Seasonal impact of zooplankton diversity and their potential implications on climate change in Singanallur Lake, Coimbatore, South India.

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Abstract

Because of their swift reaction to environmental changes, zooplankton biodiversity acts as an evolutionary measure of the marine climate. The effect of cyclic variations on zooplankton diversification was investigated in the Singanallur Lake located in Coimbatore, South India. On a seasonal basis, the ecology of zooplankton taxa was observed from December 2016 to November 2017. During this time period, 23 species of zooplankton were discovered, including 7 *Rotifera* and *Cladocera* species, as well as 5 Copepoda and Ostracoda species. The overall abundance of *Rotifer*a was found to be prevalent with 35 percent in this study, led by *Cladocera>Copepoda>Ostracoda*. The mass of the population in different zooplankton groups was observed, and the order *Rotifera>Copepoda> Cladocera>Ostracoda* was discovered. Summer and early monsoon seasons saw the highest and lowest population densities, respectively. This Lake's temperature acceleration could be responsible for the higher zooplankton population density in the summer. The current study discovered that when the temperature in the Singanallur Lake was raised during the summer season, zooplankton productivity improved. This suggests that temperature has an effect on zooplankton diversity. As a result, rising temperatures as a result of global climate change could have an effect on zooplankton productivity. In the near future, assessing zooplankton ecology would be helpful in monitoring the health and resources of this lake system.

Keywords: Climate variation, Zooplankton, Singanallur Lake, Diversification of fauna.

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Introduction

Many ecological indicators such as Zooplankton diversity is main source for the maintain quality in aquatic environment. These zooplanktons are maintaining our ecosystem in healthy manner through recycling of healthy nutrients and quality maintenance of soil quality [1]. Zooplankton diversity is important elements of lake ecosystems which control the centre of aquatic food web. Furthermore, zooplankton populations are very sensitive to anthropogenic environmental conditions and its very crucial role in study of ecological changes in natural calamities [2]. Several studies reported that zooplankton is important marker for ecological changes such as species diversity and community composition changes due to numerous disturbances in ecological changes.

Several reports were depicted that, the capacity of filtering and significant implications of lake eutrophic signal and control only by zooplankton diversity. Zooplankton species density and composition are major role in maintaining water chemical properties, morphology and anthropogenic modifications in watersheds of lake [3]. A direct proportional to the Physico-chemical properties of aquatic ecosystem with zooplankton diversity has been predicted several previous studies [4-7].

Due to the increasing human population and increasing the industrialization leads to increasing the wastewater disposal into the environment. High quantity of heavy metal and other substances directly discharged into the lake water and automatically degrade the quality of lake water. The physico-chemical properties are confined with total number of biological contents present in the water [8-10]. Moreover, Awareness of water quality and the states of affected living organisms in water sources are needed prior to the implementation of any management techniques. In both freshwater and marine water, plankton diversity was the most significant ecological parameter. The number of various species in a population, including both abundant and endangered species, is referred to as species diversity.

Singanallur Lake is a natural lake that is connected to Coimbatore's Noyyal River. Freshwater supply and value in this lake are critical because it provides opportunities for fishermen and is the primary source of income for the poor population in this demographic region. As a result, the current research was conducted to determine the effect of seasonal variations in zooplankton ecology in the lake.

Materials and Methods

Demographic profile of selected area

Singanallur Lake is situated in Singanallur, Coimbatore, India. It covers 1.153 km^2 (0.445 sq mi) and has an average depth of 4.25 metres (13.9 ft). It is one of the city's nine major lakes. Totally it occupied 52, 270, 000 m^3. Canals that originate in the Noyyal River feed the pool. Sanganur drain water is also pumped into the lake.

The water can be released through the lake's two sluice gates. To pump excess water during flooding, pipes were laid connecting the lake to Valankulam Lake in 2010.

Collection of water samples

Samples (Water and Zooplankton) were obtained at three different locations for a year, from December 2016 to November 2017. The water samples were collected in sterile bottles. Using Van Dorn sampler, samples were taken between 1 and 4 m depth by vertically, with a few metres of space between the top and bottom samples, transported immediately after collecting the sample to analyse the different parameters.

Analysis of water samples

Temperature of the atmosphere and surface water were taken immediately once sample was collected. The µP based water and Soil analysis lit was used to quantify the Physico-chemical parameters such as Total Dissolved Solids (TDS), Dissolved Oxygen (DO), pH, Electrical Conductivity (EC) and salinity.

Qualitative analysis of Zooplankton

Towing-regular Henson's plankton net (150 m mesh) was used to gather samples from the lake by towing in a zig-zag pattern horizontally at a depth of 0.50 to 1.00 m for around 5 to 10 minutes at a uniform boat speed.

Quantitative analysis of Zooplankton

For quantitative zooplankton analysis, 100 l of water was filtered through a plankton net made of bolting silk (150 m), and the plankton biomasses were transferred to specimen bottles with 5% formalin for microscopic analysis. *Rotifer, Cladocera, Copepod,* and *Ostracoda* were among the zooplankton groups studied.

Identification of Zooplanktons

For the collection of zooplankton, plankton net which is a ring type terricot net (24 mesh/mm^2) was used. A total of 10 liters of water were filtered through plankton net and the filtered water was collected in 125 ml reagent bottle. The plankton was preserved in 5% formaldehyde solution on the spot and was brought to the laboratory for identification. For the identification of plankton standard book of APHA and Ward and Whipple were consulted [11,12].

Results

Physicochemical analysis

Current study, recorded atmospheric temperature fluctuated between 22.63 ± 0.76 to 25.47 ± 0.98 and temperature of the surface water varied from 23.54 ± 0.53 to 27.83 ± 0.45 (Table 1). During the study period, the monsoon season had the lowest atmospheric and surface water temperatures, while the summer season had the highest minimum atmospheric and surface water temperatures. The pH of the lake recorded ranged from 7.13 ± 0.42 to 8.13 ± 0.74. The lowest and highest pH levels were observed during the summer and monsoon seasons respectively. The lowest (0.91 ± 0.07) and highest (1.31 ± 0.23) salinity levels were measured during the summer and post-monsoon seasons, respectively. The value of DO (from 6.79 ± 0.26 to 9.43 ± 0.09), EC (from 0.76 ± 0.03 to 1.02 ± 0.04) and TDS (from 0.58 ± 0.05 to 0.90 ± 0.07) of lake were recorded the ranges were shown seasonal variation and climatic difference in demographical area. During the summer, all three criteria were found to be higher, and during the monsoon season, they were found to be lower.

Analysis of Zooplankton

Seasonal fluctuation in water quality of the Singanallur Lake have a marked an influence on the numerical abundance of zooplankton (Table 2). Stated that the abundance and diversity of zooplankton vary according to limnological and physico-chemical features and the topical state of freshwater bodies. The analysis of zooplankton for each and every month (November 2016 to December 2017) of water samples from 3 different sites (Tables 3-6). Totally 29 species of zooplankton were observed. Most of the species of zooplankton are present in post-monsoon to summer months except few species. The zooplankton are not present during monsoon season most of the species were absent from rainfall and dilution of the water. About 23 species to Zooplankton 7 species of *Rotifers*, 7 species of *Cladocera*, 4 species of *Copepods* and 5 species of *Ostracoda* are recorded.

Table 1. *Physico-chemical parameters of Singanallur lake during the period of December 2016 to November 2017.*

Particular Parameters	Post-monsoon			Summer			Pre-monsoon			Monsoon		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Atmospheric Temperatu(ºC)	22.63 ± 0.76	23.52 ± 0.38	23.39 ± 0.58	24.04 ± 0.49	24.97 ± 0.62	25.47 ± 0.98	24.52 ± 0.71	24.01± 0.39	.42 ± 0. 2391	23.49 ± 0.49	22.91 ± 0.02	22.02 ± 0.08
Surface water Temperature (ºC)	23.54 ± 0.53	23.91 ± 0.83	24.82 ± 0.84	25.32 ± 0.81	26.40 ± 0.27	27.83 ± 0.45	26.06 ± 0.16	26.18 ± 0.82	25.26 ± 0.17	24.81 ± 0.83	24.01 ± 0.81	23.24 ± 0.76
pH	7.13 ± 0.42	7.35 ± 0.04	7.56 ± 0.12	7.63 ± 0.29	7.79 ± 0.32	8.13 ± 0.74	7.72 ± 0.51	7.81 ± 0.35	7.91 ± 0.60	7.74 ± 0.14	7.89 ± 0.55	8.01 ± 0.59
DO (mg/l)	6.79 ± 0.26	6.98 ± 0.37	7.45 ± 0.56	8.01 ± 0.47	8.68 ± 0.60	9.43 ± 0.09	8.57 ± 0.61	8.61 ± 0.07	8.53 ± 0.38	8.11 ± 0.81	7.36 ± 0.58	6.88 ± 0.65
Salinity (mg/l)	0.91 ± 0.07	0.93 ± 0.05	0.95 ± 0.07	0.97 ± 0.08	0.98 ± 0.12	1.31 ± 0.23	0.97 ± 0.41	0.96 ± 0.09	0.96 ± 0.08	0.93 ± 0.45	0.92 ± 0.25	0.91 ± 0.57
TDS (mg/l)	0.58 ± 0.05	0.67 ± 0.12	0.72 ± 0.42	0.81 ± 0.34	0.89 ± 0.52	0.90 ± 0.07	0.84 ± 0.05	0.88 ± 0.04	0.63 ± 0.06	0.72 ± 0.03	0.70 ± 0.06	0.60 ± 0.04
EC (mg/l)	0.76 ± 0.03	0.81 ± 0.34	0.8 ± 0.07	0.92 ± 0.06	0.97 ± 0.04	1.02 ± 0.04	0.96 ± 0.09	0.90 ± 0/05	0.87 ± 0.12	0.84 ± 0.13	0.80 ± 0.43	0.76 ± 0.35

Table 2. *List of zooplankton diversity identified in the Singanallur Lake during the period of December 2016 to November 2017.*

Genera of Zooplankton	Genus	Species
Copepoda	*Heliodiaptoms*	*Heliodiaptoms viduus*
	Sinodiaptoms	*Sinodiaptoms indicus*
	Mesocyclops	*Mesocyclops hyalinus*
		Mesocyclops leuckarti

Rotifera	*Brachionus*	*Brachionus angularis*
		Brachionus calyciflorus
		Brachionus caudatus personatus
		Brachionus diversicornis
		Brachionus diversicornis
		Brachionus falcatus
		Brachionus quadridentatus
Cladocera	*Diaphanosoma*	*Diaphanosoma sarsi*
	Daphnia	*Daphnia carninata*
		Daphnia magna
	Ceriodaphnia	*Ceriodaphnia cornuta*
		Ceriodaohnia reticulata
	Moina	*Moina brachiata*
		Moina micrura
Ostracoda	*Cyprus*	*Cypris protubera*
	Eucyprus	*Eucypris bispinosa*
	Cyprinotus	*Cyprinotus nudus*
	Heterocypris	*Heterocypris dentatomarginatus*
	Hemicypris	*Hemicypris anomala*

Table 3. *Diversity of zooplankton and seasonal variation identified at site I, December, 2016 to November, 2017.*

Genera of Zooplankton	**Seasonal variation**											
	Post-monsoon			**Pre-monsoon**			**May**			**Monsoon**		
	Dec	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Copepoda												
Heliodiaptoms viduus	*	-	-	-	*	*	-	-	-	-	-	-
Sinodiaptoms indicus	-	-	**	*	-	-	-	*	*	-	-	-
Mesocyclops hyalinus	-	*	-	*	*	-	-	-	-	*	*	*
Mesocyclops leuckarti	-	-	*	**	-	-	-	-	-	-	***	-
Rotifera												
Brachionus angularis	-	***	**	*	-	-	**	-	-	*	-	-
Brachionus calyciflorus	*	-	-	-	*	-	*	-	-	*	-	-
Brachionus caudatus personatus	-	-	*	-	-	*	*	-	-	*	-	-
Brachionus diversicornis	*	*	-	**	-	-	*	***	-	-	-	-
Brachionus diversicornis	*	-	-	-	*	-	-	-	-	-	-	-
Brachionus falcatus	-	-	-	-	*	-	*	-	-	-	-	-
Brachionus quadridentatus	-	-	-	*	*	-	**	-	--	-	*	-
Cladocera												
Diaphanosoma sars	*	-	-	**	-	-	-	-	-	-	-	*
Daphnia carninata	-	-	-	*	-	*	*	*		-	*	-
Daphnia magna	-	-	-	***	*	-	**	*	*	**	-	-
Ceriodaphnia cornuta	-	*	-	-	-	-	-	*	*	-	-	-
Ceriodaohnia reticulata	-	-	-	***	**	*	-	*	*	-	-	-
Moina brachiata	-	-	*	-	**	-	-	-	-	-	-	-
Moina micrura	-	-	*	*	*	--	-	-	-	***	-	-
Ostracoda												
Cypris protubera	-	-	**	*	-	-	*	-	-	-	*	-
Eucypris bispinosa	-	-	*	-	-	-	-	-	-	-	-	-
Cyprinotus nudus	-	-	-	-	-	-	-	-	-	-	-	*
Heterocypris dentatomarginatus	-	-	-	*	-	-	*	-	-	-	-	-
Hemicypris anomala	*	-	**	-	-	-	-	-	-	*	-	-
(-=Not Significant, *=Significant, **=Moderately Significant and ***=Highly Significant).												

Table 4. *.Diversity of zooplankton and seasonal variation identified at site II, December, 2016 to November, 2017.*

Genera of Zooplankton	Seasonal variation											
	Post-monsoon			Summer			Pre-monsoon			Monsoon		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Copepoda												
Heliodiaptoms viduus	*	-	-	-	*	-	-	-	-	-	-	-
Sinodiaptoms indicus	-	*	**	*	-	-	-	*	*	-	-	-
Mesocyclops hyalinus	-	*	-	-	*	-	-	-	-	-	*	*
Mesocyclops leuckarti	-	-	*	**	-	-	-	-	-	-	***	-
Rotifera												
Brachionus angularis	-	***	**	*	-	-	**	-	-	*	-	-
Brachionus calyciflorus	*	-	-	-	*	-	*	-	-	*	-	-
Brachionus caudatus personatus	*	-	*	-	-	-	*	-	-	*	-	-
Brachionus diversicornis	*	*	-	**	-	-	*		-	-	-	-
Brachionus diversicornis	*	-	***	-	*	-	-	-	-	-	-	-
Brachionus falcatus	-	-	*	-	-	-	*	-	-	-	-	-
Brachionus quadridentatus	-	-	-	-	-	-	-	-	-	-	*	-
Cladocera												
Diaphanosoma sars	*	-	-	**	-	-	-	-	-	-	-	*
Daphnia carninata	-	-	-	*	-	-	*	*	-	-	*	-
Daphnia magna	-	-	*	**	-	-	**	*	*	**	-	-
Ceriodaphnia cornuta	-	*	*	-	-	-	-	*	*	-	-	-
Ceriodaohnia reticulata	-	-	*	***	**	*	-	*	*	-	-	-
Moina brachiata	-	-	*	-	**	-	-	-	-	-	-	-
Moina micrura	-	-	*	*	*	-	-	-	-	**	-	-
Ostracoda												
Cypris protubera	-	-	*	*	-	-	-	-	-	-	*	-
Eucypris bispinosa	-	**	*	***	-	-	-	-	-	-	-	-
Cyprinotus nudus	-	**	*	-	-	-	**	-	-	**	-	*
Heterocypris dentatomarginatus	*	-	-	*	-	-	*	-	-	-	-	-
Hemicypris anomala	*	-	**	-	-	-	-	-	-	*	-	-
(-=Not Significant, *=Significant, **=Moderately Significant and ***=Highly Significant).												

Table 5. *Diversity of zooplankton and seasonal variation identified at site III, December, 2016 to November, 2017.*

Genera of Zooplankton	Seasonal variation											
	Post-monsoon			Summer			Pre-monsoon			Monsoon		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Copepoda												
Heliodiaptoms viduus	*	-	-	-	*	**	-	-	-	-	-	-
Sinodiaptoms indicus	-	*	**	*	-	-	-	*	*	-	-	-
Mesocyclops hyalinus	-	-	-	*	**	-	-	-	-	-	*	-
Mesocyclops leuckarti	-	-	*	**	-	-	-	-	-	-	***	-
Rotifera												
Brachionus angularis	-	***	**	*	-	-	**	-	-	*	-	-
Brachionus calyciflorus	*	-	-	-	**	-	*	-	-	*	-	-
Brachionus caudatus personatus	*	-	*	-	-	-	*	-	-	*	-	-
Brachionus diversicornis	*	*	-	**	-	-	*	***	-	-	-	-
Brachionus diversicornis	*	-	-	-	**	-	-	-	-	-	-	-
Brachionus falcatus	-	-	*	-	-	-	*	-	-	-	-	-
Brachionus quadridentatus	-	-	-	*	-	-	**	-	--	-	*	-
Cladocera												
Diaphanosoma sars	*	-	-	**	-	-	-	-	-	-	-	*
Daphnia carninata	-	-	-	*	-	-	*	*	-	-	*	-
Daphnia magna	-	-	*	**	-	-	**	*	*	**	-	-
Ceriodaphnia cornuta	-	*	-	-	-	-	-	*	*	-	-	-
Ceriodaohnia reticulata	-	-	-	***	**	-	-	*	*	-	-	-
Moina brachiata	-	-	*	-	**	-	-	-	-	-	-	-
Moina micrura	-	-	*	*	*	--	-	-	-	**	-	-

Ostracoda												
Cypris protubera	-	-	***	*	-	-	*	-	-	-	*	-
Eucypris bispinosa	-	-	*	-	-	-	-	-	-	-	-	-
Cyprinotus nudus	-	*	*	-	-	-	-	-	-	-	-	*
Heterocypris dentatomarginatus	*	*	-	*	-	-	*	-	-	-	-	-
Hemicypris anomala	*	-	**	-	-	-	-	-	-	*	-	-
(-=Not Significant, *=Significant, **=Moderately Significant and ***=Highly Significant).												

Table 6. *Total density of Zooplankton in Singanallur Lake during the period of December 2016 to November 2017.*

	Major Genera of Zooplankton					
Period	***Rotifera***	***Cladocera***	***Copepoda***	***Ostracoda***	**P value**	**F value**
Post-monsoon	5416 ± 67	4134 ± 28*	4364 ± 32*	816 ± 25	0.000	4867.34
Summer	8263 ± 53	4425 ± 47	4163 ± 38	1536 ± 21*	0.000	7565.24
Pre-monsoon	6169 ± 27*	4871 ± 28*	4720 ± 13*	936 ± 28	0.000	18236.42
monsoon	4256 ± 28	3083 ± 31	3765 ± 27	792 ± 16	0.000	16431.36
*N=3; mean±SD. * Statistically significant at p<0.001.*						

Zooplankton diversification with seasonal variations of three different regions is given. The maximum number of zooplankton population were detected at site 1 followed by site III and Site II respectively. Site I. Site I was recorded by 23 species included 4 genera such as *Rotifera, Cladocera, Copepoda* and *Ostracoda*.

The maximum zooplankton genera were recorded at site-II followed by site-III and site-I respectively. Site-I was represented by 13 genera among which the dominating groups were *Cladocerans* and *Rotifers* with 4 genera constituting 30%-31% species ostracod and small number of species of zooflagellate with 1(8%) genera each. At site-II a total of 23 genera were reported among which the order *Rotifer* was dominant with a total number of 7 (30%) genera followed by *Cladoceran* and others. Site-III was represented by 21 genera of seven groups. The most dominating group was *rotifer* with a total number of 6 (28%) genera followed by *Cladocerens*. Among *Copepods*, only *Cyclops* was recorded which was found abundant at site-II and site-III. Among *Psorifera, Spongiella* and *Trochospongiella* were reported occasionally only at site-II and site-III. At site-I, *Cladocera* was reported maximum during post monsoon season while *Cladoceran* and *rotifers* were reported maximum during winter season. Zooflagellates were recorded maximum during monsoon and post monsoon months while *copepods* were not recorded at all.

At site-II, *Cladocera* were reported maximum during summer season while *Rotifers, Ostracod* and *Zooflagellates* were reported maximum during winter season. *Copepods* were reported occasionally at site-II during certain months whereas *cladocerans* showed maximum distribution almost throughout the year with maximum number of species recorded during post monsoon months. At site-III, the Copepoda showed maximum abundance during summer season while *Rotifers* and *Cladocerans* were reported abundantly almost throughout the year. *Copepod* and *Ostracod* were reported occasionally showed maximum distribution during winter season.

Discussion

The physical and chemical properties are crucial role in lake water properties and distribution of various species diversity of planktons [13]. In aquatic environments, environmental factors such as water salinity, pH, hardness, phosphates, and nitrates, as well as physical and chemical properties, are critical for phytoplankton growth and dispersal, on which zooplankton rely for their survival. The Singanallur Lake shows considerable variation in water physico-chemical parameters, species composition, population density, species diversity, species evenness, and species abundance of various zooplankton species in the current research. This work account to give awareness among the people about the quality of water and can help reduce the water pollution through housekeeping and management practice.

Seasonal variations in water physico-chemical parameters influenced the density, diversity, evenness, and richness of zooplankton in the Singanallur Lake, according to the findings, resulting in substantial differences in zooplankton density, diversity, evenness, and richness. The density, diversity, evenness, and richness of zooplankton in the Singanallur Lake were all influenced by seasonal changes in water physico-chemical parameters.

It was found that zooplankton diversity was highest in September and lowest in January. The maximum planktonic diversity was found in the winter months when the water temperature was down, the water current was low, and the water was clear without turbidity [14,15]. Numerous research studies found out that, freshwater diversity and observed the species-dependent influence of zooplankton on the phytoplanktonic environment, concluding that the existence of predaceous *Cladocerans* and *Copepods* has a significant impact on the presence of many algae species, dissolved nutrients, and ciliate micro-zooplanktons [16]. The present study was found that high numbers of zooplankton populations are found in pre-monsoon and summer season only.

On the other hand, highest zooplankton density from September to January and concluded that dissolved oxygen levels and temperature variations affect zooplankton diversity [17]. Also, the freshwater diversity of zooplanktons in general are very resilient to environmental changes and are a vital part of the aquatic food chain [18]. As a result, any negative impact on zooplankton would have an impact on the water system's productivity. He also came to the conclusion that they are the best predictor community for assessing any kind of aquatic pollution. Conferring to investigated zooplankton diversity as well as physicochemical parameters from selected lakes in Tamil Nadu, concluding that higher densities of zooplankton were observed during the rainy season, with *copepods* being the most abundant, followed by *Cladocera, Rotifera* and *Ostracoda* [19].

Despite their ability to withstand a wide variety of environmental conditions, ostracods were not found in contaminated waters. The reduced abundance of zooplankton in the summer compared to the rainy months was due to higher temperatures, lower nutrients, and therefore a lower phytoplankton population.

The steady rise in both air and water temperatures from April to August can be explained by an increase in solar radiation and concomitant evaporation due to the comparatively longer day length. A steady drop in solar radiation, similar to the decline in temperature from October to February (monsoon to post-monsoon), could explain the increase in temperature from March onwards. Water temperature is also significant when measuring oxygen and carbon dioxide solubility, as well as bicarbonate and carbonate equilibrium [20,21]. The pH scale measures the concentration of H+ ions in water and measures the level of acidity and alkalinity. The elevated pH level observed in the months of May (summer) suggests a high rate of photosynthesis in water bodies [22,23]. The highest pH was recorded during the summer and the lowest during the pre-monsoon period in this report.

Increased photosynthesis during the summer due to high temperatures resulted in higher carbon dioxide consumption in the aquatic environment, according to recent studies. Similarly, the current research found that pH levels were highest during the summer months and lowest during the pre-monsoon season. Increased photosynthesis during the summer due to high temperatures resulted in higher carbon dioxide consumption in the aquatic environment [24,25].

Similarly, present study shows that pH levels were highest during the summer months and lowest during the pre-monsoon season. In addition, electrical conductivity was higher during the summer and lower during the monsoon. Water conductivity changes followed the same seasonal trend as salinity changes. In the freshwater lake ecosystem, the pioneer researchers found that EC was highest in the summer season and lowest in the monsoon season. [26,27] It's possible that the first report in the maximum average value of total dissolved solids was due to an accumulation of anthropogenic activities that hampered water quality. The high level of TDS observed during the summer months in this study indicates that nutrient stagnation in the lake resulted in increased zooplankton development [28].

The effect of high temperature on the diversity of zooplankton in the Singanallur Lake was studied. The life history characteristics of zooplanktonic species are constrained by changes in metabolic rate and function, which have direct effects on development and reproduction [29,30].

The current findings show that elevated temperature caused by the disposal of household and industrial waste will increase TDS. As a result, it is known that increased water temperature combined with TDS may benefit the zooplankton population in some cases. In the Singanallur Lake, statistical results revealed a favourable association between physico-chemical characteristics of water and zooplankton population. The current findings are consistent who found that zooplankton abundance was highest during the summer season and lowest during the rainy season [31,32].

In this analysis, *Rotifera* was found to have the highest proportion of zooplankton, followed by *Copepoda>Cladocera>Ostracoda*. These findings co-existed with numerous studies [33]. The predominant physico-chemical parameters of the ecosystem determine the distribution and population density of zooplankton. *Rotifers* were observed to be prevalent in groups in which they are markers of eutrophication in the current research, and steps must be taken to reduce water contamination by monitoring human activities in the watershed environment [34,35].

Moreover, *Rotifers* plays a crucial role in energy flow and nutrient cycles, responsible for more than half of zooplankton intake in some freshwater systems [36]. The density of *rotifers* and the features of their communities are used as reliable measures of environmental changes such as acidity, nutrient availability, and humidity [37,38]. Diaptomus sp. species are the *copepods* have seen in current analysis. Moreover, Copepod species distribution and abundance are determined by water depth, clarity, pH, and predators [39].

Conclusion

The current study on the effect of cyclic variations on zooplankton diversification was investigated in the Singanallur Lake located in Coimbatore, South India examines how physico-chemical parameters are used to reflect an ecosystem's abiotic status, as well as biological parameters and zooplankton diversity for water quality regulation of biodiversity and tropic ecosystem. This suggests that temperature has an effect on zooplankton diversity.

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