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Brachionid Rotifers (Eurotatoria: Monogononta) from Meizailung Fish Farm, with Four Records in Ukhrul District, Manipur, India

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ABSTRACT

The experiment was conducted from January to December, 2023 at Meizailung Fish Farm Ukhrul District, Manipur, India, to provide valuable taxonomic descriptions and highlight the Brachionid rotifer's ecological significance in freshwater habitats. Brachionid rotifers played a vital part in aquatic ecosystems, acting as primary consumers in freshwater habitats and significantly contributing to nutrient cycling and energy transfer. This study investigates the diversity and records of brachionid rotifers from Meizailung Fish Farm, Ukhrul District, Manipur, India. Monthly sampling was conducted, covering different seasons to assess seasonal variations in species composition and abundance. Water samples were collected using plankton nets (mesh size: 55 µm) and analyzed using standard taxonomic keys. Physicochemical parameters such as temperature, pH, dissolved oxygen, free carbon dioxide, alkalinity, Ammonium nitrate, phosphates, and chlorides were also measured to determine their influence on rotifer distribution. Out of 12 rotifer species belonging to the family Brachionidae (Eurotatoria: Monogononta), the genus Brachionus was the most abundant, with 8 species recorded. Among these, 4 species- *Anuraeopsis ceolata*, *Anuraeopsis navicula*, *Brachionus budapestinensis*, *Keratella valga* were state records from Manipur. The highest diversity was observed during the pre-monsoon season, while the lowest was recorded in winter. This study highlighted the rich biodiversity of brachionid rotifers in Meizailung Fish Farm, with four records contributing to the understanding of regional zooplankton diversity. These findings provide baseline data for the region's future ecological monitoring and aquaculture management. Further investigations on the functional role of rotifers in local aquatic food webs are recommended.

KEYWORDS: Brachionidae, India, Manipur, Meizailung, Northeast, Rotifers, Ukhrul

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1. INTRODUCTION

Rotifers are microscopic, pseudocoelomate metazoans that play a crucial role in aquatic ecosystems. Belonging to the phylum Rotifera and are distributed worldwide in various freshwater and marine habitats. These organisms typically range in size from a few microns to several millimeters and are known for their high reproductive potential and adaptability to diverse environmental conditions (Segers, 2008; Wallace et al., 2015; Wilkie and Gilbert, 2020). The phylum Rotifera consists of approximately 2,000 described species, broadly classified into two major classes: Monogononta and Bdelloidea. Among these, monogonont rotifers dominate freshwater planktonic communities and contribute significantly to both primary and secondary production (Sharma and Sharma, 2014; Xie and Yang, 2021).

The family Brachionidae, a key group within Monogononta, comprises ecologically significant genera such as *Brachionus*, *Keratella, Platyias*, *Anuraeopsis*, *Notholca*, *Kellicottia*, and *Paranuraeopsis* (Koste, 1978; Sharma and Sharma, 1990, 2014). These rotifers were often numerically dominant in freshwater systems and played crucial roles in nutrient cycling as they graze on phytoplankton and bacteria, they facilitate energy transfer across trophic levels (Zhang and Wang, 2019). Furthermore, rotifers maintain water quality by consuming suspended organic particles and controlling algal blooms (Battish, 1992; Fathibi et al., 2020). Due to their rapid response to environmental changes, they were widely used as bioindicators for assessing water quality and ecosystem health (Jeelani et al., 2022; Mukherjee et al., 2014). Recent studies have enhanced the knowledge of rotifer ecology and biogeography. Ghosh and Roy (2020) and Chakraborty and Sen (2023) contributed taxonomic insights from Eastern India and West Bengal, while research in Assam and Kerala (Choudhury and Dutta, 2021; Nair and Menon, 2024) highlighted regional diversity. These studies build on foundational work by Sharma (2005) and Sharma and Sharma (2004, 2005), who documented rich rotifer assemblages in the Brahmaputra basin and Northeast India water bodies.

Despite their ecological importance, rotifer diversity and distribution remain underexplored in several parts of Northeast India, including Manipur-a biodiversity hotspot in the Indo-Burma region. While earlier studies in Loktak Lake, a Ramsar site, reported an impressive 162 rotifer species from 40 genera and 20 families (Sharma et al., 2016), research on other freshwater bodies in Manipur has been limited. Yenapat Lake and Phubala Irrigation Canal have revealed notable rotifer diversity, particularly from the family Brachionidae (Bimola et al., 2017; Salam et al., 2021). Seasonal variation and ecological dynamics of rotifers have also been documented in nearby regions such as Chilika Lagoon (Mukherjee et al., 2014).

In addition to species diversity, environmental factors such as temperature, pH, dissolved oxygen, and nutrient availability significantly impact rotifer abundance and distribution (Bimola et al., 2017; Bora et al., 2019; Taseer and Yousuf, 2017). Studies have shown that eutrophic water bodies tend to support higher rotifer densities due to increased food availability (Xie and Yang, 2021; Zhang and Wang, 2019). Additionally, rotifers exhibit remarkable adaptability to changing environmental conditions, making them valuable indicators of ecological stability (Wilkie and Gilbert, 2020).

Given the limited research on rotifers in Manipur, the present study aims to enrich the understanding of rotifer taxonomy in this region. It focuses on 12 species from the family Brachionidae collected from the Meizailung fish farm in Ukhrul District. Notably, four of these species were recorded from Manipur, contributing to the growing body of knowledge on rotifer biodiversity in the region. The study provides detailed taxonomic descriptions and emphasizes the ecological importance of these rotifers in freshwater ecosystems.

2. MATERIALS AND METHODS

2.1. Study sites

The present study was conducted for 12 months, from January to December 2023, at Meizailung Fish Farm, located in Ukhrul District, Manipur, Northeast India. The study site is situated at a latitude of 25.130145°N and a longitude of 94.37445°E, with an average elevation of 1,662 meters above sea level. Meizailung Fish Farm is a freshwater aquaculture facility characterized by multiple interconnected ponds, which support a diverse array of aquatic life, including various species of plankton, fish, and aquatic macrophytes. The region experiences a temperate to subtropical climate, with distinct seasonal variations in temperature, precipitation, and hydrological conditions, making it an ideal location for studying the diversity and ecological significance of rotifers. The fish farm's water sources primarily include rainwater, natural springs, and small tributaries, which contribute to the overall nutrient dynamics and planktonic composition of the habitat.

Figure 1: Location of the study area

2.2. Method of collection.

Zooplankton samples were collected monthly with a plankton net (no. 25 with a mesh size of 55 microns). The collected plankton samples in the tube were transferred to the sample bottles and fixed with 4% formaldehyde solution. The preserved zooplankton samples were examined under a Motic BA210 LED Trinocular Microscope, which provided high-resolution imaging necessary for detailed morphological observations. Taxonomic identification was carried out based on established methodologies and identification keys provided in classical and contemporary studies, ensuring a comprehensive and accurate classification. The primary taxonomic references consulted included the pioneering works of Ahlstrom (1940) and Edmondson (1959), along with later contributions by Nayar and Nair (1969), Koste (1978), Sharma (1987), Battish (1992), and Segers (2002). More recent studies, such as those by Athibai et al. (2013), Sharma and Sharma (2005, 2021), and additional contemporary sources, including Dumont and Silva-Briano (2000), Wallace et al. (2006), Smirnov (2017), and Fontaneto and De Smet (2019), were also consulted to incorporate updated taxonomic revisions and regional species records.

2.3. Measurement of physicochemical parameters.

Water temperature was measured using a Mercury Thermometer. pH was measured using a digital pH meter. Dissolved oxygen (DO) was estimated following Winkler's method. Free carbon dioxide and total alkalinity were measured by the titration method (APHA, 1992). Phosphate, Ammonia Nitrogen (NH_3-N), and Chloride content were estimated by using the Rankem water testing kit Aqua check test pack.

3. RESULTS AND DISCUSSION

3.1. Systematic description

Systematic list of Brachionid taxa reported from Meizailung Fish farm, Ukhrul, Manipur:

Twelve (12) species of the Brachionidae family were identified. Out of twelve (12) species, eight (8) belong to the genus *Brachionus*, two species from each of the *Anuraeopsis* and *Keratella* genera.

Phylum: Rotifera Cuvier, 1817; Class: Eurotatoria De Ridder, 1957; Order: Ploima Hudson & Gosse, 1886; Family: Brachionidae Ehrenberg, 1838.

Anuraeopsis ceolata de Beauchamp, 1932; *A. navicula* Rousselet, 1911; *Brachionus angularis* Gosse, 1851; *B. bidentata* Anderson, 1889; *B. budapestinensis* Daday, 1885; *B. calyciflorus* Pallas, 1766; *B. caudatus* Barrois and Daday, 1894; *B. falcatus* Zacharios, 1898; *B. quadridentatus* Hermann, 1783; *B. urceolaris* Muller, O.F., 1773; *Kerattella tropica* (Apstein, 1907); *K. valga* (Ehrenberg, 1851).

3.1.1. Anuraeopsis ceolata de Beauchamp, 1932

1932. *Anuraeopsis ceolata*: Beauchamp, P. de., Journal of Zoology of the Linnean Society, p.238.

1987. *Anuraeopsis ceolata*: Koste, W. and Shiel R.J., Invertebrate Taxonomy, p.1015, Figure 32:4; 33:1, 2.

Description: Lorica is granulated with variable structures on a dorsal plate, double keel with marginal laterals, and caudal pointed gently.

Distribution: India: Meghalaya, Assam, Nagaland, Tripura, Manipur, Arunachal Pradesh, Orissa, West Bengal.

Remarks: A record from Manipur.

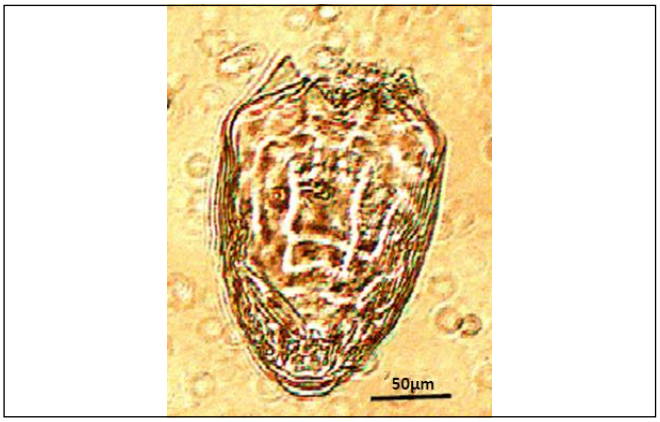

Figure 2: *Anuraeopsis coelata*

3.1.2. Anuraeopsis navicula Rousselet, 1911

1911. *Anuraeopsis navicula*: Rousselet, C., Journal of the Quekett Microscopical Club. Series 2, 11, p.161.

1987. *Anuraeopsis navicula*: Koste, W. and Shiel, R.J., Invertebrate Taxonomy, p.1015, Figure 32:1.

Description: Lorica spindle-shaped with finely granulated surface; anterior dorsal margin with a cleft in the middle, mental edge divided into two lobes, caudal tapering gently.

Distribution: India: Assam, Tamil Nadu, Meghalaya, Manipur.

Remarks: A record from Manipur.

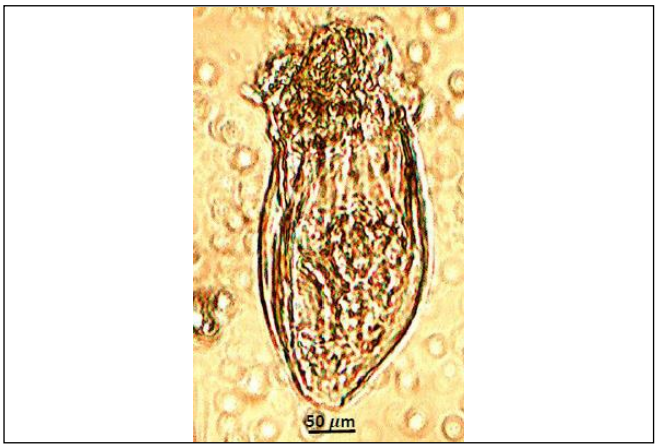

Figure 3: *Anuraeopsis navicula*

3.1.3. Brachionus angularis Gosse, 1851

1851. *Brachionus angularis*: Gosse, P. H., Annals and Magazine of Natural History, p.203.

1940. *Brachionus angularis*: Ahlstrom E.H., Bulletin of The American Museum of Natural History, p.154, pl.5 Figure 2-13.

1987. *Brachionus angularis angularis*: Koste, W. and Shiel R.J., Invertebrate Taxonomy, p.990, Figure 22:1, 2, 2 a-h.

Description: Lorica: oval, dorsal plates with cuticular ridges; Anterodorsal margin with two subtle median spines with V-shaped notch in between, foot opening large, and posterior spine is missing.

Distribution: India: West Bengal, Andhra Pradesh, Chandigarh, Mizoram, Orissa, Delhi, Haryana, J & K, Rajasthan, Kerala, Tamil Nadu, Anthra Pradesh, Maharashtra, Punjab, Madhya Pradesh, Arunachal Pradesh, Assam, Meghalaya, Tripura, Manipur, Nagaland, and Kolkata. Elsewhere: Cosmopolitan.

Figure 4: *Brachionus angularis*

3.1.4. Brachionus bidentata Anderson, 1889

1889. *Brachionus bidentatus*: Anderson, H.H., Journal of the Asiatic Society of Bengal, p.357 Figure 21:13.

1940. *Brachionus bidentatus*: Ahlstrom, E.H., Bulletin of The American Museum of Natural History, p.167, pl.13, Figure 4-9.

1987. *Brachionus bidentatus*: Koste, W. and Shiel, R.J., Invertebrate Taxonomy, p.974 Figure 15:3, 4.

Description: Lorica: firm, barrel-shaped, divided into a dorsal, ventral, and a basal plate; anterior dorsal margin with six spines; laterals longer than medians and medians longer than intermediates. Mental margin flexible and elevated in the middle. The posterior spine varies in length. Foot opening with projecting sheath.

Distribution: Assam, Tripura, Manipur, Kolkata, Arunachal

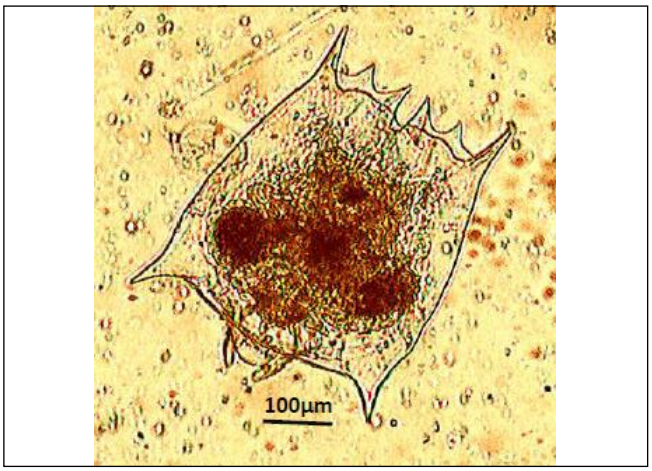

Figure 5: *Brachionus bidentata*

Pradesh, Orissa, Nagaland, West Bengal, Kashmir, Andhra Pradesh, Punjab, Haryana. Elsewhere: Pantropical.

3.1.5. Brachionus budapestinensis Daday, 1885

*1*885. *Brachionus budapestinensis*: Daday, E.von., Termesz Fuzetek, Budapest, 9, p.113, 211, Figure 1-4, 8.

1940. *Brachionus budapestinensis*: Ahlstrom E.H., Bulletin of The American Museum of Natural History, p.152, pl.4, Figure 6-9.

1987. *Brachionus budapestinensis*: Koste, W. and Shiel R.J., Invertebrate Taxonomy, p.988, Figure 20:4a-g.

Description: Lorica firm, granulated, oval, divided into a dorsal and a ventral plate. Anterior dorsal margin with four spines. Median spines crooked, their distal ends curve

Figure 6: *Brachionus budapestinensis*

ventrally; Mental edge nearly straight. Foot opening with V-shaped aperture.

Distribution: India: Assam, Manipur, Orissa, Nagaland, Arunachal Pradesh, West Bengal.

Remarks: A record from Manipur.

3.1.6. Brachionus calyciflorus Pallas, 1766

1766. *Brachionus calyciflorus*: Pallas P.S., Elenchus Zoophytorum, p.93.

1940. *Brachionus calyciflorus*: Ahlstrom, E.H., Bulletin of the American Museum of Natural History, p.150, pl.3 Figure 1-9.

1987. *Brachionus calyciflorus calyciflorus*: Koste W. and Shiel R.J., Invertebrate Taxonomy, p.990 Fig. 21:1c.

Description: Lorica flexible, oval to sub-circular, not separated into dorsal and ventral plates. Occipital margin with four-based spines of variable length, Median spines longer than laterals, mental margin flexible, usually somewhat elevated with a shallow V-shaped notch. Posterior spines were present with variable length.

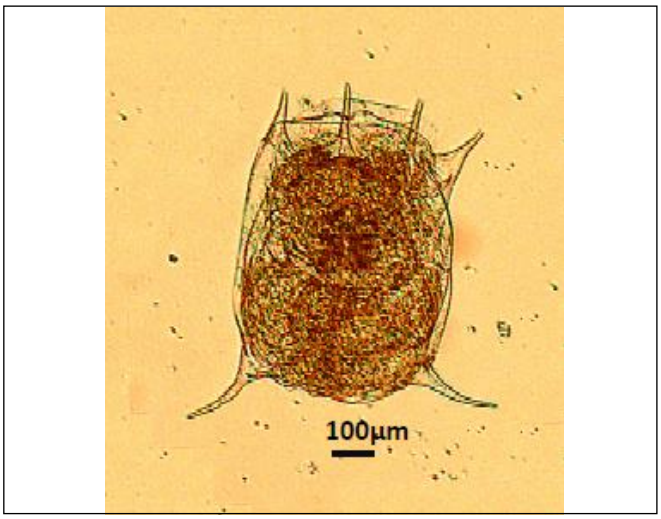

Figure 7: *Brachionus calyciflorus*

Distribution: India: West Bengal, Orissa, Tamil Nadu, Andhra Pradesh, Punjab, Manipur, Assam, Tripura, Meghalaya, Mizoram, Nagaland, Arunachal Pradesh, Kolkata. Elsewhere: Cosmopolitan.

3.1.7. Brachionus caudatus Barrois and Daday, 1894.

1894. *Brachionus caudatus*: Barrois, T and Daday, J., Mathematikai es Termeszettudomanyi Ertesito, p.232, Figure 9, 10, 13.

1940. *Brachionus caudatus*: Ahlstrom, E.H., Bulletin of the American Museum of Natural History, p.159, pl.7, Figure 9-12.

1987. *Brachionus caudatus*: Koste, W. and Shiel R.J., Invertebrate Taxonomy, p.992, Figure 22:4b, 23:1, 2.

Description: Lorica firm, divided into a dorsal and a ventral plate, somewhat compressed dorsoventrally, anterior margin with two median spines separated by a V-shaped sinus. Lateral spines were longer than the median. Mental margin

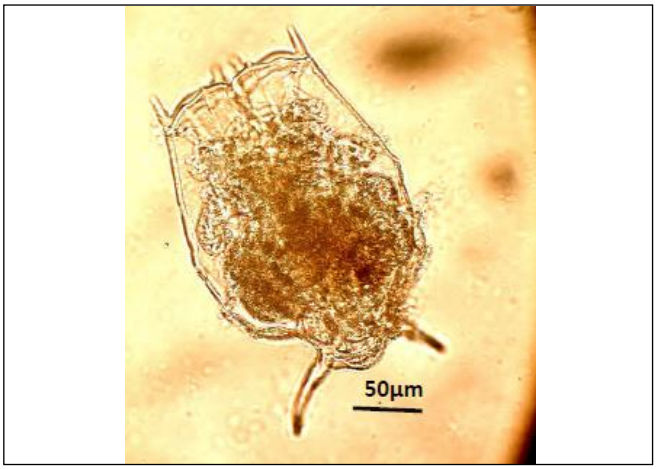

Figure 8: *Brachionus caudatus*

is slightly elevated and wavy with a shallow median sinus. Posterior spines are long and well developed.

Distribution: India: Haryana, Orissa, Punjab, Tripura, West Bengal, Assam, Tripura, Manipur, Arunachal Pradesh, Nagaland, Kolkata. Elsewhere: Cosmopolitan.

3.1.8. Brachionus falcatus Zacharias, 1898

1898. *Brachionus falcatus falcatus*: Zacharias, O., Berichte aus der Biologischen Station zu Plon, 6, p.133.

1940. *Brachionus falcatus*: Ahlstrom, E.H., Bulletin of the American Museum of Natural History, p.164, pl.10, Figure 1-3.

1987. *Brachionus falcatus falcatus*: Koste, W. and Shiel, R.J., Invertebrate Taxonomy, p.980, Figure 1a-e, g, h.

Description: Lorica firm, divided into a dorsal and a ventral plate, greatly compressed dorsoventrally. Dorsal margin with six spines, median spines mostly equal to laterals. Extremely long submedian anterior spines of variable length. The mental margin is rigid and wavy. Caudal spines are inwardly arched. Foot opening terminal.

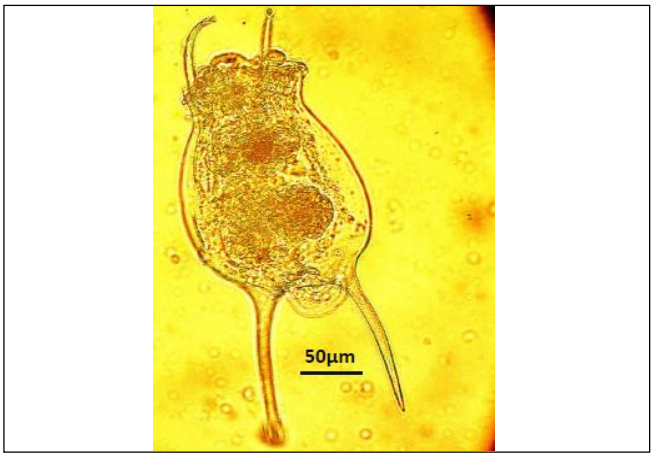

Figure 9: *Brachionus falcatus*

Distribution: India: Andhra Pradesh, Assam, Delhi, Maharashtra, Tamil Nadu, Jammu, Bihar, Gujarat, Haryana, Kerala, Madhya Pradesh, Meghalaya, Orissa, Punjab, Rajasthan, Tripura, West Bengal, Arunachal Pradesh, Nagaland, Kerala, and Kolkata. Elsewhere: Pantropical and subpantropical.

3.1.9. Brachionus quadridentatus Hermann, 1783

1783. *Brachionus quadridentatus*: Hermann, J., Der Naturforscher. Halle, p.47, pl.2 Fig. 9.

1940. *Brachionus quadridentatus*: Ahlstrom, E.H., Bulletin of the American Museum of Natural History, p.165, pl.11, Fig. 9.

Description: Lorica firm, divided into a dorsal and a ventral plate, moderately compressed dorsoventrally. Anterior dorsal margin with six spines: Median spines longest, curved outward, laterals spine longer than intermediates; mental margin rigid, elevated, and wavy with a median

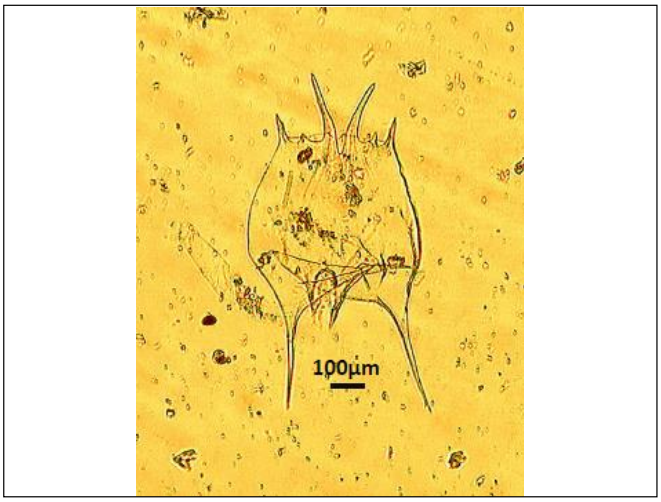

Figure 10: *Brachionus quadridentatus*

notch flanked on either side by a small tooth-like papilla, posterolateral spines of almost equal length.

Distribution: India: Andhra Pradesh, Meghalaya, Mizoram, Arunachal Pradesh, Orissa, Madhya Pradesh, Punjab, Rajasthan, Kashmir, Tripura, West Bengal, Delhi, Maharashtra, Tamil Nadu, Kerala, Manipur, and Nagaland. Elsewhere: Tropics and subtropics.

3.1.10. Brachionus urceolaris Muller, 1773

1773. *Brachionus urceolaris*: Muller, O.F., Vermivm Terrestrium et Fluviatilium, seu Animalium Infusoriorum. Quarto. p.131.

1940. *Brachionus urceolaris*: Ahlstrom, E.H., Bulletin of the American Museum of Natural History, p.171, pl.16 Figure 1-11.

1987. *Brachionus urceolaris*: Koste, W. and Shiel, R.J., Invertebrate Taxonomy, p.985, Figure 19:1.

Description: Lorica firm, oval, moderately compressed dorso-ventrally, divided into a dorsal and a ventral plate. Anterior dorsal margin with six spines: Medians are longest, laterals and intermediates are of equal length. Mental margin rigid, undulate, Posterior spines wanting; Foot

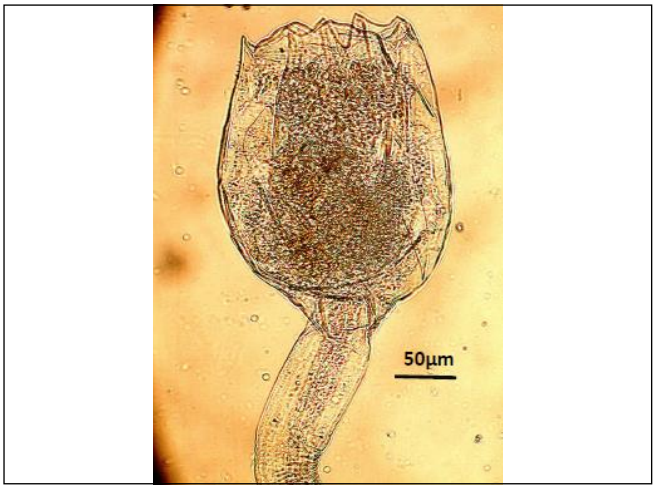

Figure 11: *Brachionus urceolaris*

opening with a sub-square to rectangular aperture in the dorsal but semi-circular ventrally.

Distribution: Madhya Pradesh, Kolkata, Punjab, Manipur, West Bengal, and Maharashtra. Elsewhere: Cosmopolitan.

3.1.11. Keratella tropica (Apstein, 1907)

1907. *Anurea valga f. tropica*: Apstein, C., Zeitschrift fur Zoologische Systematik. p.210, Figure F.

1934. *Keratella valga f. tropica*: Edmondson, W.T and Hutchinson, G.E., Memoirs of the Connecticut Academy of Arts and Sciences. p.170.

1987. *Keratella tropica*: Koste, W. and Shiel, R.J., Invertebrate Taxonomy, p.1001, Figure 26:2, 27:1.

Description: Lorica: oval and elongated; divided into a dorsal and a ventral plate; anterior dorsal margin with six spines: medians longest, pointed and curved outwardly,

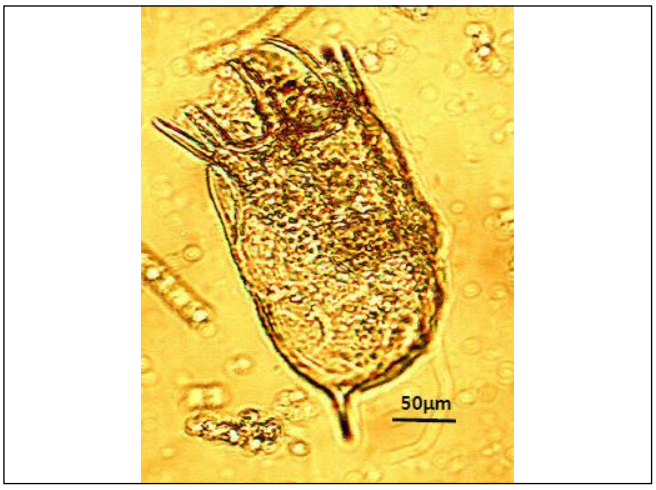

Figure 12: *Keratella tropica*

intermediate shortest. Posterior spines two, unequal in length, right spine much longer than the left spine.

Distribution: Arunachal Pradesh, West Bengal, Delhi, Andhra Pradesh, Tamil Nadu, Assam, Bihar, Orissa, Madhya Pradesh, Kerala, Gujarat, Rajasthan, Punjab, Haryana, Kashmir, Ladakh, Meghalaya, Nagaland, Mizoram, Manipur, and Tripura. Elsewhere: Tropics and subtropics.

3.1.12. Keratella valga (Ehrenberg, 1834)

1834. *Anurae valga*: Ehrenberg, C.G., Abhandlungen der Akademie der Wissschaften zu Berlin, p.198.

1987. *Keratella valga*: Koste, W. and Shiel, R.J., Invertebrate Taxonomy, p.1001, Figure 27:2.

Description: Lorica: wider at anterior end; anterior spines six; no posteromedial remnant under posteromedial plaque; only one caudal spine is present.

Distribution: India: Tripura, Manipur, Bihar, Jammu & Kashmir, Gujarat, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, and Tamil Nadu.

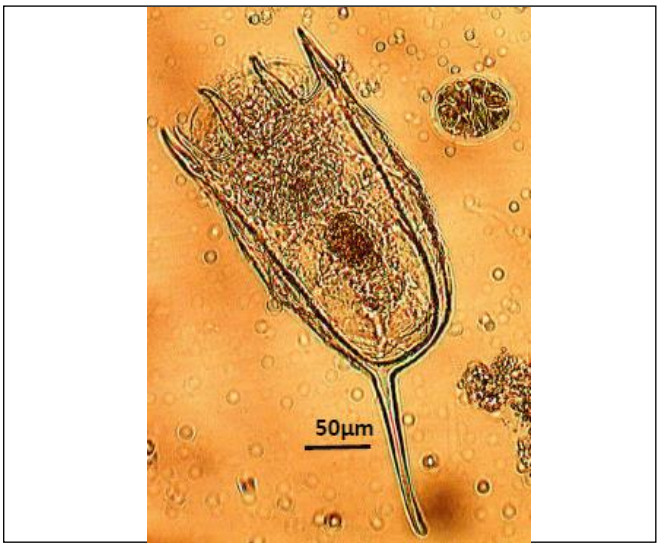

Figure 13: *Keratella valga*

Remarks: A record from Manipur.

3.2. Analysis of physicochemical parameters

The study assessed the physicochemical parameters of water at two different stations, presenting their annual range and mean values (Table 1)

The air temperature at Station 1 ranged from 14–32°C (mean 23°C), while Station 2 recorded a slightly narrower range of 15–30°C (mean 22.5°C). Water temperature showed minimal differences, with both stations having an average of 21°C, though Station 1 had a wider range (14–28°C) compared to Station 2 (17–25°C).

The pH values ranged from 5.5–7 (mean 6.25) at Station 1 and 5.5–9 (mean 7.25) at Station 2, indicating a more neutral to slightly alkaline condition at Station 2. Station 1 exhibited lower DO levels (1–5.04 mg l^{-1}, mean 3.02 mg L^{-1}) than Station 2 (2.3–9.6 mg l^{-1}, mean 5.95 mg l^{-1}), suggesting better oxygenation at Station 2.

The CO_2 levels fluctuated widely at both stations, with Station 1 showing a higher range (0–33 mg l^{-1}, mean 16.5 mg l^{-1}) compared to Station 2 (0–22 mg l^{-1}, mean 11 mg l^{-1}), indicating greater carbon dioxide retention at Station 1. Alkalinity remained stable at both stations, with Station 1 ranging from 120.5–122.5 ppm (mean 121.5 ppm) and Station 2 between 120–121 ppm (mean 120.5 ppm). Ammonium nitrate levels were higher at Station 1 (2.0–2.5 ppm, mean 2.25 ppm) compared to Station 2 (1.5–2.15 ppm, mean 1.82 ppm).

Phosphate concentrations were also slightly higher at Station 1 (6.5–12.2 ppm, mean 9.35 ppm) than at Station 2 (6.1–12.0 ppm, mean 9.05 ppm). There was a significant difference in chloride concentration. Station 1 had a lower range (25.6–32 ppm, mean 28.8 ppm) than Station 2, which had much higher values (120.0–122.5 ppm, mean 121.25

Table 1: Annual ranges and the mean value of physicochemical parameters of two ponds

Sl. No.	Parameter	Station 1		Station 2	
		Range	Mean	Range	Mean
1.	Air temperature (°C)	14–32	23	15–32	22.5
2.	Water temperature (°C)	14–28	21	17–25	21
3.	pH	5.5–7	6.25	5.5–9	7.25
4.	Dissolved oxygen (mg l^{-1})	1–5.04	3.02	2.3–9.6	5.95
5.	Free carbon dioxide (mg l^{-1})	0–33	16.5	0–22	11
6.	Alkalinity (ppm)	120.5–122.5	121.5	120–121	120.5
7.	Ammonium nitrate (ppm)	2.0–2.5	2.25	1.5–2.15	1.82
8.	Phosphates (ppm)	6.5–12.2	9.35	6.1–12.0	9.05
9.	Chlorides (ppm)	25.6–32	28.8	120.0–122.5	121.25

ppm). The physicochemical parameters indicate that Station 2 generally has better water quality, with higher dissolved oxygen, lower free carbon dioxide, and a more neutral to alkaline pH. However, Station 1 exhibits higher nutrient levels (ammonium nitrate and phosphates), suggesting possible external nutrient inputs. The significantly higher chloride concentration at Station 2 may be due to differences in water source, geological influence, or anthropogenic activities. These variations could impact aquatic life and should be considered in ecological assessments and conservation efforts.

The present study provides significant insights into the diversity and seasonal variations of brachionid rotifers in Meizailung Fish Farm, Ukhrul District, Manipur, India. The identification of 12 species belonging to three genera highlights the ecological richness of the study site, with *Anuraeopsis*, *Brachionus*, and *Keratella*, being the predominant taxa. The presence of these genera aligns with recent studies on freshwater rotifer communities, where members of the family Brachionidae are recognized as key indicators of trophic conditions and water quality (Silva et al., 2021).

The discovery of four recorded species-*Anuraeopsis coelata*, *Anuraeopsis navicula*, *Brachionus budapestinensis*, and *Keratella valga*-from Ukhrul, Manipur, significantly expands the known distribution range of these taxa. Their presence may be attributed to the unique environmental conditions of the Meizailung Fish Farm, including nutrient availability, hydrological factors, and seasonal variations. Such records emphasize the need for continued monitoring and taxonomic exploration of zooplankton communities in Northeast India.

The highest diversity was observed during the pre-monsoon season, while the lowest was recorded in winter. These fluctuations in species richness can be linked to physicochemical parameters, particularly temperature and dissolved oxygen, which were found to have significant influences on rotifer diversity. Warmer temperatures during the pre-monsoon period may have promoted higher reproductive rates in rotifers, as temperature is a critical factor affecting rotifer life cycles and metabolic activity. The decline in diversity during winter could be attributed to lower temperatures and reduced food availability, which may have adversely affected rotifer population dynamics (Silva et al., 2021).

Physicochemical factors such as pH, alkalinity, phosphates, chloride, and dissolved oxygen played a vital role in shaping rotifer community structure. In this study, Station 2 exhibited better water quality and a higher abundance of Brachionus species. It is suggested that favourable environmental conditions increase the rotifer communities. These observations align with the findings of (Sharma et al., 2021), who reported that soft and de-mineralized waters are characterized by low zooplankton. The significant correlation between rotifer diversity and temperature aligns with previous findings that warmer conditions favour higher metabolic rates, growth, and reproduction in rotifers (Kuczynska-Kippen and Basinska, 2014). Similarly, dissolved oxygen levels directly influence zooplankton metabolism and survival, with higher oxygen levels typically supporting a more diverse assemblage of rotifers. The studies indicated the water quality met acceptable standards, with dissolved oxygen levels averaging from 3.02 mg l^{-1} at station 1 to 5.95 mg l^{-1} at station 2. These observations were drawn from (Banerjee et al., 2019), which demonstrated that the optimal dissolved oxygen level is 4.5 mg l^{-1}.

Rotifers, especially members of Brachionidae, served as primary consumers in freshwater food webs, linking microbial producers to higher trophic levels such as fish larvae. Their abundance and diversity are crucial for maintaining balanced aquatic ecosystems, particularly in fish farms where zooplankton serve as natural food sources for hatchlings and fry (Silva et al., 2021). The findings of this study provide baseline data for aquaculture management, emphasizing the importance of maintaining optimal environmental conditions to sustain a diverse and productive plankton community.

Moreover, the identification of four records highlights the need for regular biodiversity assessments to monitor changes in species composition over time. With increasing anthropogenic pressures and climate variability affecting freshwater habitats, long-term studies on rotifer populations could serve as valuable indicators of ecosystem health and resilience (Ka et al., 2024).

While this study comprehensively assesses brachionid rotifers in Meizailung Fish Farm, further research is required to explore their functional roles in the local aquatic food web. Investigations into their feeding ecology, reproductive strategies, and interactions with other planktonic organisms would offer deeper insights into their ecological significance. Additionally, the application of molecular techniques for species identification could enhance taxonomic resolution and detect cryptic diversity within rotifer communities (Fontaneto, 2014).

4. CONCLUSION

Twelve (12) rotifer species under the Brachionidae family have been identified from Meizailung fish farm. *Anuraeopsis coelata*, *Anuraeopsis navicula*, *Brachionus budapestinensis*, and *Keratella valga* represent records from

Manipur. Rotifers are a major food source for live fish food and other aquatic animals, their abundance greatly depends on the water quality. This study would give the information to understand the ecosystem, conserve water quality, the biotic life of the water bodies, and for the overall sustainable development for the people Ukhrul District.

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