



Diversity and abundance of phytoplankton communities of Rudrasagar Lake, Tripura

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ABSTRACT

A study was carried out during October (2017) to May (2019) to assess the phytoplankton diversity and abundance of Rudrasagar lake of Tripura. The study revealed occurrence of 35 phytoplankton genera belonging to four main groups *viz.* Chlorophyceae (18 genera), Bacillariophyceae (9 genera), Cyanophyceae (7 genera) and Euglenophyceae (1 genus). Chlorophyceae dominated the phytoplankton quantitatively followed by Cyanophyceae, Bacillariophyceae and Euglenophyceae. The average monthly phytoplankton abundance varied between 14229 – 25970 cells l⁻¹. One way ANOVA revealed significant seasonal variation in the abundance of the phytoplankton groups. Maximum species richness was observed in pre-monsoon season. The phytoplankton communities of Rudrasagar lake showed high Shannon Weiner index (3.004 – 3.996) and high Pielou's evenness index (0.939 – 0.986).

1. Introduction

Phytoplankton are the primary autotrophs and play vital role in the transfer of energy to higher aquatic life forms. Phytoplankton diversity and abundance are ecological indicators of the trophic status of an aquatic ecosystem and helps in assessing the extent of eutrophication (Weysi *et al.* 2014). Several studies have been made to study phytoplankton diversity, abundance in wetlands of the north eastern region of India (Sharma, 2004, 2009, 2010, 2012, 2015; Laskar and Gupta, 2009; Devi *et al.*, 2016; Sharma and Hatimura, 2017). Much has not been studied on the diversity and abundance of phytoplankton in the wetlands of Tripura, north-eastern state of India. Hence, the present study aims at studying the diversity and abundance of phytoplankton communities of the lake, which is also the largest lake of the state.

2. Materials and Methods

The study was carried out during October, 2017 to May, 2019 at Rudrasagar lake, located at Sepahijala district of Tripura. Water samples for qualitative and quantitative assessment of phytoplankton were collected by filtering 60 litres of water through a nylon plankton net (No. 25) at monthly intervals during morning hours and preserved in 5% formalin. Phytoplankton taxa were identified following Needham and Needham (1965) and Adoni (1985). Abundance of the phytoplankton was estimated with the help of a Sedgewick Rafter cell and expressed in cells l⁻¹. The ecological indices *viz.* Shannon-Weiner diversity index (H'), Margalef's evenness index (d) and Pielou's species richness (J) were estimated following Ludwig and

Reynolds, 1988. Statistical analysis was done with the help of SPSS software version 16.

The mathematical computations for the diversity indices are as follows:

The mathematical computations for the diversity indices are as follows:

$$\text{Margalef's Richness Index, } d = \frac{S-1}{\ln n}$$

where, S is the number of species and n is the total number of individuals

$$\text{Shannon index, } H' = - \sum_{i=1}^S (p_i \ln p_i)$$

where, S is the number of species in the sample, p_i is the proportion of the i^{th} species in the total sample.

$$\text{Pielou's Evenness Index, } J' = \frac{H'}{\ln S}$$

where, S is the number of species in the sample and H' is the Shannon index

3. Results and Discussion

Table 1 mentions the 35 phytoplankton genera belonging to four main groups *viz.* Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae, that were observed during the study. Chlorophyceae dominated the population with 18 genera belonging to the group. Similar dominance by Chlorophyceae was observed in other wetlands including the report of 52 species of phytoplankton in Ghorajan beel of Assam (Sharma, 2012); 30 phytoplankton taxa Baskandi anua, an oxbow lake in Assam (Gupta and Devi, 2014). The average monthly phytoplankton abundance varied between 14229 – 25970 cells l^{-1} . The minimum abundance was observed during January (2018) and the maximum abundance was recorded during April (2018) as presented in Figure 1.

Table 1. Phytoplankton taxa recorded in Rudrasagar lake

Chlorophyceae	<i>Chlorella sp.</i> , <i>Cosmarium sp.</i> , <i>Closterium sp.</i> , <i>Spirogyra sp.</i> , <i>Scenedesmus sp.</i> , <i>Volvox sp.</i> , <i>Ulothrix sp.</i> , <i>Zygnema sp.</i> , <i>Coelastrum sp.</i> , <i>Microspora sp.</i> , <i>Staurastrum sp.</i> , <i>Oocystis sp.</i> , <i>Actinastrum sp.</i> , <i>Pediastrum sp.</i> , <i>Selanastrum sp.</i> , <i>Pandorina sp.</i> and <i>Euastrum sp.</i>
Bacillariophyceae	<i>Cymbella sp.</i> , <i>Navicula sp.</i> , <i>Nitzschia sp.</i> , <i>Synedra sp.</i> , <i>Pinnularia sp.</i> , <i>Fragillaria sp.</i> , <i>Melosira sp.</i> , <i>Cyclotella sp.</i> and <i>Aulacoseira sp.</i>
Cyanophyceae	<i>Anabaena sp.</i> , <i>Nostoc sp.</i> , <i>Microcystis sp.</i> , <i>Spirulina sp.</i> , <i>Oscillatoria sp.</i> , <i>Chroococcus sp.</i> and <i>Calothrix sp.</i>
Euglenophyceae	<i>Euglena sp.</i>

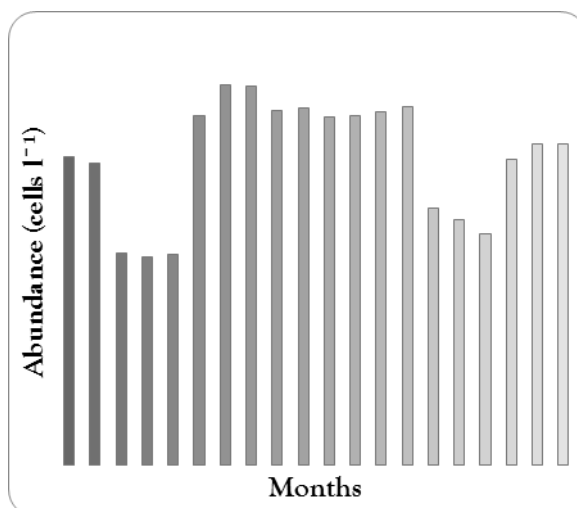


Figure 1. Monthly variations in abundance of phytoplankton in Rudrasagar lake

Table 2 presents the abundance of phytoplankton groups in Rudrasagar lake. Among the various phytoplankton groups, Chlorophyceae (39.89 %) contributed maximum abundance (Table 2). Chlorophyceae abundance ranged between 4905 – 11495 cells l^{-1} with its highest abundance found in

September (2018) and lowest during December (2019). Table 3 depicts that Cyanophyceae abundance fluctuated between 4312 - 8504 cells l⁻¹. The minimum abundance was observed in August (2018) and maximum abundance was recorded in December (2018). Bacillariophyceae abundance varied between 3149 - 8417 cells l⁻¹. The minimum abundance was observed in February (2019) while the highest abundance was found in August (2018). Euglenophyceae abundance varied between 258- 979 cells l⁻¹. Some of the dominant taxa include *Microcystis* followed by *Oscillatoria*, *Aulacoseira*, *Nostoc*, *Pediastrum*, *Chroococcus*, *Anabaena*, *Navicula*, *Ulothrix* and *Nitzschia*.

One way ANOVA revealed that the abundance of Chlorophyceae, Cyanophyceae and Bacillariophyceae showed significant difference (p< 0.05) between the months but not among the sampling sites. Figure 2 explains graphically the variation in abundances of the phytoplankton groups during the study. Euglenophyceae showed significant difference (p < 0.05) between the months as well as between the sampling sites. The highest abundance of Cyanophyceae was observed in winter and the maximum abundance of Euglenophyceae in post monsoon are in conformity with the observations in Chatla wetland, Assam (Laskar and Gupta, 2009).

The average monthly species richness ranged from 24 to 29 phytoplankton genera during the study (Figure 3). The species richness of different phytoplankton groups varied between 8 – 13 genera, 6 – 9 genera, 4 – 7 genera and 1 genus for Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae respectively. The maximum number of genera (29) was recorded during pre-monsoon season and the minimum number of genera (24) was observed during winter season. The highest number of species was recorded in pre monsoon followed by monsoon, post monsoon and winter although it was not so pronounced. Similar variations were observed in Chalta floodplain lake of Assam by Laskar and Gupta (2009). The lowest total number of individuals of phytoplankton (14229 units l⁻¹) was observed in winter and the highest total number of individuals (25970 units l⁻¹) was observed in pre-monsoon season. The lake's species diversity, expressed in the form of Shannon –Weiner index ranged between 3.004 – 3.996 during the study period that indicated general well being of the lake. Margalef's richness index varied between 2.354 – 2.815. The Pielou's evenness index ranged between 0.939 – 0.986 which indicated an even distribution of species in the lake.

Table 2. Group wise abundance of phytoplankton in Rudrasagar lake

Year	Month	Chlorophyceae		Bacillariophyceae		Cyanophyceae		Euglenophyceae	
		Cells l ⁻¹	(%)	Cells l ⁻¹	(%)	Cells l ⁻¹	(%)	Cells l ⁻¹	(%)
2017	Oct	8416	39.95	6401	30.39	5384	25.56	865	4.10
	Nov	8271	40.10	6951	33.70	4593	22.27	812	3.94
	Dec	5092	35.17	3201	22.11	5820	40.20	365	2.52
2018	Jan	5237	36.81	3237	22.75	5493	38.60	261	1.84
	Feb	4985	34.60	3351	23.26	5821	40.40	250	1.74
	Mar	10171	42.56	5749	24.05	7358	30.78	623	2.60
	Apr	10902	41.98	6145	23.66	8239	31.72	685	2.64
	May	10671	41.25	6305	24.37	8310	32.12	583	2.25
	Jun	10605	43.78	8303	34.28	4750	19.61	562	2.32
	Jul	10726	44.04	8417	34.56	4776	19.61	436	1.79
	Aug	10746	45.15	8373	35.17	4312	18.11	373	1.57
	Sep	11495	48.22	7533	31.60	4387	18.40	425	1.78
2019	Oct	8662	35.90	7255	30.07	7389	30.63	821	3.40
	Nov	9094	37.14	6780	27.69	7636	31.18	979	4.00
	Dec	4905	28.02	3553	20.30	8504	48.58	542	3.10
2019	Jan	4829	28.76	3480	20.73	8124	48.39	354	2.11
	Feb	4924	31.15	3149	19.93	7473	47.28	258	1.63
	Mar	8982	43.07	5136	24.63	6230	29.87	506	2.43
	Apr	9614	43.86	5452	24.87	6255	28.53	600	2.74
	May	9280	42.30	5609	25.57	6487	29.57	562	2.56
Mean		8380	39.89	5719	27.22	6367	30.31	543	2.58

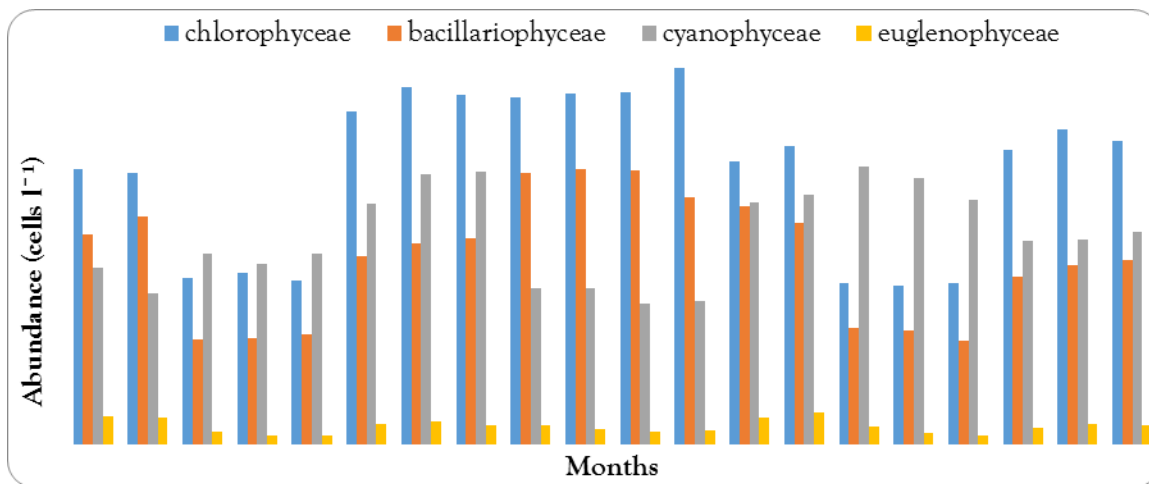


Figure 2. Monthly variations in abundance of different phytoplankton groups

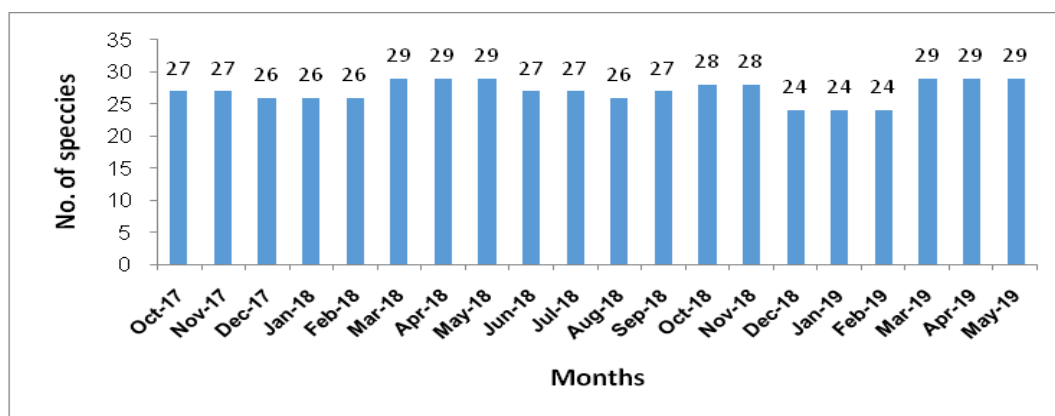


Figure 3. Monthly variation in species richness of phytoplankton in Rudrasagar lake

4. Conclusion

The lake's phytoplankton population was dominated by Chlorophyceae communities. Phytoplankton recorded high diversity index and high evenness index during the study revealing well being of the ecosystem and even distribution of phytoplankton species in Rudrasagar lake. The knowledge on the phytoplankton with reference to its diversity and abundance will help in further studies to assess ecological health of the lake.

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