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Rotifer diversity of Mirik Lake in Darjeeling Himalaya

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ABSTRACT

Rotifer diversity was studied in Mirik Lake, Darjeeling Himalaya, for a period of two years during October, 2005 to September, 2007 from the surface water samples of seven selected sampling locations. A total of seventeen varieties of rotifers were recorded during the whole study period, of which *Asplancha* sp. and *Brachionus* sp. were the most common genera in the lake. While the density varied from 24 to 8530/m³ it was relatively higher during summer months. The highest diversity was recorded at sampling location 6.

Key words: Rotifer, Mirik Lake, density, diversity

INTRODUCTION

Rotifers are important ecological group occupying a wide range of habitats in aquatic ecosystem [1]. They are first order consumers drawing energy directly from primary producers of the ecosystem, viz., phytoplankton, and in turn form the food of a large number of planktivorous fishes and other invertebrates and thereby help in transferring energy to higher trophic levels. Thus population of rotifer is sensitive indicators of aquatic ecosystem.

Rotifer diversity has been studied by various workers in different freshwater bodies of India [2, 3, and 4]. However, study on rotifer diversity in the freshwater bodies of Darjeeling Himalaya is scanty. Till now there is no report found on rotifer diversity of Mirik Lake of Darjeeling Himalaya. Therefore the present investigation was aimed at finding out the diversity in Mirik Lake of Darjeeling Himalaya.

MATERIALS AND METHODS

Study site

Mirik is one of the famous hill resorts in the Darjeeling Himalaya at an altitude of 1767 meters. It extends between 26° 53'N and 88° 10'E and covers an area of 135.9 ha. "Sumendu Lake" or "Mirik Lake" is an artificial reservoir of

Mirik Town. It was constructed in 1979 under “Mirik Tourist Project” for the facilitation of commercial tourism. The area, under jurisdiction of Mirik Municipal Corporation, is overall controlled by Darjeeling Gorkha Hill Council (DGHC). This lake has been included under National Lake Conservation Programme, formulated by the Ministry of Environment and Forests, Government of India.

Area and Surroundings of Mirik Lake

The total lake area is about 16.19 ha with approximate length of 1.25 km and the peripheral road is about 3.5 km. The arch-type over bridge across the lake is 24.38 m long. Initially maximum depth of the lake was 7.92m while minimum was 1.83 m [5]. While eastern bank of the lake is flat at ground level, the western bank, having hill slopes, is covered by a rich forest of about ten thousand *Cryptomaria japonica* trees.

The lake is fed by both perennial streams and rainwater. Since the lake is situated in a valley encircled by hill ridges with extensive natural drainage network, it receives wastewater from human settlements through numerous inlets. There is one out-fall point through which the spillover water of the lake is discharged into the river Mechi, situated to the Western side of the lake. The catchment area consists of residential areas, vacant lands and commercial centers comprising of hotels, restaurants and other shops.

Mirik Lake and its surroundings, as a whole, contain multifarious recreational features like boating, jogging, organizing fair, picnic and many others. This is the most beautiful lake of Darjeeling district where visitors come from different parts of the world. Besides attracting tourists, the lake water also serves as a major source of drinking water to the local people.

Sampling sites

Rotifer diversity of Mirik Lake water was studied for two years from October 2005 to September 2007. Considering length of the lake as well as point and non-point sources of pollution, seven sampling sites were identified in the Lake (Fig. 1). The water samples were collected every month at regular intervals from these locations with the help of paddle-boat. The brief descriptions of the sites are as follows:

Site 1 ($26^{\circ}53'08.49''$ N and $88^{\circ}11'08.32''$ E) is 250 m away from DGHC Nursery toward North- West. This site is located at the point where wastes from hotels and residential area join into the lake. Car washing also takes place at this site.

Site 2 ($26^{\circ}53'16.80''$ N and $88^{\circ}11'14.95''$ E) is situated at the flank of the lake where tourists assemble to observe the fishes that agglomerate specifically here for consuming various food items thrown by the visitors. Wastes from hotels and residential areas also join at this site.

Site 3 ($26^{\circ}53'20''$ N and $88^{\circ}11'01''$ E) is located at 100 m away from the concrete bridge of the lake towards South East. This site is situated near the proposed children park area. Human activity is comparatively lesser at this site.

Site 4 ($26^{\circ}53'017''$ N and $88^{\circ}10'927''$ E) is located at the centre of concrete bridge over the lake. Some amount of surface runoff joins here.

Site 5 ($26^{\circ}53'38.40''$ N and $88^{\circ}10'55.11''$ E) is situated at 90 m away from the water intake point towards North East. This water intake well is used for water treatment plant under PHED having a capacity of 1MGD (Million Gallon per Day) to cater the water supply for the people of Mirik Municipality area.

Site 6 ($26^{\circ}53'27.99''$ N and $88^{\circ}10'56.53''$ E) is the area where waste water is discharged primarily from Mirik market. Bathing and washing of clothes take place at this site.

Site 7 ($26^{\circ}53'34.53''$ N and $88^{\circ}10'51.89''$ E) is situated near the outlet of Mirik Lake which joins to the Mechi River through weirs. Washing of clothes and bathing take place near this site.

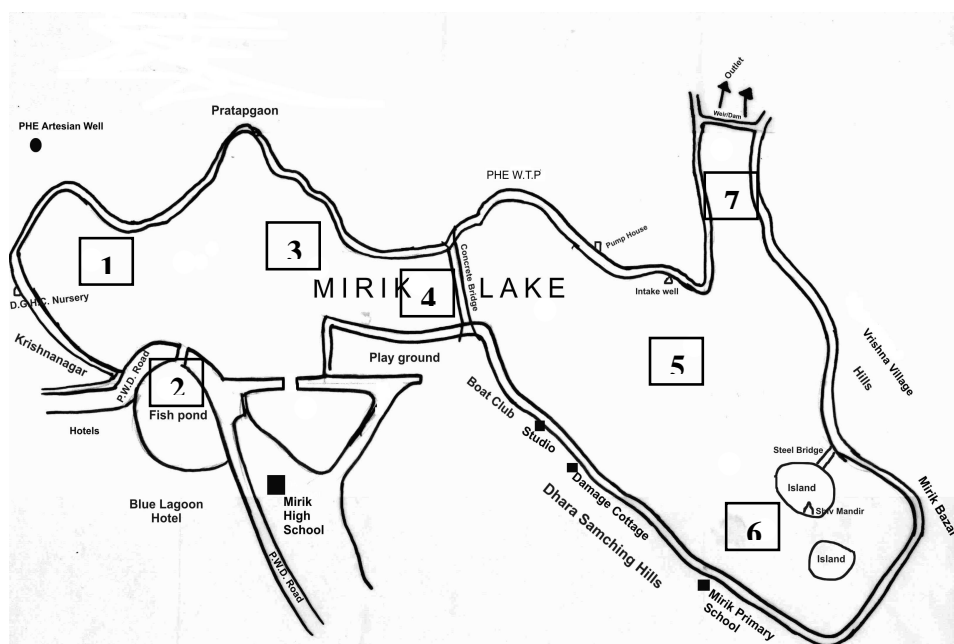


Fig. 1. Location of sampling sites at Mirik Lake, Darjeeling

MATERIALS AND METHODS

Rotifer samples were collected by filtering the surface water through plankton net (conical tow net made of bolting silk) and preserved in 4% formalin solution immediately after collection of sample. In laboratory, the samples were concentrated by centrifugation at 1500 r.p.m. for 15 minutes. Sedgwick- Rafter (S-R) cell was used as a device for enumeration of planktonic rotifers under microscope. The rotifers were identified up to genera level or wherever possible upto species level, and were reported as number per cubic meter. The identification was done by referring the keys [6, 7, 8 and 9].

RESULTS AND DISCUSSION

A total of seventeen rotifer species were recorded from seven sampling sites of Mirik Lake during the whole study period (Table 2). *Asplancha* sp. and *Brachionus* sp. were the most common rotifer genera of the lake. The highest diversity of rotifers was found at Site 6 having fifteen rotifer species while lowest diversity was recorded at Site 2 where only ten rotifer species were recorded. The higher rotifer diversity of Site 6 was probably due to inflow of wastes into the lake from Mirik market area [10].

Table 1. Range of physico-chemical parameters of surface water of seven sampling sites of Mirik Lake

Parameters	Sampling Stations						
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Air Temperature (°C)	7.0-26.0	8.0-26.0	8.0-25.5	8.0-25.0	10.0-26.0	10.0-26.5	8.5-25.0
Water Temperature (°C)	5.0-25.0	5.0-25.0	5.0-24.0	5.0-24.0	6.0-23.0	9.0-25.0	5.5-23.5
pH	6.5-7.5	6.4-7.5	6.4-7.7	6.6-8.1	6.5-7.8	6.7-8.1	6.3-7.8
Conductivity (µmhos)	31.0-126.0	77.5-163.2	49.3-116.6	48.9-138.1	52.3-116.7	56.8-116.4	51.3-117.1
Dissolved Oxygen (mgL ⁻¹)	5.0-7.7	4.6-7.8	4.6-10.6	4.2-12.6	4.4-13.6	4.0-9.0	4.2-13.5
Free CO ₂ (mgL ⁻¹)	4.0-14.0	6.4-16.0	4.8-12.0	3.6-14.0	4.0-9.0	4.0-9.8	3.8-8.0
Total alkalinity (mgL ⁻¹)	20.0-52.0	24.0-60.0	20.0-60.0	24.0-44.0	22.0-52.0	20.0-56.0	22.0-48.0
Total hardness (mgL ⁻¹)	8.0-30.0	8.0-38.0	11.0-30.0	10.0-32.0	8.0-32.0	10.0-36.0	9.0-28.0
Chloride (mgL ⁻¹)	9.0-28.0	10.0-26.0	9.2-26.0	12.0-31.0	10.0-26.0	11.0-31.0	9.5-26.0
Biological Oxygen Demand (BOD) (mgL ⁻¹)	1.8-6.4	2.3-5.6	1.2-5.0	1.0-5.0	1.0-4.6	2.0-5.4	1.0-4.6

Table 2. Rotifer species recorded from the surface water samples of seven sampling sites of Mirik Lake (October, 2005-September, 2007).

Rotifers	Sampling Stations						
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
<i>Asplancha sp.</i>	+	+	+	+	+	+	+
<i>Anuraeopsis fissa</i>	+	+	+	-	+	+	-
<i>Brachionus bidentata</i>	-	-	-	+	-	+	+
<i>Brachionus calyciflorus</i>	+	+	-	+	+	-	+
<i>Brachionus caudatus</i>	+	-	+	-	-	+	-
<i>Brachionus diversicornis</i>	+	+	+	+	-	+	+
<i>Brachionus forficula</i>	-	+	-	+	-	-	+
<i>Brachionus quadridentatus</i>	+	-	+	+	+	+	+
<i>Filinia sp.</i>	-	-	+	+	+	+	-
<i>Gastropus sp.</i>	+	+	+	+	+	+	+
<i>Keratella sp.</i>	+	+	+	+	+	+	+
<i>Lepadella sp.</i>	+	+	+	+	+	+	+
<i>Monostyla sp.</i>	-	-	+	-	+	+	-
<i>Phylodina sp.</i>	-	-	-	+	+	+	-
<i>Polyarthra sp.</i>	+	+	+	+	+	+	+
<i>Testudinella sp.</i>	-	-	+	+	+	+	+
<i>Trichocera sp.</i>	+	+	+	+	+	+	+

+ Present, -Absent

The highest rotifer density (8530/m³) was observed at Site 6 during summer in the second year, while lowest density was recorded at Site 5 during winter of the first year (24/m³) during the study (Fig. 2). In general, rotifer density was relatively higher during summer months.

During the first year of study, the rotifer population density and diversity were highest in summer followed by monsoon and winter. Higher population density and diversity of rotifer in summer were also reported by Jeelani *et al.* [3] in Anchor Lake, Kashmir.

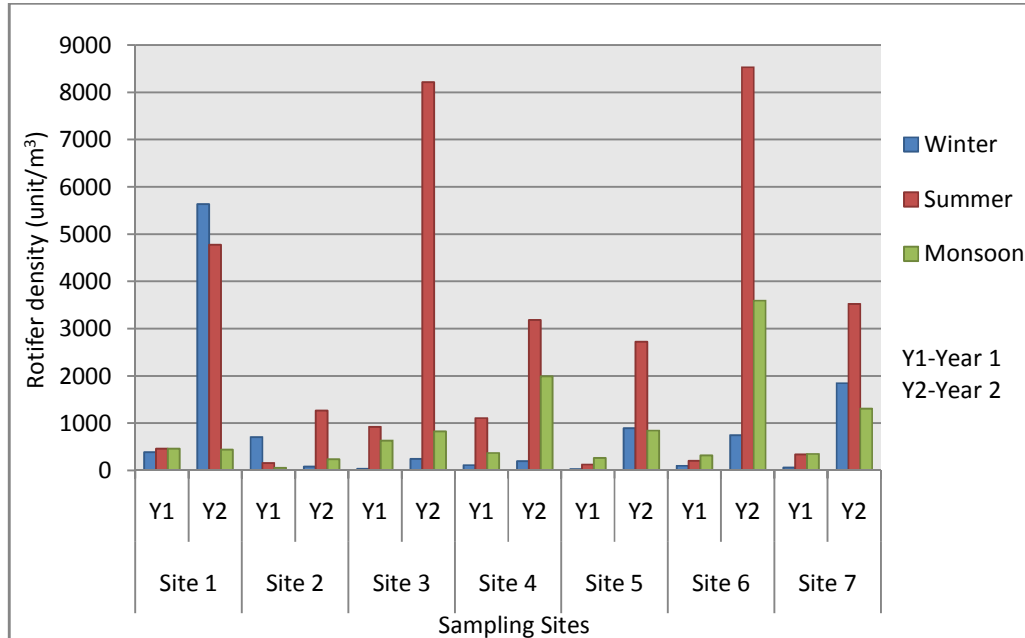


Fig. 2. Seasonal variations in population density of rotifers in Mirik Lake (October 2005-September 2007)

The environmental parameters, mainly the water temperature, exert significant impact on the relative abundance of rotifers [11]. In the present study, maximum rotifer density was observed at a temperature range of 21.00- 24.60°C (Table 1). Although pH is not the only factor influencing the occurrence as well as abundance of rotifers, the

maximum rotifer density was recorded in the pH range of 6.70-8.10 (Table 1). The role of oxygen appears to be an important limiting factor in the occurrence as well as abundance of rotifer species. Most of the rotifer species were recorded in a wide range of oxygen concentration (4.00-9.00 mgL⁻¹) (Table 1). According to Hofmann [12] in many water bodies, bicarbonate alkalinity also acts as a limiting factor for the distribution of some rotifer species. The present investigation depicts maximum abundance of total rotifers at bicarbonate alkalinity of 20.00-56.00 mgL⁻¹ (Table 1).

In the present study, rotifera depicted high qualitative diversity and it showed a number of peaks (Fig. 2). The irregular periodicity in the abundance of rotifer population was reported earlier by several authors [13, 14, 15, 16 and 17]. It may be mentioned that according to Reid and Wood [18], rotifers never follow any predictable population pattern in fresh water impoundment. According to Singh [19] rotifers have versatile capacity to survive in different environments. Similar observations were found in the present study also, since they were abundant in summer months indicating direct relationship with high temperature (Table 1). The peak abundance of rotifers during warm (summer) season can be attributed to low population of diatoms in this period as reported by Jain *et al.* [20]. Deshmukh [21] reported 28 species of rotifera from Chhatri Lake, Amravati, Maharashtra, with maxima in summer, and this observation corroborates with the present investigation. Devi [22] also observed the maxima of rotifera in Ibrahimbagh during premonsoon and in Shathamraj reservoir, Hyderabad during monsoon period.

CONCLUSION

The results obtained during the present study demonstrate that Mirik Lake supports the growth of quite a large number of rotifer species. The lake water should be properly maintained to conserve its rotifer diversity.

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