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Zooplankton Diversity of Anchar Lake with Relation to Trophic Status, Srinagar, Kashmir

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Abstract: The present work was focused on the taxonomic composition of zooplankton in Anchar Lake during June 2010 to May 2011. In the present investigation 25 species of zooplankton were observed belonging to the different groups i.e., Protozoa, Rotifera, Copepoda, Cladocera, Ostrocoda. During study period, the zooplankton was composed of 6 taxa of Protozoa, 8 taxa of Rotifera, 8 taxa of Cladocera, 2 taxa of Copepoda and 1 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.

Key words: Zooplankton · Trophic Status · Eutrophication · Anchar lake

INTRODUCTION

The variety of phytoplankton and zooplankton is an important indicator of anthropogenic interference within natural ecosystems may lead to reduction in biodiversity [1]. 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 [2] and the productivity of zooplantaon varies considerably in different ecosystems [1]. 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 [3]. 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 [4]. 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; however, phytoplankton are the most dominant species in aquatic ecosystems [5] Indian lentic ecosystems were investigated extensively for plankton from mid 20th century [6, 7]. These studies showed 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. However, Zooplankton was investigated in Indian lentic ecosystems [8, 9]. These studies reveal different groups of zooplankton have their own peak periods of density, which is also affected by local environmental conditions prevailing at the time. Zooplankton by their heterotrophic activity plays a key role in the cycling of organic materials in aquatic ecosystems and used as bioindicators. The biondicators are evaluated through presence/absence, condition, relative abundance, reproductive success, community structure (i.e. composition and diversity), community function (i.e. trophic structure), or any combination thereof [10]. Eutrophication of aquatic ecosystems can greatly alter the structure of zooplankton communities. Hence, zooplankton has been used as an

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indicator of a lake's trophic state [11]. Changes in the aquatic environment accompanying anthropogenic pollution are a cause of growing concern and require monitoring of the surface waters and organisms inhabiting them [12]. Composition and structure of zooplankton community are affected by eutrophication [13]. 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 sites between 9 and 11 AM. The collection was made during the period of June 2010 to May 2011. The collection was made by using a with plankton net of 68 μm mesh and filtering known quantity 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 *QB/T* quotient [14]. In comparing the faunastic composition of zooplankton we used the Sorenson similarity index (S) [10].

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

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) [10].

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

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 25 species were registered during this study period. Among Rotifera group out of 13 species recorded earlier, only 8 species were listed in the present study, while in the Cladocera group out of the 13 reported species, 8 species were recorded and in the Copepoda group out of 6 species reported earlier 2 species were recorded in this work. Among the Ostracoda group out of 3 species reported earlier, 1 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 for which nitrogen and phosphorus paly an important role [15] leads to the changes in community structure [16]. A similar trend was also reported [17] while studying Grosnica reservoir (Serbia, Yugoslavia). According to [10, 11] 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 the 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 [11]. Among the zooplankton rotifers respond more quickly to the environmental changes and used as a change in water quality [18] and have been found to be highest in summer. Rotifera diversity is affected in the lake. Values of

Table 1: Zooplankton composition in Achar 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 bases 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%

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 continued 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 in course 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 [19]. The *Q*B/T results also give evidence for eutrophic conditions of lakes. As cladocers prefers to live in clear waters. The cladocera 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. Some scientists [20, 21] 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. [22] reported that the *D. longispina* is present only in oligotrophic lakes. In the present findings the absence of *D. longispina* clearly indicates 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 [23]. All these results indicate that changes of conditions affecting composition of the zooplankton occurred in the lake are 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 were recorded by earlier researchers only 25 species were registered during study period. The lower values of Jaccard index (9%) and Sorenson index (13%) were recorded for rotifera group and higher values Jaccard index (23%) and Sorenson index (18%) 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 Lake Anchar, total zooplankton composition has significantly changed compared to earlier reports (Table 2). Since during 2001 this lake has recorded total 32 species; however in the present study only 25 species were registered. Eutrophication leads to the changes in community structure [20]. A similar trend was also reported by Lind and Davalos-Lind [23] while studying Grosnica reservoir (Serbia, Yugoslavia). 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 [15]. 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 [31]. Among the zooplankton rotifers respond more quickly to the environmental changes and used as a change in water quality [13]. Rotifera diversity is affected in the lake The low values of Sorenson index (18%) and Jaccard index 23% in Anchar Lake reveals drastic change in the rotifera composition due to the disappearance of species (Table 1). Sladecek [14] reported that the *Triclocerca similes, T. ruttus, T. cylindrical and T. longiseta* are present in oligotrophic conditions. Due to continue inflow of nutrients from the surroundings, the lake reached eutrophication state and sensitive species are disappeared from the lake. While in Bosga lakeall *Triclocerca* species were absent except the *T. cylindrical*. This lake was bigger lake but in course 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 form the lake and similar results are investigated in Gobber Lake. In present investigation we have prepared the trophic status by calculating *Q*B/Tquotient (Table 3). The *Q*B/T results also give evidence for eutrophic conditions of the lake. cladocers prefer to livein clear waters. The cladocers composition has much affected in Anchar Lake. Some workers [19], it has been 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. [4] reported that the *D. longispina* is present only oligotrophic lakes.

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)

In the present findings the absence of *D. longispin* clearly indicates that lakes are reached eutrophication state. In the present investigation least changes were observed in copepods and ostracods. Compositions of these groups are more or less similar to the earlier reports. In the present study the maximum Jaccard and Sorenson index values of ostracods were recoded in lake Gobbur (CJ=75% and S=85.7%) while lowest values were recoded in other lakes. These variations may be attributed to the water volume, as the water quality is significantly determined by the water quantity [21]. All these results indicate that changes of conditions affecting composition of the zooplankton occurred in the three lakes 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 these lakes. 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 lakes.

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