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RESEARCH ARTICLE

ZOOPLANKTON DIVERSITY WITH RELATION TO TROPHIC STATUS IN ANCHAR LAKE, KASHMIR

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ABSTRACT

Our work was focused on the taxonomic composition of zooplankton in Anchar lake during June 2010 to May 2011. During the investigation, 23 species of zooplankton were observed belonging to the different groups i.e., Protozoa, Rotifera, Copepoda, Cladocera and Ostrocoda. During study period, the zooplankton was composed of 06 taxa of Protozoa, 07 taxa of Rotifera, 07 taxa of Cladocera, 02 taxa of Copepoda and 01 of Ostrocoda. Comparison of the obtained results with those of earlier investigations performed during 2001 showed that changes have occurred in the interval. The total zooplankton composition is significantly changed. Comparison of diversity and density in the lake was studied with diversity indices. The study results clearly indicate intensified eutrophication of lake. This fragile ecosystem has to be prevented from further eutrophication.

INTRODUCTION

Biodiversity is the variety of organisms considered at all levels and includes genetic and ecosystem variants, which comprise arrays of species, genera, and families, as well as communities of organisms within particular habitats and the physical conditions under which they live. Because of intensive exchange of nutrients between their water columns and sediments, shallow lakes are sensitive to eutrophication (Ekholm *et al.,* 1997). Under the influence of eutrophication usually associated with a loss of structural diversity and as a result, a decrease in biodiversity at the higher trophic levels takes place (Scheffer, 1998), While oligotrophic lakes are generally clear and hypertrophic lakes frequently turbid, shallow lakes at intermediate nutrient concentrations may exhibit either clear water or turbid states. Biological studies have been increasingly employed in monitoring water quality in lakes. Phytoplankton, zooplankton, macrophytic plants and fishes were used considerably in biomonitoring of lake ecosystems. Indian lentic ecosystems were investigated extensively for plankton from mid 20th century (Biswas,1949 and Das *et al*., 1959). These studies show that the dominant plankton and their seasonality are highly variable in different water bodies according to their nutrient status, age, morphometry and other locational factors. Hence the present work was under taken to analyze the changes in zooplankton communities those which have occurred over a period due to the changed trophic status with aim of contributing to the knowledge of freshwater biodiversity in Anchar lake, Srinagar.

MATERIALS AND METHODS

Zooplankton samples were collected from four different sampling points between 9 A.M. and 11 A.M. The collection was made during the period of June 2010 to May 2011.The collection was made with plankton net by filtering known quanity of water. Samples were fixed in 4% formaldehyde. Organisms were identified to the greatest possible taxonomic level (Genus/species), using an optical microscope and a specialized bibliography. Both quantitative and qualitative analysis of zooplankton was done. Trophic status was analyzed using Q*B/T* quotient. In comparing the faunastic composition of zooplankton we used the Sorenson similarity index (S) (Hellawell, 1986).

$$S= 2C/A+B$$

Where,
A is the numbers of species present in one population,
B is the number of species present in the other population, and
C is the number of species present in both populations.

As control we used Jaccard index (CJ) (Hellawell, 1986).

$$CJ=J/a+b-J$$

Where,
a is the number of species present in one population,
b is the number of species present in the other population, and
J is the number of species present in both populations.

RESULTS AND DISCUSSION

On the basis of the results presented in Table 1, it can be easily explained that the changes have occurred in the total zooplankton composition in the lake. Out of 68 species which were recorded by earlier workers only 23 species were registered during this study period. Among Rotifera group out of 13 species recorded earlier, only 07 species were reported in the present study, while in the Cladocera group out of the

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13 reported species, 08 species were recorded and in the Copepoda group out of 06 species reported earlier, 02 species were recorded in this work. Among the Ostracoda group out of 03 species reported earlier, 01 species was recorded. The lower values of Jaccard index (12.3%) and Sorenson index (17.4%) were recorded for Rotifera group and higher values Jaccard index (43.2%) and Sorenson index (31.4%) of these indices were recorded for the group Ostracoda (Table 2).The present study provides the evidences for the changes in the composition of zooplankton (Table 1). The total zooplankton composition has significantly changed in the lake (Table 2).The lower values of Sorenson's and Jaccard's indices for total zooplankton composition reveal the change in community structure. In Anchar lake total zooplankton composition has significantly changed compared to earlier reports (Table 2). Since during 2001 this lake has recorded total 68 species; however in the present study only 25 species were registered. Eutrophication leads to the changes in community structure [Kudari *et al.*, 2006]. According to (Hellawell, 1986 and Sampaio *et al*., 2000) biotic communities respond to pollution or to eutrophication in three main ways first one is biomass alters but community structure (species composition and relative abundance) does not. Second one is species remain the same but relative abundances alter and biomass may alter and third one is species composition and relative abundance alter and biomass may alter. Lake Anchar gradually loosing its catchment area by increasing urbanization and due to pollution loading changes in the composition of zooplankton. Rotifers are prominent group among the zooplankton of a water body irrespective of its trophic status. This may be due to the less specialized feeding, parthenogenetic reproduction and high fecundity [Sampaio *et al*., 2002]. Among the zooplankton rotifers respond more quickly to the environmental changes and used as a change in water quality (Gannon *et al.*, 1978). Rotifera diversity is effected in the lake. Values of Sorenson index (17.4%) and Jaccard index (12.3%) in Anchar lake reveals that the drastic change in the rotifera composition is due to the disappearance of species (Table 1). Due to the continues inflow of nutrients from the surroundings, the lake reached eutrophication state and sensitive species are disappeared from the lake. This lake was bigger lake but incourse of time increase the development activities surrounding the lake it has become smaller and its water volume is come down. Therefore may species have been disappeared from the lake. The *Q*B/T results also give evidence for eutrophic conditions of lakes. As cladocers prefer to live in clear waters. The cladocers composition has much affected in Anchar lake. In this present study the presence of *Brachionus calyciflorous* lake can also be considered as an indication of increased organic content in the water bodies. (Kirk *et al.*, 1990) reported that the decrease in the water level, live stock disturbances and anthropogenic activities increase the turbidity and thus inhibits the competitive abilities of *Daphnia* species. (Boucherle, 1983) reported that the *D. longispina* is present only in oligotrophic lakes. In the present findings the absence of *D. longispin* clearly indicate that lake has reached eutrophication state. In the present investigation least changes were observed in copepods and ostracods. The composition of these groups are more or less similar to the earlier reports. These variations may be attributed to the water volume, as the water quality is significantly determined by the water quantity (Lind *et al.*, 2002). All these results indicate that changes of conditions affecting faunistic composition of the zooplankton occurred in the lake this is mainly due to eutrophication. The increase in the anthropogenic activities and urbanized catchment area and agricultural runoff are major cause for eutrophication in the lake. So there is urgency to take conservation steps for preventing from further eutrophication. We strongly recommend to the concerned authorities of the city corporation to take restoration programs and minimize the anthropogenic activities in and around the lake.

Table 1: Zooplankton composition in Anchar Lake in comparison with earlier reports

	ANCHAR LAKE	
SPECIES/YEAR	2001	JUNE 2010-MAY2011
PROTOZOA		
Arcella mitrata	+	+
Centropyxis constricta	+	-
C. stellate	+	-
Difflugia labes	+	+
Euglypha laevis	+	-
E. mucronata	+	+
ROTIFERA		
Brachionus calyciflorous	+	+
B. bidentata	+	+
B. quadrideatata	+	+
Bryocamptus hiemalis	-	+
Keratella cochlearis	+	+
K. valga	-	+
Lecane luna	-	+
CLADOCERA		
Alona exigna	+	-
Bosmina longirostris	+	+
Pseudosida bidentata	+	-
Daphnia pulex	+	+
Moina brachiate	-	+
Moinadaphnia macleayii	+	-
Sida crystalline	+	-
COPEPODA		
Cyclops scutifera	+	+
Eucyclops agilis	+	-
OSTRACODA		
Cypris subglobosa	+	+
Total	19	15

Table 2: Similarity in total zooplankton as well as cladocera, copepod, and rotifer group in Anchar Lake based on *Jaccard similarity index* (CJI) and *Sorenson similarity index* (S)

ZOOPLANKTON	*ANCHAR LAKE*
CJ	*16.1%*
S	*22.3%*
ROTIFERA	
CJ	*12.3%*
S	*17.4%*
CLADOCERA	
CJ	*27.4%*
S	*33.4%*
COPEPODA	
CJ	*36.4%*
S	*41.2%*
OSTRACODA	
CJ	*43.2%*
S	*31.4%*

Table 3: Calculation of Quotient $Q_{B/T}$ of Anchar Lake

Lake name/year	*2001*	*Lake condition*	*2011*	*Lake condition*
Anchar lake	*0.2=0.7*	*oligotrophic*	*5.0=5*	*Highly eutrophic*

Values of $QB_{/T}$ less than 1.0 means oligotrophy, values between 1.0-2.0 mesotrophy and values over 2.0 Eutrophy (14)

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