Original Article

Multivariate Analysis of Rotifers Community from Safari Zoo Lake Lahore, Pakistan

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Abstract:

Rotifers are zooplanktons that react more sharply to the environmental changes.

Objective:

To better understand the community composition of rotifers in Safari Zoo Lake, Lahore, Pakistan

Methods:

We collected 16 water samples on monthly basis, dividing lake into four major sites: northern, southern, eastern, and western sites. Each of these was further subdivided into four locations, for a total of 16 sampling sites. A total 23 rotifer species were recorded from the lake with Brachionus calyciflorus having maximum abundance. A species abundance curve was plotted between months and number of species of rotifers indicating their lowest and highest abundance through the study period.

Results:

A Cluster Analysis yielded three main groups of closely related species including species like Brachionus quadridentatus, Synchaeta stylata and Brachionus calyciflorus etc. We used a Principal Component Analysis (I and II) to study variation in the rotifer community on a seasonal basis and among sampling sites. A biplot of Principal Component Analysis (PCA I) reflected the relationship of rotifers with the months. Some of the species showed a positive positive relationship, while others showed negative one. PCA II was plotted between months and physico-chemical parameters showing their negative and positive relations.

Conclusions:

We conclude that a lesser replacement of fresh water, increased density of waterfowl, reptilia and solid waste left over during boating has resulted in eutrophication of lake leading to overall low diversity of rotifers observed.

Keywords:

Biplot, Cluster analysis, Multivariate analysis, Principal component analysis

Introduction:

Zooplanktons are considered to be one of the most important food sources for aquatic organism leading the energy flow in plankton based food webs [1-3]. Indeed zooplanktons are a rich source of lipids, minerals, fatty acids and proteins that can be used instead of fishmeal as an inexpensive source of food for aquaculture [4]. Rotifers are one of the smallest, short lived and quickly reproducing organism [5-6]. Rotifer species constitute fresh water habitat about 95% and marine about 5% [7]. Food sources, predators, competitors along with physico-chemical parameters are the major factors which affect succession of rotifers and have been studied extensively [8]. In aquatic systems, rotifers are exposed to many changes in their physical, chemical and biological processes leading their survival in these systems [9]. As

compared to other zooplanktons found in water, rotifers are the animals which react more sharply to changes in aquatic environments [10].

In standing fresh waters, there is slow water exchange. Therefore, these are particularly sensitive to inputs like pollutants, toxins, nutrients and fertilizers [11-13]. This research work was undertaken to provide a preliminary inventory of rotifers in Safari Zoo Lake and to analyze their community structure. This information will be useful to provide data critical to improve the water bodies used for recreational purposes, including water sports, fishing and boating.

Methods:

Study Site:

Our study site was an artificial lake (31°22'57"N and 74°12'51"E) located in Lahore Zoo Safari (Lahore). This lake has an area of ~ 2.023 hectares (5 acres) in which are located four large (15 m2) and one small (7.6 m2) island. Commonly used for recreational purposes, this water body has a maximum depth of ~ 2.134 m and an annual surface temperature range of ~ -1 to 50° C.

Sampling Description and Analysis:

Sample collection was made in each month between 10 am to 12 pm. The whole lake was divided into four major sites including western site, eastern site, northern site and southern site. Each site was further divide into four sites which were named A, B, C and D resulting in collection of 16 samples. At each site a 40-L sample of surface water was taken. This water was filtered using a sieve with mesh size about 44 µm was used. 4 % formalin solution was used to preserve rotifers in 50 ml pre-cleaned bottles [14-15]. Air and water temperature (HANNA HI_8053), electrical conductivity (YSI-Eco Sense EC 300), salinity, pH, turbidity (HANNA, Model # HI 93703), and dissolved oxygen (YSI-Eco Sense DO 200) were determined at the time of sampling. Sedgewick-Rafter Counting Chamber was used for rotifer species counting. A LEICA HC 50/50 microscope, equipped with a 5.0-megapixel Cannon camera, was used to document rotifer specimens. Rotifers identification to the level of species was done on the basis of morphological characters by consulting [10, 16-19]. The species names were confirmed using The Rotifer World Catalog (RWC) [20].

Principal Component Analysis I and II is a way to find out the pattern in data, explaining the differences and similarities in data. Patterns are the lines that most closely describe the relationships between the data. It was performed by XL Stat software. Cluster analysis and species abundance curve was performed by Past software. Cluster analysis was performed to divide the rotifers in set of groups. Species grouping or clustering together are similar and more related. Species abundance curve explains the relative abundance of each rotifer species throughout study period.

Results:

Species Abundance Curve:

A species abundance curve was plotted showing the species of rotifers found in each month with their relative abundance. B. calyciflorus was the most abundant species present at the peak with highest value of abundance (~38%) throughout the study period. K. cochlearis was present at the end of the curve with least abundance. The remaining species lie between these extremes (Figure 1).

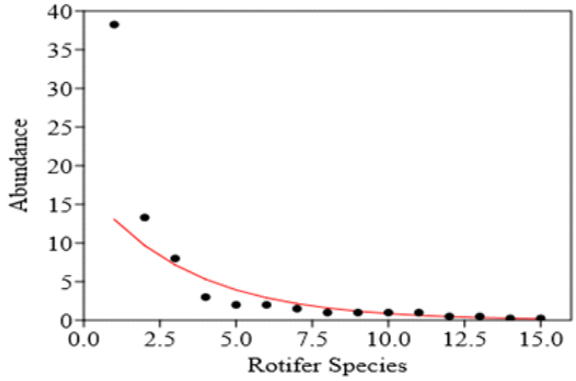

Figure 1: Species Abundance Curve

Cluster Analysis (Dendrogram):

Three major clusters were observed in dendrogram showing 23 rotifer species. Cluster I

is located at Eucladian distance of 4. Only one species B. calyciflorus is present in cluster I. Cluster 2 & 3 are located at a distance of 12. Cluster 2 is further divided into two sub clusters from which one sub cluster contains four species and a second contains 17 species. Synchaeta stylata, Synchaeta pectinata, Polyarthra minor, and Brachionus bidentatus are grouped together due to similarity among them while rest of the species showed close relation with one another. Only one species Brachionus quadridentatus is present in cluster 3 (Figure 2).

Principal Component Analysis (PCA I &II):

Biplot I of PCA I was plotted between rotifer species and months in which these were obtained. Brachionus bidentatus, B. quadridentatus, and P. minor showed strong positive relation with the months. Brachionus calyciflorus showed weak positive relation. Brachionus diversicornis, Cephalodella gibba, Keratella valga, Synchaeta stylata, and Synchaeta pectinata had strong negative relation with the months. This result also was supported by the cluster analysis (Figure 3).

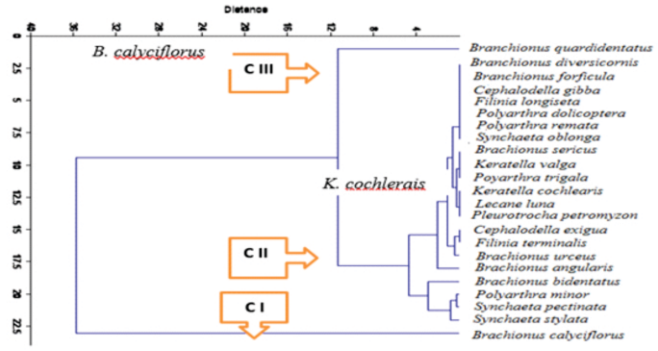

Figure 2: Cluster analysis (Dendrogram) (C I: Cluster I, C II: Cluster II and C III: Cluster III)

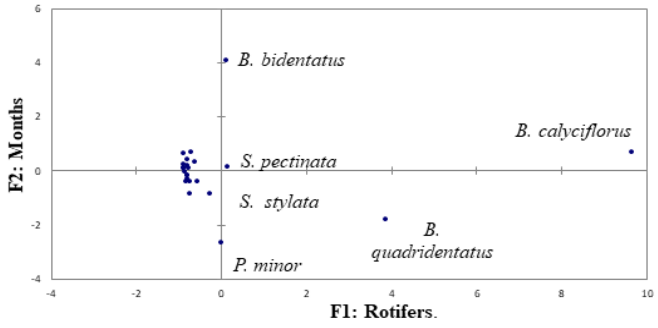

Figure 3: Biplot I between rotifer species and months

Biplot II of PCA II was plotted between the physico-chemical parameters and months. Salinity and pH were present at the upper left side. Transparency and Oxygen saturation were present at lower left side. These parameters showed strong positive relationship with the months.

Conductivity, water temperature and air temperature were present on upper right side. Turbidity and Dissolved oxygen were present at lower right side. These parameters showed negative relationship with months. Each parameter was closest to the month in which it showed the highest mean value (Figure 4).

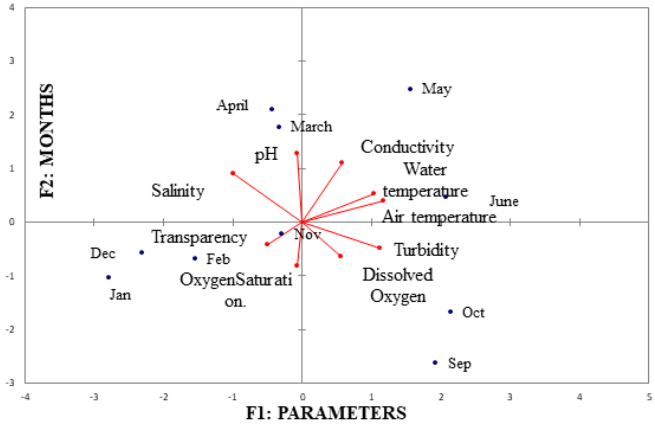

Figure 4: Biplot II between physico-chemical parameters and months

Discussion:

This is the first survey of rotifers in Safari Zoo Lake, and as such represents a preliminary study in assessing this water-body. Overall low diversity of rotifers has been observed. Several factors probably contributed to this low richness, including the presence of other zooplankton that could act as competitors (both exploitative and interference) or predators (e.g., Cladocera and Copepods), as well as fish with small gape size. We believe that water quality was also affected by a large number of reptiles and water birds that were in residence on the islands. These animals contributed nitrogenous wastes major changes in water quality. It was also observed that people coming to use the lake for recreational purposes have discarded solid waste into the water. Replacement of water was not up to the mark as a

small tubewell was working. The diversity of rotifers present in a water body is linked to the favorable conditions, abundant food present. Presence of B. calyciflorus is also reported as indicator of eutrophic state of lake.

Conclusions:

Rotifers have very important role as bio-indicators. There is a need to study more lakes, which have recreational values so that human impact on water quality in the form of pollution can be better assessed.

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