BIOLOGIA (PAKISTAN)
December, 2015, 61 (2), 235-241

PKISSN 0006 – 3096 (Print)
ISSN 2313 – 206X (On-line)

# Study of Rotifers of Safari Zoo Lake Lahore in Relation to Physico-chemical Parameters

***SARA HAYEE, ABDUL QAYYUM KHAN SULEHRIA, NAVEED AKHTER, FAHEEM NAWAZ & ALTAF HUSSAIN**

*Department of Zoology, GC University, Lahore, Pakistan.*

## ABSTRACT

A survey was conducted from September 2013 to June 2014 in Safari Zoo Lake to investigate rotifer population and their relationship with physico-chemical parameters. In total, 23 species were identified. Nine physico-chemical parameters were studied including salinity, turbidity, electrical conductivity, air and water temperature, transparency, oxygen saturation, dissolved oxygen and pH. Oxygen saturation, dissolved oxygen and pH were statistically non-significant whereas rest of the parameters were statistically significant. Pearson correlation indicated that dissolved oxygen, oxygen saturation and salinity were positively correlated with rotifer density and diversity, whereas, rest of the parameters were negatively correlated.

**Key word:** rotifers, physic-chemical parameters, lake, zooplankton,

## INTRODUCTION

Rotifers (*rota* means wheel and *fera* means to bear) derive their name from a specific structure called **corona.** It is a ciliated organ. Due to beating of cilia, it gives apperance of a rotating wheel (Hickman *et al.,* 2006). Corona helps in locomotion. Moreover, beating cilia sweep food into mouth of rotifer. Rotifers are pseudocoelomate, bilateral, triploblastic and eutelic. They range in size from 200 to 500 µm (Kenneth *et al*., 2011). They have three main body parts, head, trunk and foot. Most species live in fresh water. Some marine, terrestrial and parasitic species are also found. They are cosmopolitan in distribution and many of them are highly adapted to a wide range of fresh water conditions. Zooplanktons like rotifers are very important for aquatic ecosystem like lakes. They transfer energy from primary producers like bacteria and algae to consumers like crustacean, insects and small fish (Baloch *et al*., 2008).

Water quality of any water reservoir includes many physical, chemical and biological characteristics. The biological characteristics are linked with density and diversity of living organisms present in them. Diversity of organisms can give a clear indication of human interferences on any natural ecosystem (Chughtai *et al.,* 2011). Some factors affecting the succession of rotifers have been extensively studied which include physico-chemical parameters, food resources, competitors and predators (Wang & Geng, 2013).

## AIMS AND OBJECTIVES

The purpose of this research work was: to collect and identify the rotifers up to species level; to find physico-chemical parameters of water and their effects on rotifer population.

## MATERIALS AND METHODS

### Study Area

**Lahore Zoo Safari** known as **Woodland Wildlife Park** with latitude of **31°22'57"N** and **74°12'51"E** is located on Raiwind Road, District Lahore Punjab, Pakistan. It is a famous wildlife and safari park established in **1982** for public recreation having an area of **242** acres. The study area included an artificial lake having an area of 5 acres with five islands. Four of these islands are large and one is small (Fig., 1).

### Sampling Period and Sites

Sampling was done for 10 months from September, 2013 to June, 2014. Rotifer and water samples were collected on monthly basis from 10 am to12 pm in the mid of each month from the Lake. The whole lake was divided into four sites, Eastern Site (ES-1), Western Site (WS-2), Northern Site (NS-3) and Southern Site (SS-4). Each site was sub-divided into four sub-sites A-D.

### Water Sampling and Analysis

Water samples were collected just below the water surface from lake in pre-cleaned sample bottles to study the physico-chemical parameters. Temperature (air & water) was measured with thermometer (HANNA HI-8053). Dissolved oxygen and oxygen saturation were measured with DO meter (YSI-Eco Sense DO 200). Salinity and pH were determined with YSI – Eco sense EC 300 and

**Correspondence author: sarahayee_1@hotmail.com*

YSI – Eco sense pH 100 respectively. Electrical conductivity was determined by (YSI – Eco sense EC 300).

**Rotifer Sampling**

Rotifer samples were collected from the water with the help of a conical zooplankton net having a mesh size of 37µm and volume capacity of about 599.12 $m^3$. The base of zooplankton net had a diameter of 30cm and length of 85cm. The samples were collected by towing the net horizontally for 5 minutes to a depth of about 20-25 cm. In 5 minutes 100 liters of water can pass through it. The contents were preserved in 4 % Formalin in 50 ml plastic bottles on the spot (Koste, 1978; Sulehria & Malik, 2012). Rotifer samples of one bottle from each site were kept alive (i.e., without formalin) for studying live organisms.

**Counting and Identification**

The numerical estimation of the rotifers was done by using Sedgewick-Rafter Counting chamber (APHA, 2005) and inverted Olympus microscope at 60-100 X. Photographs of rotifers were taken with the help of LEICA HC 50/50 microscope on which a 5.0 megapixel Cannon camera was fitted. To study the internal features, rotifers were stained with vital stain i.e., 1% neutral red. By observing morphology and body shape, rotifers were identified up to species level (Hyman, 1951; Ward and Whipple, 1959; Pennak, 1978 and Segers, 2007).

**Statistical Analysis**

ANOVA was applied to study the significant differences in rotifers. Pearson's correlation test was applied to find out the relationships between the observed environmental parameters and rotifer species. The software used for ANOVA and Pearson's correlation was Minitab 13 for Windows.

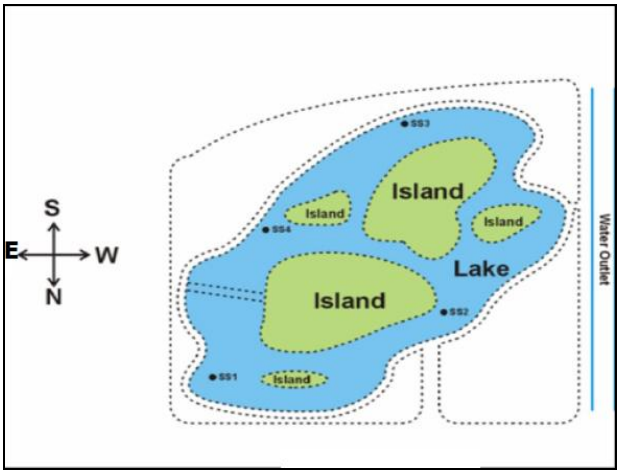


**Fig., 1:** Map of study area

## RESULTS AND DISCUSSION

In total, 23 species were identified belonging to 8 genera (Table I). Rotifer population was high in November (4.31 ± 2.46) and lowest in June (0.56 ± 0.55). The relative (%) representation of genera indicated that dominant genera were in order *Brachionus* > *Synchaeta* > *Polyarthra*. The relative (%) representation of abundant rotifer species and their mean population density were in order *Brachionus calyciflorus* (38.25%), *Brachionus quadridentatus (*13.3%), *Brachionus bidentatus* (8%)*, Synchaeta pectinata* (6.5%), *Polyarthra minor* (5.25%) (Fig., 2).

**Table I: List of Rotifers recorded from Safari Zoo Lake**

| | |
|---|---|
| *Brachionus angularis* Gosse | *Keratella cochlearis* Gosse |
| *Brachionus bidentatus* Anderson | *Keratella valga* Ehrenberg |
| *Brachionus calyciflorus* Pallas | *Lecane luna* O.F. Muller |
| *Brachionus diversicornis* Daday | *Polyarthra dolicoptera* Idelson |
| *Brachionus forficula* Wierzejski | *Polyarthra minor* Voigt |
| *Brachionus quadridentatus* Hermann | *Pleurotrocha petromyzon* Ehrenberg |
| *Brachionus sericus* Rousselet | *Polyarthra remata* Skorikow |
| *Brachionus urceus* Linneaus | *Polyarthra trigala* Ehrenberg |
| *Cephalodella exigua* Gosse | *Synchaeta pectinata* Ehrenberg |
| *Cephalodella gibba* Ehrenberg | *Synchaeta oblonga* Ehrenberg |
| *Filinia longiseta* Ehrenberg | *Synchaeta stylata* Wierzejski |
| *Filinia terminalis* Plate | |

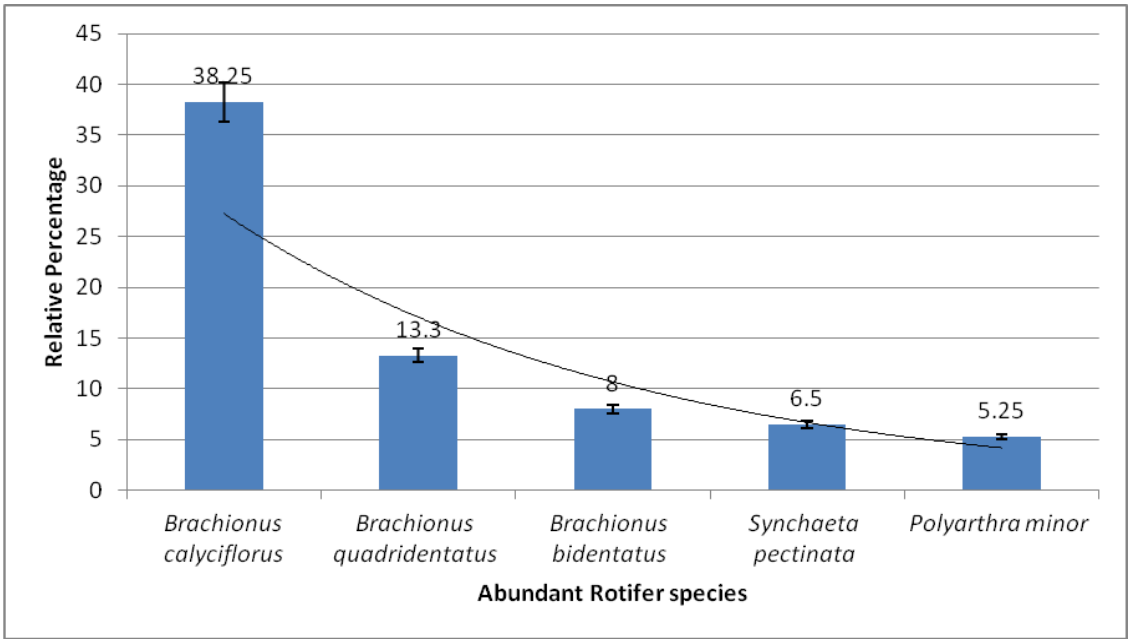


**Fig., 2:** Relative precentage of abundant rotifer species with exponential trend line and percentage error bars.

**Analysis of Variance (ANOVA)**

Analysis of variance (ANOVA) showed that salinity (F=17.14, P=0.001), turbidity (F=43.31, P=0.000), electrical conductivity (F=8977.43 E, P=0.000), water temperature (F=29.44, P=0.000), transparency (F=9.71, P=0.006), and air temperature (F=46.28, P=0.000) were significantly different. Oxygen saturation (F=1.19, P=0.289), dissolved oxygen (F=4.41, P=0.05) and pH (F=0.50, P=0.490) were statistically non-significant (Table II and Table III).

**TABLE II: ANALYSIS OF VARIANCE FOR WATER TEMPERATURE**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Factor | 1 | 1365.5 | 1365.5 | 29.44 | 0.000 |
| Error | 18 | 834.8 | 46.4 | | |
| Total | 19 | 2200.3 | | | |

DF = Degree of Freedom; SS = Sum of Square; MS = Mean of Square; F = f- Distribution; P = Probability

**TABLE III: ANALYSIS OF VARIANCE FOR OXYGEN SATURATION**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Factor | 1 | 33.1 | 33.1 | 1.19 | 0.289 |
| Error | 18 | 498.5 | 27.7 | | |
| Total | 19 | 531.6 | | | |

DF = Degree of Freedom; SS = Sum of Square; MS = Mean of Square; F = f- Distribution; P = Probability

**Physico-chemical Parameters**

During study period rotifer population diversity and density was either positively or negatively correlated with physico-chemical parameters (Table IV; Fig., 3 & 4). Monthly variations in physico-chemical parameters are shown in figure 5 and 6.

**TABLE IV: CORRELATIONS (PEARSON) OF ROTIFERS AND PHYSICO-CHEMICAL PARAMETERS**

| | Rotifer | A.T. | W.T. | O.S.. | D.O. | Cond. | Trans. | pH | Salin. |
|---|---|---|---|---|---|---|---|---|---|
| A.T. | -0.676 | | | | | | | | |
| W.T. | -0.679 | 0.957 | | | | | | | |
| O.S.. | 0.487 | 0.009 | 0.000 | | | | | | |
| D.O. | 0.132 | 0.025 | -0.122 | -0.035 | | | | | |
| Cond. | -0.577 | 0.534 | 0.598 | -0.409 | 0.037 | | | | |
| Trans. | -0.073 | -0.081 | -0.024 | 0.363 | -0.318 | -0.270 | | | |
| pH | -0.085 | 0.160 | 0.152 | -0.385 | -0.320 | 0.484 | -0.375 | | |
| Salin. | 0.368 | -0.482 | 0.345 | -0.166 | -0.524 | 0.122 | 0.031 | 0.611 | |
| Turbid. | -0.209 | 0.546 | 0.387 | 0.080 | 0.495 | -0.065 | -0.509 | -0.178 | -0.790 |

A.T. = air temperature; W.T. = water temperature; D.O. = dissolved oxygen;
O.S. = oxygen saturation; Cond. = Electrical conductivity; Trans. = transparency;
Salin. = salinity; Turbid. = turbidity

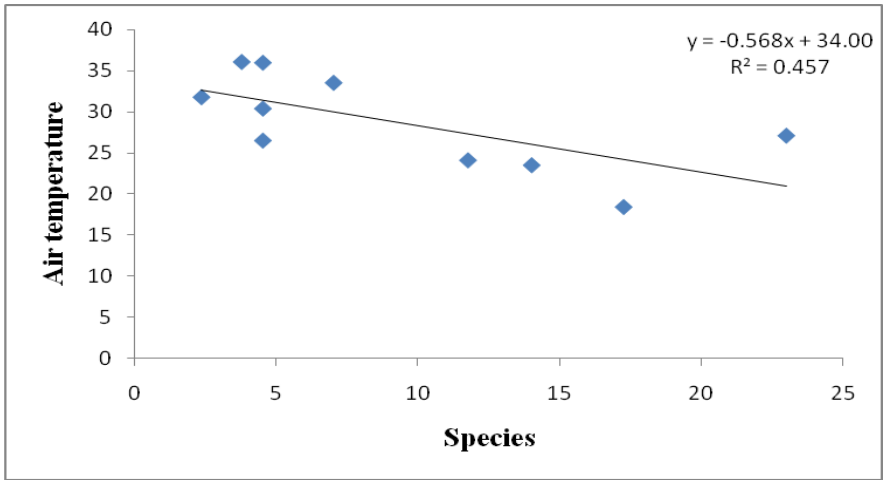


**Fig., 3:** Negative correlation between Rotifers and Air Temperature

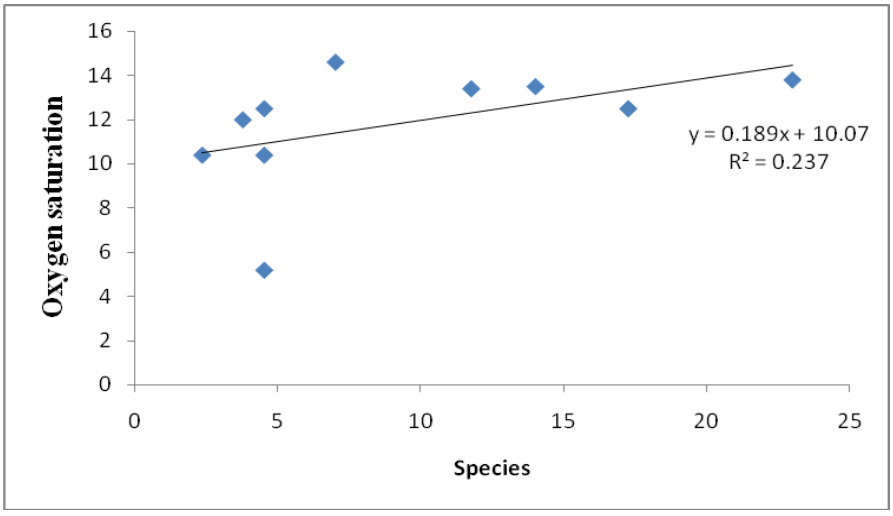


**Fig., 4:** Positive correlation between Rotifers and Oxygen Saturation

Oxygen saturation and dissolved oxygen affected rotifer population. Oxygen saturation (mg/l) was high in October (8.73 mg/l) and low in April (0.55 mg/l). Dissolved oxygen (mg/l) in water was found high in September (14.6 mg/l) and low in March (5.2 mg/l). Rotifers showed positive correlation with dissolved oxygen of water. Similar results were also reported from studies on River Ravi and Jallo Lake (Sulehria *et al*., 2009a & 2009b). Salinity was also positively correlated with rotifer density and diversity. It corresponds to the work done by Clarke *et al*. (2013).

pH values fluctuated during study period and ranged between 6.81 to 8.5.. Measured values showed that lake water was alkaline. The rotifers prefer pH value in the range of 6.5 to 8.5 (Chergui *et al*., 2013). It was close to the recorded preference. Presence of *Brachionus calyciflorus* throughout study period showed wide range of pH tolerance of this species. Similar results were also found by Abbai & Sunkad (2013). pH showed negative correlation with rotifers. A similar finding was reported by Sulehria *et al*. (2009b).

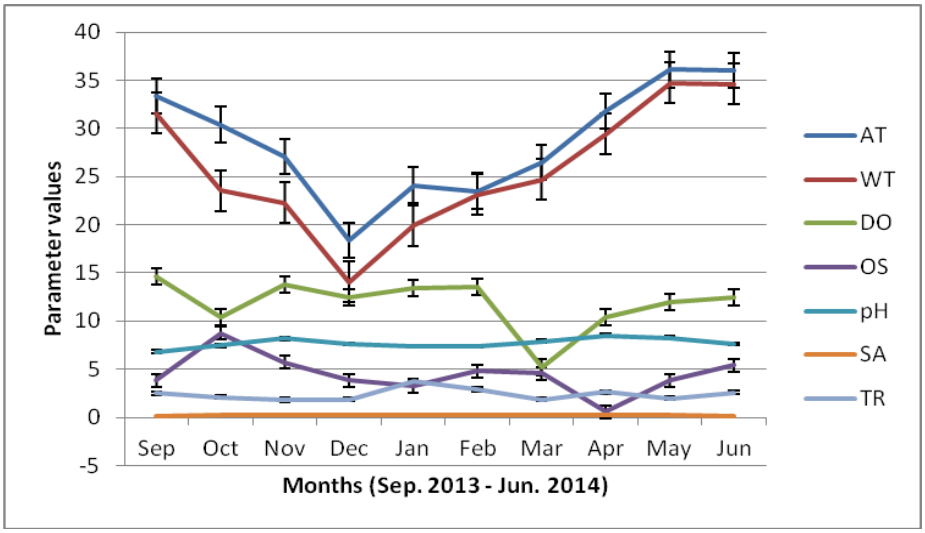


**Fig., 5:** Monthly Variation of Physico-chemical parameters (with error bars) of air and water of Safari Zoo Lake Lahore. (AT=Air temperature; WT=Water Temperature; DO=Dissolved Oxygen; OS=Oxygen Saturation; SA=Salinity; TR=Transparency)

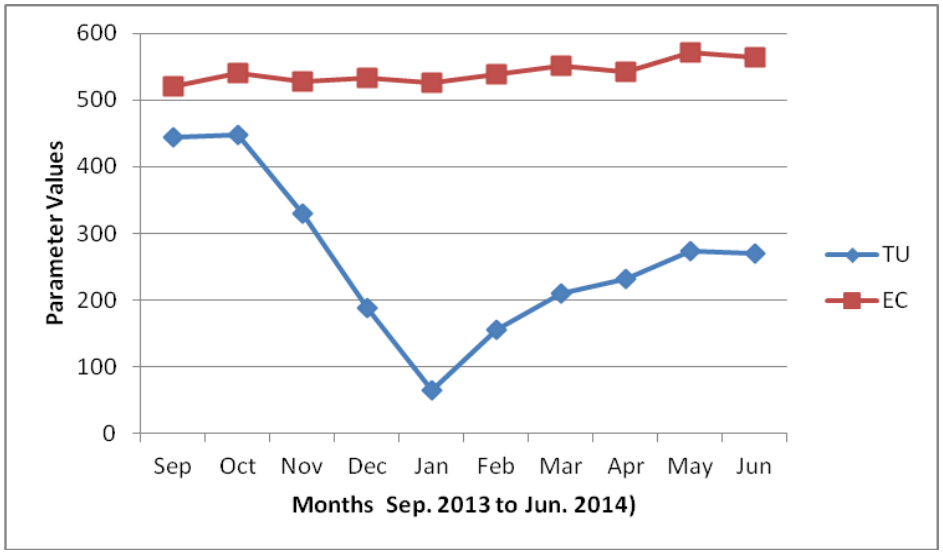


**Fig., 6:** Monthly Variation of Electrical Conductivity (EC) and Turbidity (TU) of water of Safari Zoo Lake Lahore.

Turbidity ranged 64 to 447 FTU. The highest value of turbidity was observed in October. Water of lake was turbid during most part of study period. During winter a gradual decrease in turbidity was observed. But it started increasing from spring. It showed negative correlation with rotifers. The results were comparable to those reported by Sivalingam *et al*., 2013**.**

Temperature is an important factor to control population density and diversity of rotifers. Rotifers showed wide range of tolerance for temperature. In the present study, lowest air temperature (18.4 $^{o}$C) and water temperature (14.06 $^{o}$C) were observed in December. Highest air (36.1 $^{o}$C) and water temperature (34.73 $^{o}$C) were observed in May. Air and water temperatures showed parallel relationship. Changes in temperature showed regional climatic variation. A negative correlation was observed between air temperature, water temperature and rotifers. A similar observation has been reported by Ahmed *et al*. (2012) and Clarke *et al*. (2013).

There was no sudden rise or fall in the values. Electrical conductivity (µS/cm) was highest in May (570.8 µS/cm) and lowest in September (520.9 µS/cm). In warm months, electrical conductivity was higher because water evaporation increased which resulted in decreased total quantity of water. Similar results were reported by Hussain *et al.* (2013). Electrical conductivity showed negative correlation with rotifers. The same relationship had been reported by Dutta & Patra (2013).

Transparency is an important physical parameter. It directly affects the productivity. Its highest value (3.75) was recorded in January when turbidity value was also found lowest (64 FTU). The lowest value of transparency was recorded (1.82) in November. It showed negative correlation with rotifers. The same relation had been reported by Farshad & Venkataramana (2012) and Clarke *et al*. (2013).

## Conclusion

Replacement of water is slow and turbidity is high in Safari Zoo Lake. Species diversity of rotifers was low during study period. The present study showed the eutrophic state of lake water. There was a prominent effect of physico-chemical parameters on the density and diversity of rotifers.

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Received: 27-07-2015 Revised: 21-09-2015 Accepted: 20-10-2015