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ECOLOGICAL INVESTIGATION OF A TROPICAL FRESHWATER HABITAT II. POPULATION DYNAMICS OF PHYTOPLANKTON

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ABSTRACT

The paper deals with the seasonality of total phytoplankton and the three major constituent groups i.e. Chlorophycean, Crysophycean and Mixophycean plankton. A bimodal peak pattern caused by dominance of Mixophycean group has been observed. The percentage composition and seasonal abundance have been delt with in particular reference to eutrophic nature of the lake.

Key words : *Phytoplankton, Population density, Seasonal variation.*

INTRODUCTION

Phytoplankton community plays an important part in any aquatic ecosystem may it be fresh water , marine or estuarine system. Phytoplanktonic community in one hand converts the radiant energy into chemical energy and starts ecological production as well as flow of energy to sustain the other biotic community and provides stability to the system while on the other hand is used as bioindicator (Cairns ***et.al.*** 1972), as a tool of biomonitoring (Venkateshwarlu 1981,1983; Venkateshwarlu and Sheshadri 1981; Venkateshwarlu and Sampathkumar 1982) and recently in bioremediation (Govindan 1984; Uma and Subramanian 1990; Dash and Mishra 1988; Mishra 2003; Ghosh ***et.al.*** 2003). There is great paucity of knowledge so far the population dynamics of the community is concerned from this high altitude and hilly region of Jharkhand.

The communication deals with the temporal dynamics of phytoplankton population with bioindication of trophic status of Hazaribag lake.

Study area : Hazaribag lake was studied during the investigation. The lake is located

at 85° 25 EL and 24°2 NL with an area of 7.28 hectares and at an altitude 548.64 metres above mean sea level. It is a man made waterbody and in 1967 it was renovated by desiltation and excavation. The maximum depth of the lake during monsoon month has been found to be 9.00 metres, which decreases considerably. In rainy season the lake is connected with an outlet which is channelised into the cultivated land, situated to the north of the lake.

The lake is surrounded by park, forest, buildings and roads. Eucalyptus forest is planted by the forest Department.

MATERIALS AND METHODS

Plankton were sampled with the help of Plankton net made up of bolting cloth with standard mesh size and number (No. 25), from the surface water of the lake in morning hours always in first week of the month to continuous one year (1992-93). The sampled plankton were preserved in 70% alcohol at the site and then brought to laboratory for detailed qualitative and quantitative estimation. The phytoplankton were analysed for their population density as individual/litre with the help of Sedgwick Rafter Plankton Counting Cell.

On the basis of population density Chlorophycean index (Nygaard 1949) was calculated as follows.

$$\text{Chlorophycean index} = \frac{\text{Chlorococcales}}{\text{Desmideae}}$$

OBSERVATION

The phytoplankton on the basis of qualitative estimation, were broadly categorised under three major heads as Chlorophycean, Crysophycean and Mixophycean plankton, apart form their individual details. Only group level population has been delt with in the present communication. In general Chlorophycean phytoplankton were dominated by Chlorococcls and the group abundance was during rainy season. The maximum number of Chlorophycean plankton was observed to be 5940 ind/l in the month of July while a minimum of 225 ind/l was observed in the month of January. Crysophycean phytoplankton were in fairly high number in comparison to Chlorophycean plankton. The highest number recorded was 5200 ind/l (in December) while the lowest population density was 1270 ind/l in June. The dominant group was Mixophycean plankton with maxima of population density in November and minima in January (Fig - 1).

Figure : 1. Seasonal variatiion in different gooup of phytoplankton density (ind/l) log transformed data (log_e-5)

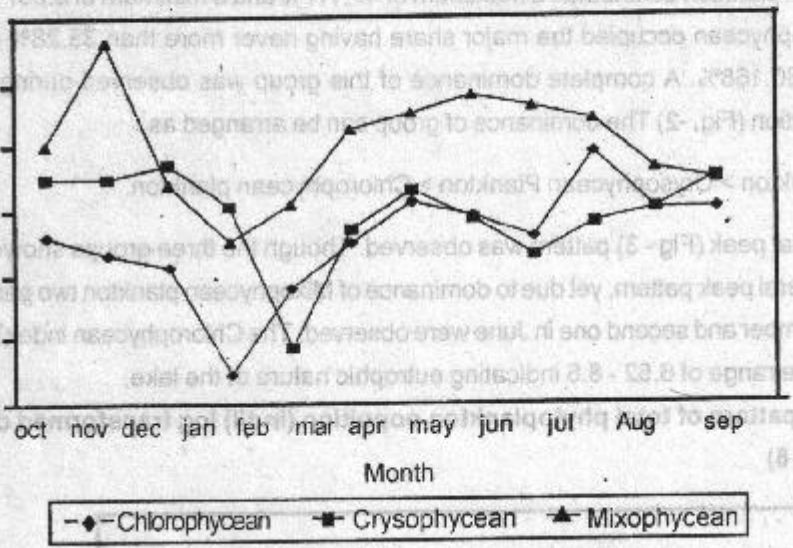
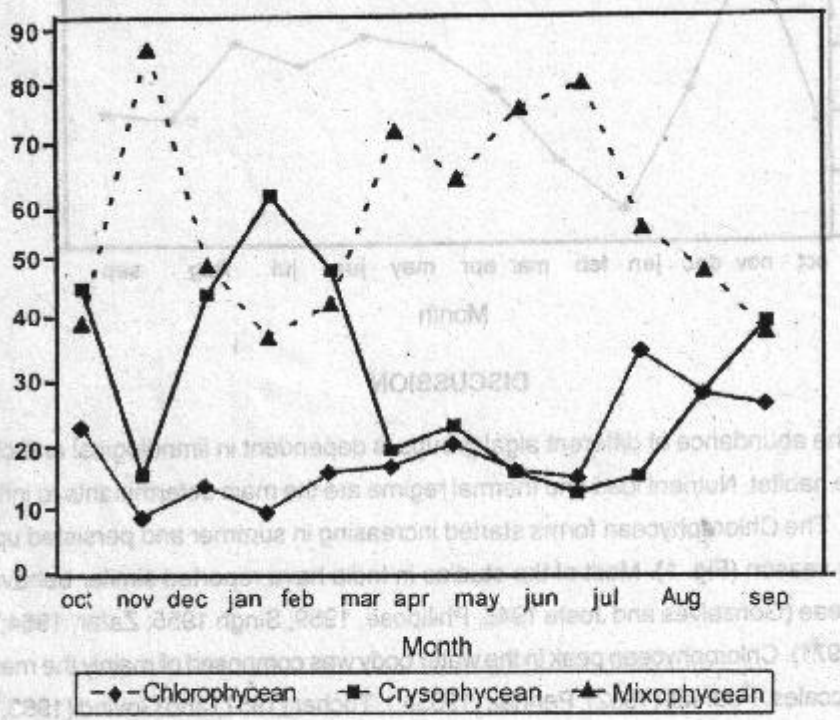


Figure : 2. Seasonal variatiion in percentage composition of different groups of phytoplankton

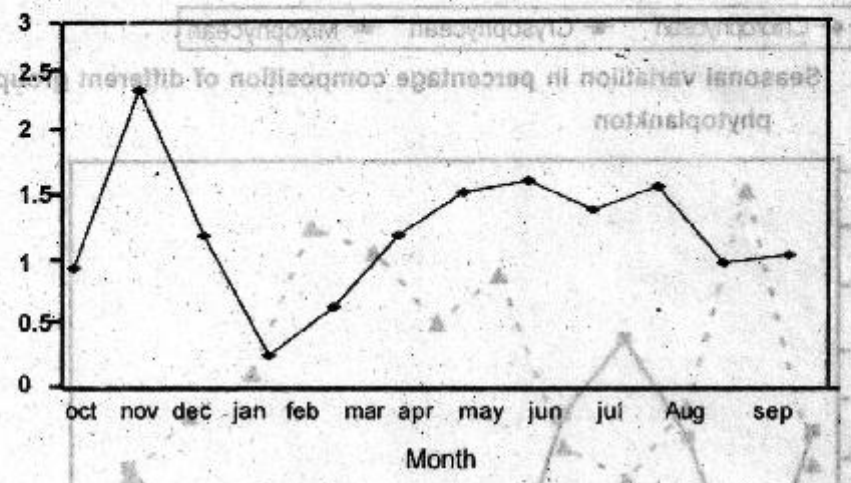


So far percentage sharing of individual group with respect to total phytoplankton is concerned the Chlorophycean group never share more than 33.374% and less than 4.653 %. The Crysophycean plankton contributed a maximum of 47.117% and a minimum of 8.537% to total density. Mixophycean occupied the major share having never more than 35.28% with highest share of 80.168%. A complete dominance of this group was observed during the period of investigation (Fig. -2) The dominance of group can be arranged as

Mixophycean plankton > Crysophycean Plankton > Chlorophycean plankton.

A bimodal peak (Fig - 3) pattern was observed. Though the three groups showed a variation from general peak pattern, yet due to dominance of Mixophycean plankton two peaks- major one in November and second one in June were observed. The Chlorophycean index was always found in the range of 6.52 - 8.6 indicating eutrophic nature of the lake.

Figure : 3. Peak pattern of total phytoplankton popultion (ind/l) log transformed data (log_e- 8)



DISCUSSION

The abundance of different algal groups is dependent in limnological and climatic profile of the habitat. Nutrient load and thermal regime are the main determinants to influence abundance. The Chlorophycean forms started increasing in summer and persisted upto the end of rainy season (Fig. 1). Most of the studies in India have reported similar behaviour of Chlorophyceae (Gonzalves and Joshi 1946; Philipose, 1959; Singh 1955; Zafar, 1964; 1967; Seenaiah, 1971). Chlorophycean peak in the water body was composed of mainly the members of Chlorococcales. Pearsall (1932), Pennak (1955b;), Tucher (1957) and Govind (1963, 1969)

have shown influences of different nutrients on various groups of phytoplankton. Chemical factors controlling Chlorophycean abundance are, however, little known (Govind, 1969; Mathew, 1969). However, Zafar (1964)relates the growth of Chlorococcales with increased organic matter supplied in rainy season and high dissolved oxygen content. Reynolds (1973b) has also correlated the abundance of Chlorococcales with high dissolved organic matter.

Different phytoplankton groups are also reported to prefer water with different physico-chemical chrematistic. A perusal of literature (Hutchinson, 1975), shows that it is diffiicult to assign any particular group to state of pollution. Each group is having a few pollution tolerant species while other are intolerant and hence pollution sensitive. Nevertheless, a few generalisations are now more or less accepted that a clean water body consists of diatom dominated flora and organic pollution leads to the development of Chlorophyceae (Chlorococcals) and Cyanophyceae. However, abundant growth of blue-green algae in nutrient-poor waters has also been reported by many authors (Hutchinson, 1975; Koshinsky, 1965; Nicholls, 1976). Hutchinson (1975) observed that blue-green algae though generally found in eutrophic waters, are those which are favoured by least concentration of nutrients. Nicholls (1976) has observed abundant growth of blue-green algae in waters where inorganic nitrogen and phosphorus concentration were less than detectable limits. Further, the dominance of blue green algae generally has an inhibitory effect on other algal forms (Ganapati, 1940). The individual richness increases with pollution while species richness decreases.

Peaks of phytoplankton are said to be caused by making habitat more productive through accumulation of ectocrine substances chiefly brought by rains from surrounding area. Overall pattern of seasonal succession of phytoplanktonic communities in the water body under investigation reflects a characteristic eutrophic type where blue - green algae, Chlorophyceae and diatoms succeeded each other (Nygaard, 1949; Hutchinson, 1975; Reynolds, 1973a). A seasonal succession as observed during the present study also substantiates the hypothesis of Moss (1973) that algal blooms and subsequent pollution crashes are characteristic of eutrophic waters, while in the oligotrophic water bodies a single pulse is observed in the whole year. A bimodal peak pattern substantiates the eutrophic nature of the lake.

The number of phytoplankton species present in water bodies is also correlated with eutrophy of water and polluted condition. Margalef (1964; 1968) has suggested that phytoplankton communities in infertile waters are more diverse than those in fertile waters. This is because due to pollution, ecosystem comes under stress and as stressed conditions

only favour certain pollution tolerant species while intolerant or less tolerant species either decline in number or gradually become eliminated from the system. The present study confirms such observation.

In the present investigation, the occurrence of large number of blue - green algae coincided with the presence of high amount of nitrate, phosphate and organic matter (Sharan ***et.al.*** 2003). The present finding thus supports the work of George (1961), Bose and Bose (1977), Rai and Kumar (1977) regarding dominance of blue green algae in relation to nutrients in water.

The dominance of Chlorophycean group has been reported in different season from different region. Vyas (1968) recorded the lowest density of green algae during the rainy season in a lake of Udaipur. Munawar (1974) observed higher number of this group during warm months. In the present observations, phytoplankton and higher percentage of green algae were observed in rainy season. The Chlorophycean index, the peak pattern and the blue-green algal dominance convincingly point out the eutrophic nature of the water body.

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