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Research Article

Seasonal Variations of Zooplankton Diversity in a Perennial Reservoir at Thoppaiyar, Dharmapuri District, South India

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Abstract

Zooplankton community is cosmopolitan in nature and they inhabit all freshwater habitats of the world. The zooplankton diversity is one of the most important ecological parameters in water quality and biodiversity assessment because they are strongly affected by environmental conditions and respond quickly to changes in water quality. Zooplankton is the intermediate link between phytoplankton and fish. The qualitative and quantitative study of zooplankton is very importance in the plankton diversity. Hence the present investigation was carried out in the Thoppaiyar reservoir (Lat. 11°57'21"N and Long. 78°6'28"E) at Dharmapuri District, South India. The physico-chemical characteristics and zooplankton diversity were studied for a period of one year from December-2010 to November-2011. A total of 55 species of zooplankton were recorded, which includes 19 species of Rotifera, 13 species of Cladocera, 15 species of Copepoda and 8 species of Ostracoda. The population abundance of zooplankton was noticed in the following order: Rotifera > Copepoda > Cladocera > Ostracoda. The present study revealed that the zooplankton productivity was found to be rich in Thoppaiyar reservoir. Further it is concluded that the Thoppaiyar reservoir could be continuously utilized for aquaculture, if proper water quality management measures are adopted.

Keywords: Zooplankton; Rotifera; Cladocera; Copepoda; Ostracoda; Biodiversity

Abbreviations

%: Percentage; °C: Degree of Celsius; µm: micrometer; µP: Microprocessor; AM: Ante Meridian; DO: Dissolved oxygen; E: East; EC: Electrical Conductivity; ind./l: Number of individual per litre; l: liter; mS: milli-Seamers; N: North; No. ind./l: Number of individual per litre; pH: power of Hydrogen; ppm: part per million; TDS: Total Dissolved solid

Introduction

The zooplankton (microscopic drifting or wandering animals) occupies a vital role in the tropic structure of an aquatic ecosystem and plays a key role in the energy transfer. Unlike algae or phytoplankton, zooplankton are microscopic animals that do not produce their own food. Freshwater zooplankton play an important role in ponds, lakes and reservoirs ecosystem and food chain. They are responsible for the eating millions of little algae that may otherwise grow to an out-of-control state. However, not all algae are edible and oftentimes it's the blue green algae that we would like to see disappear that cannot be eaten. In fact, as mostly filter feeders, a community of zooplankton can filter through the volume of an entire lake in a matter of days. The zooplankton community is composed of both primary consumers (which eat phytoplankton) and secondary consumers (which feed on the other zooplankton). The zooplankton forms a major link in the energy transfer at secondary level in aquatic food webs between autotrophs and heterotrophs [1]. Nearly all fish depend on zooplankton for food during their larval phases and some fish continue to eat zooplankton in their entire lives [2].

The aquatic ecosystems are affected by several health stressors that significantly deplete biodiversity. Zooplankton species have different types of life histories influenced by seasonal variations of biotic factors, feeding ecology and predation pressure. In the future, a loss of biodiversity and its effects are predicted to be greater for aquatic ecosystems than for terrestrial ecosystems [3]. The zooplankton is also a valuable food source for planktivorous fish and other organisms. The presence or absence of healthy zooplankton populations can determine some commercial fisheries success in both fresh and salt water bodies. By insuring that the lower parts of the food chain are healthy, we can protect the higher ordered organisms, like fish, whales and even humans.

Zooplankton has been used as an indicator for monitoring the water quality, trophic status and pollution level. Various ecological aspects of zooplankton have been a subject of study in India by several workers [4,5].The physico-chemical parameters and nutrient status of water body play an important role in governing the production of plankton which is the natural food of many species of fishes, especially zooplankton constitute important food source of many omnivorous and carnivorous fishes and also support the necessary amount of protein for the rapid growth of larval carps [6]. They respond quickly to aquatic environmental changes (e.g., water quality, such as pH, colour, odour and taste, etc.,) for their short life cycle, and are therefore

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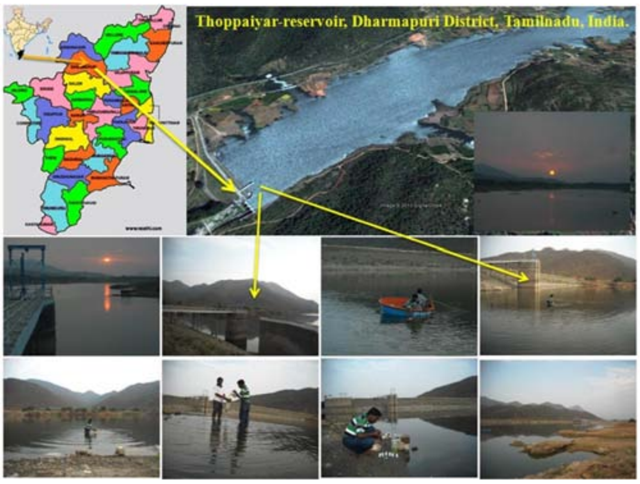

Figure 1: The Map showing in a summer month of the study area in perennial reservoir (Thoppaiyar), Dharmapuri District, South India.

used as indicators of overall health or condition of their habitats [7]. The qualitative and quantitative abundance of zooplankton in a lake are of great importance for successful aquaculture management, as they vary from one geographical location to another and lake to lake within the same geographical location even within similar ecological conditions [8]. In the present study, and attempt was made to study the freshwater zooplankton biodiversity in a perennial reservoir, Thoppaiyar, Dharmapuri District, South India were studied in seasonal wise on monthly basis of one year.

Materials and Methods

Study area

The plankton biodiversity in the Thoppaiyar reservoir, Dharmapuri District, (Latitude 11°57'21"N and Longitude 78°6'28"E) Tamil Nadu, South India was studied on monthly basis for a period of one year from December-2010 to November-2011 (Figure 1). The ayacut areas (5,330) of the reservoir comprises of the villages of Thoppur, Kammampatti in Dharmapuri district, Sekkarapatti, Vellar, Thettigiripatti and Mallikundam in Salem district, (Tamilnadu, South India) are benefitted.

Analysis of physico-chemical parameters of water samples

Water samples were taken in sterile, wide-mouth, screw capped glass bottle vertically between 1 to 4 meter depth with few meter of distance between samples from surface and bottom using Van Dorn Sampler during early morning hours (6.00 to 7.00 AM) and transported to the laboratory under ice cold condition, and subjected to analyses on the same day of collection. Air and water temperature were measured on the spot. pH, salinity, electrical conductivity, total dissolved solids and dissolved oxygen were estimated by using "µP Based Water & Soil Analysis Kit Model 1160".

Qualitative and quantitative analysis of plankton

The plankton samples were collected using Towing-Henson's standard plankton net (48 µm for phytoplankton and 150 µm mesh for zooplankton) by towing horizontally at surface for about 10 minutes with a uniform speed of boat. The collected plankton samples were preserved with 5% of neutralized formalin for qualitative analysis. The zooplankton species was identified by referring the standard manuals, text books and monographs [9-14]. The taxonomic identification was done under the compound microscope at a magnification of 40x to 100x and they were photomicrographed by using Inverted Biological Microscope (Model Number INVERSO 3000 (TC-100) CETI) attached with camera (Model IS 300). For the quantitative analysis of plankton, 100 liters of water was filtered through a plankton net made up of bolting silk cloth of 48 µm for phytoplankton and 150 µm for zooplankton. The concentrated plankton sample was subjected to count using Sedgwick Counting Rafter.

Statistical analysis of diversity indices

The data was subjected to analysis the species individuals, Shannon and Weaner's diversity index, richness and evenness were calculated using the software PAST (PAlaeontological STatistics), ver. 2.02.

Results and Discussion

Analysis of water temperature

The mean data of physico-chemical parameters obtained in the present study are depicted in Table 1. Water temperature is an important factor in any aquatic environment affecting biological processes. The maximum air temperature was 26.0°C noticed in May-2011 while minimum was 23.0°C in October-2011. In the present study area of Thoppaiyar reservoir (Dharmapuri District, Tamil Nadu, South India) the maximum air and water temperature were recorded during summer season (May-2011) and minimum in monsoon season (November-2011). The marked variation and significant differences in physico-chemical qualities of the water indicate different environmental conditions. These variations may be related to patterns of water use, temperature and rainfall [15-17]. Temperature is an important factor that influences primary

Table 1: Seasonal variations of physico-chemical parameters in a perennial reservoir (Thoppaiyar), Dharmapuri District, South India during December-2010 to November- 2011.

Parameter	Post-Monsoon			Summer			Pre-Monsoon			Monsoon			Range
	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	
Air-T (°C)	24.0	24.5	24.5	25.00	26.5	26.0	25.5	25.0	24.5	24.0	23.0	23.5	24.0-23.5
Water-T (°C)	24.5	25.0	25.0	25.5	26.0	26.5	26.5	26.0	25.0	24.5	24.0	23.0	24.5-23.0
pH	6.80	7.10	7.40	7.90	8.30	8.60	8.10	7.50	7.20	6.70	6.80	6.90	6.80-6.90
Salinity (ppm)	0.701	0.801	0.876	0.951	0.992	0.873	0.844	0.782	0.761	0.658	0.590	0.622	0.701-0.622
DO (ppm)	5.80	5.90	6.40	7.60	8.20	8.40	7.80	7.30	7.10	6.80	6.50	5.30	5.80-5.30
EC (mS)	0.781	0.830	0.852	0.940	0.935	0.940	0.861	0.839	0.822	0.797	0.751	0.761	0.781-0.761
TDS (ppt)	0.562	0.584	0.593	0.669	0.793	0.774	0.646	0.631	0.624	0.555	0.530	0.535	0.562-0.535

All the parameters are in triplicate values – DO: Dissolved Oxygen; EC: Electrical Conductivity; TDS: Total Dissolved Solids

Table 2: List of zooplankton recorded in perennial reservoir (Thoppaiyar), Dharmapuri District, South India during December-2010 to November-2011.

S.	Group	Family	Genus	Species
1	Rotifera	Brachionidae (Ehrenberg, 1838)	*Anuraeopsis* Lauterborn, 1900	*Anuraeopsis fissa* Gosse, 1851
2				*Anuraeopsis navicula* Rousselet, 1892
3			*Brachionus* Pallas, 1776	*Brachionus bidentata* Anderson, 1889
4				*Brachionus budapestinesis* Daday, 1885
5				*Brachionus calyciflorus* Pallas, 1776
6				*Brachionus caudatus personatus* Ahlstrom,1940
7				*Brachionus diversicornis* Daday, 1883
8				*Brachionus falcatus* Zacharias, 1898
9				*Brachionus forficula f typicus-urawensis* Sudzuki, 1995
10				*Brachionus quadridentatus* Hermann, 1783
11				*Brachionus rubens* Ehrenberg, 1838
12			*Keratella* Bory de St. Vincent, 1822	*Keratella cochlearis* Gosse, 1851
13				*Keratella tropica* Apstein, 1907
14			*Notholca* Gosse, 1886	*Notholca lebis* Gosse, 1887
15			*Platyias* Harring, 1914	*Platyas quadricornis* Ehrenberg, 1882
16		Lecanidae (Remane, 1933)	*Lecane* Nitzsch, 1827	*Lecane papuana* Murray, 1913
17		Asplanchnidae (Harring & myers, 1933)	*Asplanchna* Gosse, 1850	*Asplanchna brightwelli* Gosse, 1850
18				*Asplanchna intermedia* Hudson, 1886
19		Filinidae (Bartos, 1959)	*Filinia* Bory de St. Vincent, 1824	*Filinia longiseta* Ehrenberg, 1834
20	Cladocera	Sididae (Baird, 1850)	*Diaphanasoma* Fischer, 1850	*Diaphanasoma sarsi* Richard, 1895
21				*Diaphanasoma excisum* Sars, 1885
22			*Daphnia* O.F. Muller, 1785	*Daphnia carinata* King, 1853
23				*Daphnia magna* Straus, 1820
24		Daphnidae (Straus, 1850)	*Ceriodaphnia* Dana, 1853	*Ceriodaphnia cornuta* Sars, 1853
25				*Ceriodaphnia reticulata* Jurine, 1820
26		Moinidae (Goulden, 1968)	*Moina* Baird, 1850	*Moina brachiata* Jurine, 1820
27				*Moina flagellate* Hudendroff, 1876
28				*Moina micrura* Kurz, 1874
29				*Moina macrocopa* Straus, 1820.
30			*Moinodaphnia* Herrick, 1887	*Moinodaphnia macleayi* King, 1853
31		Chydodridae (Stabbing, 1902)	*Alonai* Baird 1843	*Alona quadrangularis* O.F. Muller, 1776
32				*Alona rectangular* Sars, 1862
33	Copepoda (Calanoid)	Diaptomidae (Baird, 1850)	*Heliodiaptomus* Kiefer, 1932	*Heliodiaptomus viduus* Gurney, 1916
34				*Heliodiaptomus cinctus* Gurney, 1907
35			*Neodiaptomus* Kiefer, 1932	*Neodiaptomus lindbergi* Brehm, 1951
36				*Neodiaptomus schmakeri* Poppe & Richard, 1892
37			*Phyllodiaptomus* Kiefer, 1936	*Phyllodiaptomus annae* Apstein, 1907
38			*Sinediaptomus* Kiefer, 1937	*Sinodiptomus (Rhinediaptomus) indicus* Sewell, 1934
39	(Cyclopoida Burmeister, 1834)	Cyclopoidae (Dana, 1853)	*Eucyclops* Claus, 1893	*Eucyclops speratus* Lilljeborg, 1901
40			*Mesocyclops* Claus, 1893	*Mesocyclops hyalinus* Rehberg, 1880
41				*Mesocyclops leuckarti* Claus, 1857
42			*Thermocyclops* Kiefer, 1927	*Thermocyclops hyalinus* Rehberg, 1880
43				*Thermocyclops decipiens* Kiefer, 1929
44			*Apocyclops* Lindberg, 1942	*Apocyclops dengizicus* Lepeschkin, 1900
45			*Acanthocyclops* Kiefer 1927	*Acanthocyclops vernalis* Fischer, 1853
46	(Harpacticoida Sars, 1959)	Cletodidae (Scott, 1904)	*Cletocamptus* Schmankevitch, 1875	*Cletocamptus albuquerquensis* Herrick, 1895
48	Ostracoda	Cyprididae (Baird, 1845)	*Cypris* O.F. Muller, 1776	*Cypris protubera* Muller, 1776
49			*Eucypris* Vavra, 1891	*Eucypris bispinosa* Victor and Michael, 1975
50			*Strandesia* Stuhlmann, 1888	*Strandesia elongate* Stuhlmann, 1888
51			*Cyprinous* Brady, 1886	*Cyprinotus nudus* Brady, 1885
52			*Heterocypris* Claus, 1892	*Heterocypris dentatomarginatus* Baird, 1859
53			*Hemicypris Sars, 1903*	*Hemicypris anomala Furtos, 1993*
54			*Candonocypris* Sars, 1895	*Candonocypris dentatus* Victor and Michael, 1975
55			*Cypretta* Vavra, 1895	*Cypretta fontinalis* Hartmann, 1964

production in reservoirs [18]. It depends on the climate, sun light and depth and does not undergo drastic changes during the year in lacustrine environments [19] as compared to fluviatile environments. Water temperature influences plankton production of ecosystem [20]. All metabolic and physiological activity and life processes such as feeding, reproduction, movements and distribution of aquatic organisms are greatly influenced by water temperature.

pH and salinity

The twelve month study on pH was ranged between 6.70 and 8.60. The maximum pH (8.60) noticed during May-2011, while minimum (6.70) observed in September-2011. Salinity was variable throughout the study period. Aquatic organisms are affected by pH because most of their metabolic activities are pH dependent [21]. The pH was varied from 7.20 to 7.30 (very slightly alkaline) with minimum in October-2011 and maximum in April- 2011 (Table 1). The pH was alkaline in nature [22] in a lake at Dharmapuri Town, Tamilnadu India. In the present study the maximum salinity (0.992) was observed in April-2011 and minimum (0.590 ppm) in October-2011. Salinity is one of the major ecological factors controlling the plankton population in freshwater as well as brackish water bodies. The appearance or disappearance of plankton is depending upon the salinity condition. It is the most fluctuating parameter in the freshwater environment and exerts different ecological and physiological effects depending on the interaction with temperature, oxygen and ionic compounds (Odum, 1971). The range of salinity during the present study was maximum in summer month (April) and minimum in monsoon month (October).

Dissolved oxygen (DO)

The value of dissolved oxygen was recorded in the range between 5.3 and 8.40 ppm with the maximum in May-2011 and minimum in November-2011. The DO content is the most important parameter in water quality assessment and reflects the physical and biological process prevailing [23]. The oxygen content of natural water varies with temperature, salinity, turbulence, the photosynthetic activity of algae and higher plants and the atmospheric pressure. Variations in the amount of DO occur over a day. This is due to photosynthetic and respiratory processes of algae and higher plants. In the present study, the recorded high DO content is sufficient to maintain aquatic life forms. The maximum dissolved oxygen was recorded in a summer month (May-2011) and minimum in a monsoon month (November-2011).

Electrical conductivity (EC) and total dissolved solids (TDS)

The maximum electrical conductivity of 0.940 (mS) was noticed in March and May-2011, while the minimum (0.751 mS) was observed in October-2011. Electrical Conductivity (EC) is a good indicator of the overall water quality [24]. A sudden rise in conductivity in water during monsoon and post monsoon season indicates addition of some pollutants [25]. High EC designates pollution status [26]. In this study, EC was recorded maximum in May-2011 and minimum in October-2011 (Table 1). The total dissolved solid concentration was found in the range between 0.530 and 0.793 ppt with maximum value in April-2011 and minimum in October -2011. The highest average value of total dissolved solid might be due to accumulation of the anthropogenic activity which hampered the quality of water.

Zooplankton composition

Totally, 55 species of zooplankton comprising of four orders, namely Rotifera (19 species), Cladocera (13 species), Copepoda (15 species) and Ostracoda (8 species) were identified in Thoppaiyar reservoir, South India (Table 2). The plankton is heterogeneous assemblage of minute organisms which occur in natural water and float about by wave action and movement of water [27]. Factors such as light intensity, food availability, dissolved oxygen and predation affect the population dynamics of zooplankton. Low pH or higher salinity can reduce their diversity and density [28]. In this study, the zooplankton diversity was recorded in the following order, Rotifera > Copepoda > Cladocera > Ostracoda (Table 3). During the present investigation Rotifera were the most dominant forms in the study area of reservoir.

Rotifera

In the present study, 19 species of rotifers belonging to 5 families and 8 genera were recorded (Table 2). The recorded population density of rotifers was ranged from 772 to 2170 ind./l with the minimum population recorded in October and maximum in May (Table 3). The dominance of species was found to be higher (0.086) in December and lower (0.062) in May. The Shannon diversity index was found to be the maximum (2.846) in May and minimum (2.630) in October. Simpson's diversity index was maximum (0.937) in May and minimum (0.914) in October. The species evenness was higher (0.906) in May and lower (0.725) in December. The Margalef species richness was recorded to be maximum (2.707) in October, while minimum (2.343) was noticed during May. The Menhinick index value was found to be maximum (0.683) during October and minimum (0.407) during May (Table 3). The rotifera species were play an important role as suspension feeders within the zooplankton community. The differences in periodicity and population density of different rotifera species are due to biotic interactions and nutritional content of the lake and reservoir. The rotifera species exhibit marked differences in their tolerance and adaptability to changes in physico-chemical and biological parameters of freshwater ecosystem. In the present investigation 19 different species are recorded due to interplay of above said parameters in summer months, while less species are recorded in monsoon season. They were found in maximum numbers of species in summer months. 21 species of genus *Brachionus* are known from India [10]. The species of *B. calyciflorus* considered to be a good indicator of eutrophication [22,29]. According to Goel [30] the species of *B. calyciflorus* are the pollution tolerant species and indicate accumulation of organic matter. The population of genus *Keratella* was recorded at all the stations during June and July [31] mentioned that along a trophic scale, the number of planktonic rotifer species successively increased up to mesotrophic condition after which the number declined till hypereutrophic stage. This generalization applied well to the Rotifers of reservoir, because agricultural wastewater usually enters into this reservoir during August-November which increases the fertility of reservoir water. However, the lower Thoppaiyar reservoir water is not polluted but *Brachionus* species were observed during the study period indicated the presence of organic matter.

Cladocera

This group was represented by 4 families 6 genera and 13 species (Table 2). have recorded 15 species of cladocera from the Hub Lake.

Table 3: Seasonal diversity indices of zooplankton in perennial reservoir (Thoppaiyar), Dharmapuri District, South India during December-2010 to November-2011.

Diversity Indices		Zooplankton diversity indices											
		Post Monsoon			Summer			Pre-Monsoon			Monsoon		
		Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11
Rotifera	Density (ind./l)	862	1036	1269	1537	1769	2170	1920	1763	1569	1156	772	870
	Dominance_D	0.0867	0.0796	0.0776	0.0707	0.0659	0.0624	0.0646	0.0644	0.0648	0.0692	0.0853	0.0828
	Shannon_H	2.624	2.689	2.707	2.768	2.813	2.846	2.825	2.823	2.817	2.786	2.63	2.656
	Simpson_1-D	0.9132	0.9204	0.9223	0.9293	0.9341	0.9376	0.9354	0.9356	0.9352	0.9308	0.9147	0.9172
	Evenness_e^H/S	0.7257	0.7748	0.7888	0.8386	0.8767	0.9062	0.8876	0.8855	0.8803	0.8537	0.7304	0.7497
	Menhinick (R2)	0.6471	0.5903	0.5334	0.4846	0.4517	0.4079	0.4336	0.4525	0.4797	0.5588	0.6838	0.6442
	Margalef (R1)	2.663	2.592	2.519	2.453	2.407	2.343	2.381	2.408	2.446	2.552	2.707	2.659
Cladocera	Density (ind./l)	546	665	777	874	969	1108	941	798	690	535	400	524
	Dominance_D	0.1112	0.1055	0.0987	0.0976	0.0942	0.0923	0.0935	0.0959	0.0981	0.0992	0.1066	0.0913
	Shannon_H	2.326	2.372	2.413	2.423	2.445	2.456	2.451	2.436	2.417	2.411	2.363	2.461
	Simpson_1-D	0.8888	0.8945	0.9012	0.9024	0.9058	0.9076	0.9065	0.904	0.9019	0.9008	0.8934	0.9086
	Evenness_e^H/S	0.7878	0.8249	0.859	0.8674	0.8868	0.8967	0.892	0.8793	0.8629	0.8573	0.8168	0.9016
	Menhinick (R2)	0.5563	0.5041	0.4664	0.4397	0.4176	0.3905	0.4238	0.4602	0.4949	0.562	0.65	0.5679
	Margalef (R1)	1.904	1.846	1.803	1.772	1.745	1.712	1.753	1.796	1.836	1.91	2.003	1.916
Copepoda	Density (ind./l)	697	844	1007	1120	1302	1426	1255	1148	881	739	598	682
	Dominance_D	0.0993	0.0929	0.0870	0.0851	0.0848	0.0828	0.0856	0.0878	0.0905	0.0937	0.0989	0.0918
	Shannon_H	2.455	2.51	2.551	2.57	2.572	2.588	2.566	2.543	2.526	2.496	2.455	2.511
	Simpson_1-D	0.9007	0.9071	0.913	0.9149	0.9152	0.9171	0.9143	0.9122	0.9094	0.9062	0.901	0.9081
	Evenness_e^H/S	0.7763	0.8202	0.855	0.871	0.8729	0.8868	0.8675	0.8482	0.8335	0.8091	0.7761	0.8212
	Menhinick (R2)	0.5682	0.5163	0.4727	0.4482	0.4157	0.3972	0.4234	0.4427	0.5054	0.5518	0.6134	0.5744
	Margalef (R1)	2.138	2.078	2.025	1.994	1.952	1.928	1.962	1.987	2.065	2.12	2.19	2.146
Ostracoda	Density (ind./l)	264	292	353	393	418	501	447	318	211	148	104	136
	Dominance_D	0.1429	0.1382	0.1375	0.1347	0.1339	0.1364	0.1382	0.1378	0.1444	0.1452	0.1572	0.1419
	Shannon_H	2.006	2.026	2.031	2.041	2.045	2.035	2.03	2.028	1.999	1.996	1.942	2.01
	Simpson_1-D	0.8571	0.8618	0.8625	0.8653	0.8661	0.8636	0.8618	0.8622	0.8556	0.8548	0.8428	0.8581
	Evenness_e^H/S	0.9293	0.9477	0.9523	0.9625	0.9659	0.9568	0.9515	0.9502	0.9231	0.9198	0.8719	0.933
	Menhinick (R2)	0.4924	0.4682	0.4258	0.4035	0.3913	0.3574	0.3784	0.4486	0.5507	0.6576	0.7845	0.686
	Margalef (R1)	1.255	1.233	1.193	1.172	1.16	1.126	1.147	1.215	1.308	1.401	1.507	1.425

Baig and Khan (1976) also described the 4 genera of Cladocera. Manickam *et al.*, (2012b) have reported 7 species of Cladocera in the Haledharmapuri lake, Dharmapuri Town. Sivakumar and Altaff (2004) recorded 7 species of Cladocera from the Dharmapuri District, Tamil Nadu. The maximum population (1108 ind./l.) of cladocera was noticed in May and minimum (400 ind./l.) in October (Table 3). The dominance of species was found to be higher (0.111) in December, while lower (0.062) in May. The Shannon diversity index was found to be maximum (2.456) in May and minimum (2.326) in December. Simpson's diversity index was found to be maximum (0.907) in May and minimum (0.888) in December. The species evenness was higher (0.901) in November and lower (0.787) in December. The Margalef index species richness was maximum (2.003) in October and minimum (1.712) in April. The Menhinick index value was found to be maximum (0.650) in October and minimum (0.390) in April (Table 3). Cladocera were found maximum in summer months might be attributed to favorable temperature and availability of food [22]. The genus *Diaphanosoma* occurred throughout the year while higher population was found during post-monsoon and summer months (March, April & May) at reservoir. Among the cladocera, *Diaphanosoma* occurred throughout the year, with the maximum population in summer in the Gandhisagar reservoir [32]. In the present study, species *Diaphanosoma sarsi* was first ordered in higher population throughout the study period for the cladocera in reservoir. The genus *Ceriodaphnia* was found as second highest population in summer months especially the species *Ceriodaphnia cornuta.* [33] have also reported that the *Ceriodaphnia cornuta* was present only in oligotrophic lakes. Our study was agreeable with earlier reports. In this study, the genus *Daphnia* and *Moina* were the third and fourth dominant order respectively. Among these, *Moina micrura* was observed in summer with high population followed by *Moina brachiata*.

Copepoda

The species of copepoda group was represented by 3 families 10 genera and 15 species (Table 2). The copepod density was found to be maximum (1426 ind./l.) in May and minimum (598 ind./l.) in October (Table 3). The species dominance was recorded to be higher (0.099) in December and lower (0.082) in May. Shannon diversity index was found to be maximum (2.588) in May and minimum (2.455) in December and October. Simpson's diversity index was maximum (0.917) in May and minimum (0.900) in December. The species evenness was higher (0.886) in May and lower (0.776) in October. The species richness of Margalef index was minimum (1.928) in May and maximum (2.190) in October. The Menhinick index was recorded in the range between 0.397 and 0.613. The population of cyclopoida was observed throughout the year at all sampling sites. The lowest number was observed in monsoon months, while higher population was found in summer. A peak was observed in May [34] opines that cyclopoida production shows strong evidence of association with abundance of diatoms and blue green algae. Each phytoplankton group is more important resource for all the developmental stages of cyclopoida copepods. Copepoda domination may also be due to their feeding on diatoms, Rotifera and Cladocera, [35] and high reproduction capacity. In the present study, *Mesocyclops* sp. found to be dominant due to the fact that it tolerates a wide pH range.

Ostracoda

Totally, 8 species of Ostracoda were recorded in this study (Table 2). The population of 501 ind./l. was recorded during the month of May whereas minimum of 104 ind./l was noticed during October (Table 3). The dominance of species was maximum (0.157) in October and minimum (0.133) in April. Shannon diversity index was found to be maximum (2.035) in May and minimum (1.942) in October. The Simpson's diversity index was found to be maximum (0.866) in April and minimum (0.842) in October. The maximum species evenness (0.965) was found in April and minimum (0.871) in October. The Margalef species richness was maximum (1.507) in October and minimum (1.126) in May. The Menhinick index was found to be maximum (0.784) during October and minimum (0.357) during May (Table 3). Higher population was observed during summer months. Earlier researchers found ostracoda maximum population in the month of May and minimum during the monsoon month at HaledharmapuriLake, Dharmapuri Town [22]. However, during monsoon months population was recorded lower when compared to the summer months. Sunkad and Patil (2004) recorded maximum Ostracoda population in summer at Fort Lake in Belgaum (Karnataka). Ostracoda observed maximum population in summer months and minimum in monsoon months. Similar results were reported [36].

Conclusion

Rotifers are the predominant groups of zooplankton found in the majority of reservoir, constituting more than 60% of the total zooplankton present. Zooplankton of all major groups were observed in the summer season. The summer population maximum of zooplankton was higher temperatures, lower transparency and a high standing crop of primary producers leading to greater availability of food. The current study area in the population of zooplankton was found to be higher during summer and lower during monsoon months. The presence of four Rotifera species (*Brachionus angularis, B. calyciflorus*, *B. falcatus* and *Filinia longiseta*), and two Cladocera species (*Diaphanasoma sarsi, Ceriodaphnia cornuta*) reveal that the reservoir is being eutrophicated and polluted. It is understood that the various anthropogenic activities such as entry of agricultural runoffs (eg. insecticides, pesticides) from surrounding agricultural field seem to be the major cause of eutrophication. Huge diversity of zooplankton in Thoppaiyar reservoir indicates the fact that this water body is least polluted and suggested for prevalence of proper biogeochemical cycles. Therefore, it is considered to be a suitable one for natural fin-fish and shell-fish (pisciculture) culture practices.

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