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Studies on Zooplankton Composition and α-Diversity Indices at Thanegaon Reservoir, Maharashtra, India

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Abstract: Present study was undertaken to investigate the zooplankton diversity of Thanegaon reservoir located in Arvi tehsil of Wardha district in the Indian state of Maharashtra. Samples were collected on the monthly basis for six months during January 2020 to June 2020. In this reservoir we have studied the four major groups of zooplankton: Rotifera, Copepoda, Cladocera and Ostracoda. Rotifera was found to be the dominant group during the entire study period. The study revealed a total 34 species of zooplanktons during the entire study period, of which 19 species belong to Rotifera, 8 belong to Cladocera, 5 belong to Copepoda and 2 belong to Ostracoda. Statistical analysis of data was done by using α- diversity indices. Shanon-Wiener index 4.50 to 4.72, Simpson index 0.034 to 0.043 indicated the diverse nature of the zooplankton community. Margalef richness index 5.86 to 6.23 and Menhinick index 2.40 to 2.92 indicated the good species richness. Equitability index was in the range from 0.92 to 0.95 showing much evenness of species during the study. Relative biovolume % of zooplankton and composition in terms of density was also calculated. It showed the maximum number of species during the months of January, March and June.

Keywords: Thanegaon reservoir, Zooplankton, Rotifera, α-Diversity indices, Shannon-Wiener index, Simpson index

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Introduction

Thanegaon reservoir (Wardha district, Maharashtra, India) is a freshwater natural lake which is filled to its maximum capacity throughout the year. Thus, this reservoir serves as a source of domestic and agricultural water for nearby areas. Thus, it becomes necessary to keep the quality of water good for these purposes. Study of zooplankton composition is very important due to their role in the food web by linking the producers with consumers in the Lake Ecosystem and prediction of primary productivity and aquatic pollution (Nimbalkar *et al*., 2013; Ghosh and Biswas, 2015). Many species of the zooplanktons are sensitive to pollution and thus act as a

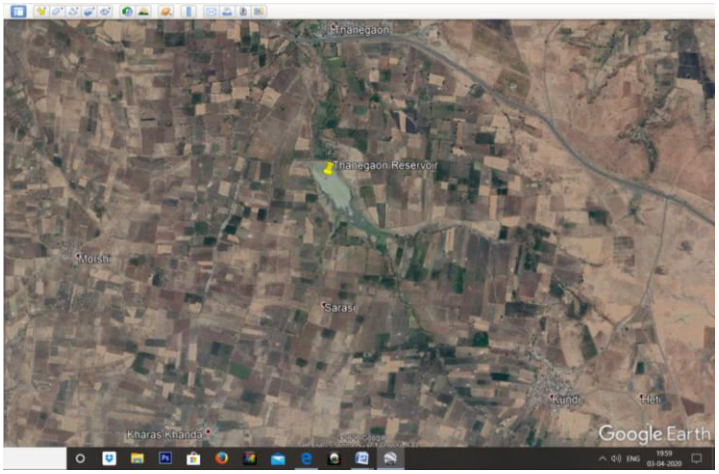

Fig.1: Google map image of Thanegaon Reservoir.

bioindicator to monitor the quality of water (Ferdous and Muktadir, 2009; Sivalingam *et al*., 2013). Zooplankton community constitutes the faunal composition of water bodies which are sensitive to water quality parameters and aquatic pollution (Schindler,1987; Jose and Senthil Kumar, 2015). Thus the aim of the present investigation was to study the zooplankton composition and structure, density, dominance and abundance along with α- diversity indices in the Thanegaon reservoir.

Materials and Methods

Thanegaon reservoir (Fig. 1) is a freshwater natural lake situated at 21° 08' 48" N Latitude and 78° 28' 41" E Longitude at the elevation of 484 Mts. near Sirsi and Kharas Khanda, approximately 10 kilometers away from Karanja (Ghadge) in Wardha district, Maharashtra, India. Collection of sample was done on monthly basis for 6 months from January 2020 to June, 2020 around 7.00 to 7.30 a.m. from selected site by filtering 50 liters of the lake water by using a standard 55 µm pore size bolting nylon plankton net. All specimens collected were preserved in 4% formalin soon after collection. Identification of the specimens was performed according to Kolisko (1974); Koste (1978); Ward and Whipple (1959); Mizuno (1964); Mizuno and Takahashi (1991), Battish (1992) and Dhanapathi (2003). Six indices were used to estimate biodiversity and species richness. Species diversity index was calculated based on Simpson (1949) and Shannon-Weiner (1949); richness index was adopted by Margalef (1951) and Menhinick (1964) and equitability Index by Magurran (1988). Dominance index or Simpson's index of diversity was calculated using formula 1-Simpson index. The percentage relative abundance and density of the specimens was estimated by direct count.

Statistical Analysis:

Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS 10.0). Graphs were drawn using Microsoft Excel Software.

Results and Discussion

Zooplankton diversity and α-diversity indices play key roles in evaluating the trophic status of lakes and suitability of water for domestic purposes and irrigation. In the present study, zooplankton diversity belonging to Rotifera, Cladocera, Copepoda and Osracoda have been undertaken. In the present study 19 species of Rotifera including 6 families and 9 genera, 8 species of Cladocera including 5 families and 8 genera, 5 species of Copepoda including 3 families and 5 genera and 2 species belonging to Ostracoda were noted. Overall 34 species of zooplankton were recorded (Table 1). The most abundant taxonomic group recorded during the study was the rotifer. Pereira *et al*. (2002) noted the rotifers as a most abundant group. Main abundant species of rotifer observed by them were *Keratella quadrata, K. cochlearis,*

Table 1: Zooplankton species identified in Thanegaon reservoir

Phylum: Rotifera			
S. No.	Class and Order	Family	Genus and Species
1.	Class: Monogonata Order : Ploima	Brachionidae	*Brachionus quadridentatus Var. Entzi*
2.			*Brachionus falcatus*
3.			*Brachionus forficula*
4.			*Brachionus diversicornis*
5.			*Brachionus calyciflorus Var.Hymani*
6.			*Brachionus platulus*
7.			*Brachionus bidentata*
8.			*Brachionus rubens*
9.			*Brachionus ureceolaris*
10.			*Keratella vulga*
11.			*Keratella tropica* (Apstein)
12.			*Platyias species*
13.		Colurellidae	*Colurella adriatica*
14.		Lecanidae	*Lecane arculata*
15.			*Monostyla bulla*
16.		Asplanchnidae	*Asplanchna intermedia*
17.		Gastropodidae	*Ascomorpha species*
18.	Class: Monogonata Order: Floscullariaceae	Filinidae	*Filinia longiseta*
19.			*Filinia apoloensis*
Phylum: Arthopoda			
20.	Subphylum: Crustacea Class:Branchiopoda Order:Cladocera	Sididae	*Diaphanasoma*
21.		Moinidae	*Moinodaphnia* (Herrik, 1887)
22.			*Moina macrura*
23.		Daphnidae	*Daphnia longispina*
24.			*Cereodaphnia reticulata*
25.		Bosminidae	*Bosmina longirostris*
26.		Chydoridae	*Chydorus sphaericus*
27.			*Alona rectangula*
28.	Class: Hexanauplia Subclass: Copepoda Order:Cyclopoida	Cyclopidae	*Mesocyclops species*
29.			*Cyclops viridis*
30.	Subclass: Copepoda Order:Calanoida	Diaptomidae	*Skistodiaptomus*
31.			*Diaptomus*
32.	Class: Hexanauplia Subclass: Copepoda	Canthocamptidae	*Nauplius*
33.	Subclass: Ostracoda Order: Podocopida	Cypridae	*Cypretta frontanalis*
34.			*Cypridopsis helvetica*

Polyarthra vulgaris, Filinia terminalis and Hexarthra mira. Picapedra *et al*. (2020) have identified a total of 115 taxa of zooplanktons. Rotifers were the richest group. However, the copepods were the most abundant. They have reported the inter-annual changes in zooplankton species composition from large daphinids and calanoid copepods to small cladocerans (e.g. bosminids) and generalist rotifers. Zooplankton were present in the following order of dominance; Cladocera > Rotifera > Copepoda > Ostracoda. The zooplankton community structure showed a mixed composition of mesotrophic to eutrophic species. Among the zooplanktons, the population of cladocera was rich in density and poor in species diversity. Rotifers are the dominant in the eutrophic lakes which are indicators of eutrophication and *Brachionus* species are indicators of eutrophic conditions (Aboul-Ezz *et al*., 1996; Baloch and Soomro, 2004; Ceirans,

2007). *Moina macrura*, *Bosmina longirostris*, *Chydorus sphaericus*, *Alona rectangula* were the dominant cladocerans in the Thanegaon reservoir. Abundance of the rotifer species like *Brachionus*, *Lecane*, *Filinia* and *Keratella* indicates the mesotrophic and semi polluted water and enrichment of nutrients in the reservoir.

Khan *et al*. (2016) have noted a total of 22 species of zooplanktons where rotifers were dominant and were represented by 15 species whereas cladocera and copepoda were represented by three species each and Ostracoda was represented by one species. 15 species of rotifers noted by them were *Asplanchna priodonta*, *Brachionus bidentata*, *Brachionus calyciflorus*, *Brachionus falcatus*, *Brachionus urceolaris*, *Cephalodella gibba*, *Habrotrocha bidens*, *Keratella tropica*, *Lecane luna*, *Monostyla bulla*, *Mytilina ventralis*, *Mytilini acanthophora*, *Platyias quadricornis*, *Rotifer tardus*, and *Filinia longiseta*. Cladocera was represented by *Ceriodaphnia cornuta, Chydorus sphaericus, Moina brachiata* and among Copepoda, *Heliodiaptomus viduus, Mesocyclops leuckarti, Tropocyclops prasinus* were noted by them and Ostrocoda was represented by *Hemicypris fossiculata*. They noted the seasonal variation in zooplanktons and found maximum number of species during summer and the minimum number of species in rainy season. Density was also recorded high during the summer as compared to rainy season. Zooplankton density and relative biovolume is represented in the Figure 2 and 3, respectively. Relative biovolume, density and composition of the zooplankton community is strongly dependent on the season. Relative biovolume of cladocerans was maximum during winter season in the month of January (46.38%) while it was minimum at the end of the summer season in the month of June (40%). Maximum number of zooplankton (Org/lit) was recorded during the winter in the month of January was 166 whereas minimum number of zooplankton 105 was noted in the month of June.

Shukla *et al*. (2012) noted the zooplankton population (Org/L) during different seasons and found maximum number of zooplankton as 285±18.68/lit during pre-mansoon whereas minimum number recorded was 215±27.33/lit during mansoon season. The observed Cladocerans species by them were *Bosmina longirostris, Cerioaphnia, Cypris, Daphnia, Moina* and *Macrothris*. Among the copepods they noted *Diaptomus, Helidiaptomus, Macrocyclops, Nauplius* and *Vidumus*. Rotifers noted by them were *Slanchna, Brachionus, Distimus, Filinia, Keratella, Nothoica and Flurcularia*. Among protozons they reported *Amoeba, Acrella, Centroysis* and *Paramecium*. Dagne *et al*. (2008) have noted the extremely high variation in abundance of zooplanktons which was ranging from 2 to 1000+ individuals per litre and correlated abundance of crustaceans with the increased phytoplankton production at the onset of rainy season. Rotifer biovolume was observed maximum in the month of January (28.91%) and it was found to be minimum in the month of May (22.42%) in summer season. Copepods showed their maximum biovolume in the month of February (23.56%). However, rapid decline in their biovolume was observed in the month of March (15.97%). Ostracods showed their maximum biovolume at the end of the summer in the month of June (9.52%) and minimum at the end of winter season in the month of March (5.55%) (Fig. 3). Annalakshmi and Amsath (2012) have recorded 45 species of zooplanktons in the Cauvery. They observed rotifera species as dominant (34.97%); followed by Cladocera (29.92%), Copepoda (18.27%), Protozoa (12.2%) and Ostracoda (8.72%), however, Dorak *et al*. (2014) have noted the Copepoda as a most abundant taxa (53%), followed by Cladocera (33%), and Rotifera (14%).

Values for α-biodiversity indices that are Simpson index, Dominance index, Shannon-wiener index, Menhinick index, Margalef richness index and Equitability index are represented in the Table 2. Simpson index was found as low as 0.034 during June and was maximum during 0.043 in summer in the month of April while Dominance index was high as 0.96 revealed the rich diversity of species in this reservoir. Shannon-Wiener index

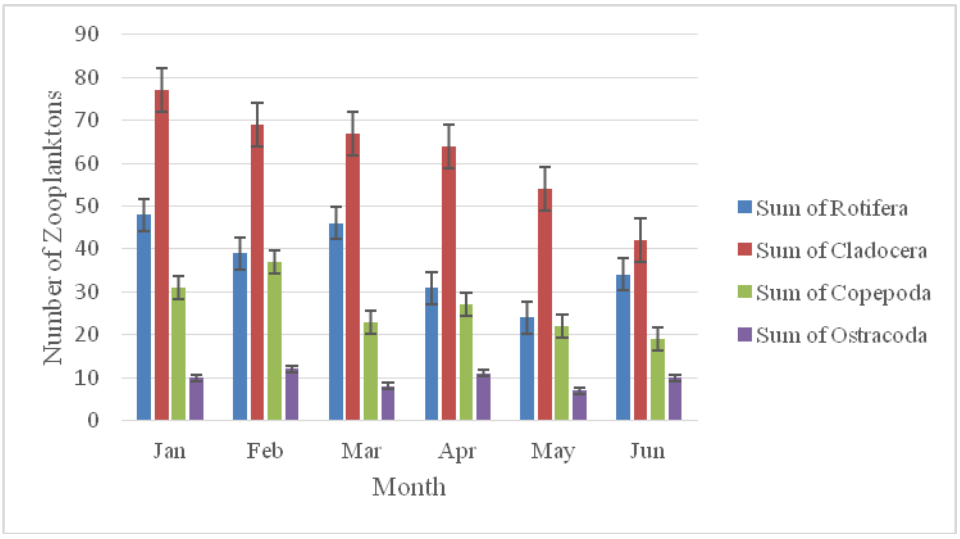

Fig. 2: Composition of zooplanktons in terms of density (Organisms lit^{-1}).

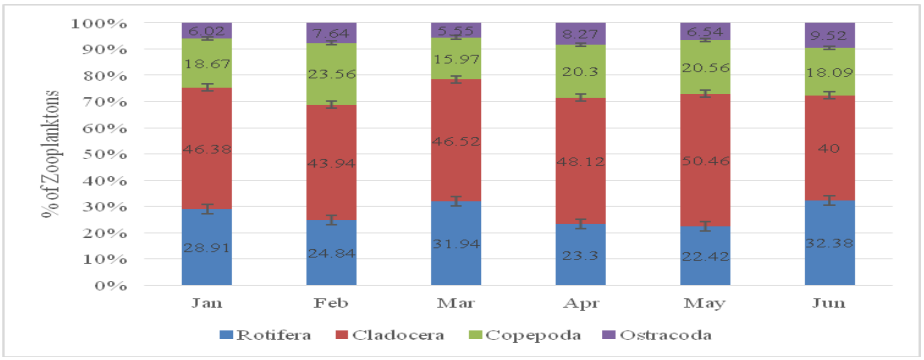

Fig. 3: Relative Biovolume (%) of Zooplanktons.

Table 2: Zooplankton community structure and α- biodiversity indices of Thanegaon reservoir

Month	Simpson Index	Dominance Index	Shanon-Wiener Index	Menhinick index	Margalef Richness Index	Equitability Index
Jan	0.037	0.96	4.71	2.4	5.86	0.95
Feb	0.039	0.96	4.66	2.74	5.93	0.94
Mar	0.036	0.96	4.72	2.58	6.03	0.95
Apr	0.04	0.95	4.6	2.68	6.13	0.92
May	0.043	0.95	4.5	2.8	5.99	0.92
Jun	0.034	0.96	4.69	2.92	6.23	0.95

values were in the range of 4.50 to 4.72, Menhinick indexes were in the range of 2.40 to 2.92 and Margalef richness index values were in the range of 5.86 to 6.23 confirms the mesotrophic status of this reservoir. The equitability index was in the range of 0.92 to 0.95 and the distribution of zooplankton species during the study was even and follows the Lorenz graph. No major fluctuation was found in the equitability index during the entire study period.

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