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ABUNDANCE AND COMPOSITION OF ROTIFERS IN A POND NEAR BALLOKI HEADWORKS

A. Q. K. Sulehria, R. Mushtaq and M. Ejaz

Department of Zoology, GC University, Kachery Road, Lahore, 54000.Pakistan.
Corresponding Author e-mail Address: khansulehria@hotmail.com

ABSTRACT

In present study, rotifer species and their seasonal variation were determined along with physical and chemical parameters of water from December 2009 to June 2010. Mostly highest and lowest values of physical and chemical parameters were observed in summer and winter seasons. Analysis of variance (P=0.926) showed that there was significant difference in the Physical-chemical characteristics of water in different seasons. 12 species belonging to 7 genera were identified in this area. Only three species were present in all seasons which included *Brachionus quadridentatus, Polyarthra vulgaris and Trichocera similis.* Highest mean values (6.75±2.51) of rotifers were observed in spring season. Lowest mean values rotifers (4.08±1.86) were found in autumn season. In summer and winter season the mean values for rotifer were (5.25±2.16) and (5.67±2.55) found.

Keywords: Planktonic rotifers, Physical-chemical parameters, *Brachionus, Polyarthra, Trichocera.*

INTRODUCTION

Rotifers are the most fascinating micro-invertebrates which were first described by Leeuwenhoek in the late 17th century (Dobell, 1958). Some rotifers are free swimmers and suspension feeders (Peter, 1980), while others are sessile (Wallace, 1980) and predacious such as *Asplanchna* (Gilbert, 2005). Ecological barriers have stronger influence on their distribution than geographical isolation (Pejler, 1995). Rotifers are found in aquatic and semi-aquatic environments, but are characteristically common in freshwaters. Rotifers may also be abundant in interstitial water of soils. They play a major role in these ecosystems because of extremely fast reproductive rates. Rotifers feed on algae, protozoa, dead bacteria and detritus, while themselves, they become the food of fish fry and other aquatic organisms.

Rotifers are also called as "pioneer organisms" because they first appear in newly created water bodies (Kippen, 2005). Rotifers are very good indicators of subtle alterations in water quality because they respond quickly to environmental changes (Gannon and Stumberger, 1978). The relationships of physical-chemical parameters of water with seasonal occurrence of planktonic rotifers have been reported from some areas of Pakistan (Mahar *et al*. 2000; Malik and Sulehria, 2003, 2004; Baloch, *et al*., 2008).

The main objective of the present work was to study the abundance and composition of rotifers in a natural pond in relation to physical-chemical parameters. It was also attempted to observe their seasonal variation and correlation between rotifers and physical-chemical parameters of water.

MATERIALS AND METHODS

Balloki Head works, with a latitude of 31.22 (31° 13' 10 N) and a longitude of 73.86 (73° 51' 35 E), on river Ravi is located at a distance of about 65 km (42 miles) from Lahore in the South-West direction near Phool Nagar (Bhai-Phero). A natural pond was selected near the Balloki Head works to collect the water samples for the study of physical-chemical characteristics and planktonic rotifers. The pond is present on the left side of the Bhai-Phero-Halla road leading to Balloki Head works, about 1 km before the Head works (Fig., 1).

Pond covers an area of 3 acres and has a depth of 6 feet in the centre. It is three times more in length than width. Throughout the stretch of the pond five sampling stations were selected such as, Eastern side (BH1), Southern side (BH2), Western side (BH3), Northern side (BH4), and central area (BH5). Sampling from above mentioned stations was carried out between December (2009) to June (2010) by taking seasonal records with a view to assess the present state of water. Timing for the collection of samples was between 12:00 P.M. to 3:00 P.M.

Water samples were collected in BOD bottles, from just below the surface of pond water. Following physical-chemical parameters were determined from the collected water samples: Water temperature; Dissolved oxygen; pH; Electrical conductivity; Total Hardness; and Oxygen saturation (%). The procedure followed to determine these parameters of waters were according to Wetzel and Likens (1979) and APHA (2005).

The plankton samples were taken monthly from a maximum depth of 15-25 cm. For plankton analysis 40 to 50 litres of water was passed through a sieve of mesh

size 341 µm, collecting filtered water in a plastic tub and discarding the material deposited in the sieve. The water of the tub was filtered by another sieve of mesh size 55 µm, the contents of the sieve were washed in a small plastic tub and preserved in 50 ml plastic bottles in 4-5% formalin (Koste, 1978).

Rotifers were counted in a Sedgwick-Rafter chamber (APHA, 2005) at 60-100x using an inverted OLYMPUS microscope. Rotifers were identified to species level by observing the body shape, morphological features and behaviour of the rotifers (Ward and Whipple, 1959; Pennak, 1978; Koste, 1978). Some of the internal features were also observed under microscope after staining live organisms with vital stain (1% neutral red).

RESULTS

Table 1 shows physical-chemical characteristics of water in different sampling sites of the pond during different seasons. Mostly highest and lowest values were observed in Summer and Winter seasons. Analysis of variance showed that there was significant difference in the Physical-chemical characteristics of water in different seasons (Table 1).

12 species belonging to 7 genera had been identified in this area.Only three species were present in all seasons which included *B. quadridentatus (Hermann), Polyarthra vulgaris (Carlin) and Trichocera similis (Muller)*. Maximum species of rotifers were present in spring season which were ten. Least species of rotifers were found in autumn season which were seven. In summer and winter season eight species were found (Table 3).

The abundance and composition of rotifers was highest during the spring season (5.67±2.55), while lowest abundance and composition of rotifers was observed during winter season (4.08±1.83) (Fig.,2). Through Analysis of Variance it was concluded that there was a significant difference in the number of rotifers in all seasons (Table 4)

During winter season rotifers showed positive correlation with water temperature, dissolved oxygen and oxygen saturation, while negative correlation with pH, Electrical conductivity and total hardness.Rotifers showed positive correlation with water temperature, dissolved oxygen, electrical conductivity and oxygen saturation, while negative correlation with pH and total hardness during autumn season.Rotifers showed positive correlation with dissolved oxygen and total hardness, and negative correlation with water temperature, pH, electrical conductivity and oxygen saturation during spring season. During summer season rotifers showed positive correlation with dissolved oxygen and total hardness, while negative correlation with water temperature, pH, electrical conductivity and oxygen saturation (Table 5).

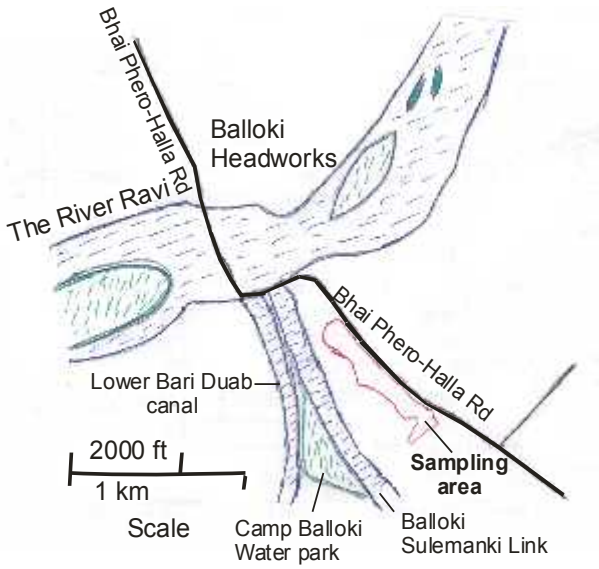

Fig., 1: Location of the study area

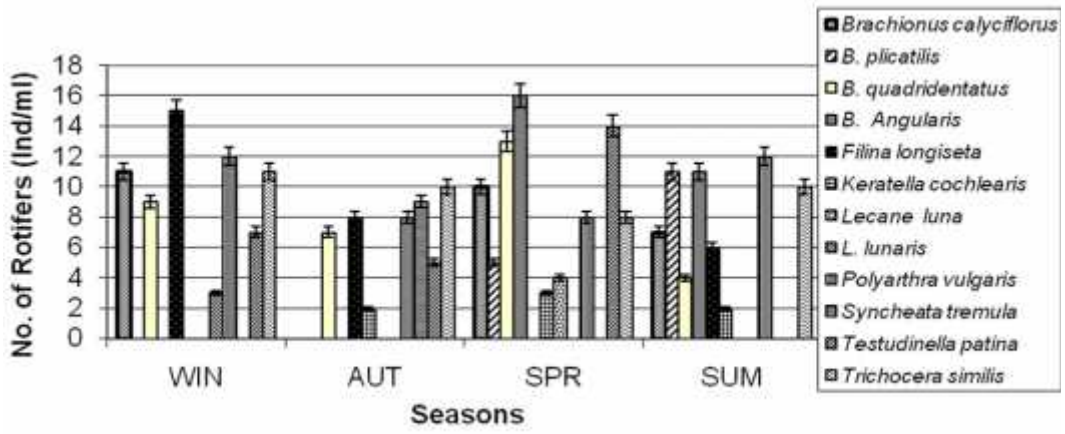

Fig. 2. Abundance and Composition of Rotifers in different seasons

Table 1. Physical-chemical characteristics of water during different seasons.

Physical-chemical parameters	WIN	AUT	SPR	SUM
Water temperature (ºC)	19.60±0.24	20.70±0.54	27.40±0.40	31.20±0.37
Atmospheric temperature (ºC)	21.60±0.22	23.00±0.14	29.60±0.37	34.20±0.34
Dissolved oxygen (mg/l)	9.34±0.34	8.31±0.15	7.69±0.35	7.14±0.19
pH	7.42±0.17	7.90±0.1	8.02±0.1	8.12±0.30
Electrical conductivity (µS/cm)	4.3±0.16	3.54±0.13	3.16±0.09	2.88±0.116
Total Hardness (mg/l)	299.40±8.22	215.00±5.52	140.60±6.60	104.80±1.16
Oxygen saturation (%)	96.50±2.10	91.10±1.80	93.80±3.59	95.40±2.09

WIN = winter season, AUT = autumn season, SPR = spring season, SUM = summer season

Table 2. Analysis of Variance of various physical-chemical parameters of water during different seasons (Dec 2009-Jun 2010)

Source	DF	SS	MS	F	p
Seasons	3	2562	854	0.15	0.926
ERROR	24	133519	5563		
TOTAL	27	136081			

DF=Degree of freedom, SS=Sum of squares, MS=Mean square, F=F-distribution, P=Probability

Table 3. Appearance of rotifer Species in different Seasons (Dec 2009 to Jun 2010)

Rotifer spp.	WIN	AUT	SPR	SUM
Brachionus calyciflorus Pallas	+	–	+	+
B. plicatilis Muller	–	–	+	+
B. quadridentatus Hermann	+	+	+	+
B. angularis Gosse	–	–	+	+
Filina longiseta (Ehrenbreg)	+	+	+	+
*Keratella cochlearis (*Gosse*)*	–	+	+	+
*Lecane luna (*Muller*)*	–	–	+	–
*L. lunaris (*Ehrenberg*)*	+	–	–	–
Polyarthra vulgaris Carlin	+	+	+	+
*Syncheata tremula (*Muller*)*	+	+	–	–
*Testudinella patina (*Hermann*)*	+	+	+	–
Trichocera similes (Wierzejski)	+	+	+	+

WIN = winter season, AUT = autumn season, SPR = spring season, SUM = summer season

Table 4. Analysis of Variance of Rotifers during different seasons (Dec 2009-Jun 2010)

Source	DF	SS	MS	F	p
Seasons	3	30.4	10.1	0.38	0.769
Error	44	1177.4	26.8		
Total	47	1207.8			

DF=Degree of freedom, SS=Sum of squares, MS=Mean square, F=F-distribution, P=Probability.

Table 5. Correlation (Pearson) and P-values of Rotifers in relation to Physical-chemical parameters of water

Seasons	Water Temperature	Dissolved oxygen	pH	Electrical Conductivity	Total Hardness	Oxygen saturation
Winter	0.349	0.330	-0.053	-0.749	-0.481	0.565
	0.565	0.588	0.932	0.145	0.412	0.321
Autumn	0.313	0.980	-0.051	0.910	-0.790	0.792
	0.608	0.003**	0.935	0.032*	0.108	0.111
Spring	-0.944	0.035	-0.103	-0.065	0.213	-0.032
	0.016*	0.956	0.869	0.917	0.731	0.960
Summer	0.000	0.195	-0.119	-0.087	-0.580	0.195
	1.000	0.753	0.849	0.889	0.306*	0.753

α = 5% (0.05); * Significant ($P < 0.05$); ** highly significant ($P < 0.01$)

DISCUSSION

By considering the results of all the sampling sites of the pond it is clear that all the physical-chemical characteristics of water under study affected the abundance and composition of rotifers either positively or negatively throughout the period of observation (Siegfrifd *et al*. 1989, Chittapun *et al*. 2007).

The highest abundance of rotifers was observed during the spring season having mean value 6.75±2.51. The lowest abundance of rotifers was found during autumn season having mean value 4.08±1.83. The abundance and composition of rotifers has significant correlation with temperature which had highest mean value of 31.20±0.37ºC during summer season while lowest mean value of 19.60±0.24ºC during winter season. There was an increase in abundance and composition of rotifers with increase in temperature in the pond. Similar results have also been obtained in various other studies (Javed and Hayat 1996; Malik and Sulehria 2003 and 2004, Baloch *et al*., 2008) and it had been found that the correlation coefficients between planktons including rotifers were positively dependent on water temperature.

The abundance and composition of rotifers is also significantly correlated with DO and oxygen saturation of water. The highest mean DO of 9.34±0.34 mg/l and highest mean oxygen saturation of 96.50±2.10 was observed during winter season, while lowest mean DO of 7.14±0.19 mg/l and lowest mean oxygen saturation of 91.510±1.80 was found during summer season. Again there was resemblance in the results of this study area with those of Javed and Hayat 1996; Malik and Sulehria 2003, 2004 and Baloch*et al* 2008.

All the other physical-chemical characteristics of water such as pH, electrical conductivity and total hardness have significantly negative effect on the abundance and composition of rotifers.

7 genera and 12 species were determined in the pond. *Brachionus* was represented by four species i.e., *B. angularis, B. quadridentatus, B. plicatilis* and *B. calyciflorus*. In the River Ravi four species of genus *Brachionus* namely *B. quadridentata, B. calyciflorus, B. plicatilis* and *B. caudatus* had been described (Malik and Sulehria, 2004). The same four species of *Brachionus* had also been reported from Manchar Lake (Mahar *et al*. 2000). One species *B. Rubens* had also been described from tanneries of Lahore city by Haq *et al*. (2001).

Keratella, Filinia, Brachionus and *Lecane* became more abundant with increase in eutrophication. *B. quadridentatus* and *B. calyciflorus* are regarded as indicators of eutrophication (Gannon and Stemberger 1978, Maemets 1983). *Filinia longiseta* was common though it showed higher population throughout the seasons. The *Filinia longiseta* is also considered as an indicator of eutrophication (Maemets 1983, Baloch *et al*. 2000). Unni (1986) reported *Keratella*, *Trichocera*, *Filinia* and *Polyarthra* in polluted waters. Patrick *et al* (1950) made extensive surveys of many streams and lakes with high pollution and suggested that rotifers play a major role in water pollution. Studies of fauna in lakes and streams polluted by mine drainage generally indicate reduced species diversity in polluted relative to unpolluted waters (Orciari and Hummon 1975).

Two species of Lecane i.e., *L. Luna* and *L. lunaris* were also reported from the pond and they were least abundant among all other species. *L. Luna* was present only in spring season, while *L. lunaris* was found in winter season. In addition to above mentioned species other rotifer species which were reported from Balloki pond include *Keratella cochlearis, Polyarthra vulgaris, Syncheata tremula, Testudinella patina and Trichocera rattus.* From all these species only *Keratella cochlearis* had been described from Manchar Lake, Sindh (Mahar*et al*. 2000). Javed and Hayat (1996) have mentioned four genera namely *Brachionus, Keratella, Filinia,* and *Polyarthra* during their work in River Ravi. Four genera of rotifers namely *Brachionus, Keratella, Filinia, and Lecane* had been described from Jallo Lake (Malik and Sulehria, 2003) and four genera namely *Brachionus, Keratella, Filinia, Polyarthra* from the River Ravi (Malik and Sulehria 2004)

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