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Distribution and Diversity of Euglenophyceae in Saroornagar Lake, Hyderabad

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ABSTRACT- **The present paper deals with the study of Euglenophyceae in Saroornagar Lake. Samples were collected from four sampling stations for a period of two years and comprehensive physico-chemical analysis was carried out. pH, temperature, carbonates, Free CO_2, bicarbonates(HCO_3^-), chlorides, dissolved oxygen (DO), biological oxygen demand (BOD), organic matter (OM), chemical oxygen demand (COD), total hardness, calcium, magnesium, phosphates, silicates, sulphates, nitrates, nitrites, total solids (TS) and total dissolved solids (TDS) played an important role in distribution and diversity of algae. Euglenoid flagellates exhibited higher peaks in winter and found very low in summer. Diversified species of *Euglena, Lipocinclis, Phacus* and *Trachelomonas* were reported. The presence of pollution tolerant species, *Euglena acus, E. oxyuris, E. gracillis, Lipocinclis ovum* and *Trachelomonas volvocina* indicated high organic pollution of the lake.**

Key words : Euglenophyceae, physico-chemical parameters, diversity, pollution.

I. INTRODUCTION

Water is the most vital resource for life to survive. Any substantial reduction in its percentage is threatening to living cell. Water with its unique physical and chemical properties allows various biochemical reactions required for cell metabolism, growth and act as best suited medium for life activities. For any country fresh water lakes are vital resources. Various human development activities, industrialization, urbanization and improper management of water resources have led to severe water quality impairment. The inland water bodies undergo eutrophication due to sewage discharge, improper agricultural practices and urban run offs and disrupt aquatic ecosystems (Suresh, 2015). The basic link in the food chain of all aquatic flora are green algae, blue green algae, diatoms, desmids and Euglenoid flagellates and were ecologically significant (Airsang, 2013). The present investigation involves distribution and diversity of Euglenoid flagellates, influence of physico-chemical parameters on Euglenophyceae, identification of algae as bio indicators in the lake. It is one of the bigger lakes of Hyderabad and lies in the coordinates of 17.35584°N latitude and 78.52714°E longitudes.

II. MATERIALS AND METHODS

The water samples were collected monthly intervals for a period of two years (September 2013 to August 2015) at four sampling stations in the lake. Station I, II, III and IV are situated near Priyadarshini Park, Pochamma temple, Singareni colony and Green park colony respectively (Fig. 1).

Fig.1: Map Showing the Location of Sampling Stations of Saroornagar Lake

The samples were analyzed for pH, temperature, carbonates, Free CO_2, bicrbonates, chlorides, DO, BOD, organic matter (OM), chemical oxygen demand (COD), total hardness, calcium, magnesium, phosphates, silicates, sulphates, nitrates, nitrites, total solids (TS) and total dissolved solids (TDS) as per the standard procedures of APHA (1995).

For Planktonic study

One litre of surface water samples were collected from four different stations of the lake and were kept in the sedimentation column after adding 2-3 ml of 4% formaldehyde solution. For about a period of one month the samples were kept undisturbed for complete settling of the organisms. The samples were concentrated to 100 ml. Finally, the concentrated material was used for identification of species and frequency measurements. The drop method of Lackey's (1938) was followed for frequency measurement.

III. RESULTS AND DISCUSSION

The samples were collected and analyzed from the four sampling stations within the Saroornagar Lake on monthly intervals for a period of two years from September 2013 to August 2015. The average, maximum and minimum analytic results of each parameter during the period of investigation are summarized in Table 1.

TABLE 1: Ranges and average values of Physico-chemical parameters

All values are expressed in mg/L except pH and Temp (^{o}C)

S.NO	Parameters	Station-I			Station-II			Station-III			Station-IV		
		Average	Range		Average	Range		Average	Range		Average	Range	
			Min	Max		Min	Max		Min	Max		Min	Max
1.	Temperature	25.6	23.5	26.5	25.3	23.0	26.5	25.6	23.5	27.6	25.7	23.5	26.8
2.	pH	8.37	7.46	9.27	8.37	7.36	9.31	8.37	7.48	9.35	8.36	7.32	9.38
3.	Alkalinity	761.2	545.0	922.7	757.5	574.1	890.3	815.6	577.1	935.8	77.1	636.1	883.8
4.	Carbonates	22.3	27.0	38.0	20.8	25.0	36.0	23.2	28.0	38.0	18.3	26.0	36.0
5.	Free CO_2	0.86	2.2	4.4	0.91	2.2	6.6	0.91	2.2	4.4	1.46	2.2	8.8
6.	Bicarbonates	738.9	518.6	884.7	736.7	549.1	854.3	792.4	549.1	897.8	758.8	610.1	847.8
7.	Chlorides	781.1	674.5	850.0	759.5	597.6	887.0	756.3	639.0	850.9	759.8	674.5	887.0
8.	DO	0.6	0.2	2.4	0.5	0.2	2.4	0.5	0.2	2.6	0.3	0.2	2.4
9.	BOD	238.7	140.0	300.0	192.0	30.0	300.0	218.3	300.0	120.0	226.6	90.0	300.0
10.	OM	63.7	30	100	80.8	30	240	88.3	20	260	101.6	20	260
11.	COD	141.0	80.0	216.0	153.8	80.0	210.0	288.3	220.0	328.0	343.9	280.0	384.0
12.	Total Hardness	748.0	552.0	832.0	702.4	500.0	750.0	705.5	520.0	830.0	715.8	520.0	810.0
13.	Calcium	145.2	100.0	192.0	154.3	31.8	288.0	136.9	52.6	192.0	133.6	34.4	192.0
14.	Magnesium	51.7	17.0	94.8	53.2	14.1	102.1	57.8	29.2	99.8	60.8	29.2	126
15.	Phosphates	16.9	14.6	20.4	20.3	18.0	23.8	20.1	17..8	23.5	17.8	15.6	21.4
16.	Silicates	1.37	1.35	1.42	1.22	1.20	1.25	1.88	1.86	1.91	1.99	1.95	2.1
17.	Sulphates	247.7	238.0	260.0	257.7	248.0	270.0	255.7	246.0	268.0	252.9	243.0	265.0
18.	Nitrates	16.5	14.6	19.3	19.8	18.0	22.7	19.6	17.8	22.5	17.4	15.6	20.3
19.	Nitrites	1.07	0.92	1.15	1.54	1.46	1.62	1.09	1.02	1.13	1.43	1.36	1.53
20.	Total Solids	2814	2791	2845	2715	2691	2745	2755	2731	2785	2804	2781	2835
21.	TDS	2615	2582	2648	2521	2491	2638	2556	2531	2584	2606	2584	2638

Temperature is considered as one of the most important factor in the aquatic ecosystem and also in survival and existence of biological life. In the present investigation temperature ranged from 23.0 ^{o}C - 27.6 ^{o}C. The pH of the lake is 8.37.The observed minimum and maximum values of total alkalinity at station II and station III are 757.5 mg/L and 815.6 mg/L respectively (Table 1). The values represent alkaline nature of the lake. Alkaline nature of lakes in India was reported by Amin Hossaini (2013) and John Mohammad (2015).

Bicarbonates were recorded high at all stations, ranged from 518.6 - 884.7 mg/L. This can be can be attributed to increase in organic decomposition during which CO_2 is released which reacts to form bicarbonates. Similar observation was made by (Mahadev and Hosamani, 2010 and Airsang, 2013). Chlorides play a very important role to determine the quality of water and indicate the presence of high organic matter. Chlorides were recorded in the range of 674.5 - 850.0 mg /L. Higher chloride concentration represents high degree of pollution (Ravish verma 2012, Ameetha Sinha 2014).

Very low DO values were recorded in the lake. The minimum and maximum DO values observed were 0.3 mg/L at station IV and 0.6 mg/L at station I. Very high values of BOD were recorded at all stations.238.7 mg/L,192 mg/L,218.3 mg/L,226.6 mg/L were BOD values recorded at station I,II,III and IV respectively. Higher BOD values indicate organic contamination, high nutrient loading, decomposition and mineralization of organic matter (Siraj, 2010, Suresh, 2015). Chemical Oxygen Demand ranged between 80.0 - 216.0 mg/L with minimum value of 141.0 mg/L at station I and 343.9 mg/L at station IV.

Total hardness was recorded high in the range of 552.0 - 832.0 mg/L, calcium and magnesium in the range of 100.0 - 192.0 mg/L and 17.0 - 94.8 mg/L. In the present observation the phosphates ranged from 14.6 - 20.4 mg/L, 238 - 260 mg/L was the range of sulphates recorded and confirms the lake receiving sewage influx (Langmuir 1971, Sudha Rani 2004).Silicates, nitrites and nitrates ranged between 1.35 - 1.42 mg/L, 0.92 - 1.15 mg/L and 14.6 - 19.3 mg/L respectively. Sewage, industrial discharges, road runoff, fertilizers, and soil erosion acts as major sources of total solids in the water body. Total solids and total dissolved solids were observed in high concentration and reported in the range of 2791 - 2845 mg/L and 2582 - 2648 mg/L.

Diversified species of *Euglena, Lipocinclis, Phacus* and *Trachelomonas* were present. *Euglena acus, E. polymorpha, E. viridis E. elastica, E. convoluta, E. minimata, E. elongata, E. oxyuris, E. sanguinea, E. gracillis, Lipocinclis fusiformis, L. ovum, Trachelomonas hispida, T. euchlora, T. volvocina, Phacus curvicauda, P. caudatus, P. longicauda, P. accuminatus, P. orbicularis, P. tortus, P. triquater* were the species recorded in the present observation. Table. 2 represents the station wise distribution of Euglenophyceae species in the lake.

TABLE 2: Station wise distribution of Euglenophyceae

S.No	Euglenophyceae species	Station I	Station II	Station III	Station IV
1.	*Euglena acus* Ehren.	+	+	+	+
2.	*Euglena polymorpha* Dang.	+	+	+	+
3.	*Euglena viridis* Ehren.	+	+	+	+
4.	*Euglena elastica* Prescott.	+	+	+	+
5.	*Euglena convoluta* Korsh.	+	-	+	+
6.	*Euglena minima* France.	-	+	+	+
7.	*Euglena elongata* Schew.	-	+	+	+
8.	*Euglena oxyuris* Prescott.	+	+	+	+
9.	*Euglena sanguina* Ehreb.	-	+	-	+
10.	*Euglena gracillis* Klebs.	+	+	+	+
11.	*Lipocinclis fusiformis* Lemm.	+	+	+	+
12.	*Lipocinclis ovum* Ehreb.	+	+	+	+
13.	*Trachelomonas hispida* Lemm.	+	+	+	+
14.	*Trachelomonas euchlora* Ehre.	+	+	+	+
15.	*Trachelomonas volvocina* Ehren.	-	-	+	+
16.	*Phacus curvicauda* Swir.	+	+	+	+
17.	*Phacus caudatus* Hueb.	+	+	+	+
18.	*Phacus longicauda* Ehrenb.	+	+	+	+
19.	*Phacus accuminatus* Skvor.	-	+	+	+
20.	*Phacus orbicularis* Namy.	+	+	+	+
21.	*Phacus tortus,* Lemm.	+	-	+	+
22.	*Phacus triquater* Ehren.	+	+	+	+

At station I, Euglenoid flagellates have attained high peaks during winter (Fig. 2) and bloom of *Trachelomonas sp.* was observed. *Euglena sp., Lipocinclis sp. and Phacus sp.* were also represented during winter. The lowest peaks were observed in August with the representation of *Euglena sp.* and *Phacus sp.* High pH and Free CO_2 exhibited positive influence on Euglenoid flagellates. This was in accordance to Ashwani K Dubey (2012) and Ansari Ekhalak (2013) with reference to pH and Kiran (2002), Ashesh Tiwari (2006) and Shankar (2012) regarding Free CO_2. Temperature influenced negatively on the growth of algae. Temperature and bicarbonates negatively influenced the algal growth. Similar observations were made by Suresh (2013), Altaf H. Ganai (2014) and Suresh (2015).

Calcium, silicates, and sulphates exhibited direct relationship with Euglenophyceae. The positive influence of sulphates was observed by Ashwani Dubey (2012). DO, COD and nitrates showed the significant positive influence on the growth of algae. This is in accordance with Shankar (2012) and Suresh (2015). TDS, and phosphates influenced algal growth negatively and high Magnesium concentration decreased Euglenoid flagellates. This is in conformity with Suresh (2015) and Ananthaiah (2010). The higher peaks of Euglenophyceae were associated with high pH and silicates and low TS and TDS.

At station II, The winter dominance of Euglenophyceae (Fig. 3) was due to *Trachelomonas sp., Euglena sp.* and *Lipocinclis sp.* The low peaks were reported during May. Euglenoid flagellates have attained peaks in November constituted the bloom of *Trachelomonas sp.* and the bloom of *Euglena* and *Lipocinclis* was observed in February. The winter dominance of Euglenophyceae was due to Trachelomonas *sp. Euglena sp.* and *Lipocinclis sp.* The low peaks were reported during May and showed the presence of *Trachelomonas sp., Euglena sp.* and *Phacus sp.* The maximum number of *Phacus* was represented in August.

Bicarbonates, phosphates, silicates and nitrites exerted positive influence on algae. Similar relationship of bicarbonates and Euglenophyceae was reported by Ananthaiah (2010) and Agale (2013) and was observed as important parameter which regulates Euglenophyceae growth. Total phosphorus favouring the abundance of Euglenophyceae was reported by Munawar (1972), Ananthaiah (2010) and Shankar (2012). Nitrates, magnesium, sulphates, carbonates, Free CO_2, chlorides, TS and TDS negatively influenced Euglenoid flagellates. Among these factors nitrates, TDS, sulphates, chlorides, influencing algal growth on negative side was in accordance to Suresh (2015). The higher peaks at this station were associated with high bicarbonate concentration and low sulphates and TS.

At station III, Euglenophyceae showed their peaks in January (Fig. 4) with the bloom of *Trachelomonas* and *Euglena*. The winter dominance of Euglenoid flagellates was represented by the species of *Trachelomonas, Euglena* and *Lipocinclis.* The low peaks were reported in June and the species found were *Euglena* and *Lipocinclis. The* bloom of *Euglena* was reported in January. *Lipocinclis* bloom was found in February and *Trachelomonas* bloom was observed during winter and attained maximum November. The *Phacus* peaks were reported in April. Temperature, carbonates, organic matter, chlorides, calcium, magnesium, TS and TDS showed negative influence on Euglenoid flagellates and total hardness, sulphates, nitrites, silicates and Free CO_2 exerted positive influence. The low levels of TS are associated with the peaks of Euglenoids at this station.

In the present investigation at station IV, highest percentage of Euglenoid flagellates were reported compared to the other stations. High peaks were observed in January (Fig. 5) represented by the bloom of Lipocinclis, *Trachelomonas* and *Euglena* and all the species were in the maximum numbers. Euglenophyceae peaks were low in June. *Phacus* was reported in maximum number in April. Significant influence of Free CO_2, COD and silicates was observed on positive side. Calcium and magnesium exhibited positive relationship with algal growth. This was in accordance to Sudha Rani (2004). Temperature, chlorides, phosphates, organic matter, BOD, nitrites, TS and TDS exerted a significant negative influence on the growth of Euglenoid flagellates.

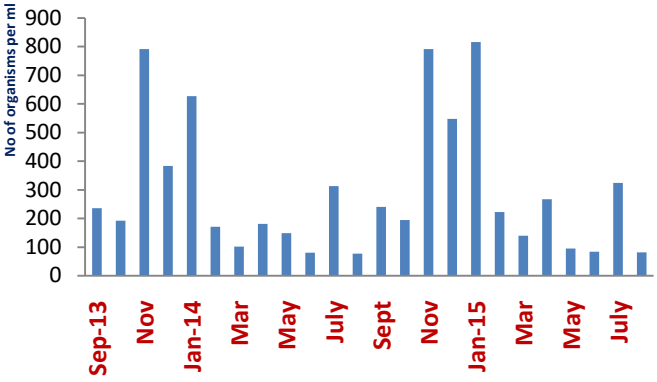

Figure. 2: Distribution of Euglenophyceae at Station I

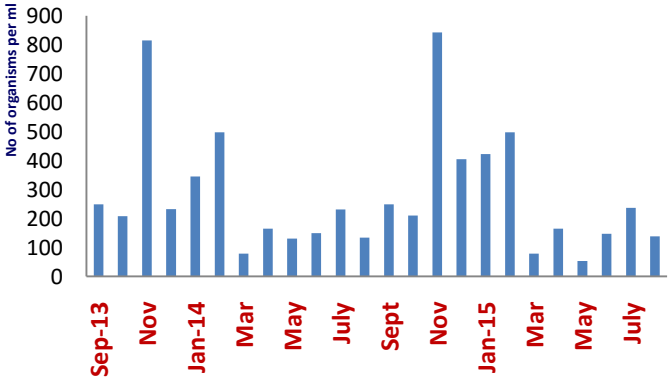

Figure. 3: Distribution of Euglenophyceae at Station II

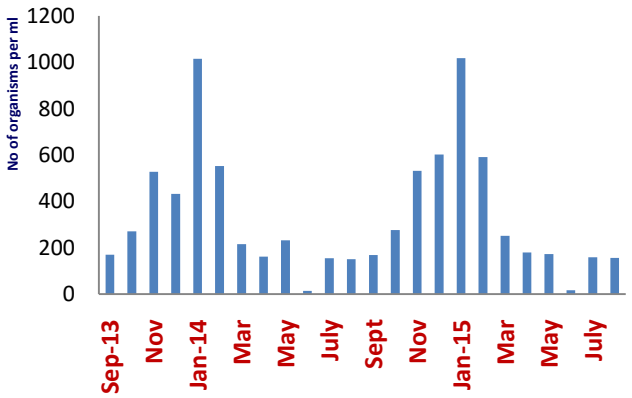

Figure. 4: Distribution of Euglenophyceae at Station III

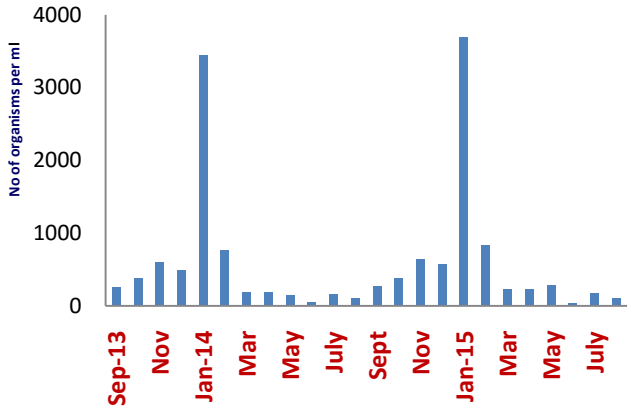

Figure. 5: Distribution of Euglenophyceae at Station IV

The concentration of organic matter and nutrients was very high in the lake at all stations and the presence of *Euglena and Phacus* species indicates organic pollution and these species also tolerates high degree of pollution. This was in conformity with Palmer (1980), Nayak and Khare (1993), Ashesh Tiwari (2006), Shankar (2012), Altaf H. Ganai (2014) and Suresh (2015). Rama Swamy (1982) reported that the species of *Euglena, Phacus and Trachelomonas* are commonly encountered in waters with rich oxidizable organic matter. *Euglena oxyuris* and *E. gracillis* were represented in good numbers at all the stations. According to Amin Hossaini (2015) *Euglena and Trachelomonas* are the bio indicators of eutrophic lake and the blooms represent eutrophic condition of the lake.

The present investigation elevated the distribution and diversity of Euglenophyceae in Saroornagar Lake. The evaluated physico-chemical parameters considerably influenced the growth of algae. Euglenoid flagellates were represented by diversified species and presence of *Euglena, Phacus and Trachelomonas* species which are pollution indicators symbolize eutrophic condition of the lake.

High diversity of Euglenophyceae was reported in the lake representing 10 species of *Euglena*, 7 species of *Phacus*, 3 species of Lipocinclis and 2 species of *Trachelomonas*. The diversity is very high compared to other lakes. The distribution and diversity of Euglenoid flagellates indicates polysaprobic condition of the lake, high pollution load and organic contamination. The presence of *Euglena, Phacus* and *Lepocinclis* species indicates the eutrophic nature of the lake.

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