International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 7.032 Volume 10, Issue 05, May 2023
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

Diversity and Seasonality of Chlorophycean flora in Freshwater Lakes of Koratagere taluk, Karnataka

Shalini, B. R and V. N. Murulidhara*
Department of Botany, University College of Science, Tumkur, Karnataka
* Department of Botany, YER Government First Grade College, Pavagada, Karnataka
Corresponding author e-mail: drvnmgfgcsira@gmail.com

ABSTRACT

Impact of anthropogenic activities in fresh water lakes results in variation in the quality of water which is evaluated by estimating various water quality parameters along with environmental factors such as temperature and rainfall. Altered water quality parameters cumulatively influence the biota of the fresh water lakes where phytoplanktons are noteworthy organisms. The present work was conducted with a goal to understand the effect of water quality parameters on one of the important groups of phytoplankton, the Chlorophyceae. In order to do so a survey was conducted on floristic composition of the class Chlorophyceae in four fresh water lakes of Koratagere taluk is discussed. Surface water samples were collected on monthly basis at specific sites along the marginal regions of the lakes. Current study was attempted with two objectives, first being the enumeration of diversity, abundance and seasonality of Chlorophyceae and second being the impact of water quality parameters on the population of Chlorophyceae. From the water samples collected 14 species belonging to 9 genera were recorded. Highest density of 37.90 % was recorded in Gattlagollahalli lake fallowed by Tumbadi lake (24.32%), Birdenahalli lake (21.62%) and the lowest density was recorded in Gokulakatte lake (16.22%). Seasonally, Chlorophyceae recorded maximum density during summer in all the four lakes, where, minimum density was recorded during rainy and winter seasons. In accordance with Karl Pearson's correlation the water quality parameters such as temperature of air and water, biological oxygen demand, carbonates, bicarbonates, sulphates, chlorides and phosphates remained positively correlated to population of Chlorophyceae and also had a direct bearing on the distribution and ecology of Chlorophyceae. Though, water in these lakes as such not potable, can be used for agriculture and aquaculture. It is suggested that these fresh water lakes be scientifically maintained for sustainable use.

Key words: *Water quality parameters, Chlorophyceae, Seasonality, Diversity, Correlation*

Introduction

Chlorophyceae, one of the largest groups of phytoplankton commonly called as grass green algae in which the thallus organization varies from motile unicellular to complex heterotrichous filamentous forms. Singh (1960), Munawar (1970), Hegde and Bharati (1985), Puttaiah and Govindappa (1993), Sigrid Haande *et.al.,* (2007), Rakesh Kumar *et.al.*,(2012), Barauah *et.al.,* (2013), Sushma Das *et.al.,* (2013) have studied the periodicity and diversity of Chlorophyceae and their relationship with different water quality parameters in fresh water bodies.

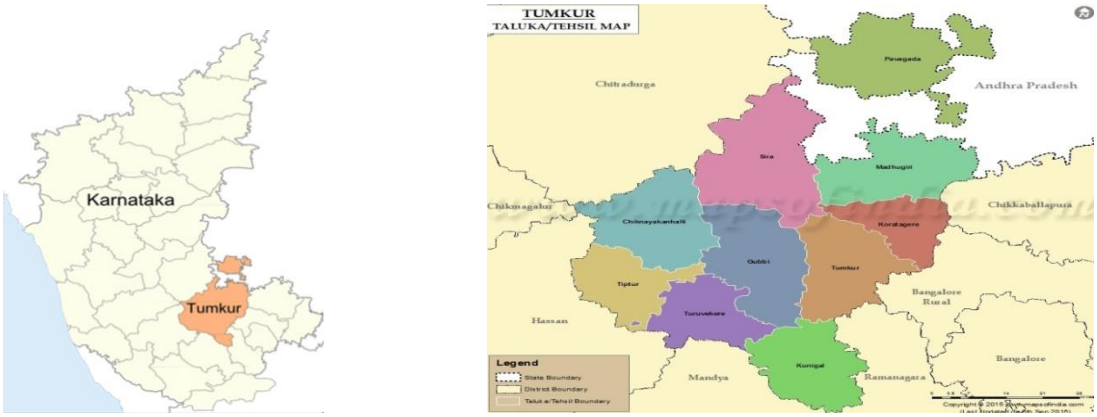

Figure-1: Map of Tumkur district in the state of Karnataka

The abundance of Chlorophyceae among the phytoplankton groups in fresh water bodies was reported by Pawar and Phulle (2006), Jayabhaye, *et.al.,*(2007), Malik and Umesh (2012) and Patil Alaka (2015). The four fresh water lakes selected from Koratagere taluk of Tumkur district for the current study were: Gattlagollahalli lake, Gokulakatte lake, Tumbadi lake and Birdenahalli lake (Figure-2) where, all are rain fed and also receive water from upstream lakes during monsoon. As all the four lakes are subjected to anthropogenic pressures the water quality parameters are not exactly according to standards of BIS and WHO.

Materials and Methods

Figure-2: IRS Map of koratagere showing the Lakes studied
Source: NRDMS, Zilla panchayat, Tumkur

Two litres of water samples were collected at monthly intervals for a period of one year from June 20019 to May 2020 at a depth of one feet from all the four lakes in black coloured poly-ethylene cans. Temperature of air, water and pH were measured on the spot at the time of sampling. Water samples were fixed separately on the spot for the estimation of dissolved oxygen and rest of the water quality parameters were analysed within 24 hours. Methods of APHA (2005) were fallowed during sampling, preservation and analysis. For taxonomic identification and enumeration of Chlorophyceae one litre of water sample was preserved in 10 ml of 2% Lugol's iodine solution for sedimentation and centrifugation. Camera lucida diagrams were drawn and species level identification was made using reprints of monograph of Philipose (1967). Density of Chlorophyceae was calculated using the methods of Rao (1955). The correlation matrix of 15 variables (water quality parameters) with Chlorophycean population for 48 (12X4) water samples (pooled in to 4) was computed using excel 2007 software.

Results and Discussion

Table-1: Descriptive statistics of four Lakes of Koratagere Taluk

Water quality Parameters	Lakes							
	Gattlagollahalli		Gokulakatte		Tumbadi		Birdenahalli	
	Mean	Standard deviation	mean	Standard deviation	Mean	Standard deviation	mean	Standard deviation
P1	31.17	3.13	32.29	2.911	32.04	2.18	30.50	2.27
P2	28.83	2.40800	30.04	3.14100	29.88	1.70200	28.29	1.65400
P3	6.93	0.43200	6.97	0.19220	6.91	0.3882	7.05	0.26700
P4	6.0	1.30540	3.59	0.66590	3 .48	0.36740	5.37	1.03070
P5	47.33	9.66200	32.76	14.56500	47.46	6.29200	48.65	11.05100
P6	1.27	0.2145	2.78	0.49400	2.64	0.76600	2.42	0.22710
P7	56.25	10.80000	28.66	7.96300	43.46	10.85500	36.08	5.507000
P8	45.29	7.86000	26.59	7.26800	33.71	11.05900	33.72	5.14200
P9	219.50	91.46800	149.67	57.90600	195.17	74.49600	145.79	48.82000
P10	1.50	0.77000	6.13	21.5000	3.42	1.29600	2.33	1.10100
P11	8.71	2.69400	23.00	82.05400	12.58	3.04900	11.42	2.72400
P12	196.26	121.38651	112.92	34.71113	202.74	111.74195	90.83	25.48771
P13	72.63	41.48290	53.78	20.30168	82.55	50.65320	54.00	17.72585
P14	1.85	0.775770	1.15	0.25220	2.54	0.73950	1.03	0.25110
P15	0.10	0.01880	0.19	0.28	0.29	0.31	0.10	0.17630

Index: P1- Air temperature, P2- Water temperature, P3- Ph, P4- Dissolved oxygen, P5- Free CO_2, P6- BOD, P7- Calcium, P8-Magnesium, P9-Total Hardness, P10-Carbonates, P11-Bicarbonates, P12-Sulphate, P13-Chloride, P14-Phosphate, P15- Nitrate

Munawar (1970) and Singh (1960) were of the opinion that the concentration of dissolved oxygen in water is a pre requisite for the growth and abundance of Chlorophyceae. However, Hegde and Bharati (1985) gave a different opinion where the dissolved oxygen did not show any relationship with Chlorophyceae. The results of the present study revealed that the mean value of dissolved oxygen is recorded in all the water bodies was in the range of 3.48mg/l to 6 mg/l (Table-1) which supported the moderate diversity and fair density of Chlorophyceae (Table - 2 & 3). Statistically concentration of dissolved oxygen as evidenced in table-4 did not show any type of correlation with the population of Chlorophyceae in all the water bodies remained as an independent variable. However, present findings are in conformity with that of the findings of Hegde and Bharati (1985).

Hegde and Bharati (1983) while working on fresh water algae of Bijapur district of Karnataka stated that the growth and abundance of Chlorophyceae depends on water quality parameters. Results of the present study revealed that temperature of air and water, carbon dioxide, carbonates, sulphates, chlorides and phosphates in Gattlagollahalli lake, carbonates, sulphates and chlorides, phosphate in Gokulakatte lake, bicarbonates in Birdenahalli lake have established positive correlations at significant level and had direct bearing on the growth and abundance of Chlorophyceae (Table-4). Many of the water quality parameters did not show any type of correlations and few parameters showed inverse correlation (Table-4). It is also noted that in Tumbadi lake all the water quality parameters remained as independent variables without any type of correlations (Table-4), hence our findings in partial agreement the findings of Hegde and Bharati (1983),

Chlorophyceae in the present investigation appeared in maximum numbers during summer and the lowest peaks were observed in winter similar observations were made by Jayabhaye, *et.al.*,(2007) and Padma Priya *et.al.,* (2017). Murulidhar and Murthy (2015) were of the opinion that high temperature and bright sun light favour the growth of the Chlorophyceae and observed that total hardness and chloride were positively correlated to Chlorophycean flora where, we are also of the same opinion in our studies except for the fact that total hardness had an inverse relationship with Chlorophyceae. Similar type of inverse relation between Chlorophyceae and total hardness was noticed by Murulidhar (2022) while working on trophic status of Bugudanahalli lake ecosystem of Tumkur. Verma and Singh (2010) and Uday Bhan Singh *et.al.*, (2013) were of the opinion that, presence of species of Scenedesmus and Chlorella known to live in nutrient rich lake which indicate high level of organic pollution and is in partial agreement with present studies where we have reported two species under the genus Scenedesmus. Species of Crucegenia represented by *Crucigenia qudricauda,*

Crucigenia rectangularis known to live and multiply in nutrient rich water (Ansari Ekhalak, 2013) present study also recorded *Crucigenia tetrapedia*, *Crucigenia quadricauda* and remained in partial agreement with above researchers

Diversity, distribution and Periodicity of Chlorophyceae

Table- 2: Diversity and distribution of Chlorophyceae in lakes of Koratagere

Sl No	Chlorophycean Flora	Lakes			
		Gattla gollahalli	Gokulakatte	Tumbadi	Birdenahalli
1	*Ankistrodesmus falcatus*	+++	++	+	+
2	*Ankistrodesmus gracilis*	+	–	–	+
3	*Closteriopsis longissima*	+	–	–	–
4	*Crucigenia tetrapedia*	++	++	+	+
5	*Crucigenia quadricauda*	+	–	+	+
6	*Kirchinarialla lunaris*	+	–	–	–
7	*Oocystis gigas*	+	++	–	–
8	*Pediastrum duplex*	+++	+	++	+
9	*Pediastrum tetras*	++	–	+++	–
10	*Pediastrum simplex*	+++	–	+	–
11	*Senedesmus accuminatus*	+	–	+	+
12	*Senedesmus quadricauda*	+++	+	+	++
13	*Selenastrum gracile*	+	–	–	–
14	*Tetraedon muticum*	+	++	+	+

Index

+++	++	+	-
100 to 500 Org / L	Between 50 to 100 Org / L	1 to 50 Org / L	Absent

Table-3: Seasonal abundance of Chlorophyceae in Lakes of Koratagere

Sl No	Lakes	Summer	Rainy	Winter
1	Gattlagollahalli	9375	7858	8899.7
2	Gokulakatte	4879	4406	4215
3	Tumbadi	8597	8342	8472
4	Birdenahalli	9073	8013	2695

With regard to relative abundance as detailed in figure-3 an highest of 37.90% appeared in Gattlagollahalli lake followed by Tumbadi lake (24.32%), Birdenahalli lake (21.62 %) and the lowest density was recorded in Gokulakatte (16.22%). Gattlagollahalli lake harboured 14

species under 9 genera where *Ankistrodesmus falcatus, Pediastrum duplex, Pediastrum simplex and senedesmus quadricauda* appeared abundantly up to 500 org/l. The genus Ankistrodesmus, Closteriopsis, Crucigenia, Kirchinarialla, Oocystis, Scenedesmus, Selanastrum and Tetraedon were represented by single species each (Table-2).

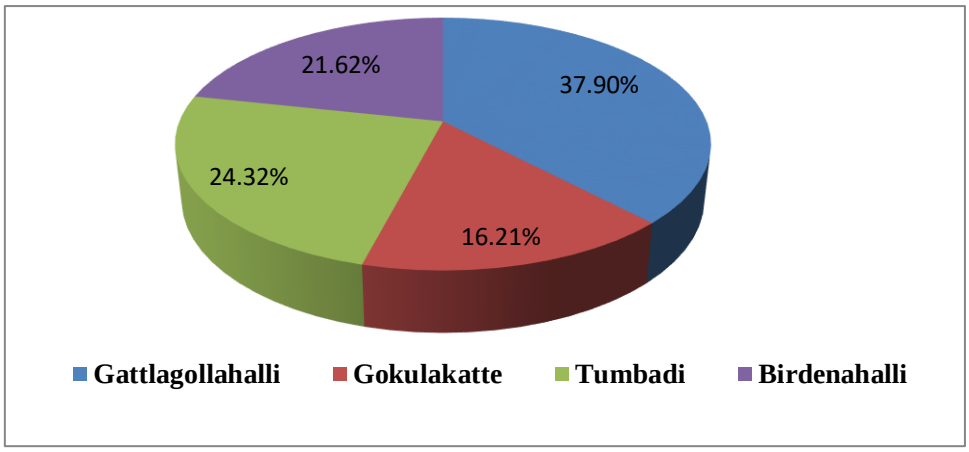

Figure- 3: Relative Density of Chlorophyceae in Lakes of Koratagere

Table-4: Karl- Pearson's correlation between water quality parameters and Chlorophyceae

Lakes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
Gattlagolla halli	.599**	.599**	-0.2	-0.4	-.593**	478*	0.247	-0.227	-.415*	.517**	0.314	.472*	.469*	.426*	-0.14
Gokulakatte	0.132	0.095	-0.33	-0.373	-.601**	-0.16	-.494*	-.496*	-.588**	0.520**	-0.08	.468*	.556**	0.259	0.326
Tumbadi	0.25	0.05	0.19	0.054	-0.28	-0.35	-0.005	-0.032	-0.384	0.113	0.248	0.143	0.089	0.142	.0.01
Birdenahalli	0.27	0.18	0.37	-0.03	-.431*	-0.1	-.452*	-0.29	-0.329	0.011	646**	0.076	0.34	0.15	0.085

Index: P1- Air temperature, P2- Water temperature, P3- Ph, P4- Dissolved oxygen, P5- Free CO_2, P6-BOD, P7- Calcium, P8-Magnesium, P9-Total Hardness, P10-Carbonates, P11-Bicarbonates, P12-Sulphate, P13-Chloride, P14-Phosphate, P15- Nitrate.

This lake recorded a highest relative density of 37.90% of Chlorophyceae when compared to other lakes (Figure-3). Seasonally maximum density of Chlorophyceae 9375 org /l recorded during summer is may be due to higher temperature where temperature of air and water had a direct bearing on Chlorophyceae (Table-4) and a minimum of 7858 org/l recorded during rainy (Table-3) which is attributed to low temperature and dilution due to rain water, where similar observations were made by Mahajan and Harney (2016). Gokulakatte lake recorded a lowest of 16.21% with 6 species under 6 genera and stands at the end with regard to relative density (Figure-3). The genus *Ankistrodesmus falcatus, Crucigenia tetrapedia, Oocystis gigas*

and Tetraedon muticum appeared up to 100 org /l (Table-2). Summer recorded seasonal maxima with 4879 org /l and that of minimum of 4215 org /l was noticed during winter (Table-3). Tumbadi lake supported 9 species and 5 genera which amounts to 24.32 % and ranks second among the other lakes (Figure-3). With regard to diversity, the genus Crucigenia and Senedesmus represented by two species each whereas Pediastrum is represented by 3 species and the remaining genera are represented by single species (Table-2). As in other lakes even in this lake highest peak was noticed during summer and that of lowest was recorded in rainy (Table-3). Birdenahalli lake witnessed 8 species under 5 genera constitutiong 21.62% occupies third position among the four lakes (Figure-3). The genus Ankistrodesmus, Crucigenia and Senedesmus represented by two species each whereas Pediastrum and Tetraedon represented by single species each. All the species except *Senedesmus quadricauda* appeared less abundantly with 50 org /l throughout the study period (Table-2). Seasonally summer recorded maximum density with 9073org /l and winter recorded minimum density of 2695 org /l (Table-3). Abdar (2013), Sarwade and Kamble (2013) reported *Ankistrodesmus falcatus* and rated it as organic pollution indicator the same is true to the present studies

Conclusion

The present investigation concentrated on the diversity and seasonality of Chlorophyceae in four fresh water lakes whose water quality parameters are not exactly according to standards of BIS and WHO as they are subjected to anthropogenic pressures. 14 species were recorded under 9 genera with seasonal maxima during summer. Water quality parameters such as temperature of air and water, biological oxygen demand, carbonates, bicarbonates, sulphates, chlorides and phosphates had a direct bearing on the diversity of Chlorophyceae and remained positively correlated. *Ankistrodesmus falcatus* recorded during entire study period emerged as bio indicator and pollution tolerant species representing eutrophic condition of the lakes. It is high time to introduce conservational strategies to bring back the lakes from eutrophic status for human consumption.

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