LIMNOLOGICAL PROFILE OF GATTLA GOLLAHALLI WETLAND OF TUMKUR DISTRICT, KARNATAKA

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ABSTRACT

Enumeration of phytoplankton and the estimation of physico-chemical parameters were carried out in Gattla Gollahalli wetland during the year 2014 -2015. A total of 45 species of phytoplankton under 30 genera belonging to five different groups were identified. Among the phytoplankton groups identified *Chlorophyceae* with 33.33% dominated the other groups followed by *Bacillariophyceae* [26.67%], *Cyanophyceae* [24.44%], *Euglenophyceae* [11.11%] and D*esmidaceae* [4.44%]. All the groups of phytoplankton recorded their maximum density during summer season except *Euglenophyceae* which recorded its seasonal maxima during monsoon. Seasonal averages of physico-chemical parameters have been worked out along with mean and standard deviation. *Chlorophycean* and *Cyanophycean* indices of Nigaard's trophic state indices indicate that, the wetland is eutrophic. The compound quotient value of Nigaard also confirms the eutrophic condition of the wetland. The inter relationship of the physico-chemical parameters is statistically evaluated using Carl-Pearson correlation and is discussed in the text.

Key Words: *Limnology, Wetland, Phytoplankton, Seasonal*

INTRODUCTION

Wetlands are important part of fresh water ecosystem, act as the chief source of drinking water, flood controlling, ground water recharging and also in supporting biodiversity. Wetlands are facing threats due to unplanned residential set ups, encroachments, eutrophication and pollution. Protection and restoration such wetlands which are extremely poor in condition are the need of the hour, hence limnological monitoring of the wetlands is of prime importance to know their ecological status. Limnological studies helps to know the biological productivity and also reflect on the quality of a fresh water ecosystem (Ghavzan *et al*., 2006). Phytoplanktons are the simplest, microscopic, floating organisms which are found abundantly in fresh water systems and play a very important role in the productivity of an ecosystem. The present study aims to evaluate the limnological profile of Gattla Gollahalli wetland by analyzing the water samples for different physico-chemical parameters, phytoplankton diversity, density, seasonality with the help of correlation studies and Nigaard algal indices to assess the condition of the wetland ecologically as this wetland has not been considered for the similar studies so far.

Gattla Gollahalli wetland, situated at a distance of 4 kilometers south-west of Koratagere town, is a medium seized lake with a water spread area of around 0.8 square kilometers with a raised S shaped earthern bund. The lake is surrounded by Siddarabetta hills on one side and coconut plantation on the oppositr side.The average depth of the lake is around 1.5 meters with a clayish bed. *Ipomea aquatica* is most abundantly grown along the borders of the lake along with species of *Cyperus, Jatropa, Leucas, Euphorbia, Tribulus* along the banks.

MATERIAL AND METHODS

Surface water samples were collected at monthly intervals from the wetland in black coloured cans of 4 liters capacity for the estimation of physico–chemical parameters. Procedures of Chemical and Biological methods for water pollution studies (R. K. Trivedy and P. K. Goel: 1986) were followed during sampling, transportation and estimation. Temperature of air and water (o C) were recorded during the collection of samples. All the physico–chemical parameters were expressed in terms of mg/l except PH. Turbidity is expressed in terms of NTU and conductivity in

terms of ms/cm. For the enumeration of phytoplankton one liter of water sample from the wetland is collected simultaneously during the said period in a different can and fixed with 20 ml of 1% lugol solution for a day for sedimentation process. 100ml of the sedimented sample is subjected to centrifugation process at a speed of 1500rounds per minute for 45 minutes and 10ml from this sediment is labeled and preserved for phytoplankton studies. Phytoplanktons were identified up to the level of species by adopting camera lucida technique and by using relevant literature. Density of phytoplankton was calculated using Rao's method (1965). Trophic status of the wetland was calculated using Nigaard's algal indices (1949) and Nigaard's compound quotient value (1976). Inter relationships of different physico- chemical parameters have been assessed by using Carl Pearson's correlation coefficient.

RESULTS AND DISCUSSION

Physico – chemical properties of water in any wetland ecosystem depends on rainfall, climatic conditions and soil characteristics and determines the structural and functional status of wetland ecosystem (Zuber, 2007). However, limnological characteristics altered by inlet of pollution load, agricultural runoff and domestic activities. In the wake of human interference the present studies was conducted and the data obtained has been consolidated in the tables 1-4. Phytoplankton diversity depends upon the limno chemical features of the wetland waters. A total of 45 species of phytoplankton under 30 genera belonging to five different groups were identified. The order dominance among the phytoplankton identified has also been noticed where; *Chlorophyceae* with 33.33% dominated the other groups followed by *Bacillariophyceae* [26.67%], *Cyanophyceae* [24.44%], *Euglenophyceae* [11.11%] and D*esmidaceae* [4.44%]. List of phytoplankton encountered during the study have been appended in the text as under

CHLOROPHYCEAE

Ankistrodesmus falcatus, Ankistrodesmus gracilis, Closteriopsis longissima, Crucigenia tetrapedia, Crucigenia quadricauda, Kirchinariella lunaris, Oocystis gigas, Pediastrum duplex, , Pediastrum tetras, Pediastrum simplex, Scnedesmus accuminatus, Scnedesmus bijucatus, Scnedesmus quadricauda, Selenastrum gracile and *Tetraedon muticum.*

BACILLARIOPHYCEAE

Cocconeis placentula, Cymbella cymbiformis, Cymbella lanceolata, Gyrosigma kutzingii, Melosira granulate, Navicula cuspidata, Navicula acicularis, Navicula cryptocephala,, Pinnularia biceps, Stauraneis anceps, Surirella ovata and *Synedra ulna.*

CYANOPHYCEAE

Anabaena spiroides, Arthospira tenuis,Chroococcus turgidus, Cylindrospermum muscicola, Gloeocapsa minuta, Merismopaedia glauca, Microcystis auruginosa, Microcystis viridis, Oscillatoria tenuis, Oscillatoria Chlorina and *Oscillatoria princepis*

EUGLENOPHYCEAE

*Euglena minuta***,** *Euglena polymorpha, Euglena proxima, Euglena viridis,* and *Tracheolomonas hispida*

DESMIDACEAE

Closterium aerosum and *Cosmarium retusiformae*

Seasonal variation of phytoplankton in lakes has been studied by Kour *et.al*., (2001) and Jarousha (2002) . Quantitatively all the groups of phytoplankton showed their peak abundance during summer season except *Euglenophyceae* which recorded its seasonal maxima during monsoon (Table-3). Seasonal averages of physico-chemical parameters have been worked out along with mean and standard deviation (Table-1) *Chlorophycean* and *Cyanophycean* indices of Nygaard's trophic state indicex (1976) indicate that, the wetland is eutrophic. The compound quotient value of Nygaard (1949) also confirms the eutrophic condition of the wetland (Table-4). The inter relationship of the physico-chemical parameters is statistically evaluated using Carl-Pearson's correlation (Table-5) and the same has been discussed in the text in comparison with the earlier research.

Temperature of water and air in the present study recorded seasonal maxima during summer. Water temperature is influenced by ambient temperature and act as a major factor in influencing species abundance and diversity. Our results are in agreement with the findings of Kaur *et.al*., (2001) who made similar observations. Correlation matrix revealed that, ambient temperature remained as independent variable, where as Water temperature established significant positive correlation with Turbidity (0.49), Chloride (0.440), Phosphate (0.443) at 0.05 level and showed similar correlation with Bicarbonates (0.618) and Sulphates (0.551) at 0.01 level. Mean value of PH (6.93) in the present investigation indicates that the water is acidic and seasonal maxima is recorded during rainy than summer and winter (Table-1). Similar observations have been made by Rajesh *et. al.*,(2011). PH statistically established significant positive correlations with Dissolved oxygen (0.61), Total hardness (0.70) and Silica (0.612) at 0.01 level. Murulidhar and Yogananda murthy (2015) are of the opinion that, higher value of turbidity during monsoon is due to inflow of water which reduces photosynthetic activity of algae leading to accumulation of carbon dioxide. The present findings are in conformity with the findings of the above researchers. Positive correlation of Turbidity is noticed with parameters such as Conductivity, Free carbon dioxide, BOD, Calcium, Magnesium, Bicarbonate, Sulphate, Chloride, and Phosphate (Table-5). Conductivity is due to various ions present in the water body and is regarded as a measure of TDS. Higher values of conductivity recorded in the present study during rainy season is attributed to inlet of surface runoff carrying agricultural and domestic wastes. Conductivity showed direct impact on the concentration of Carbon dioxide, BOD, Calcium, Magnesium and Silica (Table-5).

Dissolved oxygen is resulted from atmosphere and by photosynthesis in aquatic flora. Fairly good amount of DO recorded in the present study is an indication of non intervention by anthropogenic activities and no direct discharge of domestic sewage in to the wetland. Seasonally higher DO noticed during winter and low during summer. Dissolved oxygen established a direct relationship with PH, total hardness, total nitrogen and silica at 0.01 level. Carbon dioxide carbonates and bicarbonates equilibrium governs the PH of the water (Chapman, 1996). Verma and Agarwal (1982) were of the opinion that, the growing plants cause the depletion in carbon dioxide resources. In the present study values of carbon dioxide recorded is fairly high. Seasonally highest values observed during rainy and the minimum values recorded during winter. Statistically carbon dioxide showed significant positive correlation with BOD, calcium, magnesium at 0.01 level and at 0.05 level carbon dioxide and bicarbonates remained positively correlated. Kiran tripathi *et. al*., (2011) recorded high BOD during summer, which they attributed to the maximum biological activity at high temperatures and low in winter indicating the lower biological activity. Seasonally maximum value of BOD in present investigation is recorded during rainy and minimum during winter, hence our findings are in partial

agreement with the findings of the above researchers. Statistically BOD has a direct bearing on the values of turbidity and carbon dioxide at 0.01 level and conductivity and bicarbonates at 0.05 level. Calcium and Magnesium are the two cat ions which play a major role in determining the hardness of the water. It is evident from table-1 that, both calcium and magnesium seasonally remained high during rainy and low during winter. Table -5 revealed that both of them remained significantly correlated at 0.01 level. Calcium and magnesium when combine with water produce carbonates and bicarbonates which result in high level of hardness (Rajput *et. al*.,2017). Murulidhar and V. N. Y. Murthy (2015 a) are of the opinion that in addition to calcium, magnesium, chloride, sulphate, carbonates and bicarbonates, soil characters also play an important role in determining the total hardness of water. Seasonally hardness recorded high during rainy and less during summer, which is attributed to the inlet of surface runoff carrying sulphates and phosphates from the surrounding agricultural fields during monsoon and also washing activities during summer. Statistically also pH, sulphates and phosphates have direct bearing on the concentration of hardness (Table-5). Both carbonates and bicarbonates have recorded maximum values during summer and minimum during winter. Chlorides and sulphates together makes the water salty and unpalatable (Haroon *et. al*., 2010). Shalini *et.al*., (2018) noticed the entry of sulphate in to the water body from the catchment area through surface runoff during monsoon. Phosphate, a very important nutrient in growth of the algae occurs in low concentration in natural waters and tends the water in to eutrophic condition (Rajesh *et. al*., 2011). Chloride, sulphate and phosphate in the present investigation appeared high during summer which is attributed to domestic activities in lesser quantity of water. They appeared less during winter except chloride which recorded low values during rainy. As evident from the table -1 total kjeldhal's nitrogen, silica and nitrate seasonally recorded high during rainy and low during winter except, total kjeldhal's nitrogen which appeared low during summer. Murulidhar and V.N.Y. Murthy (2014) are of the opinion that, Silica coupled with nitrate closely correlates the diatom density and they also noticed that concentration of nitrates determines the population of diatoms. Statistical correlation of these parameters with other parameters has been given in table-5.

CONCLUSION

Presence of 45 species of phytoplankton in the wetland indicates that the wetland is biologically productive and is rich in diversity and density of phytoplankton, which is in turn controlled by the concentration and seasonality of physico – chemical parameters of water. *Chlorophycean* and *Cyanophycean* indices of Nigaard's trophic state indices indicate that, the wetland is eutrophic. The compound quotient value of Nigaard also confirms the eutrophic condition of the wetland. The present condition of the wetland is suitable to initiate aquaculture on a commercial scale.

Table-1 Seasonal averages of physico-chemical parameters of Gattla gollahalli wetland

Sl. No.	Physico – Chemical Parameters	Jan 2014 – Dec - 2015			Mean	Standard Deviation
		Summer	Rainy	Winter		
1	Air temperature	32.12	30.25	29.12	31.17	3.13
2	Water temperature	29.87	27.75	27.25	28.83	2.40800
3	pH	6.93	7.07	7.1	6.93	0.43200
4	Turbidity	27.27	29.39	16.24	52.58	13.66700
5	Electrical conductivity	95.37	150.12	78.62	191.38	113.22500
6	Dissolved oxygen	4.72	5.61	5.76	3.59	0.66590
7	Free CO_2	45.89	60.80	39.25	47.33	9.66200
8	BOD	2.39	2.57	2.31	2.78	0.49400
9	Calcium	36.28	41.16	32.28	56.25	10.80000
10	Magnesium	33.42	38.22	29.51	45.29	7.86000
11	Total hardness	96.75	171.37	169	219.50	91.46800
12	Carbonates	3.21	1.94	2.18	1.50	0.77000
13	Bicarbonates	12.88	12.41	8.96	8.71	2.69400
14	Sulphate	115.37	81.37	75.75	196.26	121.38651
15	Chloride	68.37	47.32	46.28	72.63	41.48290
16	Phosphate	1.2	1.02	0.87	1.85	0.77570
17	Total dissolved solids	454.62	435.25	547.75	14.67	2.61580
18	Total Kjeldahl nitrogen	2.36	5.21	4.43	14.67	2.61580
19	Silica	0.11	0.14	0.04	0.10	0.01880

Table – 2 Density of phytoplankton in Gattla gollahalli wetland (org/l)

Sl. No.	Months	Phytoplankton density				
		Chlorophyceae	Bacillariophyceae	Desmidaceae	Cyanophyceae	Euglenophyceae
1	Jan' 2014	9625	3134	70	7416	2361
2	Feb'2014	10134	3848	63	7820	3416
3	Mar'2014	10626	2951	82	7840	2700
4	Apr'2014	8718	2729	48	5918	0991
5	May'2014	9875	3549	58	6211	1135
6	Jun'2014	9727	3269	52	5980	2482
7	Jul' 2014	8286	2246	66	6348	2110
8	Aug'2014	6526	2107	38	4288	1926
9	Sep'2014	7310	2964	55	3930	1345
10	Oct'2014	8586	1980	39	4370	941
11	Nov'2014	8910	3142	51	6418	1246
12	Dec'2014	9576	4316	44	6521	3466
13	Jan'2014	8726	2611	57	8326	3211
14	Feb'2015	9110	1984	52	7444	1610
15	Mar'2015	9171	3146	69	5477	2917
16	Apr'2015	8417	3826	65	6146	1416
17	May'2015	8956	3126	52	6781	1917
18	Jun'2015	8936	2918	42	7209	1991
19	Jul' 2015	6528	2956	51	6740	2241
20	Aug'2015	7137	2810	31	5119	2418
21	Sep'2015	8418	2147	44	4891	1916
22	Oct' 2015	8110	1510	31	5243	1215
23	Nov'2015	8545	2916	46	7110	1881
24	Dec'2015	9120	2954	39	6882	2147

Table – 3 Seasonal abundance of phytoplankton in Gattla Gollahalli wetland (org/l)

Sl No	Phytoplankton	Summer	Rainy	Winter
1	Chlorophyceae	9375	7858	8899.7
2	Desmidaceae	61.1	47.3	47.1
3	Bacillariophyceae	3144	2677	2 820
4	Euglenophyceae	2012	2053	1934.5
5	Cyanophyceae	6704.6	5563.1	6535.7

Table-4 Nygaard's trophic state indices

SL NO	Index	Value obtained	Ecological Status of wetland
1	Myxophycean index	5.5	Eutrophic
2	Chlorophycean index	7.5	Eutrophic
3	Compound Quotient Value	21.5	Eutrophic

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