Original Article

Density and Diversity of Rotifers from Shore of a Flood Plain, Balloki Head Works

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Abstract:

The present research work is an investigation of Rotifers from flood plains of Balloki Head Works using diversity indices. **Objective:** To study the density and diversity of rotifers of flood plain. **Methods:** collection of rotifers was done from the shore of flood plains from September to July. In total, 15 different species were identified. Rotifers were extracted from soil sample by a customized Baermann Funnel method. A moderate diversity of rotifers was explored by Shannon – Weaver. Simpson index of dominance supported this result. Analysis of variance (ANOVA) showed that there was no significant difference in population density of rotifers among months as the p-value was greater than 5% (α= 0.05). Population density of rotifers was negatively correlated with water temperature and pH whereas a positive correlation was observed with electrical conductivity **Results:** Overall a moderate diversity was observed. Rotifer density and distribution was under the influence of physico-chemical parameters.

Key Words:

Shannon-Weaver index, Simpson index of Dominance

Introduction:

Fresh water zooplanktons have mainly three groups including Rotifers, copepods and cladocera [1]. Zooplanktons play a vital in formation of aquatic ecosystem as they are the links of food chain and food web. They can be used to study the overall health of a water body [2]. Zooplanktons respond differently to various environmental stresses. Therefore they are used as bio-indicators [3]. Rotifers get their name from two words *rota* meaning wheel and *fera* meaning to bear, driving their name due to presence of corona [4]. Phylum Rotifera consists of three classes: Monogonata, Bdelloidea and Seisonidea. The largest group is the Monogonata which consists of some 1500 species. A particular class called Bdelloidea can be found living in almost all freshwater as well as brackish and marine water. A good source of food for larger zooplanktons and higher trophic levels, rotifers are also important type of zooplanktons [5]. Humidity and temperature are the two factors that determine rotifer ability to withstand desiccation. Rotifers community dynamics and abundance was affected by two important factors which include temperature and trophic state of water reservoir. For the abundance and growth of rotifers, limiting factors include light intensity during day; high temperature flourishing phytoplankton [6].The community structure of rotifers can also be used as bio-indicators of water quality. Rotifer abundance is related to trophic state of water body [7].

Materials and Methods:

Study Area

Study area was near Balloki Head Works, having latitude of **31°13'10"N** and a longitude of **73°51'35"E.** It is located on River Ravi, 65 km from Lahore. Above sea level elevation of site was

about 196 m. The selected flood plain was 250 m wide and 750 m long with maximum depth of 250 ft.

Sampling Period and Sites

Five sampling sites were selected along the shore of flood plain. Soil samples were taken from April to June with the help of a cylindrical corer from an area of 10 cm^2 having depth of 10 cm.

Rotifer Sampling

Rotifers were extracted with the help of a customized Baermann Funnel method having a gradient of light and temperature [8, 9 and 10]. Twenty-five grams of soil sample was submerged in distilled water. A 60-watt bulb was hanged on the funnel at a distance of 12 inches to provide heat.

Counting and Identification

Sedgewick-Rafter counting chamber with inverted Olympus microscope at 60-100 X was used in rotifer numerical estimation [11]. A microscope (model LEICA HC 50/50) was fitted with 5.0 megapixel Cannon camera. It was used to make photomicrographs of rotifers. Rotifers were identified with the help of keys up to species level mainly by observing body shape and morphology [12, 13, 14, 15 and 16].

Physico-chemical Parameters

Temperature was measured with the help of common laboratory thermometer. The pH was determined by pH Meter (YSI – Eco Sense PH 100). Electrical conductivity was measured with electrical conductivity meter (YSI Eco Sense EC 300).

Diversity Indices

The diversity of rotifers was studied with help of diversity indices including Shannon-Weaver Index (H), Simpson's Index of Diversity (SID) and Simpson's Index of Dominance (D). Components of diversity of rotifers were also calculated with the species richness (SR) and Species evenness (E) [17].

The **Shannon–Weaver Index** (H) was obtained with the help of Shannon–Weaver equation [18]:

- $H = -\Sigma\ Pi\ (\ln Pi)$

  Pi = Proportion of every species in the sample
- $Pi = ni / N$ [19]

  Ni = Number of individuals of a particular species

  N= Total number of individuals of all species in a whole sample

  Simpson's equation was used to calculate **Simpson's Index of Dominance (D)** [20]:
- $D = \sum n(n-1) / N(N-1)$

  D = Simpson's index of dominance,

  N = Total number of individuals of all species

  $\sum$ = Sum

  n = Number of individuals

  Following equations were used to find out **Simpson's Index of Diversity (SID)** and **Simpson's Reciprocal Index (SRI)**:
- $SID = 1-D$

  $SRI = 1/ D$

  Margalef's formula was used to calculate **Species Richness (SR)** [21]:
- $SR = (S-1) / \ln N$

  S = Total number of species

  Pielou's equation has been used to find out Species Evenness (E) [22]:
- $E = H / \ln S$

  Where,

  H = Shanon- Weaver Index

Statistical Analysis

Statistical analysis was performed to study significant differences with the help of Analysis of variance (ANOVA). It was applied to the data obtained from various months. Rotifer species and physico-chemical parameter relationships were studied with the help of Pearson Correlation Test. A computer software program Minitab 13 was used for test application.

Results:

In total, 15 species of rotifers (4 Monogonata and 11 Bdelloidea species) were observed. High rate of species was obtained from first site (S1). The most abundant species were *Wierzejskiella vagneri, Adineta vaga, Habrotrocha aspera, Macrotrachela nana, Macrotrachela plicata, Mniobia tetans* [Figure 1]. Highest soil

temperature was found in June and lowest in April. The pH ranged between 7.27 to 7.27. Electrical conductivity of water was highest in June and lowest in April [Table 1]. Highest number of species was found in April. Shannon–Weaver Index (H) ranged from 2.591±0.002 to 2.598±0.005, being lowest in April and highest in June. The above values reflected that flood plain had moderate rotifer diversity. Simpson's index of dominance ranged 0.084±0.008 in April to 0.080±0.005 in June showing greater diversity in the month of April and lower in June. Species richness was higher in the month of April and lower in June [Figure 2].

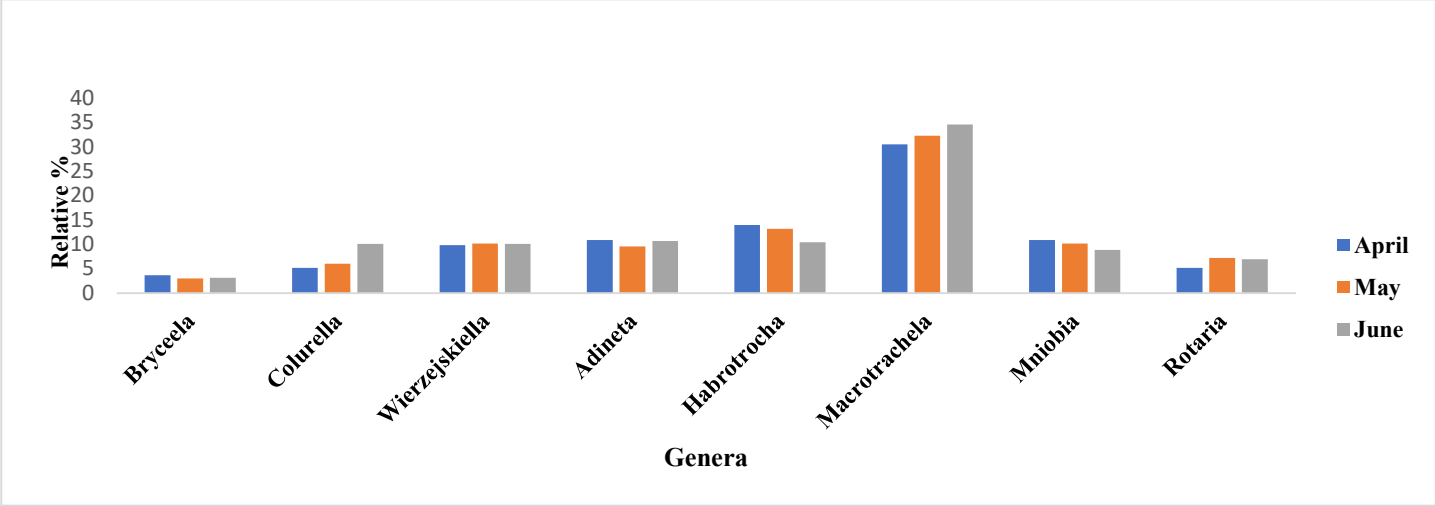

Figure 1: Relative Percentage of Rotifer Genera.

Parameters	April	May	June	Mean
Soil Temperature (◦c)	30	32	34	32
pH	7.27	7.24	7.21	7.24
Electrical Conductivity (µs/cm)	532	537	541	536.6
Air Temperature (◦c)	27	30	31	29.3

Table 1: Physico-chemical Parameters.

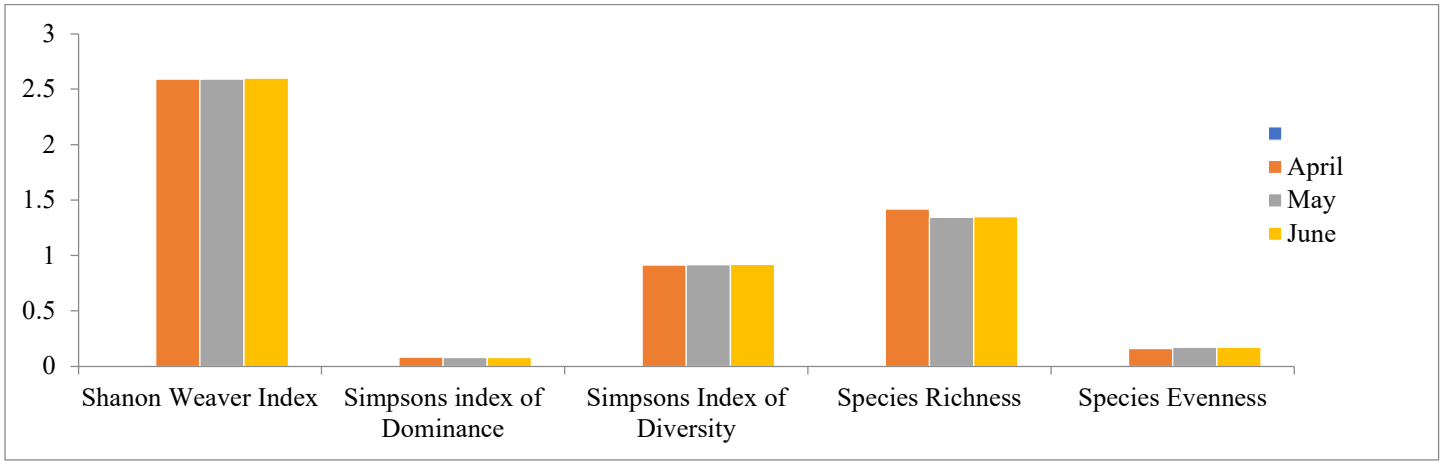

Figure 2: Monthly ariation of diversity indices, species richness and species evenness.

Source	DF	SS	MS	F	P
Months	2	126.4	63.2	2.30	0.142
Error	12	329.2	27.4		
Total	14	455.6			

Table 2: Analysis of Variance for Rotifers

Discussion:

Taking into account, it was clear that diversity and distribution of rotifers was under the influence of physico-chemical parameters throughout the study period. Rotifers are adaptable organisms and they have shown changes in relation to environmental conditions. Rotifers showed positive correlation with pH, a similar result has also reported earlier [23]. Water temperature and electrical conductivity was negatively correlated. As temperature increased the electrical conductivity was also increased but pH value decreased. Temperature was found to be significant in controlling rotifer diversity and density. This result has gotten support from a similar observation [24]. Statistical relationship of rotifers with parameters was studied with help of ANOVA (analysis of variance). No significant difference (F=2.30, p= 0.142). Rotifers have shown linear numerical increase with the rise in flood levels.

Conclusions:

A moderate diversity of rotifers was observed in our research. This is first attempt to study rotifers present in a flood plain. Rotifers are the opportunists which play an important role as zooplankton and respond very quickly to the changes in physic-chemical parameters of the water body they are present in.

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