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RESEARCH ARTICLE

QUALITATIVE PATTERN OF PHYTOPLANKTON DIVERSITY IN TWO LAKES OF UDUPI DISTRICT, KARNATAKA, INDIA

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ABSTRACT

Phytoplankton diversity is an important criterion for evaluating the suitability of water for irrigation and drinking purposes. Phytoplankton composition of Chantaru lake, Brahmavara and Manipalla lake, Manipal was studied for a period of one year from June 2013 to May 2014 (see Fig.1).The physicochemical parameters of water such as water temperature, dissolved oxygen, water pH, biological oxygen demand, nutrients such as nitrates and phosphates ware observed and their ranges were 24.5º –30.7º c, 5.59–11.40µg/l, 6.74 – 9.49, 2.89–5.61 µg/l, 21.3–36.5 µg/l, 0.12–4.91 µg/l and 0.21–5.24 µg/l. During the period of investigation 33 species of phytoplankton representing five taxonomic groups such as Cyanophyceae, Chlorophyceae, Euglenophyceae, Bacillariophyceae and Dinophyceae. The Chlorophyceae is dominant than all other forms.

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INTRODUCTION

Phytoplankton is one of the most rapid detectors of environmental changes pollution stress reduces the number of algal species but increases the number of individuals. Planktonic abundance, distribution, and production in aquatic environment have received considerable attention in India, but little or no data is available particularly in the lakes of Udupi District. Keeping this in mind the present research investigation has been undertaken. The deterioration of inland water has been increasing since the five decades at an alarming rate (Wetzel 1975; Golterman 1975; Hillbricht and Ilkowska, 1978) due to water pollution, the main factor being the discharge of sewage and toxic chemicals from industries to the water bodies .Agriculture with its extensive use of fertilizers and pesticides emerges as the major factor in the further deterioration of inland water, increasing nutrient status in the lake ecosystem and thus making the lake Eutrophicated. This has a direct impact on BOD levels which in turn leads to cause of rapid growth of plankton and algae and other micro-organisms which in turn consume more O_2 that leads to depletion of BOD levels which will be causing the death of aquatic flora. Investigation on the qualitative composition of phytoplankton in freshwater lakes provides valuable information on the quantum of energy or food available to the tertiary consumers which have normally the fishes.

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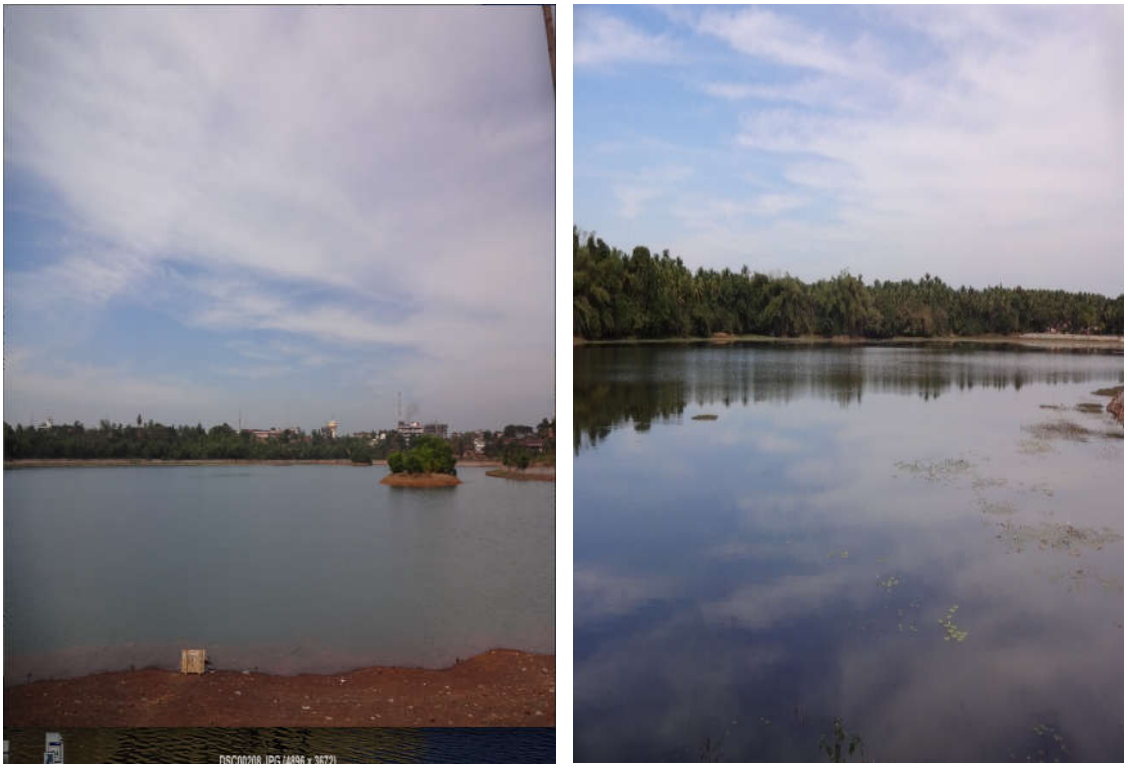
MATERIALS AND METHODS

Two lakes have been selected from Udupi district of Karnataka. Manipalla lake, Manipal, and Brahmavara, Chantaru lake. Five Sampling stations will be selected in each lake. The water samples will be collected twice in a month from the selected sampling sites. The water samples will be analyzed for water temperature, dissolved oxygen, BOD, COD, pH, nutrients like phosphate and nitrates and the phytoplankton will be analyzed following the standard methods for the examination of water analysis.

Phytoplankton collection and analysis

Phytoplankton samples will be collected using a Heron-Tranter net (length 1.2m, mouth area 0.25m² with the mesh size of 60µ). Samples will be fixed in 4% formalin and later preserved in 2% formalin in the laboratory for further analysis. In the laboratory, 200µ mesh size nylon netting will be used to separate the phytoplankton from zooplankton. Phytoplankton cells will be identified and expressed in terms of a number of cells per cubic meter. The collection, identification, and enumeration of plankton will be done following the methods



(a) (b)

Fig. 1. a) Manipalla lake Manipal b) Chantaru lake Brahmavara, Lake overview of 2 lakes in winter

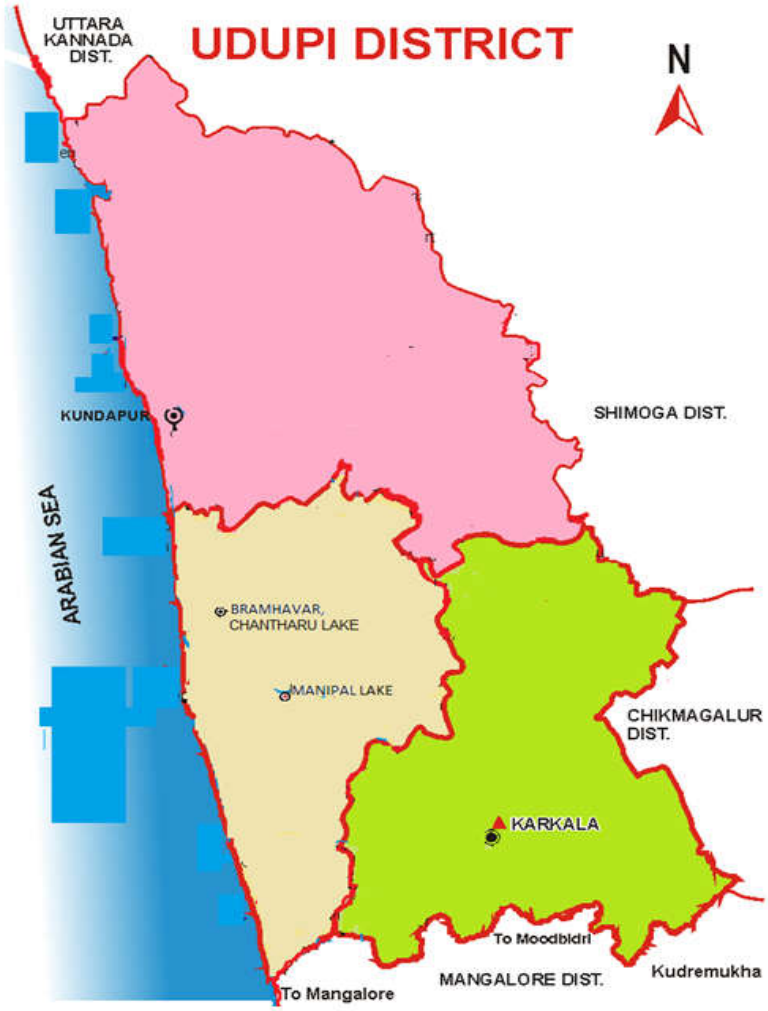


Fig. 2. Map shows different locations of lakes in Udupi district

Table 1. Water temperature (°C) in the two Lakes, studied

Months	2013														2014							
	JUN		JUL		AUG		SEP		OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY	
Water Body	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Chantharu Lake	28.0	27.0	27.0	26.5	25.0	27.4	28.0	27.4	26.0	28.1	26.7	25.1	23.0	23.5	24.5	25.1	29.4	27.4	28.8	27.8	28.0	29.7	29.0	29.1
Manipalla Lake	30.1	29.1	30.0	27.8	25.8	30.7	29.0	30.1	27.2	30.7	27.0	26.1	23.6	23.8	25.0	27.4	30.0	30.4	30.1	31.4	29.4	31.8	30.0	30.2

Table 2. Dissolved Oxygen (µg/l) in the two Lakes, studied

Months	2013														2014							
	JUN		JUL		AUG		SEP		OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY	
Water Body	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Chantharu Lake	7.41	6.76	8.74	5.84	6.85	8.55	6.13	6.75	7.83	8.64	8.64	8.60	7.40	7.01	6.81	6.74	5.43	6.65	6.23	6.10	5.59	4.86	5.60	5.45
Manipalla Lake	8.22	9.54	12.33	8.11	8.16	11.32	9.21	8.86	8.66	10.3	11.40	11.03	9.35	8.57	10.46	7.87	6.83	8.61	5.83	6.86	9.33	7.84	7.11	6.25

Table 3. pH of Water in the two Lakes studied

Months	2013														2014							
	JUN		JUL		AUG		SEP		OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY	
Water Body	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Chantharu Lake	8.0	8.10	8.15	8.24	8.24	8.82	8.29	8.24	8.13	8.39	8.09	8.08	7.80	8.09	8.00	7.50	7.40	7.17	7.79	6.85	6.74	6.94	6.87	6.88
Manipalla Lake	8.79	9.19	9.09	8.80	8.48	9.15	9.44	9.49	9.47	8.59	8.29	8.27	8.09	8.79	7.79	7.50	7.75	7.42	7.56	6.80	6.81	6.91	6.77	6.89

Table 4. Biological Oxygen Demand (B.O.D.) (µg/l) of Water in the two Lakes, studied

Months	2013														2014							
	JUN		JUL		AUG		SEP		OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY	
Water Body	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Chantharu Lake	3.63	3.60	2.92	3.51	3.64	3.51	2.89	3.19	4.91	4.62	5.16	5.12	5.61	5.59	4.89	4.92	4.34	4.25	4.12	4.10	3.99	4.00	4.04	4.05
Manipalla Lake	2.99	3.05	3.22	3.35	3.45	3.42	2.93	3.20	4.89	4.72	5.05	5.13	5.59	5.43	4.93	4.91	4.26	4.23	4.10	4.07	4.19	4.12	4.03	4.04

Table 5. Chemical Oxygen Demand (C.O.D.) (µg/l) of Water in the two Lakes, studied

Months	2013														2014							
	JUN		JUL		AUG		SEP		OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY	
Water Body	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Chantharu Lake	29.2	28.8	30.1	30.2	29.1	29.4	28.1	28.5	32.5	31.9	33.6	34.1	35.2	34.9	36.2	35.1	22.4	21.3	23.4	22.5	24.1	23.9	25.2	24.9
Manipalla Lake	28.7	28.2	29.2	28.8	27.3	26.8	29.3	28.6	33.6	34.9	32.8	33.4	35.1	36.2	36.5	35.7	22.1	21.9	22.9	23.2	24.2	25.3	25.4	25.9

Table 6. Nitrate - Nitrogen (µg/l - at N/l) of Water in the two Lakes, studied

Months	2013														2014							
	JUN		JUL		AUG		SEP		OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY	
Water Body	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Chantharu Lake	0.35	0.87	0.61	1.22	1.03	0.69	0.89	0.56	4.91	2.53	T	2.14	T	2.08	1.30	T	T	10.86	0.38	T	4.72	10.71	3.88	1.30
Manipalla Lake	3.62	1.95	1.82	8.17	10.81	6.15	1.86	3.85	2.71	0.35	1.43	1.4	3.22	0.14	0.12	0.26	T	0.95	T	T	2.92	3.01	1.08	2.04

Table 7. Phosphate (Phosphorus) (µg/l - at P/l) of Water in the two Lakes, studied

Months	2013																2014							
	JUN		JUL		AUG		SEP		OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY	
Water Body	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Chantharu Lake	1.14	0.64	0.21	0.54	0.46	3.00	1.05	T	0.70	1.50	0.90	0.82	1.51	1.25	0.20	1.34	T	2.31	0.81	2.14	3.51	0.24	1.71	0.96
Manipalla Lake	0.91	0.36	0.40	0.51	1.26	0.36	5.24	0.56	0.05	T	1.31	0.91	0.75	T	15.91	T	1.20	0.24	0.86	5.46	4.16	T	1.41	1.66

T = Traces

Table 8. The Monthly Variation in different genera and species of phytoplankton's in Manipalla Lake, Manipal

	Phytoplankton forms	2013							2014				
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
	Cyanophycere												
1.	Anabena flosaquae	+	-	+	+	+	+	-	-	+	+	+	+
2.	Anabaena circularis	-	-	-	-	+	+	+	+	+	-	-	-
3.	Nostoc sp.	+	+	+	+	+	+	+	+	-	-	-	-
4.	Oscillatoria princeps	+	+	+	+	+	+	+	+	+	+	+	+
5.	Oscillatoria curviceps	+	+	+	+	+	+	+	+	+	+	+	+
6.	Trichodesmium sp.	+	+	+	+	+	+	+	+	+	+	+	+
7.	Spirulina princeps	-	+	+	+	+	+	-	-	-	+	+	+
8.	Microcystis flosaquae	+	-	-	+	-	-	+	-	-	-	-	-
9.	Microcystics aeruginosa	+	+	+	+	+	+	+	+	+	+	+	+
10.	Anabaenopsis arnoldii	+	+	+	+	+	+	+	+	-	-	-	-
Chlorophyceae													
11.	Closterium microsporum	-	-	+	+	-	-	+	+	-	-	-	-
12.	Closterium acerosum	-	-	+	+	+	+	-	-	-	-	+	-
13.	Oedogonium sp.	+	+	+	+	+	+	+	+	+	+	+	+
14.	Spirogyra sp.	+	+	+	+	+	+	+	+	+	+	+	+
15.	Scenedesmus abundans	-	-	+	+	+	+	+	+	-	-	-	-
16.	Dimorphococcus lunatus	+	+	+	+	+	-	-	-	+	+	+	+
17.	Selenastrum gracile	+	+	+	+	+	+	+	+	+	+	+	+
18.	Scenedesmus obliquus	+	+	+	+	+	+	+	+	-	-	-	-
19.	Coelastrum microsporum	+	+	+	+	-	-	-	-	-	-	-	-
20.	Coelastrum cambricum	-	+	+	+	+	+	+	+	-	-	-	-
21.	Chlorella vulgaris	+	+	+	+	+	-	-	-	-	-	-	-
22.	Tetraedron muticum	-	-	+	+	+	+	-	-	+	+	-	-
23.	Eudorina elegans	+	+	+	+	+	+	+	-	-	+	+	+
24.	Pandorina morum	+	+	+	+	+	+	-	-	-	+	+	+
25.	Volvox globator	-	-	-	-	-	-	+	+	+	-	-	-
Euglenophycere													
26.	Euglena acus	+	+	+	+	+	+	+	+	+	+	+	+
27.	Euglena tripteris	-	-	-	+	+	-	-	-	-	+	+	+
28.	Lepocinclis fusiformis	-	-	+	+	+	-	-	-	-	-	-	-
29.	Lepocinclis ovum	-	-	+	+	+	+	-	-	-	-	-	-
30.	Euglena elastica	+	+	+	+	-	-	-	-	-	+	+	+
Bacillariophyceae													
31.	Navicula sp	+	+	+	+	+	+	+	+	+	+	+	+
32.	Melosira granulata	+	+	+	+	+	+	+	+	+	+	+	+
33.	Gomphonema sp.	+	+	+	+	+	+	+	+	+	+	+	+
34.	Pinnularia sp.	+	+	+	+	+	+	+	+	+	+	+	+
35.	Asterionella sp.	-	-	-	+	+	+	+	-	-	-	-	-
Dinophycere													
36.	Peridinium pusillum	-	-	+	+	+	+	+	+	-	-	-	-
37.	Glenodinium sp.	+	-	-	-	-	+	+	+	-	-	-	-

Table 9. The Monthly Variation in different genera and species of phytoplankton's in Chantaru Lake, Brahmavara

	Phytoplankton forms	2013							2014				
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
	Cyanophycere												
1.	*Anabaena flosaquae*	-	-	+	+	+	+	+	-	+	+	+	+
2.	*Anabaena circularis*	-	-	-	-	+	+	+	+	+	-	-	-
3.	*Nostoc sp.*	+	+	+	+	+	+	+	+	+	-	-	-
4.	*Oscillatoria princeps*	+	+	+	+	+	+	+	+	+	+	+	+
5.	*Oscillatoria curviceps*	+	+	+	+	+	+	+	+	+	+	+	+
6.	*Oscillatoria Chalybea*	-	-	+	+	+	+	+	+	-	-	-	-
7.	*Trichodesmium sp.*	+	+	+	+	+	+	+	+	+	+	+	+
8.	*Spirulina princeps*	-	-	-	+	+	+	-	-	-	+	+	+
9.	*Microcystis flosaquae*	-	-	-	-	-	+	+	-	-	-	-	-
10.	*Anabaenopsis arnoldii*	-	-	-	+	+	+	+	+	+	+	+	+
Chlorophyceae													
11.	*Closterium microsporum*	-	+	+	+	+	+	+	-	-	+	+	+
12.	*Closterium acerosum*	-	-	-	+	+	-	-	-	-	-	-	-
13.	*Oedogonium sp.*	+	+	+	+	+	+	+	+	-	-	-	-
14.	*Spirogyra sp.*	+	+	+	+	+	+	+	+	+	+	+	+
15.	*Scenedesmus abundans*	-	+	-	-	-	+	+	+	-	-	-	-
16.	*Dimorphococcus lunatus*	-	-	+	+	-	-	-	-	+	+	+	+
17.	*Scenedesmus obliquus*	-	+	+	-	+	+	+	+	+	+	+	+
18.	*Coelastrum microsporum*	+	+	+	+	-	-	-	-	-	-	-	-
19.	*Coelastrum cambricum*	-	-	-	+	+	+	+	-	-	-	-	-
20.	*Chlorella vulgaris*	-	-	+	+	+	+	-	-	+	+	+	+
21.	*Tetraedron muticum*	-	-	+	-	-	+	+	+	+	-	-	-
22.	*Pediastrum simplex*	-	-	-	-	-	+	+	+	+	-	-	-
23.	*Pediastrum duplex*	+	+	+	+	+	-	-	-	-	-	-	-
24.	*Pediastrum tetras*	-	-	+	+	+	-	-	-	+	+	-	-
25.	*Eudorina elegans*	-	-	+	-	-	+	-	+	-	-	-	-
26.	*Pandorina morum*	+	-	+	-	-	+	-	-	+	-	-	-
27.	*Volvox globator*	-	-	-	-	-	+	+	+	+	-	-	-
Euglenophycere													
28.	*Euglena acus*	+	+	+	+	+	+	+	+	+	+	-	-
29.	*Euglena tripteris*	-	-	-	-	-	+	+	+	-	-	-	-
30.	*Lepocinclis fusiformis*	-	-	-	-	-	+	+	+	+	+	+	+
31.	*Euglena elastica*	+	+	+	+	+	-	-	+	+	+	+	+
32.	*Lepocinclis texta*	+	+	+	-	+	-	-	-	-	-	-	-
Bacillariophycere													
33.	*Navicula sp.*	+	+	+	+	+	+	+	+	+	+	+	+
34.	*Melosira granulata*	+	+	+	+	+	+	+	+	+	+	-	-
35.	*Gomphonema sp.*	-	-	+	+	+	+	+	+	+	+	+	+
36.	*Pinnularia sp.*	+	+	+	+	+	+	+	+	+	+	+	+
37.	*Asterionella sp.*	-	-	+	+	+	+	+	-	-	-	-	-
Dinophycere													
38.	*Peridinium pusillum*	-	-	-	-	-	+	+	-	-	-	-	-
39.	*Glenodinium sp.*	+	+	+	-	-	-	+	+	+	+	+	+

adopted by Hosmani and Bharathi (1980). Seasonal water sampling from selected sites of the lake will be done by February 2013 to March 2015.The samples will be analyzed for physicochemical parameters following the procedures of Trivedi and Goel (1984), (Pant *et al.,* 1983), Jana (1979).

RESULTS AND DISCUSSION

The two lakes Chantaru and Manipalla are geographically located in Udupi and their coordinates are the latitude of Manipalla lake Manipal is 55^0 46'North and longitude is 74^0 44' East, 54Ft. The latitude of Chantaru lake Brahmavara is 55^0 45' North and longitude is 74^0 46' East, extending up to 55Ft in semi-rural area of Brahmavara and Manipal of Udupi District. Species diversity has been mentioned in tables 8 and 9. Which is also found in other lakes of Mysore, Bangalore, Dharwar, and other districts also confirmed. The distribution of freshwater phytoplankton alone with this region (Hosmani, 1980, Sugunan, 1980). Never the less we have been in both these lakes distribution pattern is variable with reference Cynophyceae, Chlorophyceae, Euglenophyceae, Bacillariophyceae, and Dinophyceae. However, in Manipal lake, the Chlorophyceae is dominant than that of all other forms. Whereas in Chantaru lake Chlorophyceae is dominant but is less in population when compared with Manipalla lake. The Dinophyceae population is represented equally in both the lakes as far as Bacillariophyceae, Eugliniphyceae Chantaru lake dominant than Manipalla lake. In Manipalla lake Cynophyceae is dominant over Chantaru lake. Thus the various phytoplanktonic distribution can be clearly seen due to various physicochemical parameters in different months i.e monsoon, winter, and summer.

In monsoon months *Oscillotoria curviceps* represented as dominant community in both the lakes. *Microcystis aeruginosa* is found only in Manipalla lake during all season, it is absent in Chantaru lake. During winter *Spirogyra* found in both the lakes. *Selenastrum gracile* a chlorophycean member found only in Manipalla lake, where it is absent in Chantaru lake. During summer months *Oscitalloria chalybea* found only in Chantaru lake, it is absent in Manipalla lake. In both the lakes Euglenophyceae, Bacillariophyceae are seen but *Lepocinclis ovum* is only found in Manipalla lake, whereas *Lepocinclis texta* is seen in Chantaru lake. Thus it clearly seeking among the two lakes the species diversity is rich and unique in chantaru lake than Manipalla lake and Manipalla lake is slowly getting pollution is evidence through the observations.

Conclusion

The biological examination of chantaru and Manipalla Lakes of Udupi District showed rich and diverse phytoplankton population. In Manipalla lake Chlorophyceae is dominant than all other forms. The Dinophyceae population is represented equally in both lakes. In Chantaru lake Bacillariophyceae and Euglenophyceae populations are dominated. In Manipalla lake Cyanophyceae is dominant. Our observation is in confirmation with some other freshwater lakes of North Karnataka in different regions, because of the climatic, topographic and edaphic factors are broad and will be similar in the Geographical regions.

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