Journal of Materials and Environmental Science
ISSN : 2028-2508
e-ISSN : 2737-890X
CODEN : JMESCN

J. Mater. Environ. Sci., 2022, Volume 13, Issue 11, Page 1327-1338

http://www.jmaterenvironsci.com

A study on the diversity and community structure of freshwater zooplankton and Ichthyofaunal in Kumaraswamy Lake, Coimbatore district, Tamil Nadu, India

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Received 01 Nov 2022,
Revised 20 Nov 2022,
Accepted 21 Nov 2022

Keywords
- ✓ *Zooplankton*
- ✓ Ichthyofauna,
- ✓ Water quality,
- ✓ Species composition,
- ✓ Kumaraswamy lake.

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Abstract

The monitoring programs of plankton species are essential because they provide information on possible new introductions to ecosystems. They serve as an early warning system to detect the most on set of potentiality hazardous blooms and suggest predictive factors in aquatic ecosystems. The present study focused on the diversity and community structure of freshwater zooplankton and Ichthyofaunal in Kumaraswamy Lake, Coimbatore city, Tamil Nadu. A study was conducted for a period of four months from January-2022 to April-2022. The results from the study revealed that a total of 31 species of zooplankton and 23 species of Ichthyofaunal were identified. The physico-chemical parameters such as water temperature, pH, Salinity, DO, TDS, EC, Alkalinity and Hardness were analysed during the study period. The moderate fluctuation on hydrographical parameters, and they positively supports to the fish cultivation and zooplankton density. The Kumaraswamy Lake is moderately polluted due to various anthropogenic activities, therefore it is recommended that a strict vigilance be maintained and general awareness be crated to ensure proper conservation of this precious water resource and aquatic organisms.

1. Introduction

Aquatic ecosystems are characterized by remarkable for zooplankton and fish diversity. The aquatic ecosystems can be broadly classified in to two types; fresh water and marine water ecosystem. Freshwater ecosystems occupy approximately 0.8% of the earth's surface but supports almost 6% of all know species **[1]**. Freshwater are considered as one of the most essential natural resources for all the living organisms on the earth. The habitats that freshwater ecosystem provide consist of rivers, ponds, lakes and estuaries, streams and etc. Lakes are considered to be the significant watershed, multi-usage components by offering drinking water, irrigation, agriculture output, fishing sector, etc.

The density of plankton in water body determines stocking rate of fishes because they are the chief sources of the food of commercially important fishes as well as development in production of inland fishery sector **[2]**. Plankton are microscopic organisms that drift with water currents, and they reacts quickly to environmental change because of their short life cycle. Any undesirable change in the aquatic ecosystems may affect the diversity and biomass of the plankton community **[3]**. Plankton divided into two groups namely phytoplankton and zooplankton, on their ability to carry out photosynthetic activity.

Zooplankton are the minute, free swimming, microscopic consumers of aquatic ecosystem. Diversity and their ecology greatly contribute to as understanding of the basic nature and general

economy of aquatic habitats. The qualitative and quantitative abundance of zooplankton and relation to environmental condition [4] has become a prerequisite of zooplankton is beneficial for aquaculture process. Zooplankton contribute significantly to the secondary production and occupy an intermediate position [5] in the food web by transferring energy from lower trophic level to higher trophic level thus zooplankton represent an important link in aquatic food chain in fresh water ecosystems [6,7]. The freshwater zooplankton comprise of Rotifera, Cladocera, Copepoda and Ostracoda. The zooplankton communities respond to a wide variety of disturbance including nutrient loading, acidification and sediment of input in an ecosystem. Therefore, they can be used as a tool in monitoring aquatic ecosystems, hence, zooplankton have been considered as ecological importance organisms [8].

Fishes are an important vertebrate group of the animal world and contribute overwhelmingly to global biodiversity and invariably one of the most important biotic components of an aquatic ecosystem which apart from forming protein rich food source for human beings, also act as a bio-indicators of a water body [9]. The study of fish and their stability is important because fish populations very significantly from year to year. The fishes are not only useful for food and recreation, but also act as a tool for biological control by feeding upon the planktonic community in aquatic vegetation [10,11]. Totally 39,000 vertebrates species recognized the world over, 21,723 are living species of fish of which 8411 are fresh water and 11,650 marine species. In the Indian region alone, of the 2500 species, 930 are freshwater inhabitants and 1570 are marine species. Totally 930 freshwater species are identify, it includes 326 genera, 99 families, 20 orders.

Industrialization, urbanization and exploitation of natural resources are major causes for pollution in cities and towns. In India, the industrial development has resulted in the establishment of several industries. As result, water gets contaminated with harmful pollutants and became unsuitable for all the legitimate use including agricultural purpose. The pollutants are mainly toxic chemicals which cause a chain of undesirable effects on water quality and aquatic organisms [12]. The quality of an aquatic ecosystem is mainly dependent on the physical and chemical nature of water and also on biological diversity. The process of eutrophication is driven by an increase in nutrients in the aquatic ecosystems, particularly [13] nitrogen and phosphorus in the ecosystem, which leads to an increase in primary production and an accumulation of organic matter in the lakes. Common sources of cultural eutrophication are due to sewage, erosion of land, and even the air is a source food web [14]. Eutrophication can also have negative impact on the reservoir ecology and as well as the natural stability of the lake, affecting practically all of the biological communities and their interactions in water body. The water quality is defined in terms of the physical, chemical and biological contents of water [15,16].

The objectives of the present study aim to analyses of physico-chemical parameters, freshwater zooplankton and fish diversity in Kumaraswamy Lake, Coimbatore city, Tamil Nadu, India. Limnological studies provide a basic understanding of nature and generally help to monitor the environment. These include the observation of diurnal, monthly and seasonal variations in both the biotic and abiotic components of freshwater ecosystems and finding out the possible relationship among them. This lake also provides habitat for a diversity of life including the migratory birds, aquatic macrophytes, bentic forms, insects, amphibians and reptiles. This lake fed from the rainwater through the year of raining seasons. Species density correlated with physicso-chemical characteristics, provide one of the best ways to detect and evaluate the impact of pollution on aquatic communities.

2. Methodology

2.1 Study area

The Kumaraswamy Lake located in (Lat. 11.01°N and Long.76.94°E) of Coimbatore city, Tamil Nadu, India, is fed by canals derived from Noyyal River and Selva Chinthamani Lake located upstream in the north (**Figure 1**). River Noyyal is known for pollution due to various anthropogenic activities. This lake also receives drainage water. The major activities carried out here are fishing by local fisher man.

2.2 Physico-chemical characteristics of lake water

The surface water samples were collected during the early morning hours (5.00 am to 7.00 AM) at five different sites of the Kumaraswamy Lake. The water samples collected by polythene cans were transported in to laboratory. The physico-chemical parameters, such as Water Temperature (°C), P^H, Salinity (ppt), DO (mg/l), TDS (g/l), EC (µS cm^{-1}), Alkalinity (mg/l) and Hardness (mg/l), Nitrate (mg/l) and Phosphorus (mg/l) were analysed by using "µP Based Water & Soil Analysis Kit" (Model 1160).

2.3 Sample collections of zooplankton and fishes

The zooplankton samples were collected during morning hours (5.00 am to 7.00 AM) from study areas for using Towing-Henson's standard plankton net (mouth diameter 0.35 nm) made up of nylon bolting cloth (mesh size 50 µm) for surface an about 10 min with a uniform speed of the boat (10 Km/h) and fish samples were collected, with a help of local fishermen using different types of nets namely gill nets, cast nets and dragnets. Immediately the photographs were taken prior to preservation since formalin decolorizes the fish color on long preservation. 10% formalin solution was prepared of fish samples. Fishes are transported in to laboratory were fixed in this solution in separate jars according to the size of species.

2.4 Qualitative and quantitative analysis of zooplankton species

The quantitative analysis of plankton samples 100 L of water was filtered through same plankton net and immediately filtering the water and zooplankton biomass was transferred to specimen bottles containing 5% of neutralized formalin and subjected to microscopic analysis. The sample is poured into graduated centrifuge tubes of 10 to 30 mL capacity and revolved in an electric centrifuge for 10–20 min at different rates of revolutions (1500–2000 rpm). After which the supernatant water is removed. A hand operated centrifuge is also useful during staining when the reagents have to be changed frequently. The species were separated under a light microscope by using a fine needle and brush. Individual species of zooplankton were mounted on microscopic slides on a drop of 20% glycerine. The sample (1 ml) was taken with a wide mouthed pipette and poured into the counting chamber of the Sedgwick Rafter. After allowing it to settle for some time, they were counted. At least 5 such counting was made for each group. The species, sex and the developmental stage of the plankton was considered. The average values were taken and total number of zooplankton species present in 1 litter of water sample was calculated **[17]**.

2.5 Identification manuals and data analysis

The zooplankton species were identified by referring the standard manuals, text books and monographs **[18-28]**. The mean and standard deviation of the noted values were calculated and tabulated. The data of the experiment was entered in Microsoft Excel and analyzed using GenStar computer-based statistical data analysis through one-way ANOVA and means were separated by DMRT at a 5% level of significance.

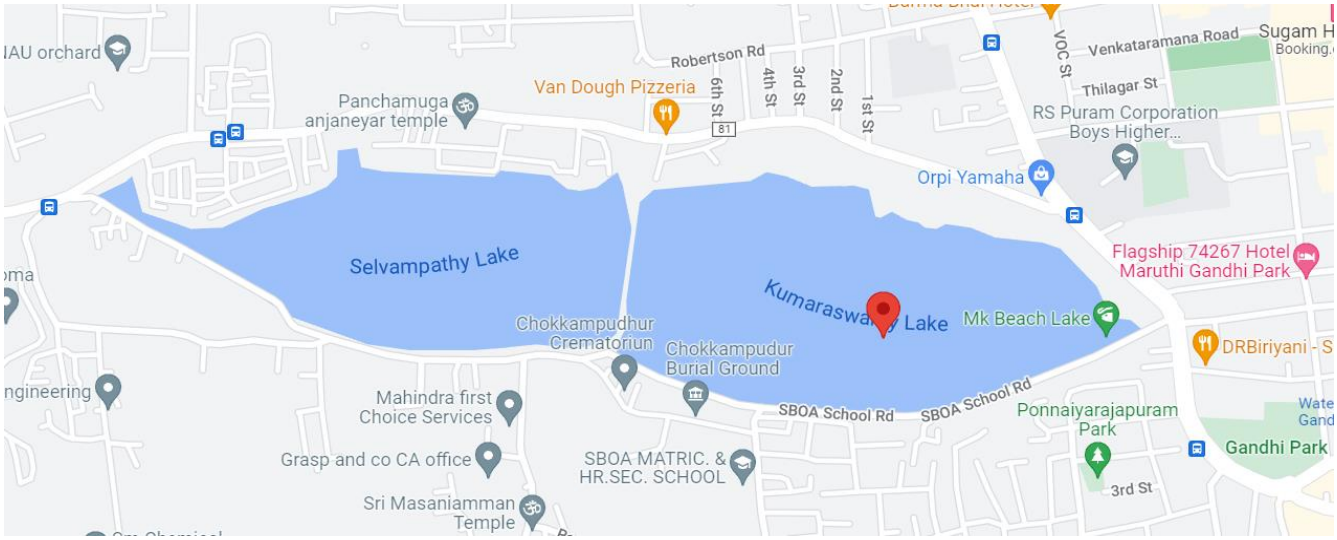

Figure 1. Geographical and satellite view of Kumaraswamy Lake, Coimbatore city

3. Results and Discussion

3.1 Analyses of physico-chemical characteristics of lake water

The physico-chemical parameters, such as Water Temperature (°C), P^H, Salinity (ppt), DO (mg/l), TDS (g/l), EC (µS cm^{-1}), Alkalinity (mg/l) and Hardness (mg/l), Nitrate (mg/l) and Phosphorus (mg/l) was calculated. The physico-chemical parameters have an important role in supporting zooplankton and fish diversity of freshwater ecosystems. The average values of physico-chemical parameters of the Kumaraswamy lake water depicted in the **Table 1**.

The average values of water temperature range between 25.22ºC to 26.38ºC and P^H ranged from 7.42 to 8.32 of Kumaraswami lake during the study period. The salinity was found between 0.728 to 1.168 ppt, the dissolved oxygen was range between 6.26 to 7.63 mg/ L and total dissolved solids respectively range between 1010 to 1021 mg/ L. The total alkalinity range between 72.9 to 92.8 mg/ L and Electrical conductivity range from 1.127 to 2.035(µS cm^{-1}). The total hardness varied from 72.28 to 80.01 mg/ L, nitrate range between 7.82 to 9.22 mg/ L and phosphorus range from 15.58 to 17.98 mg/ L was noticed during the study period from January – 2022 to April- 2022.

Table 1. Analyses of physico-chemical parameters of lake water

Parameters	Jan – 2022	Feb - 2022	Mar - 2022	April - 2022
WT(ºC)	25.22±0.78	26.38±0.75	26.05±1.54	25.37±1.08
P^H	7.44±0.27	8.23±0.36	7.42±0.47	8.32±0.43
Salinity (ppt)	0.863±0.053	1.589±0.222	0.728±0.063	1.168±0.216
DO (mg/l^{-1})	7.16±0.57	6.26±0.12	7.63±0.61	7.21±0.53
TDS (mg/l^{-1})	1012±13.05	1021±24.05	1010±10.02	1016±15.50
EC (µS cm^{-1})	1.127±0.136	2.035±0.224	1.752±0.184	1.460±0.162
Total alkalinity (mg/l^{-1})	72.9±7.98	89.2±7.92	92.8±7.07	83.9±8.02
Hardness (mg/l^{-1})	73.28±1.03	72.28±2.09	78.93±2.03	80.01±1.09
Nitrate (mg/l^{-1})	8.35±0.19	7.82±0.20	8.93±0.22	9.22±0.19
Phosphate (mg/l^{-1})	16.02±0.14	15.58±0.20	17.03±0.26	17.98±0.12

***WT**, water temperature; **DO**, dissolved oxygen; **TDS**, total dissolved solids; **EC**, electrical conductivity.

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 fishes **[29]**, especially zooplankton constitute important food source of many omnivorous and carnivorous fishes **[30]**.

Temperature is very important for lake productivity and associated their animals. The temperature range between 26.38ºC maximum and 25.22ºC was minimum noticed during the study period similarly results were obtained by Venkata Raman Solanki et al. **[31]** . pH study determined whether water is acidic or alkaline. The level of P^H range between 8.32±0.43 maximum and minimum level of P^H range between 7.42±0.47 was recorded during the study period. The maximum DO concentration between 7.63±0.61 mg/L and minimum DO concentration between 6.26±0.12 mg/L was recorded. Presence of DO in water may very useful in photosynthetic activity of autotrophs. The maximum level of electrical conductivity of the water was range between 2.035±0.224 (µS cm-1) and minimum level of electrical conductivity range between 1.127±0.136 (µS cm-1) was recorded. The maximum level of hardness range between 80.01±1.09 mg/ L and minimum level of hardness range between 72.28±2.09 mg/ L was noticed. The environmental conditions which include water temperature, P^H, Salinity, Dissolved Oxygen, Total dissolved solids, Electrical Conductivity and availability of rich nutrients in the form of bacteria, nano-plankton and suspended detritus. The maximum nitrate concentration range between 9.22±0.19 mg/ L and minimum nitrogen concentration range between 7.82±0.20 mg/ L was noticed. The maximum level of phosphorus range between 17.98±0.12 mg/ L and minimum level of phosphorus range between 15.58±0.20 mg/ L was noticed. The process of eutrophication is driven by an increase in nutrients in the aquatic ecosystems, particularly nitrogen and phosphorus in the ecosystem, which leads to an increase in primary production and an accumulation of organic matter in the lakes. Eutrophication can also have negative impact on the reservoir ecology and as well as the natural stability of the lake, affecting practically all of the biological communities and their interactions in water body.

3.2 Morphologically identified zooplankton and fish species in lake water

Totally 31 species of zooplankton were recorded under 04 groups, 12 families and 23 genera, which include 11 species of Rotifera (*Anuraeopsis fissa; Brachionus angularis; Brachionus plicatilis; Brachionus falcatus; Kreatella cochlearis; Asplanchna pridonata; Asplanchna girodi; Mytilinaa canthophora; Lecanea canthinula; Lecanea lunaris; Philodina acuticornis*), 09 species of Cladocera (*Ceriodaphnia reticulate; Ceriodaphnia cortmuta; Daphnia lumholtzi; Diaphanosoma excisum; Simocephalus mixtus; Bosminopsis deitersi; Moina micrura; Moina brachiate; Macrothirix triserialis*), 08 species of Copepoda (*Arctodiaptomus dorsalis; Diaptomus virdus; Heliodiaptomus viduus; Thermocyclops consimilis; Thermocyclops decipiens; Cyclopus affinis; Eucyclops speratus; Macrocyclops albidus*) and 03 species of Ostracoda (*Cypris globosa; Crpretta fontinalis; Potamocypris vilosa*) (**Table 2)**. **Figure 2** shows the family wise composition of freshwater zooplankton species in Kumaraswamy Lake. Totally 23 species of freshwater fishes recorded under 05 orders, 11families and 16 genera, which include 09 species of Cypriniformes (*Catla catla; Cirrihinus mrigala; Cirrihinus reba; Ctenopharyngodon idellus; Cyprinus carpio; Labeo rohita; Labeo calbasu; Labeo fimbratus; Puntis sarana*), 03 species of Ophiocephaliformes (*Channa marulius; Channa punctatus; Channa striatus*), 04 species of Siluriformes (*Mystus carasius; Mystus seenghala; Mysstus vittatus; Clarias batrachus*), 06 species of Perciformes (*Heteropneutus fossilis; Ambassis ranga; Chanda nama; Glossogobius giuris; Tilpia mossambica; Anabas testudineus*) and 01 species of Cyprinodontiformes (*Gambasia affinis*) **(Table 3)**. **Figure 3** shows the family wise composition of Ichthyofaunal in Kumaraswamy Lake.

Table 2. List of morphologically identified zooplankton species in Kumaraswamy lake

Group	Family	Genus	Species	Status
Rotifera (11 species)	Brachionidae	*Anuraeopsis*	*Anuraeopsis fissa*	+++
		Brachionus	*Brachionus angularis*	++++
			Brachionus plicatilis	++++
			Brachionus falcatus	++++
		Kreatella	*Kreatella cochlearis*	+++
	Asplanchnidae	*Asplanchna*	*Asplanchna pridonata*	+++
			Asplanchna girodi	+++
	Mtyinidae	*Mytilinaa*	*Mytilinaa canthophora*	++
	Lecanidae	*Lecanea*	*Lecanea canthinula*	-
			Lecanea lunaris	-
	Philodinidae	*Philodina*	*Philodina acuticornis*	++
Caldocera (09 species)	Daphnidae	*Ceriodaphnia*	*Ceriodaphnia reticulate*	++
			Ceriodaphnia cortmuta	-
		Daphnia	*Daphnia lumholtzi*	++++
		Diaphanosoma	*Diaphanosoma excisum*	++++
		Simocephalus	*Simocephalus mixtus*	++
	bosminidae	*Bosminopsis*	*Bosminopsis deitersi*	+++
	Moinidae	*Moina*	*Moina micrura*	++++
			Moina brachiate	++++
	Macrothricidae	*Macrothirix*	*Macrothirix triserialis*	+++
Copepoda (08 species)	diatomidae	*Arctodiaptomus*	*Arctodiaptomus dorsalis*	-
		Diaptomus	*Diaptomus virdus*	++
		Heliodiaptomus	*Heliodiaptomus viduus*	+++
		Thermocyclops	*Thermocyclops consimilis*	++++
			Thermocyclops decipiens	++++
	cyclopoidae	*Cyclopus*	*Cyclopus affinis*	+++
		Eucyclops	*Eucyclops speratus*	++
		Macrocyclops	*Macrocyclops albidus*	++
Ostracoda (03 species)	Cyprididae	*Cypris*	*Cypris globosa*	+++
			Crpretta fontinalis	++
		Potamocypris	*Potamocypris vilosa*	-

(++++ - Most abundant; +++ - Abundant; ++ - Less abundant; - Rare)

Table 3. List of morphologically identified Ichthyofaunal species in Kumaraswamy Lake

Order	Family	Genus	Species	Status	IUCN Status
Cypriniformes (09 species)	Cyprinidae	*Catla*	*Catla catla*	++++	LC
		Cirrihinus	*Cirrihinus mrigala*	++++	LC
			Cirrihinus reba	++++	LC
		Ctenopharyngodon	*Ctenopharyngodon idellus*	+++	EN
		Cyprinus	*Cyprinus carpio*	++++	VU
		Labeo	*Labeo rohita*	++++	LC
			Labeo calbasu	+++	LC
			Labeo fimbratus	+++	LC
		Puntis	*Puntis sarana*	++	LC
Ophiocephaliformes (03 species)	Channidae	*Channa*	*Channa marulius*	+++	LC
			Channa punctatus	++	LC
			Channa striatus	++	LC
Siluriformes (04 species)	Bagridae	*Mystus*	*Mystus carasius*	+++	LC
			Mystus seenghala	-	LC
			Mysstus vittatus	++	LC
	Clariidae	*Clarias*	*Clarias batrachus*	++	LC
Perciformes (06 species)	Hetropneustidae	*Heteropneutus*	*Heteropneutus fossilis*	+++	LC
	Centropomidae	*Ambassis*	*Ambassis ranga*	++	LC
	Ambassidae	*Chanda*	*Chanda nama*	-	LC
	Gobiidae	*Glossogobius*	*Glossogobius giuris*	++	LC
	Cichlidae	*Tilpia*	*Tilpia mossambica*	++++	NT
	Anabantidae	*Anabas*	*Anabas testudineus*	++	LC
Cyprinodontiformes (01 species)	Poecilidae	*Gambasia*	*Gambasia affinis*	+++	LC

*++++ - Most abundant; +++ - Abundant; ++ - Less abundant; - Rare; (IUCN Status: EX- Extinct; EW, CR, EN, VU, NT -Threatened; LC- Least Concern)

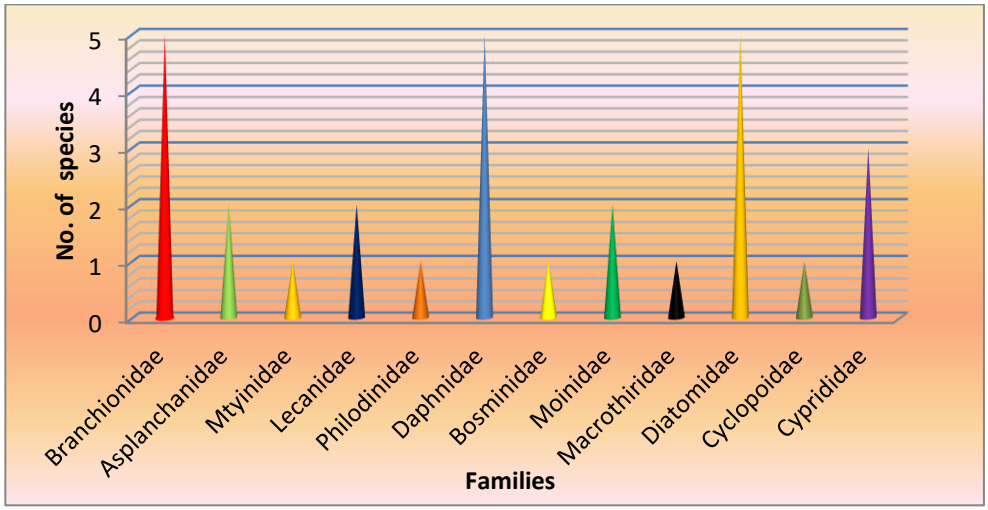

Figure 2. Family wise composition of freshwater zooplankton species in Kumaraswamy Lake.

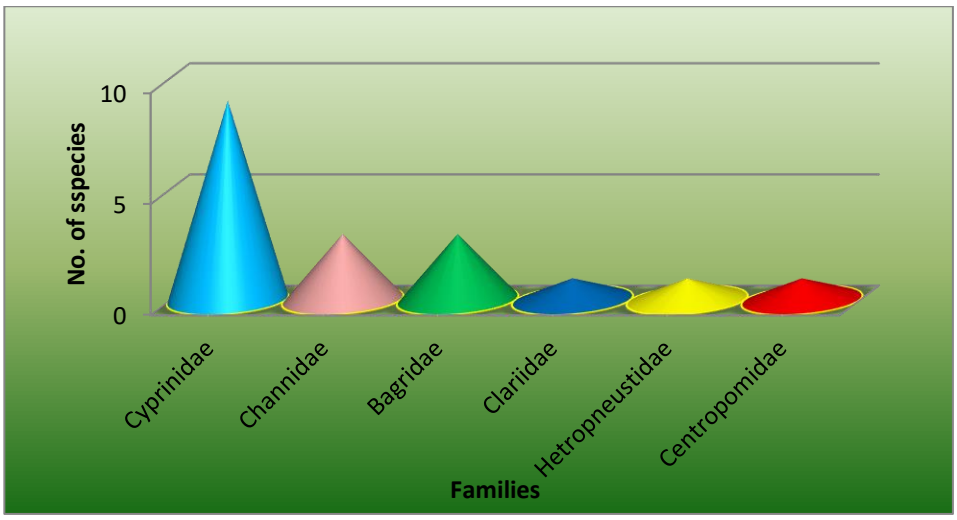

Figure 3. Family wise composition of fresh water Ichthyofaunal species in Kumaraswamy Lake

3.3 Zooplankton and fish density with percentage composition of lake water

The population density of zooplankton was recorded in the range between 3,840 and 4,535 ind./l at Kumaraswamy Lake during the January-2022 to April-2022. The minimum population density was noticed in the following order: January > February > March > April. **Table 4 & Figure 4** represent a brief values and diagrammatic representation of zooplankton density and percentage composition. In the present observation, zooplankton percentage composition shows that the Rotifer holds the top rank at Kumaraswamy Lake. The groups Rotifera were found in predominant with (34%) followed by species of Cladocera (26%), Copepoda (22%) and Ostrocoda with (18%).

The population density of freshwater fishes was recorded in the range between 374 and 490 individuals at Kumaraswamy Lake during the January-2022 to April-2022. The minimum population density was noticed in the following order: January > February > March > April. **Table 5 & Figure 5** represent a brief values and diagrammatic representation of fish density and percentage composition. In the present observation, freshwater fish percentage composition shows that the Cypriniformes holds the top rank at Kumaraswamy Lake. The groups Cypriniformes were found in predominant with (40%) followed by species of Ophiocephaliformes (14%), Siluriformes (17%), Perciformes (24%) and Cyprinodonti-formes with (05%). The study revealed that species diversity and population density of zooplankton, the rotifer was found predominant, followed by Cladocera > Copepoda > Ostacoda. These results were similar to earlier observation by Bhavan et al. **[32]** and Manickam et al. **[7]**. In the present study, the rotifers were found predominant in groups in which they are indicators of eutrophication and measures must be taken to minimize the water pollution by regulating human activities in watershed

Table 4. Zooplankton density with percentage composition in lake water

Plankton groups	Jan- 2022	Feb - 2022	Mar – 2022	Apr -2022	Total (ind./l) &%
Rotifera	1,590±43	1,532±42	1,387±40	1,356±39	5,865 (35%)
Cladocera	1,058±36	1,067±42	998±38	996±32	4,119 (25%)
Copepoda	1,009±37	956±32	853±31	868±27	3,686 (22%)
Ostrocoda	878±27	799±32	710±33	620±30	3,007 (18%)
Total	**4,535**	**4,354**	**3,948**	**3,840**	**16,677**

The population of zooplankton, such as Rotifera, Cladocera, Copepoda and Ostracoda, did not show any swarming phenomena during the study period. However, peak population was noticed in January

> February > March > April. In January, the zooplankton population was found to be higher; it might to be attributed of food (phytoplankton) in the lake ecosystems [33]. Also rich nutrient loading may support the higher phytoplankton production which can ultimately support to zooplankton population [34].

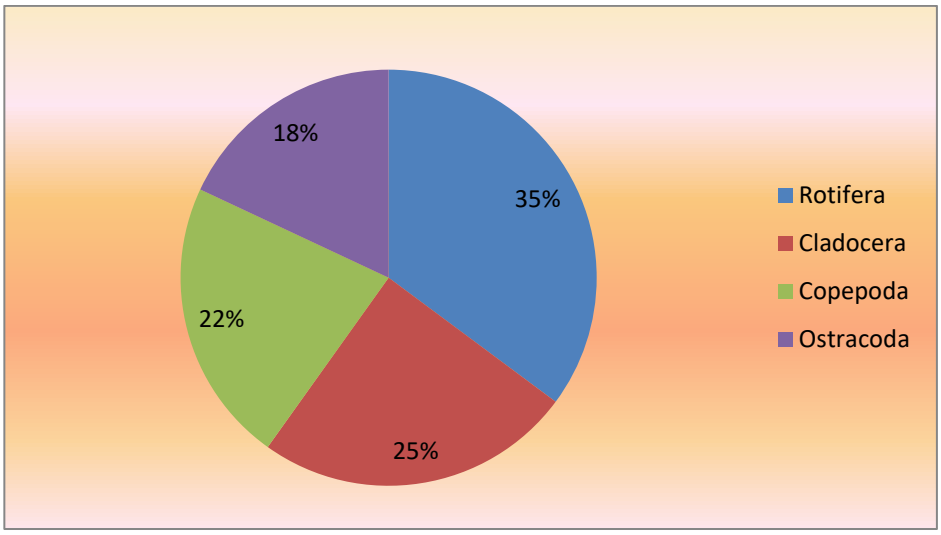

Figure 4. Percentage composition of fresh water zooplankton recorded in Kumaraswamy Lake

Table 5. Ichthyofaunal density with percentage composition in lake water

Fish order	Jan- 2022	Feb - 2022	Mar – 2022	Apr - 2022	Total & %
Cypriniformes	190±10	183±10	150±10	160±10	683 (40%)
Ophiocephaliformes	70±05	60±05	54±05	58±05	242 (14%)
Siluriformes	80±05	75±05	60±05	70±05	285 (17%)
Perciformes	120±10	100±10	90±10	105±10	415 (24%)
Cyprinodontiformes	30±05	25±05	20±05	30±05	78 (05%)
Total	**490**	**443**	**374**	**423**	**1,703**

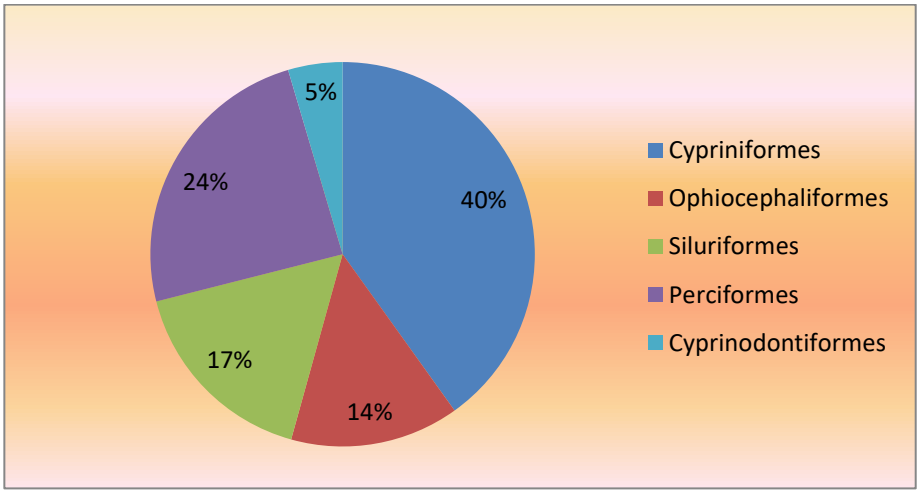

Figure 5. Percentage composition of fresh water Ichythyofaunal recorded in Kumaraswamy Lake

In the group of rotifera *Asplanchna pridonata*, *Asplanchna girodi*, *Brachionus angularis*, *Brachionus plicatilis*, *Brachionus falcatus* are dominant species found during study period and also

very good bio-indicators in aquatic ecosystems. The zooplankton population shows sudden increased in April month and indicates the fact that the prevailed physico-chemical characteristics were not support to the lentic water system. The zooplankton population falls during the April month and Increasing by the month of January.

The freshwater fish species were, family wise comparison reveals that in Cyprinidae, among the nine species were recorded, the most dominat one terms of number was *Catla catla* followed by *Cirrihinus mrigala, Labeo rohita, Labeo calbasu*. Among Channidae, the most dominant species was *Channa punctatus, Channa marulius* and Bagridae it was *Mysstus vittatus, Mystus carasius*. Baillie and Groombridge **[35]** suggested that according to IUCN Red list of threatened animals, 20% were freshwater fishes. As far as biodiversity status (ICUN-1994) is concerned, out of 23 species, 20 fishes are categorized into Least concern (LC) and 03 fishes are categorized threatened (EN, VU, NT). Cyprinidae is the most dominant family recorded during the study period **[36]**. The *Cyprinus carpio* has not only flourished well in aquatic habitats of the Kumaraswamy lake but also provides the maximum fish catch **[37]**. Leveque et al. **[38]** also reported overexploitation, flow modification, destruction of habitats, and invasion by exotic species, pollution and eutrophication as major threats to fish biodiversity. Kumaraswamy lake water is achieved a high trophic status on account of nutrient enrichment from its catchment. Kumaraswamy lake is under eutrophic state as result of human stress in the catchment area.

Conclusion

The results from this study revealed that physico-chemical parameters can positively support the population diversity of freshwater zooplankton and Ichthyofaunal with high evidence from high degree correlation between the temperature, total dissolved solids, temperature, planktons and fish diversity. The data obtained in the present study is also important in variety of manners such as to know the present status of the freshwater zooplankton and fish diversity in the local region it is very helpful for the researchers as well as fishermen's to get an idea about the tolerance and diversity of freshwater fish found in study region Kumaraswamy lake. Use of artificial fertilizers, pesticides and herbicides used nearby areas also affect the indigenous fishes due to the increase of nutrients in water which in turn increase the growth of algal blooms and other macrophytes in the lake. However, Kumaraswamy Lake is moderately polluted and continuous monitoring process can restore the lake ecosystems.

Acknowledgement: The authors are thankful to the PG & Research Department, Department of Zoology, Government Arts College, Coimbatore, 641 018.

Disclosure statement: *Conflict of Interest:* The authors declare that there are no conflicts of interest.
Compliance with Ethical Standards: This article does not contain any studies involving human or animal subjects.

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