water related habitat is crucial for maintaining ecological and environmental equilibrium. Although almost 71% of earth is covered with water but only around 1% is freshwater that is why proper management and timely conservation of freshwater ecosystem is essential for the survival of human race and biodiversity. Zooplankton are the microscopic animals that inhabits aquatic habitat and are considered as the best bioindicators of aquatic habitat health. Zooplankton often indicates pollution, nutrient enrichment, eutrophication, oxygenation, and overall health of the water body simply through absence, presence, quality, and quantity which makes them best bioindicators due to easy sampling and estimation.
Limnological parameters are crucial elements for aquatic ecosystems. Water temperature, being a crucial abiotic factor in aquatic ecosystem has wide effect on biodiversity of plankton with respect to their growth and other biological processes. pH is a numerical expression that indicates the acidic or alkaline degree of water. It is known for exerting its influence on the occurrence, distribution and growth of planktons. Higher pH values of the water were associated with greater photosynthetic activity, which led to the use of CO_2 from bicarbonates and the formation of carbonates (Baijot *et al*., 1994) [2]. Dissolved oxygen (DO) is vital parameters for the study of aquatic ecosystems. It is necessary for many organisms and also impacts the solubility and accessibility of many nutrients which has direct influence on primary productivity of aquatic ecosystems.
Rotifers are the group of freshwater zooplanktons which are basically r-selected species having short generation span and they quickly occupy available niche after any change in environment which makes them cosmopolitan; rotifers are very sensitive towards the change in surrounding and primarily indicates trophic status of water body (Duggan *et al*., 2002; Devetter and Sed'A, 2003; Segers, 2008) [6, 7, 15].

Materials and methods
Study area

Map 1: Lauseeng Pond satellite view and selected sites

Present study was conducted in Lauseeng Pond situated 30 Km away from Udaipur district, of southern Rajasthan (Map

1). It is located in Badgaon tehsil, this waterbody is surrounded by high hills of Aravalli range. The water samples and zooplankton samples was taken from three different selected sites from January 2023 to December 2024.

Water analysis

Water samples were collected from three selected sites of Lauseeng Pond during three different seasons named summer, winter, monsoon. Water temperature was calculated on site using handheld electronic thermometer, pH was estimated using digital pH meter in laboratory, where dissolved oxygen was estimated using titration methods for which DO of samples was fixed using Winkler's reagent (APHA, 2012) [1]. Obtained results were tabulated in Table 2 and 3 and comparative graphical distribution was shown in Fig 2.

Rotifers analysis

Rotifer sample were taken from three different sites of Lauseeng pond. Samples were collected during summer, winter, and monsoon with the help of Hensen's standard plankton net. The collected zooplankton samples were preserved with 4% formalin for laboratory analysis and identification of rotifer species was carried out using literature and taxonomic keys (Edmondson, 1959 [8]; Needham and Needham, 1962; Battish, 1992) [12]. The identified rotifers were tabulated in Table 1 and depicted in Fig 1.

Table 1: Rotifer diversity of Lauseeng Pond

S. No.	Group	Family	Species	Site 1	Site 2	Site 3
1	Rotifers	Brachionidae	*Brachionus caudatus*	8	17	25
2		Brachionidae	*Brachionus plicatilis*	0	8	25
3		Brachionidae	*Brachionus falcatus*	0	17	30
4		Brachionidae	*Brachionus forficula*	6	14	33
5		Brachionidae	*Keratella sp.*	22	11	0
6		Asplanchnidae	*Asplanchna sp.*	3	14	19
7		Lecanidae	*Lecane sp.*	14	8	0
8		Lecanidae	*Monostyla sp.*	11	6	0
9		Testudinellidae	*Filinia sp.*	0	3	8

Table 2: Selected limnological parameters of Lauseeng Pond (2023-2024)

S. No.	Parameters	Site 1			Site 2			Site 3		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Temperature	23.5°C	17.1°C	28.1°C	24.5°C	17.7°C	29.1°C	24.7°C	18.1°C	29.5°C
2	pH	7.3	7.5	7.1	7.6	8.1	7.4	8.0	8.3	7.8
3	DO	7.8 mg/l	8.2 mg/l	6.2 mg/l	6.6 mg/l	7.9 mg/l	6.4 mg/l	6.1 mg/l	6.5 mg/l	5.9 mg/l

Table 3: Limnological parameters and diversity indices

S. No.	Site	Average of			Species Count	Total Count	Shannon Diversity	Simpson Dominance
		Temp.	pH	DO				
1	**Site 1**	22.90	7.30	7.40	6	63	1.62	0.77
2	**Site 2**	23.77	7.70	6.97	9	96	2.09	0.86
3	**Site 3**	24.10	8.03	6.17	6	141	1.72	0.81

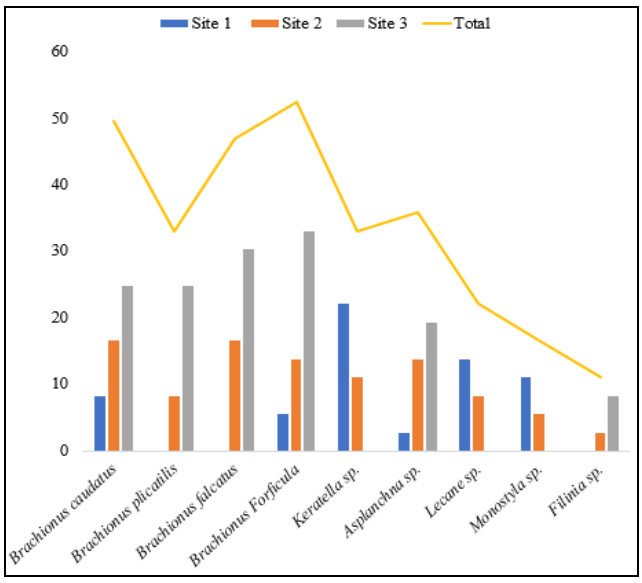

Fig 1: Distribution of Rotifer species across selected sites of Lauseeng Pond.

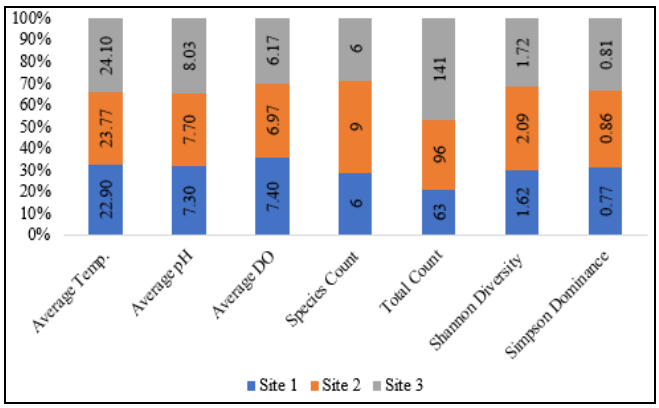

Fig 2: Water Quality and Diversity Indices Comparison at Selected sites of Lauseeng Pond

Result and discussion

Highest water temperature was recorded during summer season at site 3 (29.5°C) followed by site 2(29.1°C) and least temperature was recorded at site 1 (28.1°C). Similarly lowest water temperature was recorded during winter season

and in the following order site 1(17.1°C), site 2(17.7°C), and site 3 (18.1°C).

Highest pH was recorded during winter season at site 3 (8.3) and lowest pH was recorded during summer season at site 1(7.1).

Highest dissolved oxygen value was obtained during winter season at site 1 (8.2 mg/l), followed by site 2 (7.9 mg/l), and least DO during winter season was recorded at site 3 (6.5 mg/l). Similarly lowest DO in monsoon season was at site 3 (6.1 mg/l), in summer season at site 3 (5.9 mg/l) and site 1 (6.2 mg/l). In general, high DO value indicates magnitude of aquatic ecosystem health (Bilgrami and Datta, 1979; Fakruzzaman and Zaman, 1996 [5, 9]), hence site 3 has lowest DO but highest species abundance indicating pollution because presence of pollution indicator species in higher count like *Filinia sp*. (site 3 (8) > site 2 (3) > site 1 (0)) in comparison to other sites.

Total nine species of Rotifers were identified from the sampled collected from three different sites of Lauseeng Pond. Among the identified nine species of rotifers a highest of five species (*Brachionus caudatus*, *Brachionus plicatilis*, *Brachionus falcatus*, *Brachionus forficula*, *Keratella sp*.) belongs to the family Brachionidae; two species (*Lecane sp*., & *Monostyla sp*.) belong to family Lecanidae; and only one species each belongs to family Asplanchnidae (*Asplanchna sp*.) and family (*Filinia sp*.). *Filinia* is bioindicator species which indicates heavy pollution (Saksena, 1987) [14]; *Filinia sp*. was most abundant at site 3 where domestic activities took place, followed by site 2 which is adjacent to site 1 and have less abundance and in contrast site 1 has shown absence of *Filinia sp*. which marks site 1 as unpolluted and high oxygenated site.

Most abundant species at site 1 was *Keratella sp*. (22) and least abundant species was *Asplanchna sp*. (3). At site 2 most abundant species was *Brachionus caudatus* (25), and *Brachionus plicatilis* (25) whereas least abundant species was *Filinia sp*. (3). At site 2 most abundant species was *Brachionus caudatus* (50) whereas least abundant species was *Filinia sp*. (11).

Highest value of shannon diversity was observed at site 2 (2.09) followed by site 3 (1.72) and least at site 1(1.62) which indicates that site 2 has the optimum combination of temperature, pH and DO which supports diverse zooplankton species (9) and abundance (96 individuals). Whereas site 3 has average water quality and inhabits 6 rotifer species but high abundance (141 individuals) due to very high number of *Brachionus caudatus* and *Brachionus plicatilis* (Table 3, Fig 1, Fig 2). Similar results were obtained in terms of Simpson Dominance as highest dominance value was recorded for site 2 (0.86), followed by site 3 (0.81), and site 1 (0.77).

During present study nine rotifer species were observed among selected sites of Lauseeng pond whereas Mishra *et al.* (2019) [11] had reported 11 rotifer species from Lake Pichhola, Sharma *et al.* (2011) [13] had reported 40 species from the Lake Pichhola, Sharma *et al*. (2012) had observed 31 species from Madar Tank Udaipur, Kumar *et al.* (2007) [10] identified nine rotifer species from Daya reservoir Udaipur, Balai *et al.* (2014) [3] documented presence of 17 rotifer species from Jaisamand Lake Udaipur. Hence the number of species among different waterbodies of Udaipur shows that with time water quality has degraded which has negatively impacted the rotifer diversity as evident from the presence of 40 rotifer species in year 2011 [13] to presence of only 11 in year 2019.

Conclusion

In conclusion the water quality of site 3 was worst due to excessive domestic usage as evident by lowest dissolved oxygen and high zooplankton diversity specially presence of *Filinia sp*. indicates pollution and high eutrophication. Average levels of dissolved oxygen and absence of certain pollution indicator rotifer species justify that site 2 is affected by proximity with site 3. Highest levels of DO and presence of only six species at site 1 shows that it is less polluted as it lacks direct continuity with site 1 and site 2 and moreover site 1 is not used for domestic purpose. The absence of *Filinia sp*. at site 1 indicated that this site has no pollution and water is well oxygenated and show oligotrophic condition. Other factors like pH and Temperature varied seasonally, highest temperature was in summer season and lowest was in winter, highest pH was in winter and lowest was during summer season; hence pH and temperature showed negative correlation.

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