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Diversity and Distribution of Planktonic Communities in Krishnampathy Lake, Coimbatore District, Tamil Nadu, India

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ABSTRACT

The present study was carried out to examine the diversity and distribution of planktonic communities in Krishnampathy Lake (Latitude of 11^{0}00.283'N and Longitude 76^{0}55.237'E), Coimbatore, Tamil Nadu, India. The study includes a collection of water samples and biomass. The collected water samples were subjected for assessment of various physico-chemical parameters such as temperature, pH, BOD, COD, TDS, total hardness, calcium hardness, ammonium, nitrate, nitrite, fluoride, chloride and residual chlorine. The biomass was subjected to diurnal quantitative and qualitative analysis. Quantitative analysis revealed a high proportion of total biomass in the evening sample (0.30 ± 0.01 g/l). Zooplankton: Phytoplankton ratio of about 1:23 against morning sample of 1:65 respectively. Hundred grams of biomass collected from Krishnampathy Lake yields (32.50 ± 0.64 g) of protein to the aquatic food web. The Chlorophyceae among the phytoplankton communities and Copepoda among the zooplankton communities were widely distributed in the waters of Krishnampathy Lake, which is assessed to have poor water qualities. Therefore, it is recommended for species conservation by eliminating pollution hazards for aquaculture management.

Keywords Biomass, Food web, Planktology, Chlorophyceae, Copepoda.

INTRODUCTION

Water is one of the most important natural resources required essentially for the life and health of living organisms. It has been estimeted that there are 1,386 million cubic kilometers of water on Earth. The salt-water accounts for 97.5% of this amount, whereas freshwater accounts for only 2.5%. Of this freshwater, 68.9% is in the form of ice and permanent snow cover in the Artic, Antarctica, and mountain glaciers, 30.8% is in the form of fresh groundwater; and only 0.3% of the freshwater on Earth is in easily accessible lakes, reservoir and river systems (Shiklomanov 1998). 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 (Venkateshraju et al. 2010). 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 (Deepak

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and Singh 2014). A lake ecosystem includes biotic (living) plants, animals and micro-organisms as well as abiotic (non-living) physical and chemical interactions (Brown 1987). Plankton is the diverse collection of organisms that live in large bodies of water and are unable to swim against water current. The individual organisms constituting plankton are called plankters. These organisms include bacteria, archaea, algae, protozoa and drifting or floating animals that inhabit the pelagic zone of water bodies. The study of plankton is termed as planktology. Plankton are primarily divided into broad functional (or trophic level) groups namely– Phytoplankton, Zooplankton, Bacterioplankton and Mycoplankton.

Plankton biomass is the mass of living biological organisms in a given area or ecosystem at a given time. The biomass provides information on the energy available to support the food web. It plays a very important role in wetland food chain both in terms of recycling nutrients and providing food for larger animals, sometimes called the lower food web. Plankton is also found to support the aquaculture as they are used as feed to many larva and fishes. It is also estimated that about 50% of the world's oxygen is produced via phytoplankton photosynthesis (Roach 2004). Hence, the present work was carried out on assessment of physico-chemical parameters, species diversity, population density, population ratio and diurnal distribution of plankton communities in Krishnampathy Lake, Coimbatore District of Tamil Nadu, India.

MATERIALS AND METHODS

Description of the study site

The aquatic system chosen for the present investigation is a lake situated in Coimbatore and referred to as Krishnampathy Lake (Fig. 1) with the Latitude of $11^{0}00.283$'N and Longitude $76^{0}55.237$'E. This wetland is situated west of Coimbatore city on Thadagam to Thondamuthur road and close to Seeranaickenpalayam. The bund of the lake starts from the Sugarcane Breeding Institute and ends at TNEB substation. The storage capacity of the lake is 7.67 MCFT (Irrigation Memoir), the current storage capacity is 8.48 MCFT (AFPRO). The water level in FTL is 11 m (Irrigation Memoir) and current water level is 2.98 m (AFPRO). The catchment area is 26 sq km (water shed Atlas). The lake has two main feeding sources, namely Koilmedu and Karperayan and it also receives water from the Noyal River through the Chitrachavadi. The major activities carried out here are fishing and

Fig. 1. Map showing Krishnampathy Lake, Coimbatore District, Tamil Nadu, India.

agriculture. The common carps found are *Catla catla, Labeo rohita, Cirrhinus mrigala.*

Collection of water samples

The water sample was collected during the early morning (5–6 AM) and evening (6-7 PM) from a depth of 0.5 to 1.0 meter for assessing the quantitative analysis of physico-chemical parameters. The water samples were collected in pre-cleaned plastic bottles for analysis of physico-chemical properties.

Analysis of physico-chemical parameters

Temperature and pH of the lake water were measured at the time of sample collection by using a digital thermometer and narrow range pH strips (Fisher Scientific 10140 Indicator papers). While other parameters such as total dissolved solids, biochemical oxygen demand (3 days incubation: 27^0C), total hardness, chemical oxygen demand were estimated by using standard methods (APHA 2017). The total alkalinity, nitrite, nitrate, ammonium, fluoride, chloride, residual chlorine and calcium hardness were analyzed using water testing kit purchased from nice chemicals Pvt Ltd, India.

Collection of biomass

The biomass of plankton sample was collected during morning and evening time by filtering 100 liters of water in plankton net made up of bolting silk (No, 10, mesh size 150 μm). Plankton biomasses were transferred to the specimen bottles (per filed with 5% formalin) and subjected to microscopic analysis.

Qualitative analysis of plankton

The biomass sample was analyzed using a hand (XC-SOURCE 1600X 8LED USB 2.0 Zoom) Digital Microscope, Binocular Microscope (Labomed-CXR2) at 40X magnification and Trinocular Microscope (CETI-IS-300) at 20X magnification. The feasibility of Digital Microscope, Binocular Microscope and Trinocular Microscope were studied by observing the same species. Then the phytoplankton and zooplankton were identified using standard manuals and monographs (Santhanam et al. 1989, Anand 1989, 1998, Sridharan 1989, Altaff 2004, Manickam et al. 2019a, 2019b).

Table 1. Physico-chemical parameters of Krishnampathy Lake water. Data obtained as a result of triplicate analysis expressed as Mean ± SD. All values are significant at $p \leq 0.05$.

Sl. No.	Parameters	Estimated mean
1.	Temperature (^{0}C)	20.97 ± 0.45
2.	pH (Numbers)	9.00 ± 0.20
3.	Total dissolved solids (mg/l)	559.83 ± 1.25
4.	BOD (mg/l)	21.79 ± 1.03
5.	COD (mg/l)	112.5 ± 1.61
6.	Total hardness (mg/l)	373.9 ± 0.70
7.	Calcium hardness (mg/l)	145.16 ± 0.76
8.	Total alkalinity (mg/l)	755 ± 1.00
9.	Nitrate (mg/l)	145.16 ± 0.76
10.	Nitrite (mg/l)	0.70 ± 0.53
11.	Ammonium (mg/l)	2.80 ± 0.10
12.	Fluoride (mg/l)	0.50 ± 0.10
13.	Chloride (mg/l)	450 ± 1.00
14.	Residual chlorine (mg/l)	0.08 ± 0.01

Quantitative analysis of plankton

The quantitative analysis of plankton was done by using a counting cell of the Neubauer's chamber. For the estimation of phytoplankton and zooplankton ratio, the total number of phytoplankton and zooplankton was taken into consideration and subdivided by an integer. The ratios are represented as zooplankton : phytoplankton.

Quantitative analysis of biomass

The collected biomass sample was taken to the laboratory and weighed (grams wet weight/100 liter). Then the difference in a wet weight of biomass between morning and evening sample is noted and the values are compared.

Biochemical analysis of biomass

The total protein in biomass was estimated by Lowry et al. (1951) method, the carbohydrate content of the biomass sample was estimated by Roe (1955) method and the total lipid content was estimated by Folch et al. (1957) method.

RESULTS

Physico-chemical parameters of Krishnampathy Lake

The physico-chemical parameters of the Krishnampathy Lake water were represented in Table 1.

Table 2. Diurnal distribution of plankton and biomass. Data obtained as a result of triplicate analysis expressed as Mean ± SD. All values are significant at p≤0.05.

Plankton and biomass	Estimated mean
Total zooplankton in Morning sample (Count/l)	2000 ± 300
Total phytoplankton in Morning sample (Count/1)	129,833.33 ± 763.76
Total zooplankton in Evening sample (Count/l)	4933.30 ± 404.14
Total phytoplankton in Evening sample (Count/l)	116000 ± 500
Total biomass in Morning (g/l)	0.26 ± 0.10
Total biomass in Evening (g/l)	0.30 ± 0.01

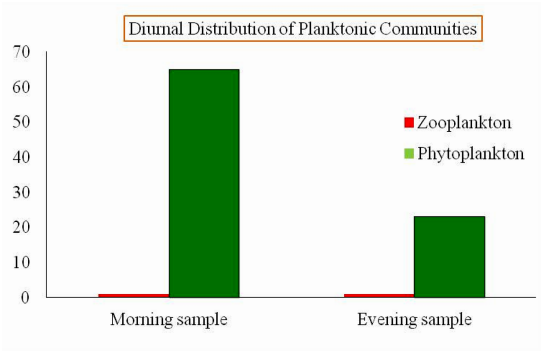

Fig. 2. Diurnal distribution of planktonic communities.

Diurnal distribution of plankton and biomass

The total zooplankton in morning sample (Count/l) was estimated as 2000 ± 300 and total phytoplankton in the morning sample (Count/l) was estimated as 129,833.33 ± 763.76. The ratio between zooplankton : phytoplankton in the morning sample was found as 1:65. The total zooplankton in evening sample (Count/l) was estimated as 4933.30 ± 404.14 and the total phytoplankton in evening sample (Count/l) was estimated as 116000 ± 500. The ratio between zooplankton : phytoplankton in the evening sample was found as 1: 23. The total biomass in morning (g/l) was found as 0.26 ± 0.10 and the total biomass in evening (g/l) was found as 0.30 ± 0.01 and is represented in Table 2 and Figure 2.

Biochemical indices of biomass from Krishnampathy Lake

The biochemical indices of biomass collected from Krishnampathy Lake are represented in Table 3 and Figures 3 and 4. The level of protein (32.50 ± 0.64) was found higher followed by carbohydrate (19.30 ± 0.31) and least value of lipid (0.003 ± 0.0001) is recorded.

Table 3. Biochemical indices of biomass from Krishnampathy Lake. Data obtained as a result of triplicate analysis expressed as Mean ± SD. All values are significant at p ≤ 0.05.

Sl. No.	Parameters	Value (g/100 g)
1.	Protein	32.50 ± 0.64
2.	Carbohydrate	19.30 ± 0.31
3.	Lipid	0.003 ± 0.0001

Phytoplankton diversity

Table 4 and Figure 5 represents the phytoplankton diversity in Krishnampathy Lake. Various members of the group include Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae (Figs. 6—10).

Zooplankton diversity

Table 5, Figure 11 represents the zooplankton diversity recorded in Krishnampathy Lake. It includes various groups namely : Rotifera, Cladocera, Copepoda and Ostracoda.

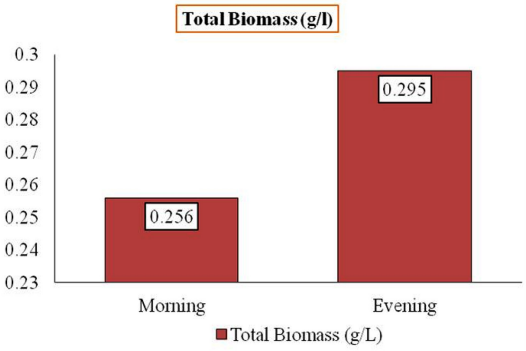

Fig. 3. Total biomass (g/l).

Table 4. Phytoplankton diversity in Krishnampathy Lake.

Group	Family	Genus	Species
Cyanophyceae (Sachs 1874) (Blue-green algae)	Chroococcaceae	*Chroococcus*	*Chroococcus mineetes*
			Chroococcus varius
	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria cortiana*
			Oscillatoria subbrevis
	Phormidiaceae	*Phormidium*	*Phormidium granulatum*
	Spirulinaceae	*Spirulina*	*Spirulina meneghiniana*
	Merismopediaceae	*Synechocystis*	*Synechocystis aquatilis*
Chlorophyceae (Willein Warming 1884) (Green algae)	Chlorellaceae	*Chlorella*	*Chlorella vulgaris*
	Closteriaceae	*Closterium*	*Closterium strigosum*
	Scenedesmaceae	*Crucigenia*	*Crucigenia tetrapedia*
	Hydrodictyaceae	*Pediastrum*	*Pediastrum tetras*
	Scenedesmaceae	*Scenedesmus*	*Scenedesmus acuminatus*
			Scenedesmus quadricauda
Bacillariophyceae (Haeckel 1878) (Diatorms)	Zygnemataceae	*Spirogyra*	*Spirogyra hyaline*
	Chlorococcaceae	*Tetradron*	*Tetradron regulare*
	Trebouxiaceae	*Trebouxia*	*Trebouxia humicola*
	Ulothricaceae	*Ulothrix*	*Ulothrix zonata*
	Catenulaceae	*Amphora*	*Amphora coffeaformis*
	Fragilariaceae	*Fragilaria*	*Fragilaria capucina*
	Gomphonemataceae	*Gomphonema*	*Gomphonema lanceolatum*
	Naviculaceae	*Navicula*	*Navicula cuspidate*
			Navicula subrynchocephala
	Pinnulariaceae	*Pinnularia*	*Pinnularia borealis*
Euglenophyceae	Euglenaceae	*Euglena*	*Euglena acus*
			Euglena proxima
		Phacus	*Phacus pleuronectes*

DISCUSSION

In the present study the number of phytoplankton was comparatively higher than the zooplankton in Krishnampathy Lake. The proportion of phytoplankton was relatively higher in the morning sample (129,833.33 ±763.76) when compared to the evening sample (116000 ± 500) . In contrast the proportion of zooplankton significantly increased in the evening sample (4933.30 ± 404.14) when compared to the morning sample (2000 ± 300). The total biomass in the evening sample (0.30 ± 0.01) significantly increased in comparison with the morning sample (0.26 ± 0.10).

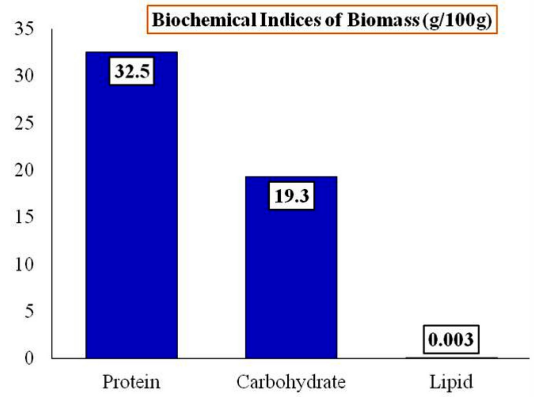

Fig. 4. Biochemical indices of biomass from Krishnampathy Lake.

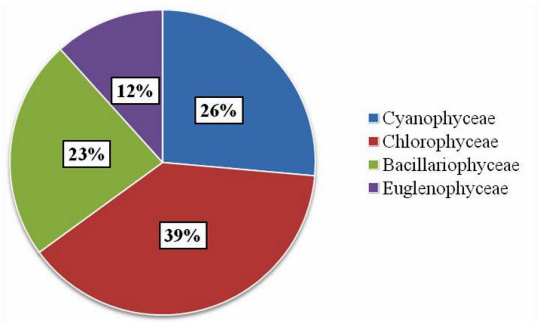

Fig. 5. Percentage composition of phytoplankton recorded in the Krishnampathy Lake.

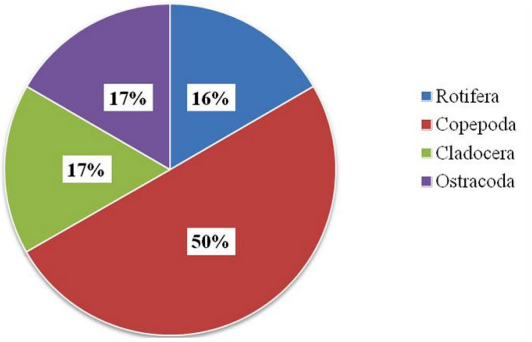

Fig. 6. Percentage composition of zooplankton recorded in Krishnampathy Lake.

The proportion of protein (32.50 ± 0.64) in the biomass was noticeably higher followed by carbohydrate (19.30 ± 0.31) and lipid (0.003 ± 0.0001).

The members of Chlorophyceae (39%) occupied a major percentage among phytoplankton recorded in Krishnampathy Lake, followed by Cyanophyceae (26%), Bacillariophyceae (23%), Euglenophyceae (12%). Notable family of the group Cyanophyceae includes Spirulinaceae which includes the species *S. meneghiniana* widely distributed in the water of Krishnampathy Lake. Among the zooplankton an Order Copepoda occupies a major proportion which includes 3 species namely : *T. hyalinus, M. leuckarti, E. speratus.*

Table 5. Zooplankton diversity in Krishnampathy Lake.

Group (Phylum /Class/Order)	Family	Genus	Species
Phylum : Rotifera	Brachionidae	*Brachionus*	*Brachionus calyciflorus*
		Thermocyclops	*Thermocyclops hyalinus*
Phylum : Arthropoda	Cyclopidae	*Mesocyclops*	*Mesocyclops leuckarti*
Order : Copepoda		*Eucyclops*	*Eucyclops speratus*
Order : Cladocera	Daphnidae	*Ceriodaphnia*	*Ceriodaphnia cornuta*
Class : Ostracoda	Cyprididae	*Cypris*	*Eucypris bispinosa*

Diel vertical migration (DVM) of zooplankton is commonly considered adaptation for feeding in food-rich and warm surface waters at night and avoiding visual predators during the day. Diel vertical migra-

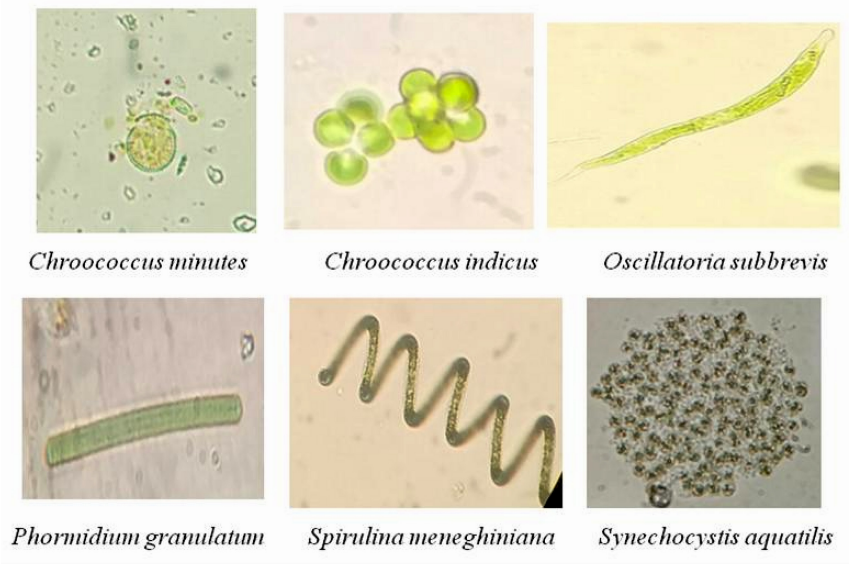

Fig. 7. Distribution of various members in the group Cyanophyceae.

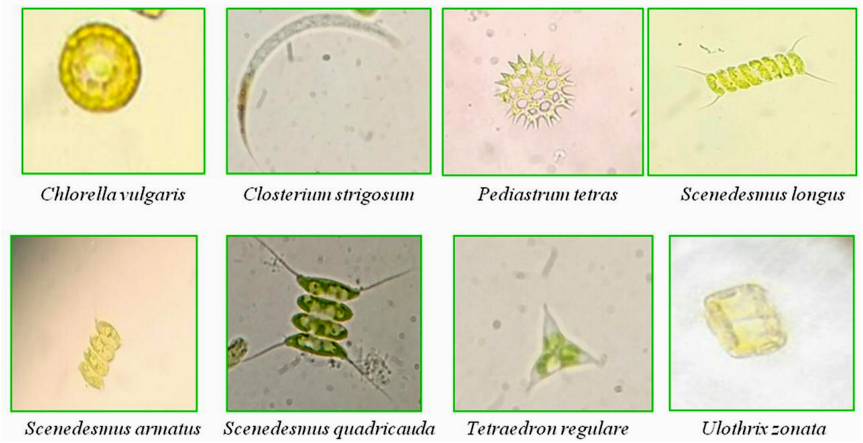

Fig. 8. Distribution of various members in the group Chlorophyceae.

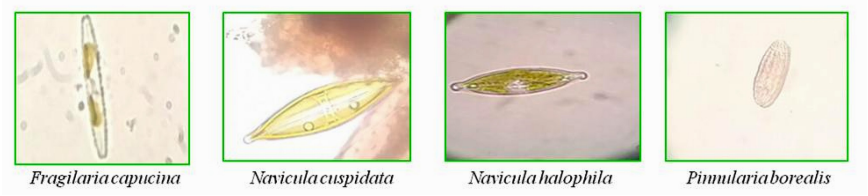

Fig. 9. Distribution of various members in the group Bacilariophyceae.

tion in *Daphnia* is apparent and studied by Wicklum (1999) and therefore their population in a lake is not affected by predatory fishes. Jindal (2005) studied diel variation in phytoplankton and zooplankton of a pond. The study reported a correlation between diel variation in relation to light, dissolved oxygen, pH, carbonates and bicarbonates. The similar results are obtained in the present study with recorded temperature of 20.97 ± 0.45 and pH of 9 ± 0.20 correlates with the zooplankton distribution showing a similar pattern of their distribution. Contradictory results were obtained by Abbasi et al. (2018) showing higher proportion of total zooplankton (73.91%) in day time and (64.41%) in night time of station 2 also Copepods comprising 64.9% in day time and 54.97% in the night time.

A wide distribution of phytoplankton in the

Fig. 10. Distribution of various members in the group Euglenophyceae.

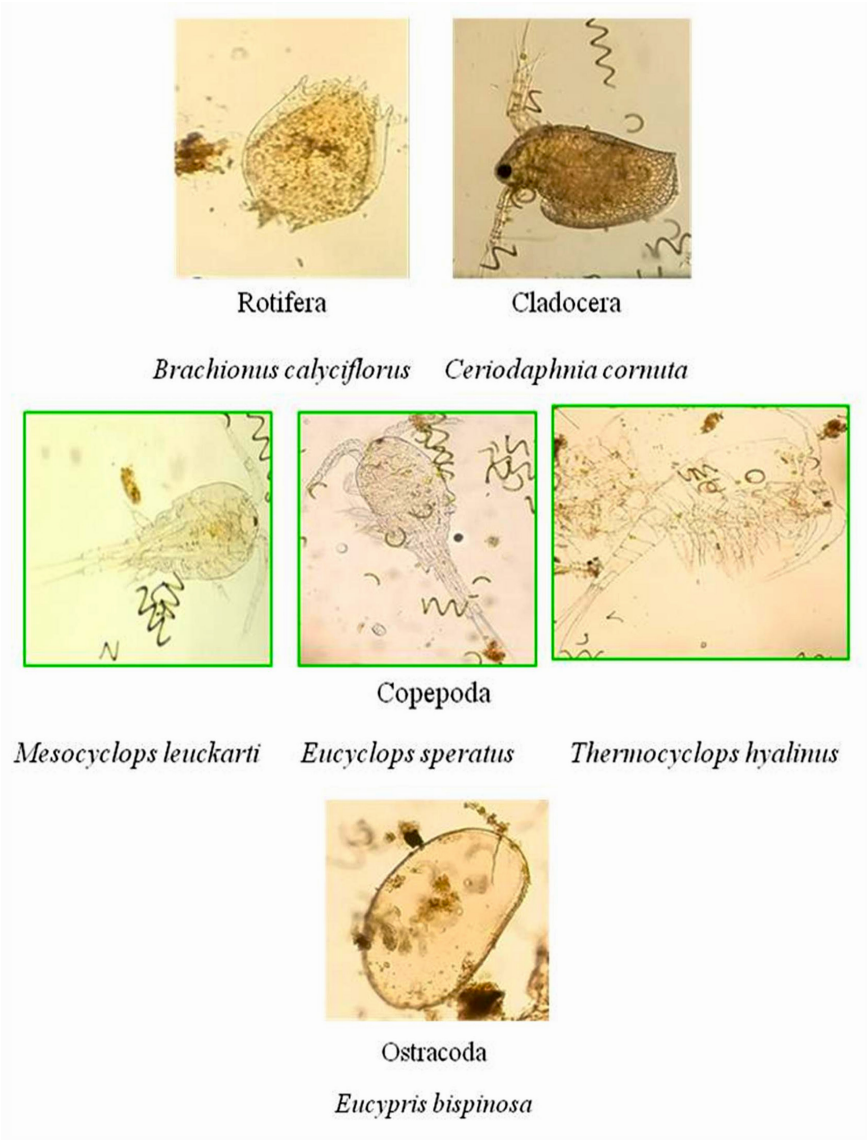

Fig. 11. Distribution of various members in the group Zooplankton.

Krishnampathy Lake signifies its high primary productivity as plankton are considered an index of fertility of water column. Lorenzen (1963) studied a correlation between day length photosynthetic activity of natural phytoplankton population. The higher pH of 9 ± 0.20 is assumed to favor for the dominance of Copepods in contrast to the low pH (6.7-8.4) favoring the dominance of Ostracoda and Rotifera in the study of Manickam et al. (2015, 2018) and Kalpana et al. (2017).

Earlier phytoplankton was studied using a small handheld microscope with an LED lamp (40X-100X magnification). In the present study USB, Digital Microscope was used to identify the phytoplankton and zooplankton and its suitability in plankton investigations is reported. Moreover, hand-held microscope and USB Digital Microscope were used in the field

of Parasitology to identify parasite. Holmstrom et al. (2017) investigated soil-transmitted helminths and *S. haematobium* using mobile digital microscope.

In the present study phytoplankton and zooplankton were viewed under USB Digital Microscope and analysis was done for species identification. The suitability of USB Digital Microscope in planktology was checked against a Binocular and Trinocular Microscope. The photographic evidence satisfactorily proves the feasibility of USB Digital Microscope in plankton studies and comparatively a simple and reliable technique in plankton identification.

CONCLUSION

It can be concluded that Krishnampathy Lake is rich in phytoplankton density and find a suitable site for herbivorus fish farming. The Chlorophyceae among the phytoplankton communities and Copepoda among the zooplankton conmmunities were widely distributed in the waters of Krishnampathy Lake, which is assessed to have poor water qualities. Therefore, it is recommended for species conservation by eliminating pollution hazards. The use of USB Digital Microscope was also found to be feasible in planktology.

REFERENCES

Abbasi JM, Abbasi Z, Khokhar NF, Siddiqui AJP (2018) Day-Night distribution, composition and abundance of zooplankton groups in coastal waters along Karachi coast of North Arabian Sea, Pakistan. J Entomol and Zool Studies 6 (5) : 603—611.

Altaff K (2004) A Manual of Zooplankton. Published by Department of Zoology, The New College, Chennai, India, pp 1—145.

Anand N (1989) Handbook of Blue -Green Algae, Bishen Singh, Mahendra Pal Singh, Publishers, Dehra Dun, India, pp 1—79.

Anand N (1998) Indian Freshwater Microalage, Bishen Singh, Mahendra Pal Singh, Publishers, Dehra Dun, India, pp 1—94.

APHA (2017) Standard Methods. In : Baird BR, Eaton DA, Rice WE (eds). 23rd edn. American Public Health Association, Washington, USA.

Brown AL (1987) Freshwater Ecology. Heinimann Educational Books, London, pp 163.

Deepak S, Singh NU (2014) The relationship between physico-chemical characteristics and fish production of mod sagar Reservoir of Jhabua District, MP, India. Res J Recent Sci 3 : 82—86.

Folch J, Lesd MD, Sloane-Stanley GH (1957) Simple method of-isolation and purification of total lipids fromo animal tissues. J Biochem 226 : 297—308.

Holmstrom O, Linder N, Ngasala B, Martensson A, Linder E, Lundin M, Moilanen H, Suutala A, Diwan V, Ludin J (2017) Point-of-care mobile digital microscopy and deep learning for the detection of soil-transmitted helminths and *S. haematobium*. Global Health Action !0 (3) : In press. DOI : 10.1080/16549716.2017.1337325.

Jindal R (2005) Diurnal variations in plankton in relation to hydrobiological factors of a fresh water pond. Proc Zool Soc Calcutta, India 58 (1) : 43—49.

Kalpana R, Bhavan SP, Udayasuriyan R (2017) Water physico-chemical characteristics, species diversity and density of zooplankton in two perennial lakes of Coimbatore city (India). Ann Res Rev Biol 15 (4) : 1—17. DOI : 10.9374/ARRB/2017/34749.

Lorenzen CJ (1963) Diurnal variation in photosynthetic activity of natural phytoplankton populations. Limnol and Oceanogr 8 (1) : In press.

Lowry OH, Rosebrough JN, Farr LA, Randall JR (1951) Protein measurement with folin phenol reagent. J Biol Chem 193 : 265—275.

Manickam N, Bhavan PS, Santhanam P, Bhuvaneswari R, Muralisankar T, Srinivasan V, Asaikkutti A, Rajkumar G, Udayasuriyan R, Karthik M (2018) Impact of seasonal changes in zooplankton biodiversity in Ukkadam Lake, Coimbatore, Tamil Nadu, India, and potential future implications of climate change. J Basic and Appl Zool 79 (15) : 1—10.

Manickam N, Bhavan PS, Santhanam P, Muralisankar T, Dinesh Kumar S, Balakrishnan S, Ananth S, Shenbaga Devi A (2019a) Phytoplankton biodiversity in the two perennial lakes of Coimbatore, Tamil Nadu, India. Acta Ecologica Sinica Ref: CHNAES658.

Manickam N, Bhavan PS, Santhanam P, Muralisankar T, Srinivasan V, Vijayadevan K, Bhuvaneswari R (2015) Biodiversity of freshwater zooplankton and physico-chemical parameters of Barur Lake, Krishnagiri District, Tamil Nadu, India. Malaya J Biosci 2 (1) : 1—12.

Manickam N, Santhanam P, Bhavan PS (2019b) Techniques in Collection, Preservation and Morphological Identification of Freshwater Zooplankton. In : Santhanam P, Begum A, Perumal P (eds). Basic and Applied Zooplamkton Biology Springer, pp 139—195. doi.org/10.1007/978-981-10-7953-5_5.

Roach John (2004) Source of Half Earth's Oxygen Gets Little Credit. National Geographic News.

Roe JH (1955) The determination of sugar in blood and spinal fluid with anthrone reagent. J Biol Chem 153 : 373—380.

Santhanam R, Velayutham P, Jegatheesan G (1989) A Manual of Freshwater Ecology. Daya Publising House, Delhi, India pp 1—109.

Shiklomanov AI (1998) World Water Resources. UNESCO.

Sridharan VT (1989) Phytoplankton and algae studies techniques of plankton methodology, integrated environment program of research on the River Kaveri a training workshop on freshwater phytoplankton. Sridharan V (ed). National College,

Tirchirapalli, Tamil Nadu, India.
Venkateshraju K, Ravikumar P, Somashekar RK, Prakash KL (2010) Physico-chemical and bacteriological investigation on the River Cauvery of Kollegal stretch in Karnataka. Engg Sci and Technol 6 (1) : 50—59.
Wicklum D (1999) Variation in horizontal zooplankton abundance in mountain lakes : Shore abundance of fish predation. J Plankton Res 21 (10) : 1957—1975.

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