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Assessment of water quality and Zooplankton diversity in the freshwater ecosystem (Lake) - in India

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Abstract

This study assessed the seasonal variations of various Physico-chemical parameters, diversity indices, Correlation between physico-chemical factors and the density of zooplankton population. During the study period, a total of 37 species of zooplanktons were recorded viz., Rotifer-18 species, Cladocera-11 species, Copepoda-4 species, Ostracoda-4 species. The results of the physico-chemical analysis were found to be within the maximum permissible limit as prescribed by BIS and WHO. The various physico-chemical parameters are either significantly positive or negative correlation with density of different zooplankton groups at the level of P<0.01 or P<0.05.Rotifera group was found to be the most dominant among the other groups. The density of zooplankton community was higher in summer and lower in monsoon. The diversity and density of zooplankton species at Perur lake during study period are as follows – Rotifera (50 %) >Cladocera (25 %) >Copepoda (21 %) >Ostracoda (4%). The various kinds of diversity indices indicate the seasonal variation of zooplankton community and good quality of Lake Ecosystem. However, the presence of certain species like Brachionus sp., Keratella sp., Philodina sp., Bosminopsis sp., Moina sp., Mesocyclopes sp., Cypris sp. Indicates the possibility of eutrophication in the near future.

Keywords: Zooplankton, Diversity Indices, Correlation Coefficient, Water quality standards, Eutrophication.

Introduction

The quality of water in every ecosystem provides major information about the available resources for sustaining life in that ecosystem. The healthy aquatic ecosystem depends on the abiotic and biotic characteristics of water[1]. The interactions of physical and chemical properties of water play an important role in abundance, composition, distribution, diversity, growth, reproduction and the movements of aquatic organisms[2-4].

Monitoring of physic-chemical parameters is necessary to recognize the magnitude and the source of any pollution load. These characteristics help to identify the essential conditions of the ecology of living organisms for recommending suitable conservation and management strategies. This sort of work is being carried out by various researchers like[5-10]. The productivity of the aquatic ecosystem is directly correlated with the density of zooplankton. Zooplankton responds more quickly to environmental changes than other aquatic organisms, therefore plankton has been used recently as an indicator to monitor and realize changes in the ecosystem[11-13].

Zooplankton is a miniature animal that float freely in the water column of lakes and oceans and whose distribution is primarily determined by water currents and mixing. The size of the zooplankton community in majority lakes ranges from a few tens of microns to >2 mm[14]. Planktonic animals especially Rotifers, Cladocerans, and Copepods (Cyclopoida) are the most important food items in freshwater aquaculture. In which, copepod Nauplii are important for feeding fry[15]. Research on Zooplanktons has attracted the attention of several workers throughout the world as they occupy a central position in the food web of aquatic ecosystem[16]. A number of studies have been carried out on the ecological condition of freshwater bodies in various parts of India[17,18,9]. However, as far as the Southern region of Tamil Nadu is concerned, the ecological studies of freshwater bodies especially zooplankton studies are very limited. Hence, the present investigation is an attempt to study the zooplanktons species in Perur Lake. The analysis of physico-chemical parameters of water, zooplankton richness, abundance, evenness, dominance, diversity, seasonal variation, the correlation between physico-chemical parameters and zooplankton density were used to understand the intermediate relationship between the water quality and aquatic organisms. The results indicate the wealth of aquatic ecosystem which would be helpful for the aquaculture management practices.

Materials and methods

Study site: Perur lake is located in Tamil Nadu, India Coimbatore with Latitude: 10° 58'06″ N and Longitude: 76° 55'41″E. The Lake draws water from the Noyyal River and major activities carried out here are fishing and agriculture.

Collection of water sample: The water sample was collected during the early morning for assessing the qualitative analysis of physico-chemical parameters and quantitative analysis of zooplankton at every month for the period of one year i.e.

March 2015 to Feb 2016. The recorded data was yearly segregated in four seasons, Summer (Mar to May), Pre-monsoon (Jun to Aug), Monsoon (Sep to Nov), Winter (Dec to Feb).

Qualitative analysis of water samples: Temperature and pH of the lake water were measured at the time of sample collection by using Thermometer and Pouch Digital pH Meter. While other Parameters Such as Dissolved Oxygen (Winkler's Method), Total Hardness, Calcium Hardness, Alkalinity, Fluoride, Chlorides, Residual chlorine, Phosphate, Iron, Nitrite, Nitrate were estimated in the Laboratory by using Standard Procedures of APHA[19].

Qualitative analysis of zooplankton: The water sample was collected for qualitative analysis of zooplankton by using horizontal plankton net made up of bolting silk (Mesh size: 150 µm). The collected samples were preserved in 4% formalin, then it is brought to the laboratory, analyzed under the Trinocular microscope (Labomed CXR2) and photomicrograph was taken using ultra scope (9.1-v) connected with the microscope. Different types of zooplanktons were identified using various standard works of literature, textbook, authenticated monographs[20-30]. After a precise identification of each species, the density of zooplankton was carried out.

Quantitative analysis of zooplankton: For the quantitative analysis of zooplankton 100 liters of water was filtered through plankton net. After filtering out the water, the plankton samples were transferred to polyethylene specimen bottles (100 ml) filled with 4% of formalin (10 ml). The quantitative analysis of zooplankton was done by using counting cell of the Sedgwick-Rafter[31].

The density of Zooplankton was articulated as organisms per liter using the formula:

$$\mathbf{N =} \; n \times v/V$$

Where: N= Total No of organisms / Liter of water filtered, n= No of organisms counted in 1 ml of sample, v = Volume of concentrated sample (ml), V = Volume of total water filtered / Liter (ml).

The season-wise mean and standard deviation value of Zooplankton population were obtained from monthly wise data.

Statistical analysis: Pearson's correlation study between physico-chemical parameters and various zooplankton groups was carried out by using IBM SPSS Statistics-21 version software package. The different diversity indices (diversity, dominance, richness, evenness) were calculated using PAST (Paleontological Statistics) software package (PAST, v 3.0).

Results and discussion

Physico-chemical parameters: In the present study, the season wise mean data of physico-chemical parameters for one year (March 2015 to February 2016) were obtained and compared with the BIS and WHO standards shown in Table-1. The mean value of water temperature, pH, Dissolved Oxygen, Total Alkalinity, Total Hardness, Chloride, Phosphate, Iron, Nitrite, and Nitrate were found to be within the desirable limit. Parameters like Calcium Hardness, Fluoride, Residual Chlorine and Ammonium are higher than the desirable limit but not exceeding the maximum permissible limit as prescribed by WHO and BIS[32-34]. The analysis of Physical and chemical properties of water body play an imperative role in the distribution and richness of biota[35].

Water temperature: In the present study, the value of water temperature was recorded in the range between 30.8±1.6°C and 24.9±0.7°C. The observed water temperature was maximum in summer season due to high atmosphere temperature, clear atmosphere, low water level and high solar radiation, and the minimum in winter season due to shorter photoperiod and cold low ambient temperature. A similar result was also observed by Pradeep *et al.*[6]. The range of water temperature acts as an "abiotic master factor" due to its influence on aquatic organisms[36].

pH: In the present study, the value of pH concentration was recorded in the range between 8.05±0.2 and 6.5±0.2. The observed pH was maximum in summer season due to high decomposition activities of biotic (aquatic organism) and abiotic (physical and chemical) factors, and minimum in monsoon season due to dilution of water by rainfall and water from the other sources. Similar results were also observed by Sharma *et al.*[37]. In 2016 RAMP[38] described that the standards of pH lower 4.5 and greater than 9.5 are generally hazardous to aquatic life of organisms still less extreme pH values can affect growth, reproduction and other biological activities.

Dissolved Oxygen: The minimum value of Dissolved Oxygen (6.5±0.2 mg/L) was recorded in summer season due to the higher temperature, salinity, and elevation, and maximum mean value (7.4±0.2 mg/L) was recorded in winter season due to the low temperature and turbulence of water facilitating the diffusion of atmospheric oxygen. A similar result was also observed by Qureshimatva Umerfaruq and Solanki[39]. The level of dissolved oxygen in natural water are depending on the physical, chemical and biochemical process existing in the water body.

Total Alkalinity: The maximum value of alkalinity (163.3 ± 7.6 mg/L) was recorded in the summer season. Jain *et al.*[40] have reported that maximum alkalinity in summer due to the accumulation of organic matters produced by the decomposition of flora. The minimum mean value of alkalinity (105 ± 10 mg/L) was recorded in monsoon season due to dilution of water. The alkalinity level may eventually be restored. However, a provisional loss of buffering capacity decreases the pH level, which is detrimental to life in the aquatic ecosystem.

Table-1: Seasonal variations of physico-chemical parameters in Perur lake, South India during Mar-2015 to Feb -2016

Physicochemical Parameters	Summer (Mar 2015 – May 2015)	Pre-Monsoon (Jun 2015 – Aug 2015)	Monsoon (Sep 2015 – Nov 2015)	Winter (Dec 2015 – Feb 2016)	WHO(1998) and BIS (1993&2012) standards for drinking water	
	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Desirable	Maximum
Temperature (°C)	30.8±1.6	28.2±2.2	26.6±0.8	24.9±0.7	30-32	-
pH	8.05 ± 0.2	7.2±0.5	6.5±0.2	7.3±0.15	6.5-8.5	No Relaxation
Dissolved Oxygen (mg/L)	6.5 ± 0.2	6.7±0.1	7.1±0.2	7.4±0.2	7.5	-
Total Alkalinity (mg/L)	163.3±0 .6	123.3±12.5	105±10	128.3±10.4	200	600
Total Hardness (mg/L)	183.3±7.63	135±15	116.6±7.6	136.6±7.6	200	600
Calcium Hardness (mg/L)	81.6 ±7.6	43.3±10.4	65±5	33.3±7.6	75	200
Fluoride (mg/L)	1.3±0.1	0.4±0.15	0.3±0.1	0.8±0.3	1.0	1.5
Chloride (mg/L)	70±5	55±5	35±5	50±5	250	1000
Residual Chlorine (mg/L)	0.16±0.05	0.26±0.05	0.5±0.1	0.2±0.057	0.2	1
Phosphate (mg/L)	0.46±0.15	0.3±0.1	0.2±0.1	0.13±0.05	0.5	-
Iron (mg/L)	0.33±0.05	0.23±0.05	0.2±0.05	0.16±0.05	0.3	No Relaxation
Nitrite (mg/L)	0.5±0.1	0.26±0.05	0.3±0.1	0.23±0.05	0.5	3
Nitrate (mg/L)	8.6±0.7	7.5±0.3	6.3±0.3	5.2±0.2	45	No Relaxation
Ammonium (mg/L)	2.23±0.25	2.0±0.4	1.53±0.3	0.7±0.2	0.5	No Relaxation

Total Hardness: The maximum value of total hardness (183.3±7.63mg/L) was recorded in summer season while the minimum value (116.6±7.6mg/L) was recorded in monsoon season. The increase in hardness can be attributed to the reduction in water volume and augmentation in the rate of evaporation at high temperature. Hujare[41] reported that the total hardness was high during summer season than monsoon and winter season. However adequate levels of hardness can help reduce the level of ammonia and pH toxicity in the aquatic ecosystem.

Calcium Hardness: The value of Calcium hardness concentration was recorded in the range between 81.6±7.6mg/L and 33.3±7.6mg/L. A high value of hardness was observed in summer which is due to quick oxidation or putrefaction of organic matter[42] and low hardness in monsoon is due to calcium absorption by the great number of organisms for shell structure, bone construction and plant precipitation of lime[43].

Fluoride, Chloride and Residual Chlorine: The maximum value of Fluoride (1.3±0.1mg/L) and Chloride (70±5mg/L) were recorded in summer season due to the high rate of evaporation, organic waste of animal origin[44]. The minimum value of fluoride (0.3±0.1mg/L) and chloride (35±5mg/L) were recorded in monsoon season due to dilution of lake water by rain. However, the most significant naturally occurring source of fluoride is drinking water. The maximum value of Residual Chlorine (0.5±0.1mg/L) was recorded in monsoon season due to rain water mixed with domestic waste. The minimum value (0.16±0.05mg/L) was recorded in the summer season. In the present investigation the range of residual chlorine not exceeding the maximum permissible limit as prescribed by WHO and BIS. This favors the portability of water and hence confirms the absence of micro-organisms.

Phosphate and Iron: The maximum value of phosphate (0.46±0.15mg/L) and iron (0.33±0.05mg/L) was recorded in summer season due to the high rate of algae, aquatic plants growth and decay of vegetation. A similar report was also given by Pradeep *et al.*[6] and Madhusudhana Rao *et al.* [45]. The minimum values (0.13±0.05mg/L), (0.16±0.05mg/L) were recorded in winter season. Qureshimatva Umerfaruq and Solanki[39] have reported that the value of phosphate lowered in winter season compared to pre-monsoon and monsoon season due to increased uptake of phosphate for the luxuriant growth of macrophytes.

Nitrite, Nitrate, Ammonium: The values of nitrite, nitrate, and ammonium are 0.5±0.1mg/L, 8.6±0.7mg/L and 2.23±0.25mg/L, respectively in the summer season. In the winter season, the mean values of nitrite, nitrate, and ammonium are 0.23±0.05 mg/L, 5.2±0.2mg/L, 0.7±0.2mg/L, respectively. The obtained values are maximum in summer season and minimum in the winter season. The maximum values are due to organic wastes,

agricultural fertilizers, intensive livestock operations, surface runoff and sewage discharge. The minimum values are due to high vegetation that supports the growth of plankton. A similar result was also observed by Pandit *et al*.[46]. However, according to FAO[47] an increase in the level of ammonia is often concomitant with the decrease in DO and increase in the CO_2 in an aquatic ecosystem. In contrast to ammonia, nitrite toxicity increases at lower pH levels[48,49].

Zooplankton composition in Perur Lake: The Zooplankton community in Perur Lake comprised of Rotifera, Cladocera, Copepoda and Ostracoda. A Total of 37 species of zooplankton were observed during the study which includes 18 species of Rotifers (Figure-1), 11 species of Cladocera (Figure-2), 4 species of Copepods (Figure-3) and 4 species of Ostracoda (Figure-4). The season wise mean value of zooplankton groups are described in Table-2. Monthly variation of the different groups of zooplankton are seen in Figure-5 and density of the zooplankton at Perur lake during the study period are as follows –Rotifer(50%) > Cladocera(25%) > Copepod(21%) > Ostracoda (4%) (Figure-6). The higher density of zooplankton in the aquatic environment indicates that the lower parts of the food chain are healthy; we can protect the higher ordered organisms, like fish and other aquatic animals and even humans.

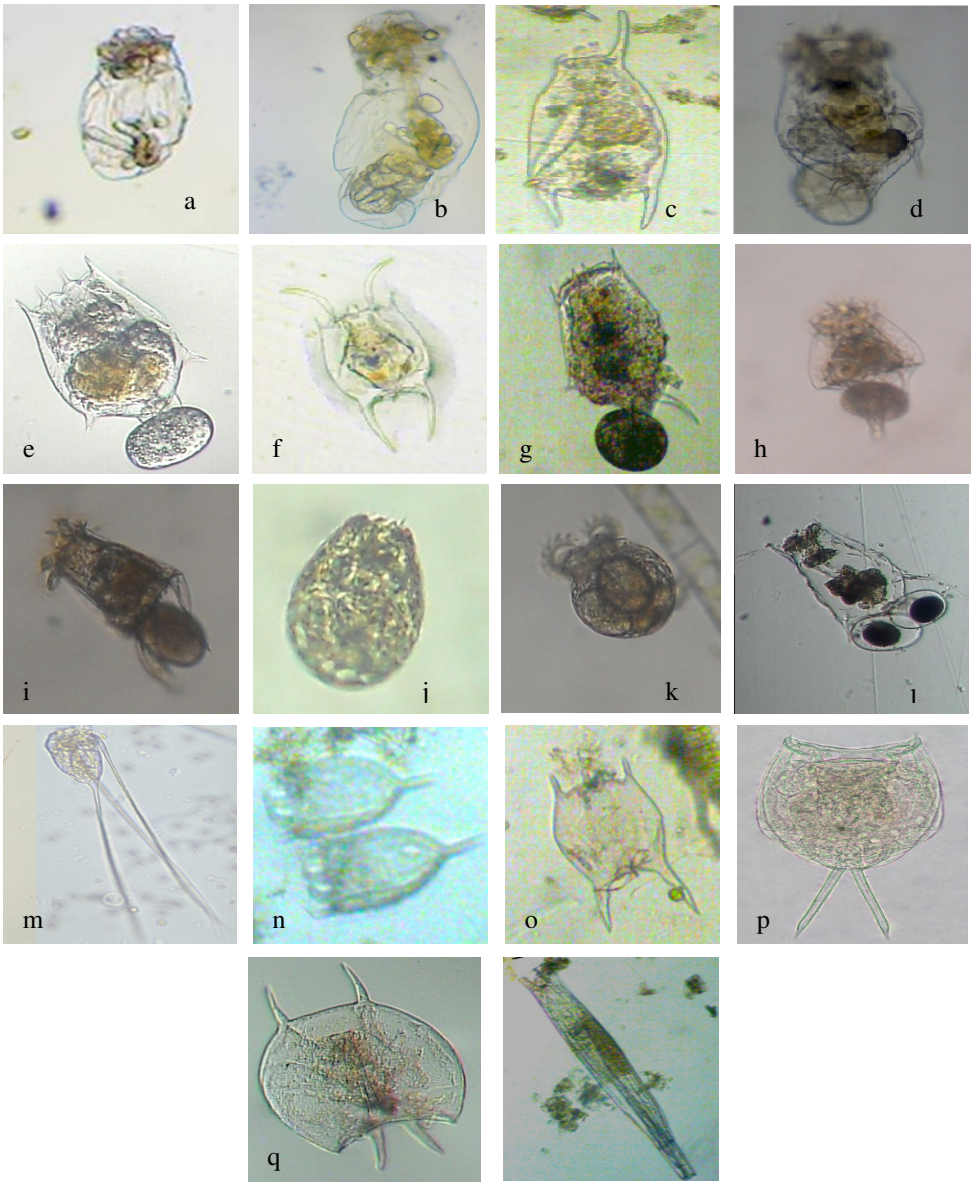

Figure-1: Group of Rotifers observed in the Perur Lake- a.*Asplanchna brightwelli* b.*Asplanchna priodonta* c. *Brachionus diversicornis* d.*Brachionus calyciflorus* e.*Brachionus caudatus* f.*Brachionus falcatus* g.*Brachionus forficula* h.*Brachionus plicatilis* i.*Brachionus quadridentatus* j.*Brachionus rubens* k.*Brachionus urceolari* l.*Brachionus rotundiformis* m.*Keratella cochlearis* n.*Keratellaprocurva* o.*Lecane curvicorni s* p.*Platyias quadricornis* q.*Filinia longiseta* r.*Philodina gregaria*

Table-2: Seasonal variations of zooplankton population No. of Ind / L in Perur Lake, South India during Mar-2015 to Feb-2016.

Zooplankton group	Summer	Pre-Monsoon	Monsoon	Winter
	(Mar 2015–May 2015)	(Jun 2015–Aug 2015)	(Sep 2015 –Nov 2015)	(Dec 2015 –Feb2016)
Rotifera	1705±97.2	891.3±39.0	555.6±130.5	742.67±73.5
Cladocera	157.6±10.2	324.6±64.5	548.6±83.1	891.6 ± 73.5
Copepoda	736.6±37.4	450.3±55.1	223.6±64.0	234.6±54.8
Ostracoda	164.6±41.5	94.6±6.5	20.6±9.2	71.3±24.3

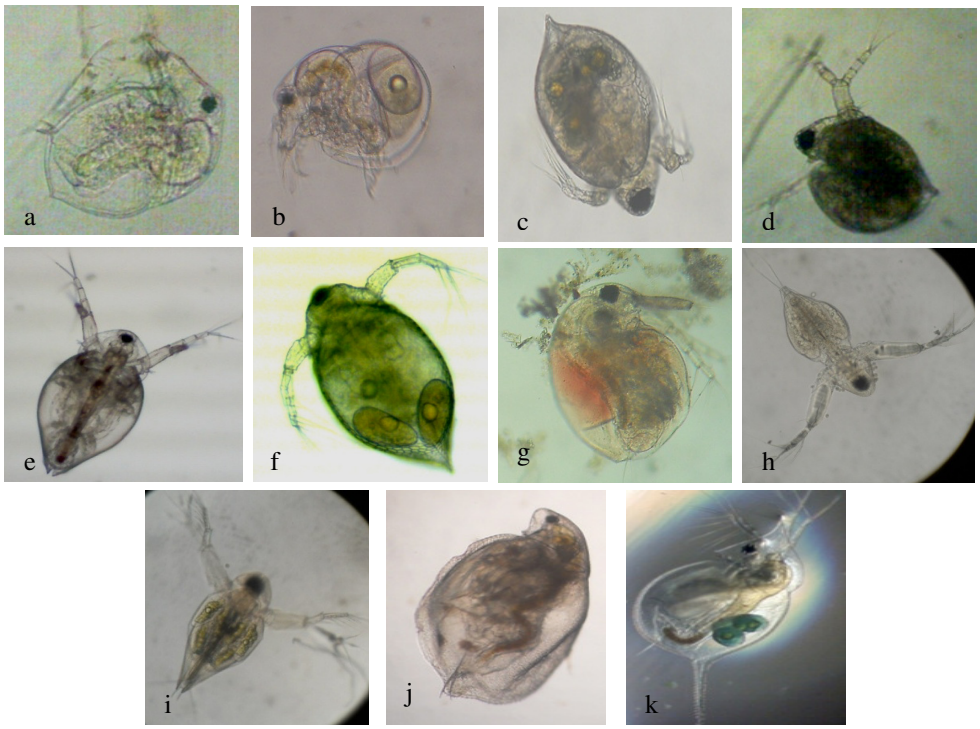

Figure-2: Group of cladocera observed in the Perur Lake-a.*Bosminopsis longirostris*b.*Bosminopsis dietersi* c.*Ceriodaphnia cornuta* d.*Ceriodaphnia laticaudata* e.*Ceriodaphnia quadrangular* f.*Ceriodaphnia reticulate* g.*Guernella raphaelis* h.*Moina macrocopa* i.*Sida crystalline* j.*Simocephalus latirostris* k.*Daphnia galeata.*

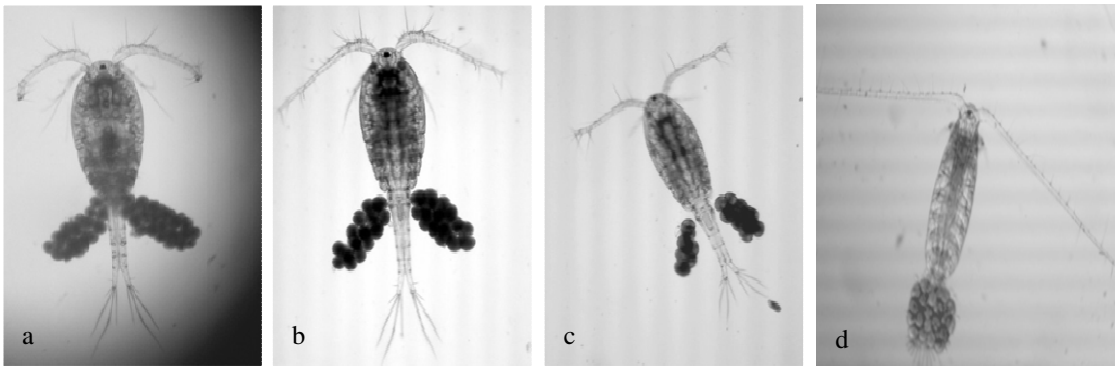

Figure-3: Group of Copepoda observed in the Perur Lake- a. *Mesocyclops aspericornis* b. *Thermocyclops hyalinu* c. *Thermocyclops desipens* d. *Sinodiaptomus indicus.*

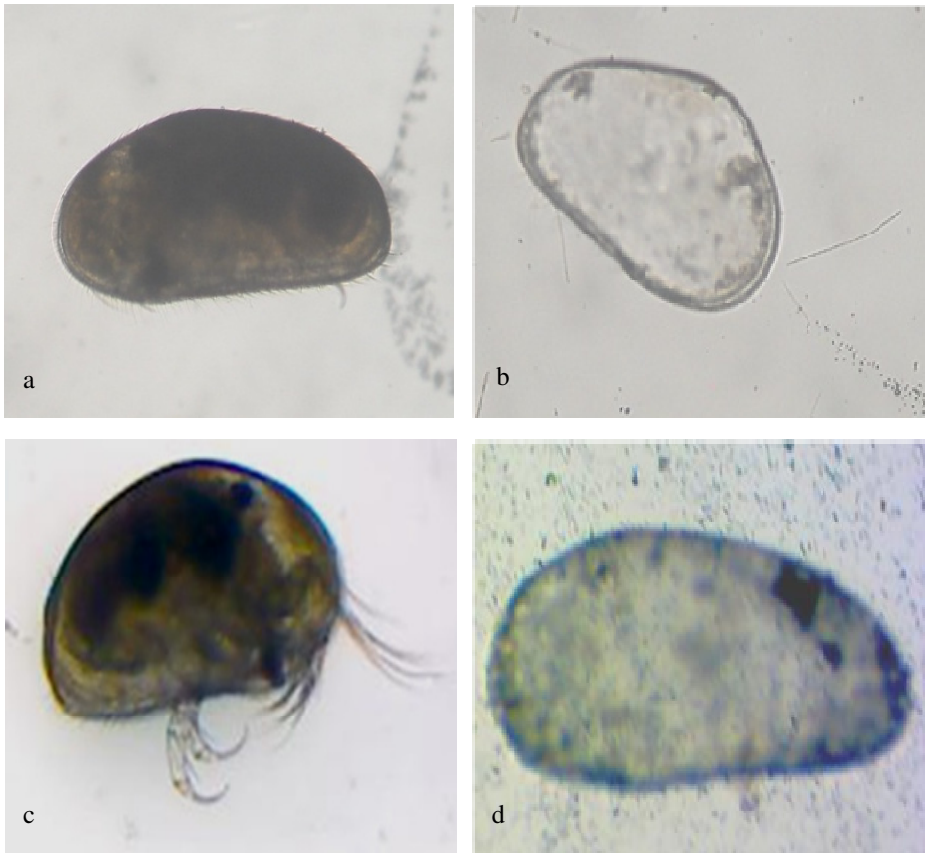

Figure-4: Group of Ostracoda observed in the Perur Lake- a.*Heterocypris incongruens b.Heterocypris punctate c. Eucypris virens d.Stenocypris hislopi.*

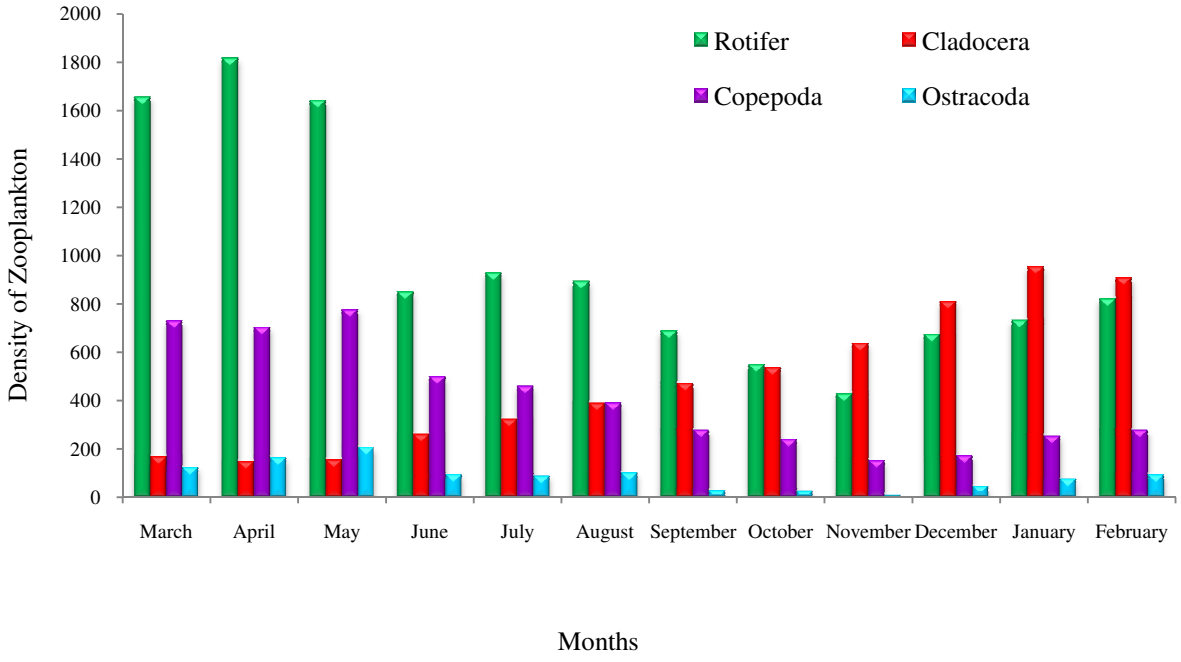

Figure-5: Monthly variation of zooplankton density No. of Ind. / L in Perur lake, South India during Mar-2015 to Feb -2016.

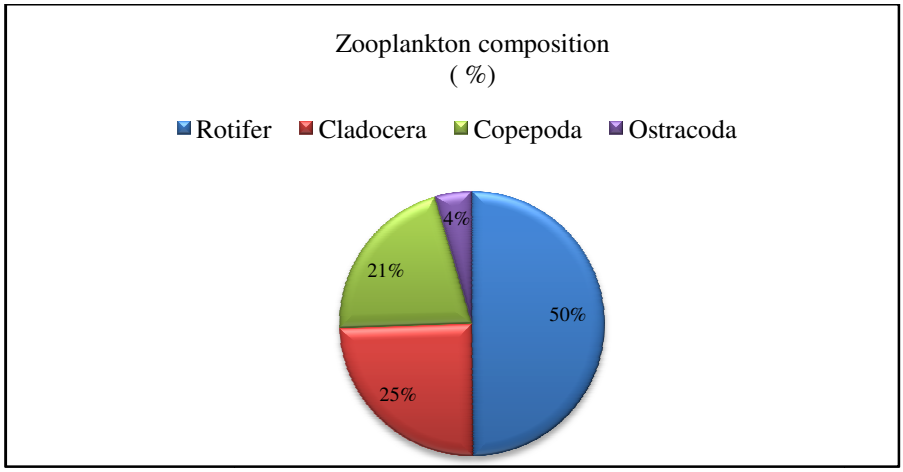

Figure-6: Annual abundance status of different Zooplankton Groups in Perur Lake during Mar-2015 to Feb -2016.

Rotifera: In the present study, Rotifera consists of 18 species (Figure-1). The mean value of rotifer density was recorded in the range between 1705±97.2 and 555.6±130.5ind./L. The minimum population recorded in monsoon season and maximum population recorded in the summer season, shown in Table-2. The maximum population in summer is due to the maximum water temperature as it enhances the biological activity of planktons. Rotifera was found to be the dominant group and has higher diversity among zooplankton community. It consists 50 % of the zooplankton population (Figure-6). Malik and Shikha[50] have observed maximum density and diversity of rotifer in Bhimtal Lake of Kumaun Region, Uttarakhand. Rotifer group was dominated by Brachionus sp. The presence of different species of Brachionus and Philodina, Keratella indicates that the lake is approaching towards eutrophication and is organically polluted as observed by other workers[51,52]. The density of rotifer in perur lake during the study period are as follows – summer > pre-monsoon > winter > monsoon season.

Cladocera: In this study, cladoceran consists of 11 species (Figure-2). The mean value of cladoceran density was recorded in the range between 891.6 ± 73.5 and 157.6±10.2ind./L. The minimum population was recorded in summer and maximum in the winter season (Table-2). The Maximum density of cladoceran was observed in winter due to the favorable condition of abiotic factors and availability of abundant food. Sharma *et al.*[37] have observed the maximum density of cladoceran in winter compare to other seasons in Temple Pond, Birpur, India.

This group was dominated by Ceriodaphnia sp., Bosmina sp. indicates that the lake towards organically polluted[35]. Cladoceran was the next dominant group among zooplankton community consists 25% of the zooplankton population (Figure-6). The density of cladocerans in perur lake during the study period are as follows – winter > monsoon > pre-monsoon > summer season. It's inversely related to other zooplankton groups.

Copepoda: In the present study, copepod consists of 4 species (Figure-3). The mean value of copepods density was recorded in the range between 736.6±37.4 and 223.6±64.0ind./L. The maximum population recorded in summer and minimum in monsoon season (Table 2). Copepoda group among zooplankton community consists 21% of the Zooplankton population (Figure-6). This group was dominated by Thermocyclops sp. The presence of Mesocyclops sp. and Diaptomus sp. indicates that the lake is towards organically polluted[53].The density of copepods in Perur lake during the study period are as follows – summer > pre-monsoon > winter > monsoon season.

Ostracoda: In the present study, Ostracoda consists of 4 species (Figure-4). The mean value of Ostracoda was recorded in the range between 164.6±41.5 and 20.6±9.2ind./L. The minimum population recorded in monsoon and maximum population recorded in summer (Table-2). Tiwari and Nair[54]havereported that the maximum density of Ostracoda in summer due to the availability of food, high values of temperature and salinity. In the present study Ostracoda group among zooplankton community consists of 4% and it represented very low population density when compared to other zooplankton groups (Figure-5). This group was dominated by Heterocypris sp. The presence of cypris sp. indicates that the lake is towards organically polluted[53]. The density of Ostracoda in Perur lake during the study period are as follows – summer > pre-monsoon > winter > monsoon season.

Correlation coefficient between physico-chemical parameters and zooplankton groups: The correlation coefficient of various physico-chemical parameters and zooplankton groups indicates their dependence with each other as shown in the Table-3. It was concluded statistically that the density of Rotifera, Copepoda, Ostracoda shows significant positive correlation with WT, pH, TA, TH, Ca H, F, Cl^-, PO_4^{-3}, Fe, NO_2, NO_3 and NH_4^+. But Ostracoda shows insignificant positive correlation with Ca Hardness, F, NO_2, NH_4^+ and significant negative correlation with DO and residual chlorine. Cladocera shows significant positive correlation with DO and

significant negative correlation with WT, Ca Hardness, PO_4^{-3}, Fe, NO_2, NO_3, NH_4^+ and insignificant negative correlation with pH, TA, TH, F, Cl^- and insignificant positive correlation with residual chlorine. However, the various physico-chemical parameters are shows either significant positive or negative correlation with density of different zooplankton groups at the level of $P<0.01$ or $P<0.05$. Each physico-chemical factor plays its own role, but at the same time, the final effect is the authentic result of the interactions of every factor. These factors provide a source for the richness of biological productivity for any aquatic environment[55].

Diversity indices: The diversity indices of zooplankton population were analyzed seasonally and values are given in Table-4. The dominance of species was found to be maximum (0.04712) in Pre-monsoon and minimum (0.03857) in Monsoon season which Ranges from 0 (all species are equally present) to 1 (one species dominates the community completely). Based on Shannon-Weaver legislation, the aquatic environment is classified as very good when H' is > 4, good at 4 – 3, moderate at 3 – 2, poor at 2 – 1 and very poor at < 1. The index value of Shannon diversity indicates good quality of the aquatic environment in Perur lake. Staub *et al*.[56] has described the scale of pollution regarding species diversity and reported the values as 3.0-4.5 (slight), 2.0-3.0 (light), 1.0-2.0 (moderate) and 0.0 – 1.0 (heavy pollution). In the present investigation, the range of Shannon diversity index (*H*) value is from 3.327 (Monsoon) to 3.21 (summer) which indicates a slight level pollution of Perur lake. The species evenness was maximum (0.8988) in monsoon season and minimum (0.7496) in pre-monsoon season. Evenness was comparatively high during monsoon season indicating a decrease in the plankton diversity at this period[57]. The distribution of individuals over species is called evenness and it makes sense to consider species richness and species evenness as two independent characteristics of biological communities that together constitute its diversity[58]. The Margalef species richness was recorded to be maximum (3.798) in pre-monsoon and minimum (3.495) in summer. The maximum species richness in summer leads to the longer food chain in an aquatic ecosystem. Vincent[59] reported that the higher values of species diversity index decrease species richness with increasing trophic status. Ludwik and Reynolds[60] have described that the greater diversity increases the stability of the community for the longer period. The present diversity indices study indicates that the lake has well-balanced zooplankton community and also species indicating the dynamic nature of this aquatic ecosystem.

Table-3: Pearson's correlation coefficient between physico-chemical parameters and density of various zooplankton groups.

Physicochemical Parameters	Rotifer	Cladocera	Copepoda	Ostracoda
Temperature	+0.765**	- 0.859**	+0.883**	+0.751**
pH	+0.777**	- 0.416	+0.769**	+0.858**
Dissolved Oxygen	- 0.701*	+0.887**	- 0.851**	- 0.738**
Total Hardness	+0.914**	- 0.560	+0.879**	+0.895**
Calcium Hardness	+0.613*	- 0.653*	+0.611*	+0.460
Fluoride	+0.824**	- 0.256	+0.695*	+0.835**
Chloride	+0.875**	- 0.548	+0.859**	+0.918**
Residual Chlorine	-0.693*	+0.255	- 0.676*	- 0.835**
Phosphate	+0.738**	- 0.779**	+0.768**	+0.684*
Iron	+0 .619*	- 0.735**	+0.559*	+0.381
Nitrite	+0.742**	- 0.586*	+0.666*	+0.552
Nitrate	+0.796**	- 0.943**	+0.861**	+0.650*
Ammonium	+0.614*	- 0.895**	+0.687*	+0.470

Table-4: Seasonal diversity indices of Zooplankton in Perur lake, South India during Mar-2015 to Feb -2016.

Diversity Indices	Zooplankton diversity indices			
	Summer	Pre-Monsoon	Monsoon	Winter
	(Mar 2015 - May 2015)	(Jun 2015 - 2015 Aug)	(Sep 2015 - Nov 2015)	(Dec 2015 - Feb 2016)
Taxa	33	34	31	35
Individuals	9469	5932	4578	6533
Dominance_D	0.04708	0.04712	0.03857	0.04089
Shannon_H	3.21	3.238	3.327	3.308
Evenness_e^H/S	0.7508	0.7496	0.8988	0.8537
Margalef-Rhichness	3.495	3.798	3.559	I3.619

Conclusion

The physico-chemical study of Perur lake water during all the four seasons shows different seasonal fluctuation among various parameters. The results of the water quality clearly show that the most number of parameters were within the desirable limit while some parameters are higher than the desirable limit but not exceeding the maximum permissible limit as prescribed by BIS and WHO. This investigation confirms that Perur Lake is not polluted. However, the presence of certain species of zooplankton like Brachionus sp., Keratella sp., Philodina sp., Bosminopsis sp., Moina sp., Mesocyclops sp., Cypris sp. indicates the possibility of eutrophication in future. Thus the status of water quality of Perur Lake should be protected and conserved by raising the awareness of the local people and by reducing anthropogenic activities.

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