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ROTIFER DIVERSITY OF OSMANSAGAR RESERVOIR, HYDERABAD, TELANGANA, INDIA

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INTRODUCTION

Rotifers are one of the most important components in zooplankton community. They play a crucial role in interlinking food chain in the aquatic ecosystem. They are considered to be one of the most sensitive indicators of water quality (Sladecek, 1983; Ali *et al.,* 1990; Pontin and Langley, 1993). It is of the opinion of many researchers that the rotifer species composition and their abundance can be used as indicators of trophic status (Berzins and Pejler 1989; Matveeva, 1991; Duggan *et al.,* 2001; Ejsmont-Karabin, 2012).

Osmansagar is a man-made reservoir, constructed across the river Musi in 1920 for controlling flood and water supply to the Hyderabad city, Telangana. The present rapid urbanization, increasing population pressure, sewage and industrial pollutants are deteriorating the aquatic habitats and ground water in the urban areas of Hyderabad leading to a greater threat to the aquatic biodiversity. Keeping in view of the present deteriorating status of the wetlands, the present study has been taken up to assess the rotifer diversity and trophic status of Osmansagar reservoir.

MATERIALS AND METHODS

Osmansagar is located between 17°21´57´´N and 78°18´14´´E, covering an area of 23.84 km^2 in the Southwest region of the Hyderabad. It is surrounded by undulating terrain with rocky surface. The study was carried out at monthly intervals from December 2010 to November 2012.

Rotifer collections were made from the littoral surface of the water column at various localities. Qualitative collections were done by towing surface water column. Quantitative samples were collected by filtering 50Lts of water through a zooplankton net made of bolting silk (No 25), 62 µm mesh size. The collected samples were transferred to a clean plastic container of 100 ml capacity and preserved in 4% neutralized formaldehyde solution. Identification of rotifer species was done with the aid of standard literature Sharma (1992), Segers (1995), Dhanapathi (2000), Sharma and Sharma (2008). Quantitative collection was estimated by using Sedgwick-Rafter cell and the results were expressed in Ind./L (Welch 1948).

The Water samples were collected in clean plastic containers (1 liter) for estimation of the physical and chemical parameters like ambient and subsurface water temperature, electrical conductivity, pH, total dissolved solids, total hardness, total alkalinity, Calcium, Chloride, Phosphate, Nitrate and Nitrite were analysed by using orlab water quality kits following standard method (APHA 1985) and dissolved oxygen content was estimated through Winkler's method.

Species diversity (Shannon diversity index H'), Species richness and abundance (Hill Numbers index), Evenness (Pielou index), dominance (Berger-Parker dominance index) were analysed according to Hayek and Buzas (1997) by using Biodiversity pro software.

RESULTS

Fifty species of rotifers belonging to 24 genera, 16 families were recorded from this reservoir. Brachionidae and Lecanidae have 50% of species, especially the genera *Brachionus* and *Lecane* (Table 1 and Fig. 1). The rotifers, *Brachionus calyciflorus, B. caudatus, B. forficula, B. diversicornis, B. quadridentatus, Keratella tropica* and *Filinia sp.* are the most common species recorded during the study. The species *Pompholyx sp.*, *Mytilina ventralis* and *Tripleuchlanis plicata* are rarely encountered.

Density of the rotifer component varied between 40No/L and 621No/L over the two year period of investigation (Table 2). It was ranging 40-621No/L in 2010-11, maximum was in August and September 2011, 621No/L and 417No/L respectively (Fig. 2). This temporal change was due to the numerical abundance of the species *Keratella tropica* (December), *Brachionus calyciflorus, B. quadridentatus* and *K. tropica* (February), *B. calyciflorus, B. forficula* (March), *B. calyciflorus, B. caudatus, T. similis* and *Trichocerca sp.* (April and May), *B. forficula, B. diversicornis, K. tropica, T. similis, Trichocerca sp., Filinia longiseta* (August and September), *B. calyciflorus, K. tropica* (October and November). Similarly, the density was 44-301No/L in 2011-12 due to the abundance of *B. calyciflorus, B. caudatus* and *K. tropica* in June, July, October and November, 2012.

The diversity (H´) of rotifer was 0.924-2.39 during the entire study period (Table 2 and Fig. 3). It was H´=1.5-2.39 in 2010-11and H'= 0.924-2.18 in 2011-12. The maximum diversity values have been recorded during the summer. The species richness was 7-20 numbers (Fig. 4), higher in April and May 2011 (19 and 20 numbers respectively). The evenness (J) was 0.547-0.978 over two years (Fig. 5). The overall abundance of rotifer ranged between 5.47 and 94.29% during the study (Fig. 6). It was 22.9-94.29% in 2010-11 and 8.96-33.83% in 2011-12. The abundance increased with the species richness, density and diversity of the rotifers. Berger-Parker dominance index was 10.2-58.8% during the study period (Fig. 7). The highest dominance was during monsoon seasons due to the numerical abundance of *Brachionus forficula* during the period 2011-12.

SHE information, analysis shows the variance ranging LnS=1. 95-3.07, LnE= -0.03 to -0.57 and LnE/LnS= -0.01- to -0.16 in 2010-11 (Fig. 8). The differences in LnS= 2.2-3.22, H= 2.07-2.59, LnE= -0.12 to -1.05 and LnE/LnS= -0.06 to -0.33 in 2011-12 (Fig. 9). It shows that the species richness was constant; the diversity and evenness were also constant in 2010-11. But in 2011-12, the species richness was constant, whereas the diversity decreased and evenness.

Physicochemical profile of the reservoir shows (Table 3) that atmospheric temperature between 18 and 31°C. The maximum temperature was in December, 2010 to September, 2011 (22-26°C), minimum in August, 2012 (16°C) and September, 2012 (17°C). The pH value was 8.05 to 9.9 during the study period; highest values are recorded during summer seasons from May, 2012 to August, 2012 (8.7-9.7). Electrical conductivity was 0.41-0.96mS, with marginal variations from December, 2010 to July, 2012 except a sudden increase in August, 2012 (0.96mS). Total dissolved solid content was 233-370ppm, with the highest record during summer seasons. Dissolved oxygen content was (6.68-10.79mg/L) uniform during the entire period of study. Total hardness and alkalinity were 100-205.4mg/L and 102-195mg/L respectively. Chloride content ranged from 45.54 to 87.7mg/L, highest during monsoon seasons in 2010-11, and winter, summer seasons in 2011-12. More concentration of chloride was recorded in October, 2011 (87.71mg/L) and March, 2012 (87.71mg/L). Calcium and Magnesium values varied between 18.96-28.44mg/L and 19.95-43.1mg/L respectively. Phosphate content was 0.08-1.99mg/L, Nitrate 0.-70mg/L high in September, 2011, Nitrite 0-0.16mg/L high in February and September, 2011 and Ammonia 0-0.02mg/L.

DISCUSSIONS

The species of *Brachionus* and *Lecane* are more dominant than the species of other rotifer genera. This trend was reported in several water bodies of tropical and subtropical regions (Nogueira,

2001; Cavlli *et al.,* 2001; Sampaio *et al.,* 2002; Neves *et al.,* 2003 and Kudari *et al.,* 2005). The greater species richness genera in Indian rotifera imparts it a general tropical character (Sharma, 1996; 2000). Hutchinson (1967) stated that the genus *Brachionus* is characteristic of hard waters.

The density of the rotifer has changed temporally with different species composition and the high density because of *B. forficula, B. diversicornis, Keratella tropica* and *Trichocerca* sp. Shannon diversity index of rotifer was found to be moderate in 2010-11 and less in 2011-12. Balloch *et al.* (1976) and Ismael and Dorgham (2003) reported that the diversity index (Shannon's) was found to be a suitable indicator for water quality assessment. The diversity was highest in summer seasons with more species richness, evenness and abundance of individuals like *B. diversicornis*, *B. forficula*, and *Keratella tropica* in the present investigation. Yeole *et al.* (2007) also observed the high diversity during summer season in Yedshi lake, Maharashtra. Sharma (1996) reported the alkaline hard waters in different parts of tropical India are characterized by abundance of *Brachionus* and *Keratella Tropica*. Dominance was highest in August, October and November, 2012, because of the presence of *B. forficula* individuals. Chakaravarty and Kumar (1991) and Bath and Kaur (1998) classified *B. forficula* and *B. calyciflorus* are warm stenothermal forms. Similarly the occurrence of *Anuraeopsis fissa, B. forficula, Dipleuchlanis propatula* and *Lecane stenroosi* are also represents the warm-stenothermal nature (Sharma 2000). SHE information, analysis reveals that the diversity more depends upon the evenness of the individuals rather than species richness.

The high temperature favours more density, species richness, evenness and diversity. The low temperature and high electrical conductivity deceases the density, species richness, evenness and diversity. The pH shows the alkaline nature of the water body. A similar observation was made in the Krishna sayer in Burdwan by Chattopadhyay (2007). The high content of the dissolved oxygen is an indication of the healthy system (Bilgrami and Datta Munshi, 1979). It was recorded that the moderate dissolved oxygen content maintains the aquatic life of the Osmansagar reservoir without much variation. The hardness content is within the permissible limit with not much fluctuation. According to the studies earlier made by Sawyer (1960) this reservoir has moderately hard water. Similarly the less total dissolved solids and alkalinity reveals the less influence of the pollution and buffer action of the water body except during monsoon due to runoff. The ionic components like Chloride, Calcium and Magnesium are also in the permissible limits, except fluctuations in the chloride during winter and monsoon periods. The chloride content of the reservoir reveals less to moderate domestic pollution (Unni 1983). The nutrient content such as phosphate is low in concentration throughout the study except in summer 2011-12. Nitrate, Nitrite and Ammonia concentrations are slightly raised during monsoon. The overall physicochemical profile was more or less similar in both the years, except minor fluctuations indicating the acceptable water quality and healthy aquatic ecosystem.

According to Pejler (1957) and Saksena (1987) the presence of species of *Brachionus* and *Keratella* indicates the moderately clean water (mesotrophic). The presence of abundant *B. forficula* is indicating the hard water nature of Osmansagar. Green (1993) and Sampaio *et al*. (2002) reported the predominance of *Brachionus calyciflorus* is considered to be good indicators of eutrophication. But, this trend is not recorded in this Osmansagar reservoir. Statkweather *et al*. (1979) reported the dominance of some species, adapted to the environmental conditions, give low value of diversity index. These species usually belong to family Brachionidae, especially genus *Brachionus*. This was corroborating with present investigation. Hence, the diversity index of Osmansagar reservoir shows mesotrophic nature.

ACKNOWLEDGEMENT

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Table 1. Rotifer species recorded in Osmansagar, Hyderabad

S. No	Family/species name	2010-2011	2011-2012
	Rotifera		
	Class EUROTATORIA		
	Subclass MONOGONONTA		
	Order PLOIMA		
	Epiphanidae		
1	*Epiphanes clavulata* (Ehrenberg, 1832)	+	+
	Brachionidae		
2	*Anuraeopsis fissa* Gosse, 1851	+	+
3	*Brachionus angularis* Gosse, 1851	+	+
4	*Brachionus bidentatus* Anderson, 1889	+	+
5	*Brachionus calyciflorus* Pallas, 1776	+	+
6	*Brachionus caudatus* Barrios & Daday, 1894	+	+
7	*Brachionus diversicornis* Daday 1883	+	+
8	*Brachionus falcatus* Zacharias, 1898	+	+
9	*Brachionus forficula* Wierzejski, 1891	+	+
10	*Brachionus quadridentatus* Hermann, 1783	+	+
11	*Brachionus quadridentatus melhemi* Barrios & Daday 1894	+	-
12	*Brachionus rubens* Ehrenberg, 1838	+	-
13	*Brachionus urceolaris* Muller, 1773	+	+
14	*Keratella tropica* (Apstein, 1907)	+	+
15	*Plationus patulus* (Muller, 1786)	+	-
16	*Platyias quadricornis* Ehrenberg, 1832	+	-
	Euchlanidae		
17	*Euchlanis dilatata* Ehrenberg, 1832	+	+
18	*Euchlanis sp.*	+	-
19	*Dipleuchlanis propatula* Gosse, 1886	+	-
20	*Tripleuchlanis plicata* (Levander, 1894)	+	-
	Mytilinidae		
21	*Mytilina ventralis* Ehrenberg, 1832	+	-
	Trichotriidae		
22	*Trichotria tetractis* (Ehrenberg, 1830)	+	-
	Lepadellidae		
23	*Colurella obtusa* (Gosse, 1886)	+	+
24	*Lepadella (Heterolepadella) ehrenbergii* Perty, 1850	+	-
25	*Lepadella (Lepadella) ovalis* Muller 1786	+	-

Table 1. contd.

S. No	Family/species name	2010-2011	2011-2012
	Lecanidae		
26	*Lecane arcula* Harring, 1914	+	+
27	*Lecane curvicornis* (Murray, 1913)	+	-
28	*Lecane leontina* (Turner, 1892)	+	-
29	*Lecane luna* (Muller, 1776)	+	-
30	*Lecane papuana* (Murray, 1913)	+	+
31	*Lecane ungulata* (Gosse, 1887)	+	-
32	*Lecane bulla* (Gosse, 1851)	+	+
33	*Lecane hamata* (Stokes, 1896)	+	-
34	*Lecane lunaris* (Ehrenberg, 1832)	+	+
35	*Lecane stenroosi* (Meissner, 1908)	+	+
36	**Notommatidae**		
	Cephalodella forficula (Ehrenberg, 1832)	+	+
37	*Cephalodella sp.*	+	+
38	**Trichocercidae**		
	Trichocerca sp.	+	+
39	*Trichocerca similis* (Wierzejski, 1893)	+	+
40	*Trichocerca bicristata* (Gosse, 1887)		
	Asplanchnidae		
41	*Asplanchna brightwellii* Gosse, 1850	+	+
	Synchaetidae		
42	*Polyarthra sp.*	+	+
	Order Flosculariaceae		
	Conochilidae		
43	*Conochiloides sp.*	+	+
	Hexarthridae		
44	*Hexarthra sp.*	+	+
	Filiniidae		
45	*Filinia sp.*	-	+
46	*Filinia opoliensis* (Zacharias, 1898)	+	+
	Testudinellidae		
47	*Testudinella patina* (Hermann, 1783)	+	-
48	*Pompholyx sp.*	+	+
	Subclass Bdelloidea		
	Philodinidae		
49	*Rotaria neptunia* Ehrenberg, 1832	-	+
50	*Rotaria sp.*	+	+

Table 2. Rotifer density and diversity during 2010-12

Index		Dec	Jan	Feb	Mar	Apr	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Density (No/L)	2010-11	40.7	53.1	147.6	115.6	212.3	134.3	127.1	298.8	621.2	417.2	63.0	64.8
	2011-12	48	59	46	73	44	141	301	137	51	71	117	292
Diversity (H')	2010-11	1.683	1.814	2.134	2.39	2.376	2.323	2.294	1.679	1.669	1.75	1.542	2.13
	2011-12	2.073	2.003	1.405	1.647	1.696	2.187	1.957	1.245	0.924	1.472	1.468	1.064
Evenness (J')	2010-11	0.865	0.826	0.753	0.905	0.807	0.776	0.81	0.7	0.589	0.73	0.742	0.888
	2011-12	0.943	0.912	0.722	0.919	0.872	0.853	0.742	0.773	0.841	0.915	0.755	0.547
Dominance (d%)	2010-11	37.40	42.87	30.13	18.58	19.6	35.22	27.27	44.16	47.0	35.2	36.6	20.71
	2011-12	25	28.81	45.65	31.50	38.63	20.56	28.57	52.55	58.82	32.39	49.57	58.21
Species richness (Nos.)	2010-11	7	9	17	14	19	20	17	11	17	11	8	11
	2011-12	9	9	7	6	7	13	14	5	3	5	7	7
Abundance (%)	2010-11	16.363	19.762	31.341	45.333	44.475	41.20	39.49	16.26	16.03	18.00	13.3	31.1
	2011-12	28.70	25.95	10.95	15.53	16.66	33.83	24.28	8.69	5.47	12.06	12.00	6.694

Table 3. Physicochemical profile of Osmansagar 2010-2012

Parameters	**Duration**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Ambient atmospheric Temperature °C	2010-11	26.75	28.75	27.50	31.00	28.50	28.94	28.25	24.00	30.00	29.67	30.67	27.67
	2011-12	27.00	27.67	27.33	26.67	25.00	22.50	21.50	21.50	18.50	19.00	18.00	24.00
Sub-surface water Temperature °C	2010-11	22.75	24.25	23.75	26.33	24.27	24.65	26.00	26.00	26.67	28.00	20.00	26.00
	2011-12	24.00	25.33	23.33	24.67	23.00	20.50	20.50	20.00	16.50	17.50	15.50	23.33
PH	2010-11	8.05	8.93	8.90	8.87	8.69	8.85	9.03	8.93	9.17	9.03	8.67	9.37
	2011-12	9.03	8.90	8.80	8.87	8.35	8.70	9.50	9.90	9.70	9.10	9.30	8.87
Electrical conductivity (mS)	2010-11	0.43	0.42	0.41	0.44	0.43	0.42	0.44	0.43	0.42	0.46	0.00	0.41
	2011-12	0.40	0.43	0.43	0.44	0.45	0.44	0.41	0.43	0.96	0.93	0.92	0.95
Dissolved Oxygen (mg/L)	2010-11	8.81	6.68	8.00	9.78	8.32	8.19	8.55	8.43	9.45	10.79	0.00	10.05
	2011-12	10.25	10.39	9.24	9.92	9.62	8.80	7.59	10.63	8.81	10.12	10.73	9.31
Total Dissolved Solids (ppm)	2010-11	327.5	302.5	307.5	290.0	306.8	301.7	342.5	360.0	349.6	370.0	306.6	316.6
	2011-12	296.6	333.3	333.3	353.3	355.0	350.0	345.0	340.0	285.0	260.0	275.0	233.3
Total Hardness (mg/L)	2010-11	100.7	159.9	159.9	158.0	144.6	155.6	189.6	197.5	158.0	205.4	197.5	173.8
	2011-12	165.9	181.7	158.0	150.1	154.0	177.7	177.7	165.9	142.2	130.3	118.5	134.3
Total Alkalinity (mg/L)	2010-11	102.0	172.1	172.1	170.0	154.0	167.0	153.0	170.0	161.5	195.5	187.0	170.0
	2011-12	178.5	170.0	187.0	170.0	191.2	165.7	165.7	140.2	153.0	153.0	153.0	144.5
Chlorides (mg/L)	2010-11	45.54	60.72	65.78	60.72	58.19	61.35	60.72	67.47	60.72	40.48	87.71	60.72
	2011-12	80.96	60.72	67.47	87.71	40.48	50.60	70.84	40.48	40.48	20.24	40.48	47.23
Calcium (mg/L)	2010-11	18.96	23.70	30.81	28.44	25.48	27.11	28.44	22.12	28.44	28.44	28.44	28.44
	2011-12	28.44	28.44	28.44	22.12	18.96	18.96	18.96	28.44	28.44	28.44	18.96	28.44
Magnesium (mg/L)	2010-11	19.95	33.25	31.52	31.61	29.08	31.37	39.32	42.79	31.61	43.18	41.25	35.47
	2011-12	33.54	37.39	31.61	31.23	32.96	38.75	38.75	33.54	27.76	24.87	24.29	25.83
Phosphates (mg/L)	2010-11	0.25	0.15	0.20	0.43	0.26	0.26	0.23	0.31	0.15	0.36	0.18	0.10
	2011-12	0.13	0.15	0.12	0.15	0.08	1.69	1.99	0.31	0.24	0.15	0.18	0.12
Nitrates (mg/L)	2010-11	6.75	-	7.50	0.33	3.65	2.87	0.00	0.33	0.04	70.00	1.33	-
	2011-12	-	-	-	-	-	-	-	-	-	-	-	-
Nitrites (mg/L)	2010-11	0.06	0.00	0.11	0.01	0.05	0.04	0.00	0.00	0.00	0.16	0.03	0.00
	2011-12	-	-	-	-	-	-	-	-	-	-	0.03	0.03
Ammonia (mg/L)	2010-11	0.02	0.01	0.01	-	-	0.01	-	-	-	-	-	-
	2011-12	-	-	-	-	-	-	-	-	-	-	-	-

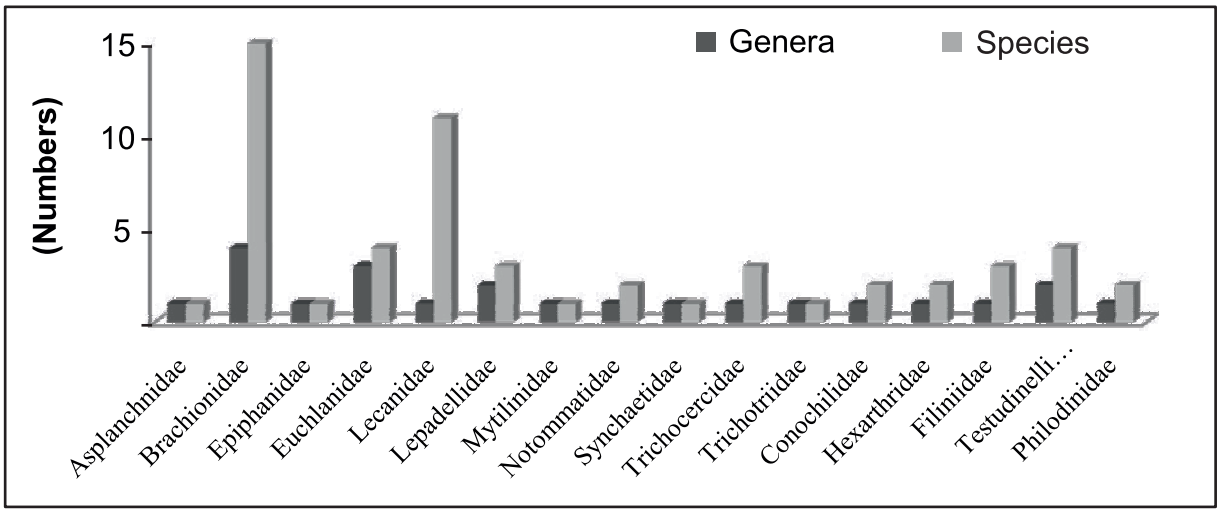

Fig. 1. Family wise species composition of rotifer

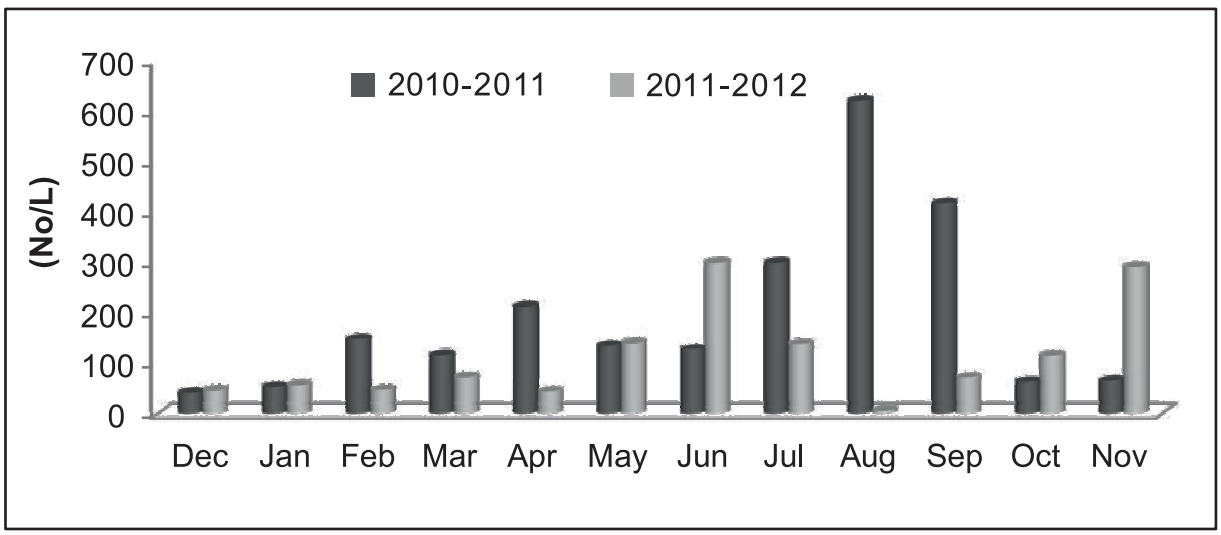

Fig. 2. Monthly variance of rotifer density

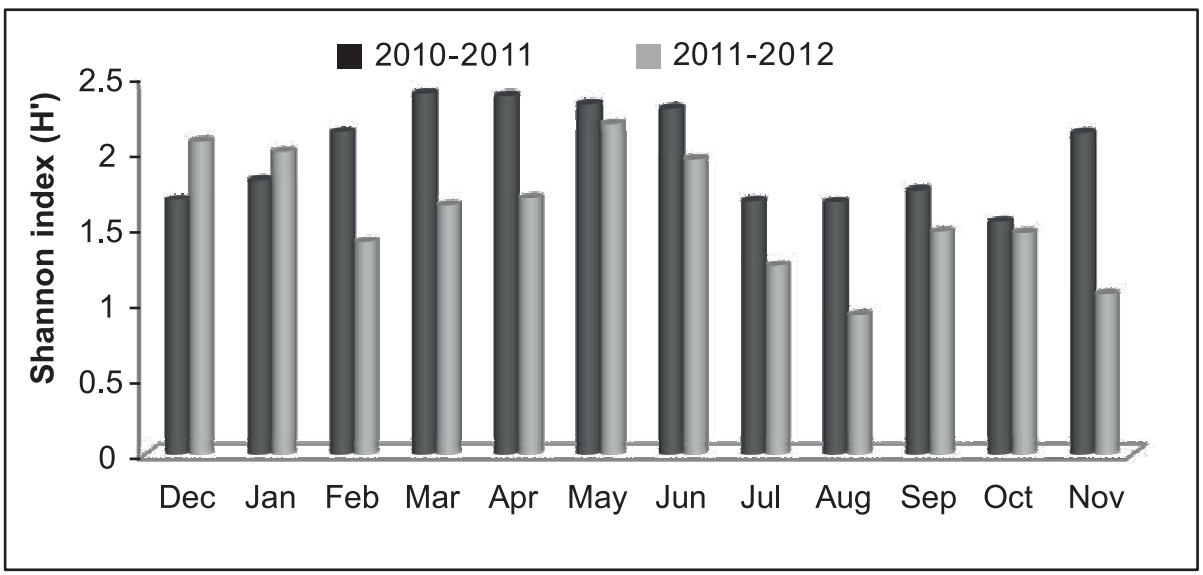

Fig. 3. Monthly variance of rotifer diversity

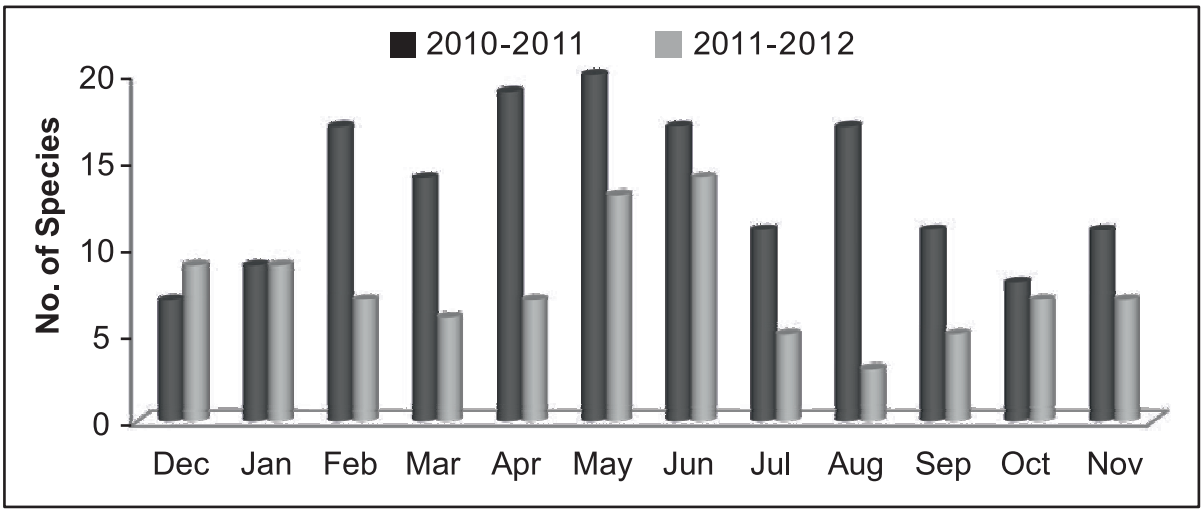

Fig. 4. Monthly variance of rotifer species richness

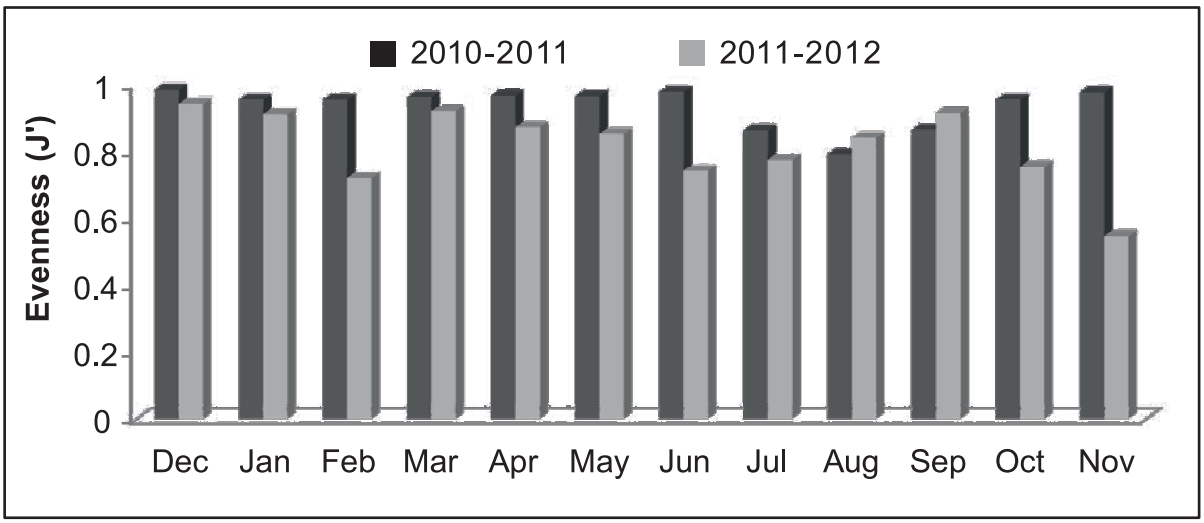

Fig. 5. Monthly variance of rotifer evenness

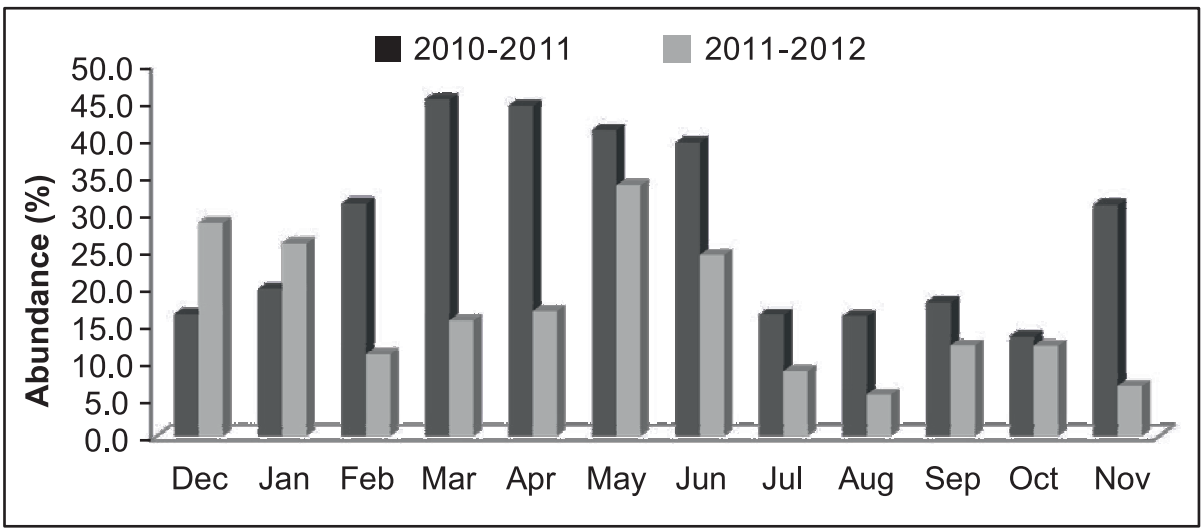

Fig. 6. Monthly variance of rotifer abundance

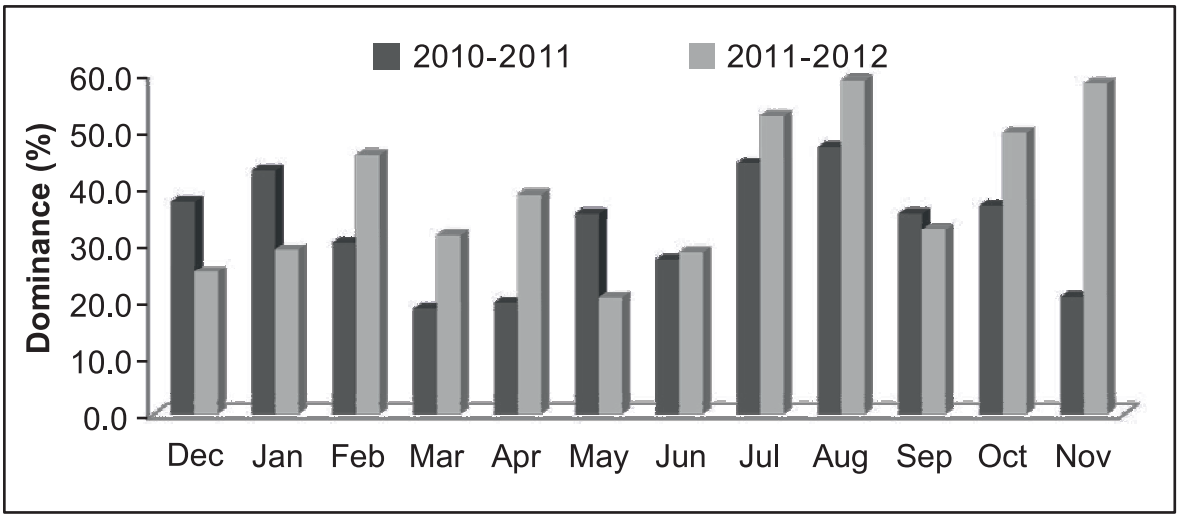

Fig. 7. Monthly variance of rotifer dominance

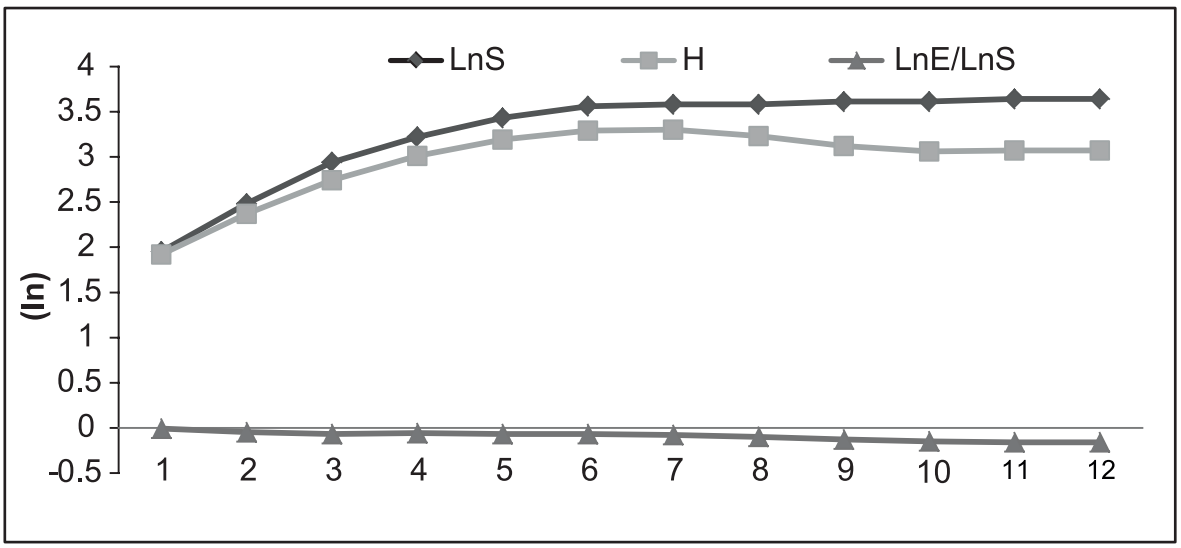

Fig. 8. SHE information analyses of from December 2010 to November 2011

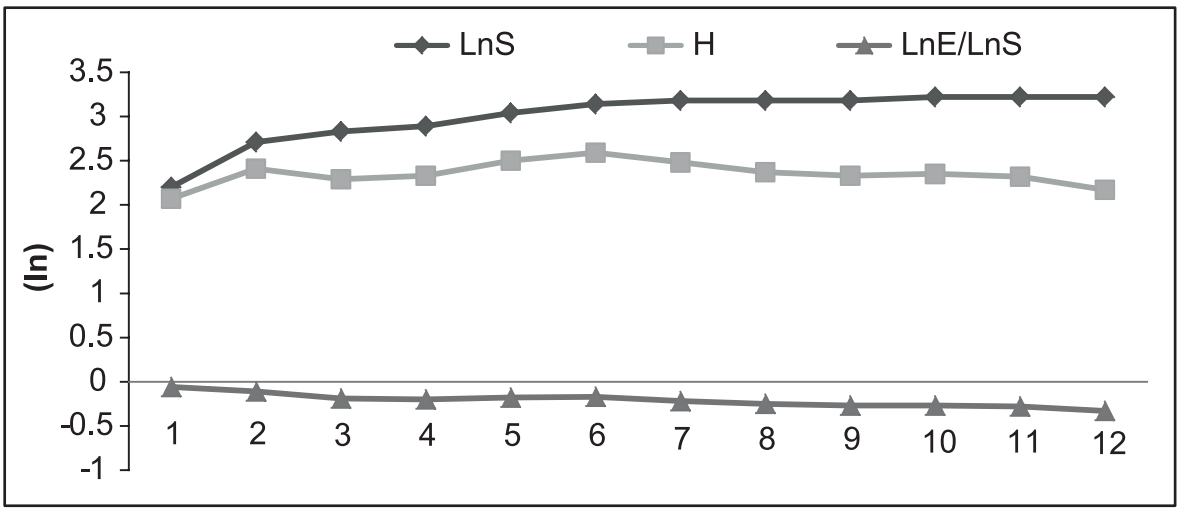

Fig. 9. SHE information analyses of rotifers from December 2011 to November 2012

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