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RESEARCH ARTICLE

Zooplankton Diversity and Seasonal Variation of Three Lakes in Coimbatore, Tamil Nadu, India

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Abstract

The present study was carried out to examine the diversity and density of zooplankton in Ukkadam Lake, Kuruchi Lake and Singanallur Lake in Coimbatore city, Tamil Nadu for the period of September 2012 to August 2013. The samples for Zooplankton analysis were collected early in the morning by plankton net of silk bolting cloth size of 25 µ and preserved in 4% formalin and glycerine for zooplankton analysis. During the present study period, a total 30 of genera of zooplankton composed of 8 genera of protozoa, 9 genera of Rotifer, in which 7 genera belonged to Cladocera and 6 to Copepoda were recorded in all the three lakes. Dominance of Rotifers indicated the eutrophic status of these studied lakes. Species diversity index for zooplankton population varied from 1.74 to 3.63. The zooplanktonic fauna of this lake were abundant during summer season while minimum numbers were recorded during rainy season. The present study findings clearly indicate intensified eutrophication of studied lakes.

Keywords: zooplankton, Coimbatore lakes, Cladocera, Copepoda, Rotifers, species diversity index.

Introduction

Zooplankton play a vital role in nutrients recycling as well as energy transfer from lower to higher organisms in aquatic ecosystem (Fetahi *et al.,* 2011). Their distribution is based on various environmental factors such as climate changes, physicochemical nature of water and vegetation cover. In aquatic ecosystem, zooplanktons are good biological indictors for determining the status of water pollution. Consequently, zooplankton diversity and seasonal variation can be used for the assessment of water quality and for irrigation of agriculture and pisciculture management (Sharma *et al.,* 2013). Sabu and Azis (1998) reported that phytoplankton and zooplankton abundance in peppara reservoir in Kerala. Das (2002) made some observations on zooplankton diversity of two fresh water and two brackish water wetlands of Goa and totally 42 species of zooplankton have been recorded. Rajagopal *et al*. (2010) reported that the presence of certain species like *Keratella, Moina daphnia* and *Brachionus* are considered to be biological indicator for eutrophication. Little information is available about zooplankton diversity and status of lake water pollution in Coimbatore. Hence, the present study investigated the abundance and diversity of zooplankton community in Ukkadam, Kuruchi and Singanallur of Coimbatore, Tamil Nadu, India.

Materials and methods

Study area: Coimbatore city is surrounded with a number of wetlands and they were the important sources of water for drinking and irrigation. These wetlands are presently deteriorated and cannot be used as a source of drinking water. Therefore, in this study three lakes were selected namely Ukkadam Lake, Kuruchi Lake and Singanallur Lake in Coimbatore city and investigated for the abundance and diversity of zooplankton community.

Ukkadam Lake: Ukkadam lake is situated between latitude of 100°59'05.9", longitude of 760°57'22.1". Catchments free area is 10.752 sq.km. Water spread area is 12.95 sq.m. Number of slices are 4 and capacity is 1.970 m. Lowest sill level is 10.64 m. Registered Ayacut area is 14.25 acres. Maximum flood discharge is 62.88 m^3/sec and the depth is 12.75 ft.

Kuruchi Lake: The second study site, the Kuruchi wetland has a water spread area of 343.96 acres and holds the least water storage capacity because of its shallowness. In the tank, 9.50 acres is encroached by about 200 huts on the bund and 274 abutting the channels. This wetland receives municipal sewage and is a site for dumping garbage from inhabitations around its vicinity.

Singanallur Lake: The third study site, the Singanallur Lake is highly affected by eutrophication and is almost filled up with *Eichhornia crassipes.* Although *Eichhornia crassipes*is praised for its ability to sequester nutrients and other chemicals from water, it is considered undesirable for wetlands. It is located within the geographical coordinates of 10°56'46'' latitude and 77°01'11'' longitude.

Table 1. Zooplankton population of Ukkadam Lake for the period of one year (September 2012 to August 2013).

Zooplankton	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Protozoa												
Didinum sp.	2	-	-	4	3	2	-	-	2	3	4	3
Vorticella globusa	-	-	3	-	-	4	6	-	-	-	-	-
Amoeba radiosa	1	-	-	-	-	-	-	-	-	-	-	-
Oxitricha sp.	5	4	3	4	3	-	-	-	2	4	3	4
O. fallax	1	2	5	3	1	-	-	-	-	-	-	-
Arcelladis coidus	4	6	7	7	5	2	1	1	2	5	6	5
A. vulgaris	3	5	7	7	5	-	-	-	2	3	7	6
Condylostoma patens	2	3	3	2	-	-	-	-	-	2	3	2
Rotifera												
Brachionus calyciflorus	-	4	-	4	-	-	-	-	-	-	-	3
B. budapestinensis	-	-	2	-	1	-	2	2	-	-	-	2
B. patulus	-	-	-	-	2	2	2	-	-	-	-	-
B. angularis	-	-	-	3	3	3	3	-	2	2	-	-
B. diversicornis	3	3	3	-	-	-	-	-	-	-	-	-
Stenocypris malcomsoni	3	3	3	3	-	1	1	-	-	-	2	3
Cladocera												
Daphnia pulux	4	4	4	3	3	3	2	-	1	2	2	2
Moina comuta	-	3	-	-	-	-	-	1	-	-	4	-
Moina sp.	2	2	-	1	-	-	-	-	-	-	1	1
Moina brachiata	2	2	3	-	-	-	-	-	-	-	1	2
Chydorus parvus	3	-	1	2	2	2	-	-	-	-	-	-
Alona sp.	-	2	1	2	2	-	2	-	-	2	-	-
Bosomina longistris	-	2	2	3	-	-	-	-	-	2	-	-
Copepoda												
Eucyclops sp.	4	4	4	5	-	-	-	-	2	2	3	3
Mesocyclops leuckartii.	5	4	3	-	4	5	3	3	3	2	4	4
Trophocyclops sp.	3	4	4	-	-	-	-	-	2	-	2	3
Ectocyclops sp.	2	-	1	2	-	-	1	-	-	2	-	-
Paradiaptomus greeni	4	4	3	3	-	-	-	-	-	-	2	2
Phyllodiaptomus blanci	2	2	2	2	-	-	-	-	-	-	2	2

(Values expressed in units/L).

The lake is divided into two equal halves, but connected by a railway line running through it. South part of the lake mainly received freshwater only during the rainy season from the Noyyal River and north part of lake receives industrial waste water, domestic sewage and urban soiled wastes (Ezhili *et al*., 2013; Ilangovan *et al*., 2014).

Sample collection: The samples for Zooplankton analysis were collected early in the morning before 6 am by plankton net of silk bolting cloth size of 25 µ and preserved in 4% formalin and glycerine for zooplankton analysis. At the laboratory, subsamples of 1 mL were obtained using a pipette; zooplankton were counted and measured from each sample in a reticulated Sedgwick-Rafter chamber, with the use of microscope. Zooplankton species were identified following the works of Michael and Sharma (1988) and Korovchinsky (1992).

Species Diversity Index: The Species Diversity Index was calculated by using the formula given by Menhinick (1964).

$$D = \frac{S}{\sqrt{N}}$$

Where, d = species diversity index, S = number of species in the sample, N = total number of individuals in the sample.

Statistical analysis was done for zooplankton density at each sampling point and months as well as a correlation analyses (r-Pearson, $p<0.05$).

Results and discussion

Zooplanktons play a critical role in aquatic ecosystems and it is considered to be the ecological indicators of water bodies (Gajbhiye and Desai, 1981). Factors like temperature, light intensity, food availability, dissolved oxygen and chemical contaminations are affecting the population of zooplankton. Present study shows the presence of 30 species, out of which 9 species belong to rotifer, 7 species of cladocera, 6 species of copepod and 8 species of protozoa (Tables 1, 2 and 3). All genera were identified in all the three lakes during the study period. Rotifers were observed to be maximum during the summer (March, April and May) and dominated other genera. An important concern, when there is a predominance of smaller species in lakes, there is a possible relation of suspended material in the water column due to the constant influence of the wind (Nimbalkar *et al*., 2013).

Table 2. Zooplankton population of Kuruchi Lake for the period of one year (September 2012 to August 2013).

Zooplankton	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Protozoa												
Didinum sp.	-	-	-	-	-	-	-	-	-	-	-	-
Vorticella globusa	-	-	3	-	-	3	5	-	1	-	-	-
Amoeba radiosa	-	-	-	-	-	-	-	-	1	-	-	-
Oxitricha sp.	-	-	-	-	-	-	-	-	1	-	-	-
O. fallax	-	-	-	-	-	-	-	-	1	-	-	-
Arcelladis coidus	2	2	3	4	3	2	3	3	2	1	-	-
A. vulgaris	2	2	2	1	-	-	2	2	2	1	-	-
Condylostoma patens	3	3	4	3	-	-	-	-	-	2	3	3
Rotifera												
Brachionus calyciflorus	4	-	4	-	4	-	-	-	-	-	-	4
B. budapestinensis	-	-	3	1	1	-	2	2	-	-	-	2
B. patulus	-	-	-	-	3	3	3	-	-	-	-	-
B. angularis	-	-	-	3	3	4	3	-	3	3	-	-
B. diversicornis	3	4	4	-	-	-	-	-	-	-	-	-
Stenocypris malcomsoni	3	3	4	4	-	2	2	-	-	-	3	3
Cladocera												
Daphnia pulux	5	5	5	3	3	3	3	-	1	2	2	2
Moina comuta	-	3	3	-	-	-	-	1	-	-	3	-
Moina sp.	2	2	-	2	-	-	-	-	-	-	2	2
Moina brachiata	3	3	3	-	-	-	-	-	-	-	2	2
Chydorus parvus	4	-	2	2	3	2	-	-	-	-	-	-
Alona sp.	-	3	2	2	2	-	2	-	-	2	2	-
Bosomina longistris	-	3	3	3	3	-	2	-	-	1	2	-
Copepoda												
Eucyclops sp.	5	5	5	5	-	-	-	-	3	3	3	3
Mesocyclops leuckartii.	5	5	4	-	5	5	4	4	4	3	4	4
Trophocyclops sp.	4	4	4	-	-	-	-	-	3	3	3	-
Ectocyclops sp.	3	-	2	2	-	-	2	-	-	2	-	-
Paradiaptomus greeni	4	4	4	3	-	-	-	-	-	-	3	3
Phyllodiaptomus blanci	3	3	3	3	-	-	-	-	-	2	3	3

(Values expressed in units/L).

Kirk and Gilbert (1990) and Nimbalkar *et al*. (2013) have documented that, several rotifers species tolerate a high concentration of suspended material because their corona and mastax structures which are highly efficient at identifying and selecting the material that will be ingested through the sensorial bristles of the mouth, avoiding inorganic particles. Gannon and Stemberger (1978) have documented that among the zooplankton, rotifers respond more quickly to the environmental changes and used as a change in water quality. This is a bioindicator of water quality (Saksena, 1986). Sendacz, (1984) have reported that high rotifer density has been characteristic of eutrophic lakes. Species Diversity Index calculated for zooplankton population varied from 1.74 to 3.63 (Fig. 1). Maximum numbers of zooplankton were recorded in the months of March and October. Presence of numerous rotifers indicates the level of algal population and show insufficient oxygen to support the rotifers. Kudari*et al*. (2005) studied that the zooplankton composition in some ponds of Haveri District, Karnataka and in some lakes of Constance, Germany and stated that Zooplanktons occupy an important position in the trophic structure and play a major role in energy transfer of an aquatic ecosystem.

In the present study, zooplankton population was found to be in a descending order of major dominant groups viz., Protozoa >Rotifera>Copepoda>Cladocera.

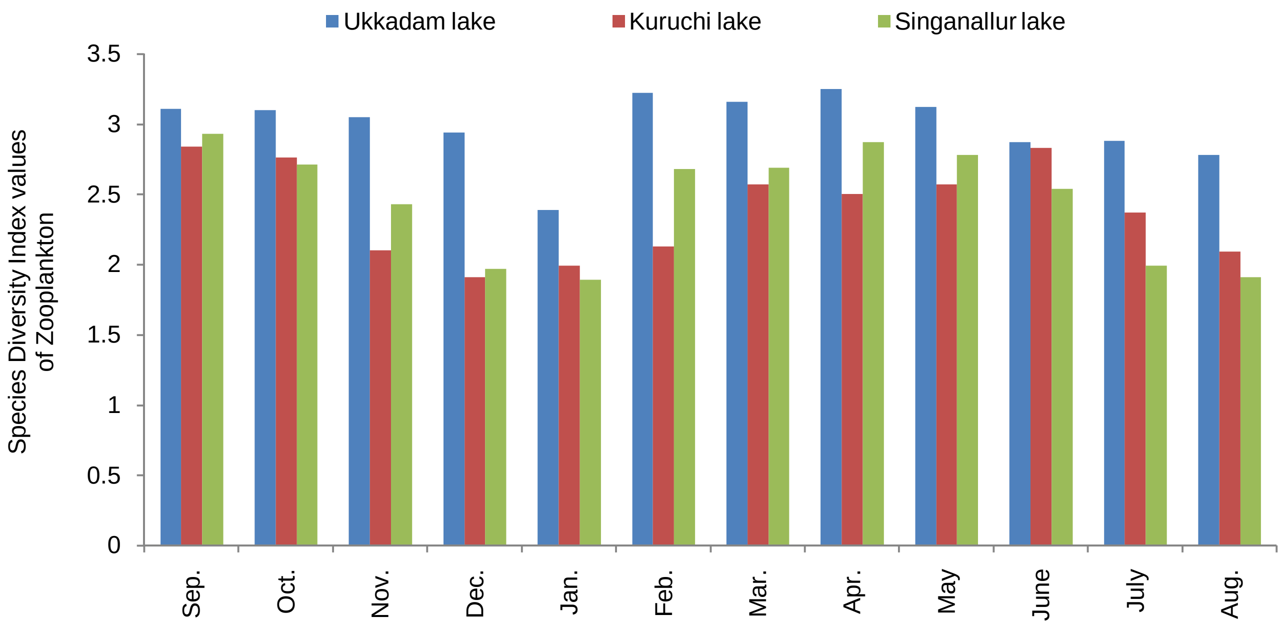
The zooplanktons form a link between phytoplankton and macro invertebrates which in turn provide food for fish. Abundance of *Brachionus* sp. and *Keratella* sp. are the determinants of high alkalinity and organically enriched conditions. A direct relationship with phytoplankton and zooplankton was observed in the present study which is in agreement with the findings of Hosmani (2013). The zooplanktonic fauna of this lake were abundant during summer season while minimum numbers were recorded during rainy season. This seasonal variation of zooplankton may be due to environmental changes. In the present study, zooplankton showed distinct seasonal variations. They indicate their own maximal and minimal peaks as observed by Manzer *et al*. (2005). In any aquatic system, determination of primary productivity gives information relating to the amount of energy available to support the bioactivity of the system. The high intensity of light may related to the maximum primary productivity of the lake as stated by Saha and Pandit (1990).

Table 3. Zooplankton population of Singanallur Lake for the period of one year (September 2012 to August 2013).

Zooplankton	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Protozoa												
Didinum sp.	3	-	-	-	4	3	3	-	2	3	3	3
Vorticella globusa	2	-	3	-	-	4	5	-	-	-	-	-
Amoeba radiosa	2	-	-	-	-	--	-	-	-	-	-	2
Oxitricha sp.	4	4	4	4	3	-	-	-	3	3	3	4
O. fallax	2	2	4	2	1	-	-	-	-	-	-	3
Arcelladis coidus	5	4	6	6	4	2	1	1	3	4	5	5
A. vulgaris	4	3	5	5	6	7	-	-	2	3	7	5
Condylostoma patens	2	3	3	3	-	-	-	-	-	3	3	3
Rotifera												
Brachionus calyciflorus	4	4	-	4	-	-	-	-	-	-	-	4
B. budapestinensis	-	-	2	-	1	-	-	2	2	-	-	2
B. patulus	-	-	-	-	2	3	3	-	-	-	-	-
B. angularis	-	-	-	4	4	4	4	-	3	3	-	-
B. diversicornis	3	3	3	-	-	-	-	-	-	-	-	-
Stenocypris malcomsoni	3	3	3	-	1	1	-	-	-	2	3	-
Cladocera												
Moina comuta	3	3	3	4	3	4	2	2	1	1	1	1
Moina sp.	3	2	-	-	-	-	2	-	-	3	-	-
Moina brachiata	2	2	-	2	-	-	-	-	-	-	2	2
Chydorus parvus	3	-	1	3	3	3	3	-	-	-	-	-
Alona sp.	-	2	2	2	2	2	-	-	-	-	-	-
Bosomina longistris	-	2	2	3	-	-	-	-	-	2	2	-
Copepoda												
Eucyclops sp.	4	3	3	4	-	-	-	-	3	3	3	3
Mesocyclops leuckartii.	5	5	4	3	-	5	4	3	3	3	3	3
Trophocyclops sp.	3	2	2	-	-	-	-	-	2	-	2	2
Ectocyclops sp.	3	-	2	2	-	-	2	-	-	3	-	-
Paradiaptomus greeni	4	3	3	3	-	-	-	-	-	-	3	3
Phyllodiaptomus blanci	2	2	3	3	-	-	-	-	-	-	2	3

(Values expressed in units/L).

Fig. 1. Species Diversity Index values of Zooplankton in three Lakes for the period of one year (Sep. 2012 to Aug. 2013).



In the present, study a well marked fluctuations in the primary productivity was recorded due to the high organic pollution and very low intensity of light.

Conclusion

The qualitative analysis of zooplankton from the studied lakes revealed that presence of pollution indicator species such as *Brachionus angularis*, *B. calyciflorus, and Stenocypris malcomsoni*. Therefore, it can be concluded that studied three lakes are under the eutrophic conditions. The results reveal the need for essential regular monitoring in order to safeguard the health of the lake. If alternate disposal systems are not adopted in near future, the pollution load will jeopardize the ecological balance completely.

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