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Zooplankton diversity of three freshwater lakes with relation to trophic status, Gulbarga district, North-East Karnataka, South India

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Abstract- Our present work focused on the taxonomic composition of zooplankton in three freshwater lakes (Sharanabasaveshwara Lake and Gobbur Lake, Bosga Lake,) of Gulbarga district during October 2005 to September 2006. In present investigation 39 species of zooplankton were to the different groups i.e., Rotifera, Copepoda, Cladocera, Ostrocoda. During study period in the lake Sharanabasaveshwara, the zooplankton was composed of nine taxa of Rotifera, four taxa of Cladocera, four taxa of Copepoda and three taxa of Ostrocoda, while in Bosga lake ten taxa of Rotifera, six taxa of Cladocera, four taxa of Copepoda, three taxa of Ostracoda and in Gobbur lake thirteen taxa of Rotifera, nine taxa of Cladocera, four taxa of Copepoda and three taxa of Ostrocoda, were encountered respectively. Comparison of the obtained results with those of earlier investigations performed during 1986-1987 showed that changes have occurred in the interval. The total zooplankton composition is significantly changed in all the three water bodies. Comparison of diversity and density in three lakes was studied with diversity indices. The study results clearly indicate intensified eutrophication of lakes. These fragile ecosystems have to prevent from further eutrophication.
Key words- Zooplankton, trophic status, eutrophication, Gulbarga

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 [11]. 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 [14,32] While oligotrophic lakes are generally clear and hypertrophic lakes frequently turbid, shallow lakes at intermediate nutrient concentrations may exhibit either clearwater or turbid states [33]. 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 [2, 5]. These studies show that the dominant plankton and their seasonality are highly variable in different waterbodies according to their nutrient status, age, morphometry and other locational factors. However, Zooplankton was investigated in Indian lentic ecosystems [1, 41]. 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 [15]. Eutrophication of aquatic ecosystems can greatly alter the structure of zooplankton communities. Hence, zooplankton has been used as an indicator of a lake's trophic state [31]. 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 [42]. Composition and structure of zooplankton community are affected by eutrophication [22, 23,] and these communities have potential value as indicators of changing trophic condition [3,4,13,27,28,40,45]. According to Horne and Goldman 'the most efficient method to advance knowledge in limnology is through comparative studies of different types of lakes within the same geographical area .But there is no literature from Hyderabad Karnataka region water bodies. 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 Hyderabad Karnataka region.

Materials and Methods

Zooplankton samples were collected from three lentic habitats of Gulbarga district between 6 A.M. and 9 A.M. The collection was made during the period of October 2005 to September 2006 the collection was made with hand plankton (standard-WP2 pattern net of 68 μm mesh) by horizontal net towing (5 m distance/spot). Towing was done in surface and just below the water surface. 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 [6-8,10,12,17,24-26,30,34-39] Only qualitative analysis of zooplankton was done. Philodinidae species were identified using fresh samples. Trophic status was analyzed using $Q_{B/T}$ quotient [40]. In comparing the faunastic composition of zooplankton we used the Sorenson similarity index (S) [15].

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) [15].

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. The data which was generated by our survey between 2005 and 2006 was compared with the earlier species composition list (Vijaykumar 1986-87) for three lakes.

Results

On the basis of the results presented in Table 1, it can be easily explain that the changes have occurred in the total zooplankton composition in all the three lakes. Out of 102 species which were recorded by earlier workers only 73 species were registered during study period. Among rotifera group out of 50 species only 31 species were listed in the present study, while in the cladocera group out of the 30 reported species 21 recorded again and in the copepoda group out of 12 species reported earlier 12 species were rerecorded. Among the ostracoda group out of 10 species reported earlier 9 species were recorded again. Sharanabasaveshwara lake a total of 22 taxa of zooplankton were recorded in the present investigation whereas 31 taxa were reported earlier (Table 1). During 1986–87 this lake was reported 16 taxa of rotifera, 9 taxa of cladocera and 3 taxa of copepoda and 3 taxa of ostracoda but now the composition presenting 09 taxa of rotifera, 06 taxa of cladocera, 4 taxa of copepoda and 3 taxa of ostracoda. The lower values of Jaccard index (19%) and Sorenson index (32%) were recorded for rotifera group and higher values Jaccard index (50%) and Sorenson index (66.6%) of these indices were recorded for the group ostracoda (Table 2). Bosga lake, 35 species of zooplankton was recorded in this lake by earlier workers whereas in the study period only 24 species were recorded (Table 1). During 1986–87 this lake was included 17 taxa of rotifera, 10 taxa of cladocera, 5 taxa of copepoda and 3 taxa of ostracoda but the present composition has changed to 10 taxa of rotifera, 7 taxa of cladocera, 4 taxa of copepoda and 3 taxa of ostracoda. The lower values of Jaccard index (21.4%) and Sorenson index (35.2%) were recorded for cladocera group and higher values of these indices for the group copepoda and ostracoda (Soreson index =66.6 and CJ=50) (Table 2). Gobbur lake, 36 species of zooplankton was recorded in this lake by earlier workers whereas in the present study only 27 species were recorded (Table 1). During 1986–87 this lake was with 17 rotifera, 11 taxa of cladocera, 4 taxa of copepoda and 04 taxa of ostracoda but the composition has changed to 12 taxa of rotifera, 8 taxa of cladocera, 4 taxa of copepoda and 3 taxa of ostraoda. The lower values of Sorenson index (48.2%) and Jaccard index (31.87%) were recorded for rotifera group and higher values of these indices for the group ostracoda (S= 85.7% and CJ=75.%) (Table 2).

Discussion

The present study provides the evidences for the changes in the composition of zooplankton (Table 1). The total zooplankton composition has significantly changed in all three lakes (Table 2). The lower values of Sorenson's and Jaccard's indices for total zooplankton composition reveal the change in community structure. In lake Sharanabasaveshwara total zooplankton composition has significantly changed compared to earlier reports (Table 2). Since during 1986–1987 this tank has recorded total 32 species; however in the present study only 24 species were registered. The condition of Bosga, and Gobbur lakes was also found similar (Table 2). Eutrophication leads to the changes in community structure[20]. A similar trend was also reported by [23] while studying Grosnica reservoir (Serbia, Yugoslavia). According to [15,31] 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 Sharanabasaveshwara gradually loosing its cathment 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 effected in all three lakes. The low values of Sorenson index (32%) and Jaccard index (19%) in Sharanabasaveshwara lake reveals that the drastic change in the rotifera composition due to the disappearance of 10 species (Table 1). Sladecek (1983) reported that the *Triclocerca similes, T. ruttus, T. cylindrical and T. longiseta* are present in oligotrophic conditions. Due to the continues inflow of nutrients from the surroundings, the lake reached eutrophication state and sensitive species are disappeared from the lake. While in Bosga lake all *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 $Q_{B/T}$ quotient (Table 3). The $Q_{B/T}$ results also give evidence for eutrophic conditions of lakes. The Sharanabasaveshwara lake showed highly eutrophic condition while, Bosga lake showed eutrophic state and Gobbur lake showed mesotrophic condition. As cladocers prefer to live in clear waters. The cladocers composition has much affected in Sharanabasaveshwara and Bosga Lake (Table 2) compared to other two lakes. The higher values of Sorenson index (46.1%) and Jaccard index (36.1%) in Gobbur lake suggest that, this lake is not reached eutrophic state. Jana and Pal (1984) reported the *Diaphanosoma excisum* is more abundant in high organic content water bodies. In this present study the presence of *Diaphanosoma excisum* all lakes can also be considered as an indication of increased organic content in the water bodies. Some workers [19,29] 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. In the present findings the absence of *D.longispin* clearly indicate that lakes are 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. Even though among the three lakes. the lake Gobbur showed peak values of Jaccard index (60%) and Sorenson index (75%) for copepoda. The Bosga lake and Sharanabasaveshwara lake showed low values of Jaccard index (40% and 50%) and Sorenson index (57.1% and 66%) respectively. 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 faunistic 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 f or preventing from further eutriohication. 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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Table 1: Zooplankton composition in three lakes in comparison with earlier reports

	Sharanabasaveshwara lake		Bosga lake		Gobbur lake	
Species/year	2005-06	1986-07	2005-06	1986-07	2005-06	1986-07
Rotifera						
Brachionus calyciflours	+	-	+	+	+	+
B. rubens	+	-	+	+	-	+
B. angularis	+	+	+	+	+	-
B. forcula	+	+	+	+	-	+
B. falcatus	+	-	-	+	+	+
Karatella tropica	-	+	-	+	+	-
K.chohelaris	+	+	-	-	+	+
Filinia longiseta	-	-	+	+	-	+
F.terminalis	+	+	-	+	+	+
Macrothaetus serica	-	+	+	-	+	+
Rotaria sp	-	-	-	+	+	-
Lapedella bicornis	+	+	-	+	-	+
L.ovlis	-	+	+	+	-	+
Lecane luna	+	-	+	-	+	-
Aslancha priodanata	-	+	-	-	+	+
A.brightwelli	-	+	+	+	-	-
Horlla brehmi	-	+	-	+	+	+
Hobrotrocha bidens	-	+	-	-	-	-
Lacinularia socialis	-	+	-	+	+	+
Triclocera similes	-	+	-	-	-	+
T. cylindrical	-	+	-	+	-	+
T. longiseta	-	-	+	+	+	+
T. ruttus	-	+	-	+	-	+
Cladocera						
Daphnia pules	+	+	-	+	+	+
D. laevis	-	+	+	+	-	+
+D. carinata	-	+	+	+	+	+
D. logispina	-	+	-	+	+	-
Euryyalona oreientalis	-	-	+	-	-	+
Monia brachiata	+	+	-	+	+	+
M.reticularis	-	+	+	-	+	+
Daphanosoma sarsi	+	+	-	+	-	+
Daphanosoma excisum	+	-	-	-	+	+
Chyodrus sphericus	-	-	+	+	-	+
C.reticulates	-	+	-	+	+	+
C. barroisi barroisi	-	+	+	-	-	-
Lantonopsis aurstralis	-	-	-	+	+	+
Dunhevedia serrata	-	-	-	+	+	-
Copepoda						
Mesocyclops leukerri	+	-	+	+	+	+
M. hyalinus	-	-	+	+	+	-
Cyclopoid nauplii	+	+	-	+	+	+
Neodiaptomus strigilips	+	+	-	+	-	-
Rhineadiaptomus indicus	-	+	-	+	+	+
Paracyclops fimbriatus	+	-	+	-	-	+
Ostracods						
Eucypris bispinosa	+	+	+	-	+	+
Posptomocypris	+	-	+	+	+	+
Hemicypris fossulata	-	+	+	+	+	+
Spirocypris	+	+	-	+	-	+
Total	22	31	24	35	29	36

Table 2: Similarity in total zooplankton as well as cladocera, copepoda and rotifera group in six water bodies based on Jaccard similarity index (CJ) and Sorenson similarity index (S)

	S.B lake	Bosga lake	Gobbur lake
Zooplankton			
CJ	29.2 %	34.1%	51.1%
S	45.2 %	50.8 %	67.69%
Rotiera			
CJ	19 %	28.85 %	31.8 %
S	32 %	44.4 %	48.2 %
Cladocera			
CJ	36.3 %	21.4 %	46.1 %
S	53.3 %	35.2 %	63.1 %
Copepoda			
CJ	40 %	50 %	60 %
S	57.1 %	66.6 %	75 %
Ostracoda			
CJ	50 %	50 %	75 %
S	66.6 %	66.6 %	85.7 %

Table 3: Calculation of Quotient $Q_{B/T}$ of three lakes

Lake Name/ year	2005-06	Lake condition	1986-87	Lake condition
Sharanabasaveshwara	5:0 = 5	Highly eutrophic	2:3 = 0.6	Oligotrophic
Bosga	4:0 = 4	Eutrophic	4:3 = 0.7	Mesotrophic
Gobbur	3:1 = 2	Mesotrophic	4:4 = 0	Oligotrophic

Values of QB/T less than 1.0 mean oligotrophy, values between 1.0–2.0 mesotrophy and values over 2.0 eutrophy (Sladecek 1983)