

ECOLOGY OF FRESHWATER ROTIFERA IN A SEASONAL POND OF THE UNIVERSITY OF PUNE (MAHARASHTRA, INDIA)

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Abstract. The present work describes the occurrence and diversity of rotifers with respect to the physicochemical parameters in a seasonal pond of Pune (India) for a period of one year. The study reports 45 rotifers belonging to 3 orders, 15 families and 26 different genera. Of these, 1, 30 and 38 are new records to India, Maharashtra state and Pune district respectively. The pond water exhibits a typical range of temperature (20.7-30.5 °C) and alkaline nature (7.4-9.5), characteristic of tropical freshwater bodies. The rotifer fauna is characterised by moderate diversity and evenness, higher dominance, and very low temporal community similarities. The study also reveals dominance of eurythermal and eutrophic rotifer species. Rotifer richness is positively correlated to rainfall and temperature, whereas a negative correlation between pH and conductivity is observed. Rotifer abundance is positively correlated with pH, whereas no such correlation is observed with temperature and conductivity. Conservation of seasonal water bodies is essential, as these habitats may reveal interesting relationships between the physicochemical parameters and the rotifer fauna present there.

Keywords: *Rotifers, seasonal water body, physico-chemical, moderate diversity, high dominance*

Introduction

Rotifers are important organisms of freshwater ecosystems and play an integral role in the aquatic food chains due to their qualitative and quantitative occurrence. The occurrence of rotifers is affected by the complex interaction of various physical, chemical, geographical, biological and ecological parameters. All these factors play an individual role in the formation of rotifer assemblages and their seasonal occurrence, but the ultimate effect is produced due to interplay and interaction of all these factors (Hulyal and Kaliwal, 2008). This imparts an exclusive and complicated nature to the rotifer fauna of a particular region. These factors also partition the environment and minimize the competitive interactions creating microhabitat boundaries for rotifer species to occur and survive (Nogrady *et al.*, 1993). The significant response the rotifers give to the physico-chemical and biological changes may be correlated to their smaller sizes, permeable bodies and high turnover rates (Nogrady *et al.*, 1993; Sladeczek, 1983).

The rotifer fauna of freshwater bodies plays an important role in the ecological balance and has a potential value as bio-indicators of changing the trophic condition (Stemberger, 1983; Sladeczek, 1983). Hence, studying the physicochemical factors may help us to understand the trophic dynamics of that water body with respect to freshwater rotifers. Understanding the function all these factors play to influence the abundance

and diversity of fauna is the most important challenge to an ecologist and biogeographers (Gatson, 2000).

Indian ecological work on freshwater zooplankton for the first time was done in a small tank in Calcutta (Sewell, 1934). Most of the studies on rotifer seasonality and ecology are from lakes, beels, ponds, tanks, reservoirs and rivers. Except for a few studies, many are just a part of yearly zooplankton studies or reporting of relationship of few physico-chemical parameters with the prevailing zooplankton. Most studies are also concentrated studying the potential of rotifers as pollution and eutrophic indicators. Quantitative statistical analysis is ignored in most of the studies and biodiversity studies on Rotifera are rare.

Comprehensive record of rotifer ecology and biodiversity of flood plain lakes is reported from the North East Indian states (Sharma, 2000a, 2000b, 2005, 2009a, 2009b, 2010; Sharma and Sharma, 2001, 2005, 2008). These studies have resulted in about 202 species, belonging to 43 families and 21 genera (Sharma, 2007). Most of the limnological studies have been carried out from large, permanent and stable water bodies.

Biodiversity studies on rotifers of temporary and seasonal water bodies, in India are scarce. In Maharashtra state, a primary ecological study on Rotifera has not been carried out. Singh and Patil (1991) have carried out the only ecological study on rotifers from Pune district. However, the study was limited to reporting of physicochemical parameters of the Pashan and Katraj lakes and the occurrence of few zooplankton species. Vanjare (2008) did a small ecological survey of rotifers from University of Pune pond and Ganesh Talav, reporting 22 species. Thereafter, a few rotifer species along with a new record to the Oriental region were reported from the University of Pune pond (Vanjare and Pai, 2010) and highly polluted Mula River (Vanjare *et al.*, 2010).

The aquatic bodies are gradually or abruptly being polluted due to anthropogenic activities. This is causing changes in the aquatic environment, and this concern prompts the requirement for monitoring of freshwater waters and fauna found in there (Kudari and Kanamadi, 2008). Reservoirs, ponds, lakes, seasonal and temporary water bodies and rivers are very significant as they harbour abundant faunal resources.

This study was carried out keeping in mind though environmental uncertainty; seasonal waters can hold a rich and dynamic zooplankton community consisting of large number of taxa (Fahd *et al.*, 2000). Studying such habitats is sure to yield new insights into the occurrence, ecology and biodiversity of rotifers with respect to the prevailing physico-chemical parameters.

Thus, the current study describes qualitative diversity, quantitative abundance and periodic occurrence of rotifers from a seasonal water body in University of Pune, Pune. The study also reports one new record to India, thirty new records to Maharashtra state and thirty-eight rotifers new to Pune district.

Materials and Methods

Study sites and stations

The study was carried out in a small seasonal pond (*Fig. 1*) in University of Pune campus, Pune (18°33'16"N; 73°49'28"E). The University of Pune is spread over 410 acres, situated in the Northwestern part of Pune city. The mean elevation is 576 meters above sea level. The University campus has extensive plantation of *Dalbergia*

melanoxylon, a deciduous plant occupying the majority of the dry deciduous forest patches.

The University of Pune pond is small seasonal water body near the University of Pune main building, adjacent to the University playground. The pond occupies an area of not more than 2.5 acres. The pond gets water supply due to the monsoon rains in June every year, subsequently drying up in the month of April. The water body houses variety of aquatic flora and fauna. Hydrophytes include *Typha*, *Hydrilla*, *Azolla* etc. The fauna includes Turtles (*Chitra*), water birds, frogs (*Microhyla*) and toads. The pond is still undisturbed in terms of human activity, except that few instances of organic waste dumping.

Water sampling was carried out from three stations along the shores of the pond. The first station (SI) near the entrance was 0.5 meter deep, with very less hydrophytes. The second station (SII) was behind a partially destroyed building, with dense vegetation of *Hydrilla*. The station (SII) was about 1.5 meters deep. The third station (SIII) was with variable depth (0.5-1.5 meters) and had good vegetation of the hydrophytes found in the pond.



Figure 1. Figure indicating the collection site-University of Pune Pond

Sampling of rotifers

Sampling of rotifers was done for a period of eleven months (June 2009-April 2010) at three fixed sampling stations of pond. Quantitative sampling was done by filtering 20 L of water through 53 μ mesh plankton net (Wildco, USA) and preserving in 4% formaldehyde (Merck, India) immediately. For filtering the water was collected using a plastic container measuring 5 L (Tarsons, India) from the shore and amongst hydrophytes.

Plastic containers (Tarsons, India) containing 100 mL of concentrate were carried to the laboratory for identification and quantitative analysis. Sampling was always done in the early hours (10.00-10.30 hours) in the first week of every month. Live samples whenever possible were also carried to the laboratory. Physico-chemical parameters as temperature, pH, electric conductivity and salinity recorded onsite using a Multiparameter PCS Tester 35 (Eutech, Singapore).

Taxonomic identifications are done using standard available references. Quantitative analysis of rotifer species as individual per litre (ind. L⁻¹) was done by screening three aliquots of 1 ml each from the sample in Sedgwick Rafter counting cell (Wildco, USA) under Olympus MLXi microscope.

Data analysis

Community similarities (Sorensen's index), species diversity (Shannon's index), dominance and evenness were calculated using BioDiversity Professional Software (Version 2). Simple correlation coefficients were calculated between various abiotic and biotic factors and amongst diversity, abundance, dominance and evenness amongst the sampled sites.

Results

Environmental variables of the pond

The sampled site displayed large variations in the measured water parameters. Variations in the physical and chemical characteristics of the pond are shown in *Table 1*. Physicochemical analysis shows the alkaline nature of the sampled water body. An elevated pH (pH = 9.5) was seen in the winter, and lowest was recorded during the monsoon season (pH = 7.4).

Table 1. Table showing physico-chemical parameters at the pond

	pH	Temp (°C)	Conductivity (µS/cm)	Salinity (ppm)	Rainfall (mm)
June	7.4	30.5	639.7	315.4	60.4
July	8.4	28.3	338.5	164.1	317.7
August	8.0	26.4	242.5	117.9	141.8
September	8.2	29.8	326.3	158.0	153.5
October	8.2	26.6	279.1	135.2	119.2
November	8.2	25.7	269.1	130.6	150.3
December	8.6	22.8	263.3	128.6	0.9
January	8.8	20.7	263.8	125.3	0.0
February	9.5	23.2	285.3	137.7	0.0
March	8.7	24.6	372.0	170.0	0.0
April	8.0	24.4	543.0	259.0	0.0
Range	7.4-9.5	20.7-30.5	242.5-639.7	117.9-315.4	0-317.7
(Mean ± SD)	(8.36 ± 0.5)	(25.72 ± 3.0)	(347.50 ± 128.2)	(167.43 ± 62.7)	(85.8 ± 102.1)

The temperature varied greatly (20.7-30.5 °C), being highest during the months of June and September (30.5 °C, 29.8 °C). Lowest temperature values were observed in January (20.7 °C). The University pond waters exhibited high conductivity ranging from 242.5-639.7 µS/cm, with an annual mean of 347.5 µS/cm. High conductivity values (640 µS/cm and 543µS/cm) were observed in the monsoon months (June) and summer (April). The rainfall in Pune ranged from 0-317.7 mm during the study period. The rainfall was highest in the month of September (153.5 mm). The site received no rainfall during the winter and summer months (January-April).

Rotifer species composition and richness

Rotifers, in the sampled site were seen throughout the study period. Taxonomic studies revealed 45 rotifers belonging to 15 families and 26 genera (*Table 2*). Thirty-eight rotifers are new records from Pune district, thirty are new records to Maharashtra

state, and one rotifer, *Mytilina trigona* (Gosse, 1851) is reported for the first time from India. The checklist exceeds the previous report from University of Pune pond (Vanjare and Pai 2010), which reported 13 species from the present site.

Table 2. Table indicating list of rotifers from the University of Pune pond (*new record to India)

Families	Genus	Species
Order Ploima		
Asplanchnidae	<i>Asplanchna</i>	<i>Asplanchna brightwellii</i> Gosse, 1850
Brachionidae	<i>Asplanchnopus</i>	<i>Asplanchnopus hyalinus</i> Harring, 1913
	<i>Anuraeopsis</i>	<i>Anuraeopsis fissa</i> Gosse, 1851
Epiphanidae	<i>Brachionus</i>	<i>Brachionus calyciflorus</i> Pallas, 1766
		<i>Brachionus caudatus</i> Barrois & Daday, 1894
		<i>Brachionus quadridentatus</i> Hermann, 1783
	<i>Keratella</i>	<i>Keratella tropica</i> (Apstein, 1907)
	<i>Plationus</i>	<i>Plationus patulus patulus</i> (Müller, 1786)
Euchlanidae	<i>Platylas</i>	<i>Platylas quadricornis quadricornis</i> (Ehrenberg, 1832)
	<i>Cyrtonia</i>	<i>Cyrtonia tuba</i> (Ehrenberg, 1834)
Euchlanidae	<i>Epiphanes</i>	<i>Epiphanes brachionus spinosa</i> (Rousselet, 1901)
	<i>Beauchampiella</i>	<i>Beauchampiella eudactylota</i> (Gosse, 1886)
Gastropodidae	<i>Euchlanis</i>	<i>Euchlanis dilatata dilatata</i> Ehrenberg, 1832
	<i>Tripleuchlanis</i>	<i>Tripleuchlanis plicata</i> (Levander, 1894)
Lecanidae	<i>Ascomorpha</i>	<i>Ascomorpha</i> sp.
	<i>Lecane</i>	<i>Lecane arcula</i> Harring, 1914
Lepadellidae		<i>Lecane bulla bulla</i> (Gosse, 1851)
		<i>Lecane closterocerca</i> (Schmarda, 1859)
		<i>Lecane curvicornis</i> (Murray, 1913)
		<i>Lecane hamata</i> (Stokes, 1896)
		<i>Lecane hornemanni</i> (Ehrenberg, 1834)
		<i>Lecane leontina</i> (Turner, 1892)
		<i>Lecane ludwigii</i> (Eckstein, 1883)
		<i>Lecane luna</i> (Müller, 1776)
		<i>Lecane lunaris</i> (Ehrenberg, 1832)
		<i>Lecane ohioensis</i> (Herrick, 1885)
		<i>Lecane quadridentata</i> (Ehrenberg, 1830)
		<i>Lecane unguolata</i> (Gosse, 1887)
		<i>Lecane unguitata</i> (Fadeev, 1925)
		<i>Colurella</i> sp.
Mytilinidae	<i>Lepadella</i>	<i>Lepadella</i> sp.
	<i>Squatinella</i>	<i>Lepadella (Lepadella) ovalis</i> (Müller, 1786)
	<i>Mytilina</i>	<i>Squatinella lamellaris</i> (Müller, 1786)
Notommatidae		<i>Mytilina trigona</i> (Gosse, 1851)*
		<i>Mytilina ventralis ventralis</i> (Ehrenberg, 1830)
Synchaetidae	<i>Monommata</i>	<i>Monommata</i> sp.
Trichocercidae	<i>Polyarthra</i>	<i>Polyarthra</i> sp.
	<i>Trichocerca</i>	<i>Trichocerca similis similis</i> (Wierzejski, 1893)
Trichotriidae		<i>Trichocerca rattus</i> (Müller, 1776)
	<i>Macrochaetus</i>	<i>Macrochaetus sericus</i> (Thorpe, 1893)
	<i>Trichotria</i>	<i>Trichotria tetractis</i> (Ehrenberg, 1830)
Order Flosculariaceae		
Flosculariidae	<i>Ptygura</i>	<i>Ptygura tacita</i> Edmondson, 1940
Hexarthridae	<i>Hexarthra</i>	<i>Hexarthra</i> sp.
Testudinellidae	<i>Testudinella</i>	<i>Testudinella patina</i> (Hermann, 1783)

Maximum species are from order Ploima (93%), and order Flosculariaceae is represented by only three (7%) species. Lecanidae formed the most abundant family (fourteen species), followed by Brachionidae (seven species) and Lepadellidae (four species). The most diverse genus *Lecane* was represented by fourteen species followed by *Brachionus* and *Lepadella*, with three species each.

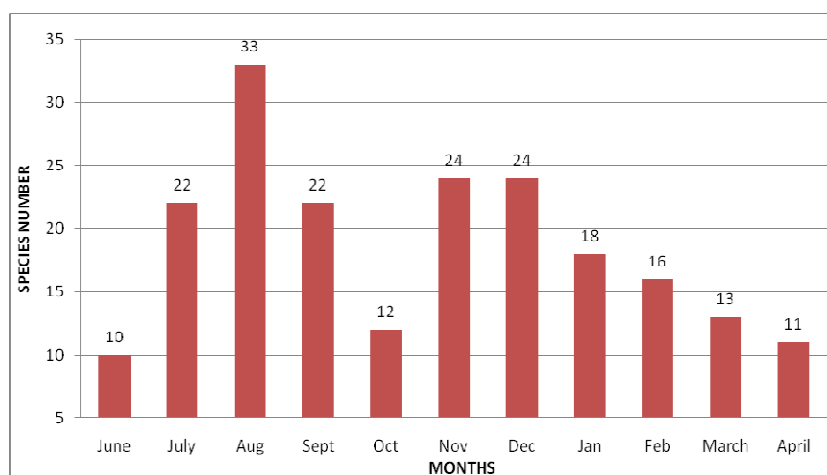


Figure 2. Graph indicating monthly variation of species richness

Monthly rotifer richness varied from 10-33 (18.63 ± 7.08) and showed a bimodal pattern of temporal variations (Fig. 2, Table 3). Highest richness was observed during the rainy season in August (33 species). Sharma and Bhattarai (2005) observed greater species richness in summer from Bhutan. A second maxima of was also seen during the mid-winter months, November and December (24 species). The species richness decreased further in the late winter and summer months. However, species richness was lowest during early rainy season (10 species).

Table 3. Table indicating temporal variations in rotifer communities

Parameters	University of Pune pond Range (\pm SD)	Lowest value in	Highest value in
Monthly richness	10-33 (18.6 ± 7.1)	June	August
Monthly abundance (n/l)	144-1266 (573 ± 365)	June	February
Diversity	0.29-2.85 (1.35 ± 0.81)	March	August
Evenness	0.11-0.83 (0.46 ± 0.20)	March	August
Dominance	0.09-0.91 (0.48 ± 0.29)	August	March
Important abundant families			
Brachionidae (n/l)	26-1202 (368.2 ± 383.1)	August	February
Lecanidae (n/l)	2-93 (38.4 ± 26.4)	June	September
Lepadellidae (n/l)	0-22 (8.9 ± 7.7)	November	August
Important abundant genera			
<i>Brachionus</i> (n/l)	0-98 (9.3 ± 29.5)	July	June
<i>Lecane</i> (n/l)	2-93 (38.4 ± 26.4)	June	September
<i>Lepadella</i> (n/l)	0-22 (8.9 ± 7.7)	November	August
Important abundant species			
<i>Anuraeopsis fissa</i> (n/l)	0-230 (39.6 ± 75.6)	August	September
<i>Keratella tropica</i> (n/l)	1-340 (62.6 ± 114.4)	November	July
<i>Lecane bulla bulla</i> (n/l)	2-45 (11.5 ± 13.4)	June	July
<i>Plationus patulus patulus</i> (n/l)	0-1200 (255.5 ± 424.8)	August	February
<i>Polyarthra</i> sp. (n/l)	0-384 (58.9 ± 127.3)	October	December

Most common species occurring during the year include *Lecane bulla bulla*, *Colurella*, *Euchlanis dilatata dilatata* and *Lecane closterocerca*. Seventeen species exhibited rare occurrence by appearing less than two times during the sampling period. Nine species occurred more than 8 times during the sampling period. *Lecane bulla bulla* was the only species occurring more than 10 times during the sampling period.

Rotifer diversity

The rotifer population in the University of Pune pond exhibited very low to moderate Shannon diversity ranging from 0.29-2.85 (*Table 3*). Species diversity was higher side in the post- monsoon and winter months. Very low diversity values were seen in the post-winter and summer months. The Shannon diversity was highest in the August (2.85), and lowest diversity values were seen in the month of March (0.29). The evenness values also ranged from 0.11-0.83. The Simpson's dominance index was toward the higher side and ranged between 0.09-0.91. Higher dominance was observed in the post winter and summer months.

Rotifer abundance

The population density varied greatly ranging from 144-1266 (513 ± 365) individuals/L during the sampling period (*Fig. 3, Table 3*). The rotifer abundance follows a multimodal pattern, with maxima during September, February and April. Minimum density was observed in June and October months.

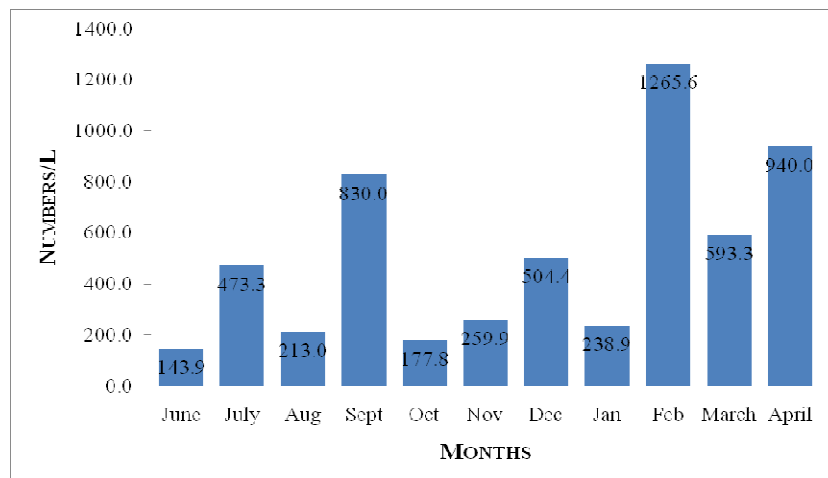


Figure 3. Graph indicating monthly occurrence of rotifers in the pond

The most abundant rotifers were *Anuraeopsis fissa*, *Keratella tropica*, *Plationus patulus patulus*, *Polyarthra* and *Lecane bulla bulla* (*Table 3*). The rotifer *Anuraeopsis fissa* showed abundance (*Fig. 4*) ranging from 4-230 individuals/L. *A. fissa* was most abundant in the monsoon and pre-winter months. The species disappeared never to be seen after September.

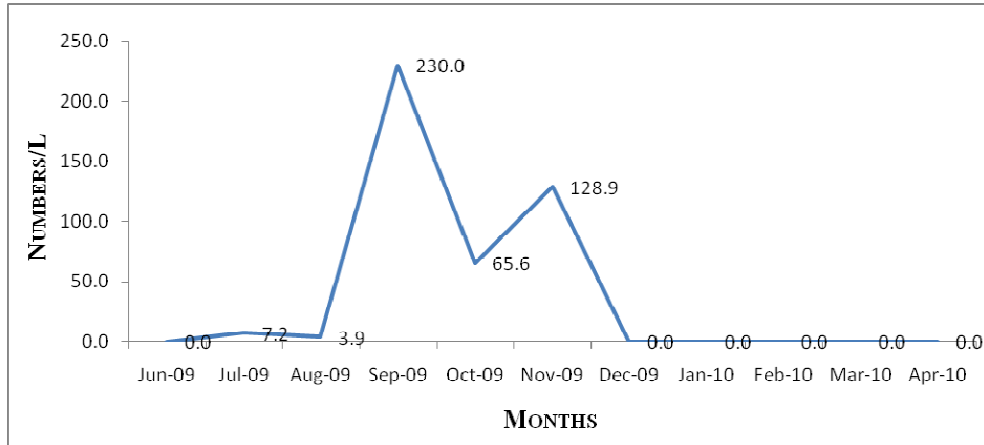


Figure 4. Graph showing monthly abundance of the rotifer *Anuraeopsis fissa*

Abundance of the rotifer *Keratella tropica* ranged from 1-346 individuals/L. The abundance of *K. tropica* showed trimodal pattern, one in July, and other in August and finally in the month of January (Fig. 5). The rotifer was present through the monsoon and winter, finally to disappear in the summer.

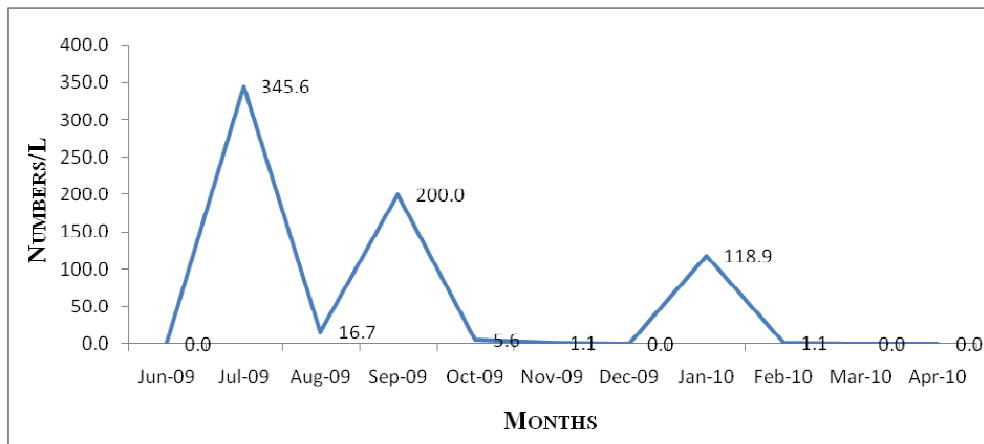


Figure 5. Graph showing monthly abundance of the rotifer *Keratella tropica*

The rotifer *Polyarthra* (Fig. 6) showed trimodal abundance pattern, ranging from 1-384 individuals/L. The rotifer occurred only in the rainy and winter months. The rotifer remained absent in the samples of post winter and summer.

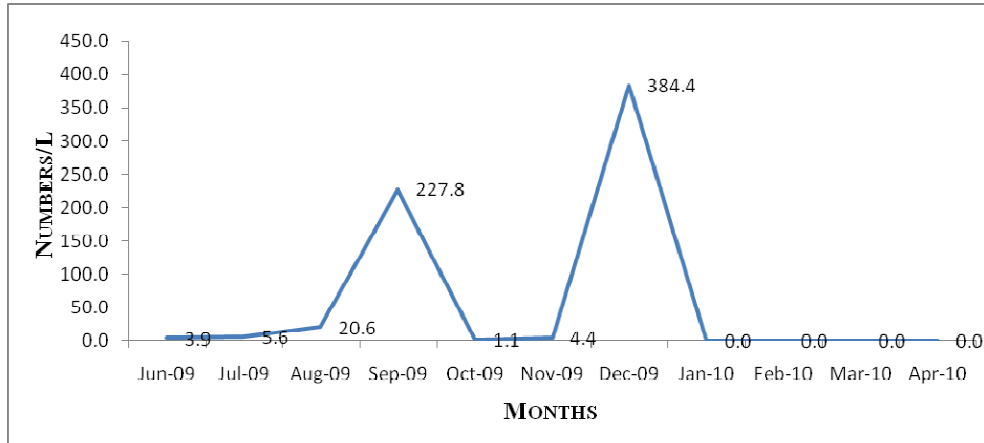


Figure 6. Graph showing monthly abundance of the rotifer *Polyarthra sp*

The rotifer *Lecane bulla bulla* was the only rotifer consistently occurring through the year (Fig. 7). The abundance ranged between 2-45 individuals/L during the sampling period. The occurrence of the rotifer during all the sampling months suggesting that it was most tolerant to the changes in the physico-chemical properties.

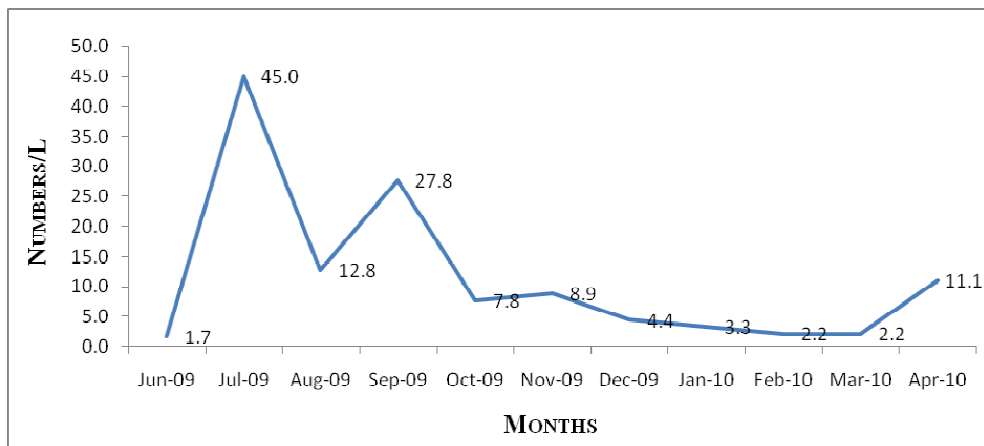


Figure 7. Graph showing monthly abundance of the rotifer *Lecane bulla bulla*

The abundance of the rotifer *Platyonus patulus patulus* ranged from 2-1200 individuals/L making it the most abundant rotifer in the University of Pune pond (Fig. 8). The rotifer appeared after the rains and seemed to dominate the waters in winter and summer months, reaching highest density in the month of February. The increase in the population of *P. patulus patulus* coincided with the decrease in abundance of *A. fissa*. *Platyonus patulus patulus* in general shows growth only in winter and early summer months.

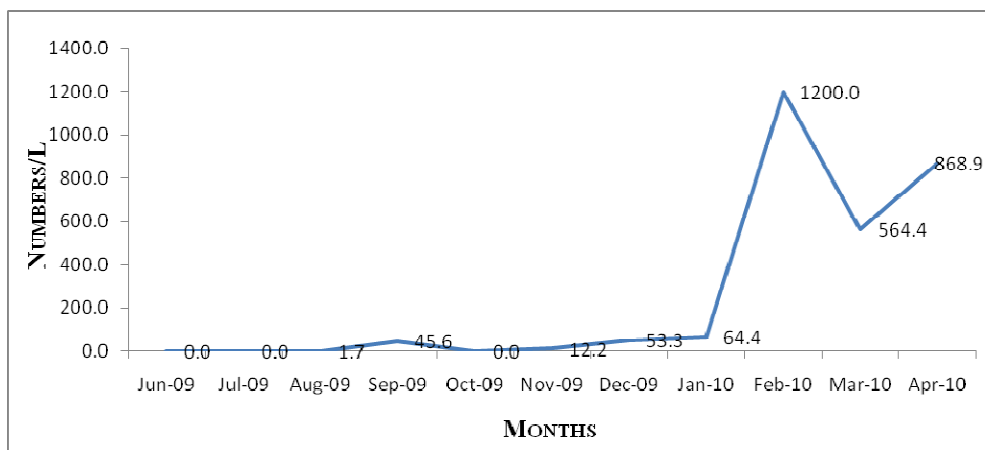


Figure 8. Graph showing monthly abundance of the rotifer *Plationus patulus patulus*

Rotifer community similarities

Rotifer communities between sampled months exhibited 0.3-79.7 % temporal similarity (Table 4). Peak similarities are noted between months February and April (79.7 %), March and April (75%) and February and March (62.8 %). Thus, higher similarities were seen amongst late winter and summer months. Lowest similarity is noticed between the months February and June (0.3 %). There was an overall high dissimilarity between rainy and summer months.

Table 4. Percentage similarities between rotifer communities at different months

	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April
June	*	2.9	6.1	1.4	3.1	3.5	2.5	1.1	0.3	1.1	2.0
July	*	*	26.9	41.9	16.9	14.8	9.0	41.7	2.9	3.8	4.0
Aug	*	*	*	20.0	38.9	23.5	21.1	26.0	4.3	5.9	5.0
Sept	*	*	*	*	21.6	34.2	47.6	37.9	6.8	8.6	7.5
Oct	*	*	*	*	*	45.9	9.7	16.4	2.5	2.9	3.8
Nov	*	*	*	*	*	*	15.8	17.0	4.6	7.1	6.0
Dec	*	*	*	*	*	*	*	23.9	8.6	13.0	9.2
Jan	*	*	*	*	*	*	*	*	12.9	19.4	12.9
Feb	*	*	*	*	*	*	*	*	*	62.8	79.7
March	*	*	*	*	*	*	*	*	*	*	75.0
April	*	*	*	*	*	*	*	*	*	*	*

Discussion

Freshwater rotifers play an important role in the conversion of plant origin food to animal food and serve as prey to other smaller predatory fauna (Hulyal and Kaliwal, 2008). Rotifers are extensively used as aquaculture feed and are good indicators of the trophic status of water bodies. The occurrence and abundance of rotifers can serve as index to understand the fertility of an area.

The water parameters of the sampled site indicate a typical tropical range of temperature (20.7-30.5 °C) and pH (7.4-9.5). The pH values are higher than those reported from the North Eastern states (Sharma, 2000a, 2005, 2009b; Sharma and

Sharma, 2001). However, the values are similar to those reported by Arora (1963a, 1963b) from Maharashtra, Arora and Mehra (2003) from Delhi, Patil and Gouder (1985), Kudari *et al.* (2006) and Majagai and Vijaykumar (2009) from Karnataka state. The temperature values are similar to the general values observed throughout the Indian region (Majagai and Vijaykumar, 2009; Patil and Gouder, 1985; Arora and Mehra, 2003; Kudari *et al.*, 2006; Sharma, 2000a, 2001, 2005, 2009b; Sharma and Sharma, 2001). The conductivity values are marginally higher than those reported from the North Eastern states (Sharma, 2000a, 2005, 2009b; Sharma and Sharma, 2001). Conductivity values conform to the observations from other parts of India (Patil and Gouder, 1985; Arora and Mehra, 2003).

The present study reports forty-five rotifer species from the sampled site of which one is a new record to India, 30 are reported for the first time from Maharashtra state and 38 species are first reports to Pune district. The checklist exceeds the previous report from University of Pune pond (Vanjare and Pai, 2010), who reported 13 species from the present site. The record of higher number of rotifers from the order Ploima (93%) is a typical pattern observed in India (Sharma and Michael, 1980). The record of higher number of species of the genus *Lecane* (fourteen species) and *Brachionus* (three species) imparts a typical tropical character to the sampled water body. (Pejler, 1977; Sharma, 1983). The high diversity of *Lecane* confirms the reports that *Lecane* is most diverse genus in tropical regions (Arora and Mehra, 2003).

This is the record of highest rotifer richness from a single site in the Maharashtra state. Patil (1987, 2005) reported earlier highest diversity with record of 24 and 22 species respectively. The rotifer richness ranged highly amongst the sampled months 10-33 (18.63 ± 7.08 species), and displayed a multimodal pattern of occurrence (Sharma, 2009). The study thus suggests that the University of Pune pond is highly dynamic in terms of its richness and diversity. Majagi and Vijaykumar (2009) reported 14 rotifer species from Karanja reservoir, Karnataka and 10 species were reported from Almatti reservoir, Karnataka (Hulyal and Kaliwal, 2008).

Higher numbers of rotifer species were recorded during the monsoon and post-monsoon months. Rainfall exhibited a moderate positive correlation with the rotifer richness ($r = 0.43$). The decrease in the species richness in the post winter and summer season may be contributed to the subsequent drying of the seasonal water body. The shallow nature of the sampled water body also may have contributed to the decrease in the species richness. This is also evident from the fact that few rotifers as *Platyonus patulus patulu.* and *Lecane bulla bulla*, who were able to survive the drying up period dominated the waters during the post winter and summer season (dominance range = 0.86-0.91).

The decrease in richness also coincided with the sudden increase in the rotifer abundance, but the correlation between the two is not significant ($r = -0.18$). The high species richness in monsoon and winter months can be correlated to higher temperature in monsoon and post monsoon period (25.7-30.5 °C). Hulyal and Kaliwal (2008) propose that the changes in the species abundance can be correlated to fluctuations in the temperature. However, rotifer richness showed moderate correlation ($r = 0.44$) to temperature fluctuations during the study period. A negative influence on the rotifer richness ($r = -0.59$) with pH was observed, as were the observation of Sharma (2000a). The reason can be contributed to the lower richness of the dominant alkaline genus *Brachionus*. Conductivity also exhibited a negative influence on the rotifer richness ($r = -0.66$).

The highly variable rotifer population in the seasonal pond ranged from 144-1266 individuals/L during the sampling period. The multimodal pattern of the rotifer abundance is evident from the three peaks, but follows no definitive pattern. Sharma (2009b) also observed a multimodal pattern at Loktak Lake, Manipur. Sharma (2010) reports a significant correlation between rotifer richness and abundance, whereas no definite relationship between the two was revealed in the current study ($r = -0.19$). The rotifer abundance is higher than the reports of Sharma (2000a, 2000b, 2005, 2009b, 2010). Temperature exhibited slight negative influence on the rotifer abundance ($r = -0.20$). Sharma (2010) reports higher values of temperature influence on the rotifer abundance ($r = -0.72, 0.91$). A positive correlation of pH with rotifer abundance ($r = 0.56$) was recorded in the present study.

Hulyal and Kaliwal (2008) report higher conductivity coinciding with increased population growth of zooplankton. However, no such correlation was observed between rotifer abundance and conductivity ($r = 0.05$). No definite seasonal periodicities of abundance of loricate or illoricate rotifers are seen in the present study.

Nine rotifer species occurred more than 70% during the yearly sampling period. The most dominant rotifer in was the rotifer, *L. bulla bulla* whose occurrence may be correlated to its ability to survive in varied habitats and tolerance to changes in pH and temperature. The high occurrence of rotifers of the genus *Lecane* as compared to *Brachionus* can be correlated to the same above assumption. The shallow waters of the sampling site, also offers the choice habitat for the rotifers of the genus *Lecane* to grow and survive. The high occurrence of genus *Lecane* is also contrary to the notion that the genus *Brachionus* dominates alkaline waters (Dadhich and Saxena, 1999; Hulyal and Kaliwal, 2008).

The highly variable diversity values (1.35 ± 0.81) are slightly lower than observed by Sharma (2000a, 2005, 2009b), Sharma and Sharma (2008) and Arora and Mehra (2003b). This can be contributed to their area of work, the floodplains, which are supposed to harbor world's richest rotifer habitats. The moderate diversity values represented in the present study can be related to the size of the water body and less amount of hydrophytes present therein. However, this suggests that University of Pune pond is important habitat of rotifer fauna, and that it should be conserved for maintaining freshwater biodiversity.

The species diversity records a direct negative correlation with rotifer abundance ($r = -0.67$), whereas a positive correlation amongst both was reported by Sharma (2009b). A positive correlation of rotifer diversity against rotifer richness ($r = 0.63$) was seen (Sharma, 2009b). The higher diversity values in post-rains and winter months coincided with the higher evenness. Correspondingly, the decrease in diversity during the drier months can be correlated to lower evenness. The evenness values observed are higher than Arora and Mehra (2003b), but are lower than that of Sharma (2009b). The evenness and dominance values show significant inverse correlation ($r = -0.98$). The values, especially of the dominance are not in accordance with the earlier observations (Sharma, 2005, 2009b; Sharma and Sharma, 2008). The increase in dominance values was characterized by decrease in diversity and evenness. Higher dominance in the summer months can be attributed to the sudden bloom of the rotifer, *Plationus patulus patulus* (564-1200 individuals/L).

Out of the most abundant five species, the rotifers *Anuraeopsis fissa*, *Keratella tropica*, *Polyarthra* and *Lecane bulla bulla* were abundant in monsoon and winter months. All, except the rotifer *Lecane bulla bulla* disappeared after winter season.

Platyonus patulus patulus was highly abundant in summer; however, it was totally absent from the monsoon and winter samples.

Majority of the recorded species are eutrophic (45%) and alkalophilic (15%) in distribution. This high occurrence of eutrophic and alkalophilic can be correlated to the alkaline nature (pH 7.4-9.5) of the sampled water bodies. The higher incidences of eutrophic elements suggest that the water body is gradually getting polluted. Most species are species are warm water (30%) inhabitants followed by eurythermal species (16%). The occurrence of warm water and eurythermal species can be attributed to the temperature range of the sampled habitats (20.7-30.5 °C).

The rotifer communities at the University of Pune pond exhibited low similarity amongst sampled months (0.3-79.7 %), with only 6% instances showing more than 50% community similarity. This is an indicative of very low homogeneity of the prevailing rotifer fauna in the pond.

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