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Original Research Paper

The Study of Phytoplankton Dynamics in Two Lakes of Mysore, Karnataka State, India

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Trophic state
Shetty lake
Hadhinaru lake

ABSTRACT

An attempt was made to compare a protected lake (Hadhinaru lake) with an unprotected (Shetty lake) lake by means of phytoplankton analysis. Based on phytoplankton analysis, Chlorophyceae were more abundant in Shetty lake than in Hadhinaru lake, while Cyanophyceae and Bacillariophyceae were uniformly distributed in both the lakes. Desmids were slightly higher in number in Hadhinaru lake. Euglenophyceae were more abundant in Shetty lake. Although one lake is protected from human activities and the other is left open for various activities, the findings are almost similar in both the lakes, and they need regular monitoring.

INTRODUCTION

The presence of phytoplankton in freshwater bodies is a widely accepted indicator of water quality. Research projects on phytoplankton (Kiss & Genkal 1993, Balogh et al. 1995, Jones 1995, Kiss 1996, Shafik et al. 1997, Kiss et al. 1998) use these characteristics to describe the trophic state (Sumner & Fisher 1979) of the system. However, identification of the algal species, the knowledge of the algal cell number, or the physiological state of cells may also be important in providing a true picture of the water quality or trophic state. Hosmani & Bharathi (1982) studied the use of algae in classifying water bodies and found it as significant. The compound quotient values obtained indicate that lakes are weakly eutrophic with less polluted and the ponds are true eutrophic with high degree of pollution. Hosmani (1988) made a study on the variation in phytoplankton communities in a pond at Dharwar. The study by Reynolds (1998) reveals the present concept relating to the selection of phytoplankton along trophic gradients. Monthly variation of phytoplankton in relation to physico-chemical factors of the pond water (Imalia) were carried out by Rajendran Nair et al. (1999) during January 1985 to December 1886. The density of the groups of the phytoplankton was found in the following order: Bacillariophyceae, Euglenophyceae and Myxophyceae. Clear bimodal phytoplankton abundance was seen with main spring peak and subsidiary peak in the autumn. The seasonal percentage composition of phytoplankton showed Chlorophyceae 80%, Bacillariophyceae 12%, and Myxophyceae and Euglenophyceae 3.5%.

In the present study, two lakes of Mysore district have been selected. Among the two one is protected (fenced) while the other remains unprotected and free for public use. Five different groups of phytoplankton applicable to water bodies have been analysed. A comparative account of these parameters has been discussed and differences between them have been drawn.

MATERIALS AND METHODS

The study area, Shetty lake is located at 12°14'14" N and 76°39'37" E at an altitude of 701.6 meters

above M.S.L. It is situated 4 km away from Mysore city. The water is used for agriculture and fishing with an independent catchment area of 1.79 sq. km spread over an area of 4.8 hectares with a live capacity of 9 Mcft. The maximum depth of the lake when full is seven meters. The other lake is Hadhinaru lake, which is located at 12°02'02" north latitude and 76°41'38" east longitude at an altitude of 653.35 meters above M.S.L. It is situated 18 km away from the Mysore city. It has an independent catchment area of 8.57 sq. km with water spread area of 10.10 hectares having a live capacity of 54.43 Mcft. The maximum depth of the lake when full is five meters. Water samples from the study area were collected from January 2006 to December 2006, once in a month between 8 A.M. and 10 A.M. The physicochemical parameters were estimated according to the standard procedures given in APHA (1995).

The samples from both the lakes were collected in 30 mL vials. Few drops of Lugol's iodine and few drops of 4% formaldehyde were added. The preserved samples were observed under microscope. Phytoplankton count was made by Lackey's drop method (1938) as mentioned in APHA (1995) and modified by Saxena (1987). Formula used for the calculation of phytoplankton as units/L is:

$$\text{Phytoplankton, units/L} = \frac{N \times V \times 1000}{V}$$

N = Number of phytoplankton counted in 0.1mL concentrate
C = Total volume of concentrate in mL
V = Total volume of water filtered through net

RESULTS AND DISCUSSION

The distribution of phytoplankton in both the lakes as population density is presented in Tables 1 and 2. The monthly distribution of phytoplankton reveals that Chlorophyceae were more abundant in Shetty lake and Cyanophyceae were distributed almost equally in both the lakes. Desmidaceae were slightly higher in Hadhinaru lake, while Euglenophyceae were abundant in Shetty lake. The percent distribution of phytoplankton in both the lakes is represented in Fig. 1 and Fig. 2. Chlorophyceae are slightly high in Hadhinaru lake (41%) while in Shetty lake they represent 39%. Cyanophyceae and Bacillariophyceae are also equally distributed; Euglenophyceae are poorly represented in Hadhinaru lake (4%) as compared to 11% in Shetty lake. On the contrary Desmidaceae are poorly represented in Shetty lake (6%) in comparison to Hadhinaru lake (14%). On an overall comparison, both the lakes are dominated by Chlorophyceae and Bacillariophyceae. The major difference between the two lakes is the occurrence of Euglenophyceae and Desmidaceae which are the two major groups of pollution indicator organisms. Desmids are high and Euglenophyceae are low in Hadhinaru lake, while their occurrence is vice-versa in Shetty lake indicating that Hadhinaru lake, which is protected, is less polluted than the unprotected Shetty lake. Among the Chlorophyceae, members, the order Chlorococcales was more abundant. Hutchinson (1967) considered that the two major groups of algae, Chlorococcales on one hand, and the Desmids on the other, generally have different physiological requirements and will, therefore, tend to have different preferences. Other workers like Joshna (1886), Hodgetts (1922), Griffith (1923), Strom (1924) and Howland (1931) suggest that large water bodies that support Desmids and other green algae are chemically different from those waters that support diatoms and Myxophyceae. These observations suggest that the ecology of total phytoplankton cannot be discussed as a whole.

Table 1: Physicochemical and algal parameters of Shetty lake.

	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Air temperature	29	28	29	27	29	29	30	30	31	28	27	29
2	pH	8.6	8.8	9	8.9	8.6	8.7	8.6	8.7	8.6	8.5	8.6	8.7
3	DO	3.4	3.6	3.8	3.8	4.6	5.2	10.2	17.3	6.4	5.8	5.2	7.1
4	BOD	9.5	10.2	16	26.4	25	12	11	14	10.2	14	10.8	12
20	Chlorophyceae	16800	18200	19600	18200	9800	11200	5600	9800	8400	9800	8400	9800
21	Cyanophyceae	4200	2800	4200	4200	2800	2800	1400	Nil	Nil	Nil	Nil	4200
22	Bacillariophycea	15400	15400	11200	19600	9800	9800	2800	8400	8400	5600	9800	9800
23	Euglenophyceae	4200	4200	2800	4200	Nil	1400	1400	2800	4800	4800	4800	2800
24	Desmidaceae	2800	1400	2800	1400	1400	2800	2800	4200	1400	1400	Nil	Nil

Temperature as °C, phytoplanktons units/L and remaining parameters as mg/L.

Table 2: Physicochemical and algal parameters of Hadhinaru lake.

	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Air temperature	28	29	28	28	29	30	29	27	28	29	28	29
2	pH	8.2	8.6	8. 3	8.6	8.2	8	7.9	7. 9	7. 8	8	8. 5	8. 5
3	DO	7.2	8.11	4.05	5.27	8.12	10.22	10.2	12.19	9.32	9.73	10.14	10.54
4	BOD	3	4.5	12	10	6.8	8	7	11	6.2	6	8.2	7.98
20	Chlorophyceae	9800	11200	14000	7000	12600	8400	5600	5600	5600	2800	2800	7000
21	Cyanophyceae	1400	1400	1400	2800	1400	1400	1400	Nil	Nil	Nil	Nil	2800
22	Bacillariophycea	8400	8400	8400	8400	7000	7000	7000	7000	4200	4200	4200	5600
23	Euglenophyceae	1400	Nil	1400	Nil	Nil	Nil	1400	1400	1400	1400	1400	Nil
24	Desmidaceae	1400	1400	2800	2800	2800	2800	2800	1400	4200	2800	2800	2800

Temperature as °C, phytoplanktons units/L and remaining parameters as mg/L.

Munnawar (1970) and Seenayya (1971) suggested that high concentration of carbon dioxide and bicarbonates affects the growth of Chlorococcales. Bicarbonates and carbonates are high in Shetty lake and Hadhinaru lake and support higher number of Chlorococcales. But Provasoli (1958) reported that members of Chlorococcales had an abnormal mode of nutrition. The observation of Griffith (1912), Fritsch & Rich (1913) and Hodgelts (1922) reported that Chlorococcales are usually high during summer when temperature is usually high. On the contrary, Seenayya (1971) did not find any significant relation between these and concluded that it was difficult to comprehend that temperature was the potent ecological factor controlling the growth of Chlorococcales. Although, the Chlorococcales in the lakes under study were abundant during summer, there was no correlation to temperature. This confirms the observations of Seenayya (1971). Among the total number of Chlorococcales recorded, maximum forms belonged to *Scenedesmus* sp. in Shetty lake.

The other major group of the planktonic algae that appeared in the two lakes was Bacillariophyceae (35% in Hadhinaru lake and 30% in Shetty lake). Schroeder (1939) recognized that waters having low pH are poor in diatoms, while the more alkaline water (pH above 8) has a restricted flora. Shetty lake had pH above 8 throughout the period of collection, while Hadhinaru lake has a slightly higher pH above 8, but the distribution of diatoms in both the lakes was almost same. Kolbe (1932) concluded that calcium neutral range of pH had the greatest diversity of diatoms, which is also true in the present lakes. Kolbe (1932) observed that calcium in alkaline waters support higher number of diatoms. Total alkalinity in both the lakes was considerably high and, therefore, Shetty lake and

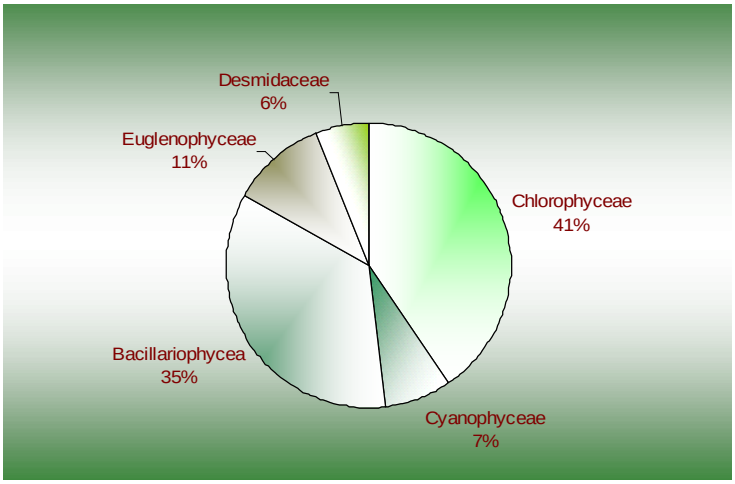

Fig.1: Percent distribution of phytoplankton in Shetty lake.

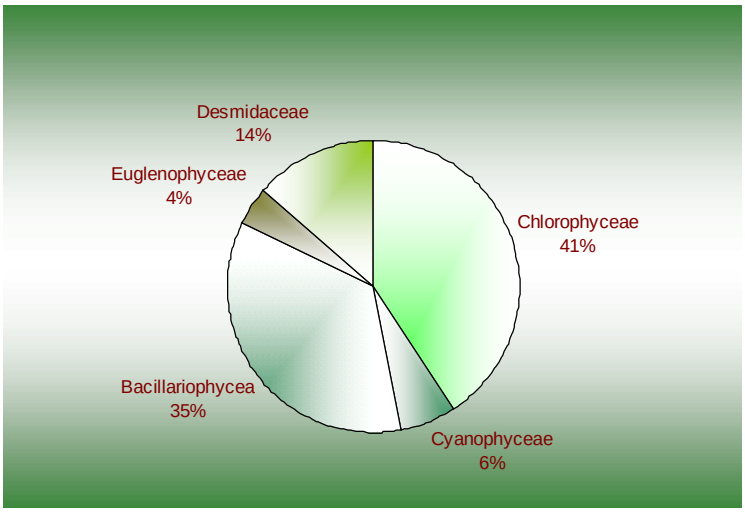

Fig. 2: Percent distribution of phytoplankton in Hadhinaru lake.

Hadhinaru lake have high diatom population. Pearsall (1932) found that diatom growth is well in phosphorus rich waters associated with nitrates. Both, nitrates and phosphorus were low in the water bodies and this observation cannot be accounted in the present study. These observations indicate that diatoms grow abundantly in waters with alkaline pH, while phosphorus and nitrate have a lesser role to play in their ecology.

The concept of distribution of desmids is well established and yet one finds variations in different bodies of water. Some have emphasized the role of calcium in their growth while others consider temperature as an important growth parameter. Pearsall (1932) considers that desmids are high in

waters where nitrates and phosphorus are low. Calcium content in both the lakes was not very high, but the phosphates and nitrates were low. However, Hadhinaru lake has slightly higher content of calcium, and the desmid population was slightly high (14%) as compared to Shetty lake (6%). Josuha (1886), Strom (1924) and Froehne (1939) assumed that acidic waters support desmid rich population, while Van Oye (1934) points out that pH increases the desmids. This observation is also true in the present study. Van Oye (1934) suggested that paucity of desmids is due to the eutrophic nature of the water, and Munnawar (1970) also found similar observations. Hadhinaru lake being protected shows higher desmid population (14%) as compared to the unprotected Shetty lake (6%).

In Shetty and Hadhinaru lakes, the population of Euglenophyceae was not significantly represented. However, Shetty lake, which is unprotected and is often contaminated, has higher growth as compared to Hadhinaru lake, which is protected and less contaminated by organic matter. Cyanophyceae were almost uniformly distributed in both the lakes and were represented in low numbers. The factors that stimulate the abundance of blue green algae are varied. Ganapathi (1960) reports that temperature, sunshine, phosphates, nitrates and calcium to be important in the growth of Cyanophyceae. The concept that a single factor may influence the luxuriant growth of Myxophyceae cannot be explained well since all the factors do not differ in the water bodies studied.

Both the lakes are dominated by Chlorophyceae and Bacillariophyceae. Among the Chlorophyceae, Chlorococcales were abundant. Diatoms grew abundantly in waters with alkaline pH and phosphorus and nitrate have a lesser role to play. Alkaline pH of water supports higher number of desmids and the paucity of desmids is due to eutrophic nature of the water. Waters organically contaminated support higher number of Euglenophyceae and the abundance of Cyanophyceae have no impact on desmids. Cyanophyceae and Bacillariophyceae in both the lakes are uniformly distributed. Desmids are slightly higher in number in Hadhinaru lake, which is an indication of clean water. Chlorophyceae and Euglenophyceae are more abundant in Shetty lake which is an indication of organic pollution and regular monitoring is required.

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