Uttar Pradesh J. Zool 8 (1) : 1-6, 1988

RELATIONSHIP BETWEEN CHLOROPHYLL AND PHYTOPLANKTON IN REWALSAR LAKE, HIMACHAL PRADESH

RAMESH CHAUHAN
DEPARTMENT OF BIO-SCIENCES, HIMACHAL PRADESH UNIVERSITY, SHIMLA-171005, INDIA.

Monthly variations in Chlorophyll concentration and phytoplankton of Rewalsar lake have been estimated and enumerated respectively. The column averaged chlorophylls showed trimodal peaks corresponding to phytoplankton populations. Relationships developed among different Chlorop' ylls and phytoplankton groups revealed significant and positive relationship of chlorophyll-a with Myxophytes ar d highly significant and positive relationship of chlorophyll-c with Bacillariophytes and total phytoplankton. Total chlorophyll content (chlorophyll-a+b+c) also showed highly significant and positive relationship with total phytoplankton population.

INTRODUCTION

One of the most interesting and complex problems facing man today is the unraveling of the mysteries of photosynthesis. In an ecosystem, autotrophs manufacture their food from inorganic substances with the help of chlorophylls by utilizing energy derived from sun, which is subsequently being used by the other organisms. Among different chlorophylls, chlorophyll-a has been found most active in the process of photosynthesis (Purushothaman & Bhatnagar, 1976). The higher values of chlorophyll-a can be treated as an index of sewage discharge, retention of nutrient rich water and abundance of blue-green algae in aquatic environments (Thomson & Ho, 1981).

Phytoplankton constitute first level in food chain of freshwater ecosystem. Their biomass can be treated as an index of chlorophyll contents (Sharma

& Pant, 1979). The presence of chlorophyll-b indicates the dominance of Chlorophyceae and Euglenophyceae while Chlorophyll-c has been related to the dominance of Bacillariophyceae, Chrysophyceae, Dinophyceae and Phaenophyceae (Bhatnagar & Purushothaman, 1978). Therefore, an attempt has been made to study the chlorophyll contents in relation to phytoplankton population of Rewalsar lake from June, 1984 to May, 1985.

Salient features of the lake

Rewalsar lake (31°. 37″, N, 76° 49 E; 1360m asl) with maximum depth of 6 m in the centre is situated at a distance of 179 kilometre away from Shimla on its north-western direction in Mandi district of Himachal Pradesh. The lake is more or less squarish in shape which has cemented Ghat along the Western side and definite boundary boarded by thick emergent macrophytic vegetation on the other three sides. The lake has resembling features of a large tank with profused vegetational cover of Phragmites, floating and submerged plants like Nymphea, Trapa and Ceratophyllum etc. Human intervention specially by way of religious activities like, mass bathing and artificlal feeding of fishes with food grains cause the luxuriant growth of microflora.

MATERIAL AND METHODS

The amount of different chlorophylls (chlorophyll-a, b and c) in phytoplankton population was estimated by Acetone extraction method following APHA (1976) as under :

$$\text{Chlorophyll-a } (\mu g l^{-1}) = 11.64\,(OD665) - 2.26\,(OD645) + 0.1\,(OD630).$$

$$\text{Chlorophyll-b } (\mu g l^{-1}) = 20.97\,(OD645) - 3.94\,(OD665) - 3.66\,(OD630).$$

$$\text{Chlorophyll-c } (\mu g l^{-1}) = 54.22\,(OD630) - 14.81\,(OD645) - 5.53\,(OD665).$$

phytoplankton were also enumerated by following APHA (1976) as under :

$$\text{Phytoplankton (number/litre)} = \frac{C \times A_t \times 1000}{A_f \times F \times V}$$

where :

C = number of organisms counted,

A_t = Total area of bottom of counting chamber (mm^2),

A_f = Area of fields counted,

V = Volume of sample settled, and

F = Number of fields counted.

RESULTS

The column averaged chlorophylls (averaged from different depths of the column), from June, 1984 to May, 1985 showed trimodal peaks. The first peak of

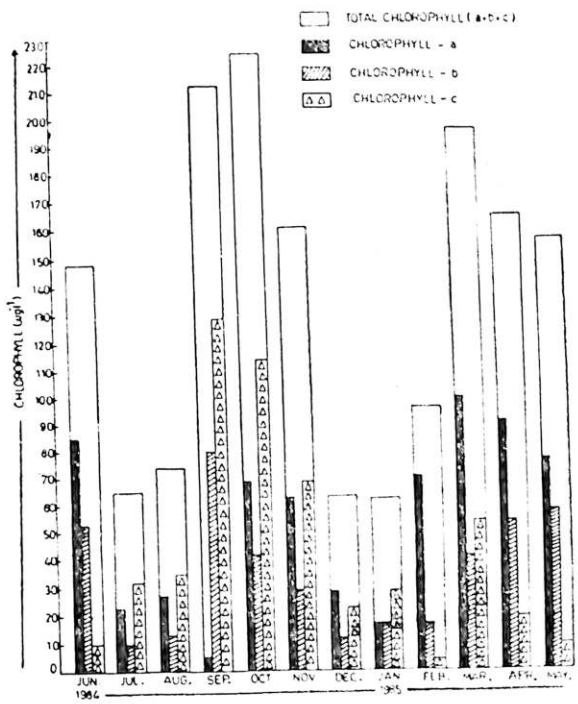

Fig. 1. Average monthly variations in different chlorophyll concentrations from June, 1984 to May, 1985 in Rewalsar lake.

chlorophyll-a (101, 0 $\mu g l^{-1}$) was recorded in March, second (85 0 $\mu g l^{-1}$) in June and third (76.0 $\mu g l^{-1}$) in February during summer (March to May), rainy (June to September) and winter (October to February) seasons respectively. Chlorophyll-b showed first peak (79.0 $\mu g l^{-1}$) in September, second (55.0 $\mu g l^{-1}$) in April and third (42.0 $\mu g l^{-1}$) in October respectively. However, chlorophyll-c showed its first peak (129.0 $\mu g l^{-1}$) in September, second (69.0 $\mu g l^{-1}$) in November and third (55.0 $\mu g l^{-1}$) in March. The average total chlorophyll (chlorophyll-a+b+c) also revealed trimodal peaks, first peak (225.0 $\mu g l^{-1}$) was recorded in October,

second (213.0 $\mu g l^{-1}$) in September and third (198.0 $\mu g l^{-1}$) in March (Fig. 1).

The average phytoplankton population in the lake showed highest density (109.4×10^4 Ind. l^{-1}) in September. However, during rainy season, phytoplankton population showed a decrease from June to July and an abrupt increase in September. In October, total plytoplankton were 50×10^4 Ind. l^{-1} of Bacillariophytes and chlorophytes each, $8 \times 10^4 .l^{-1}$ of Myxophytes and 1.6×10^4 Ind. l^{-1} of others. The lowest Bacillariophytes (0.5×10^4 Ind. l^{-1}) were recorded in February during winter season. During summer season, total phytoplankton

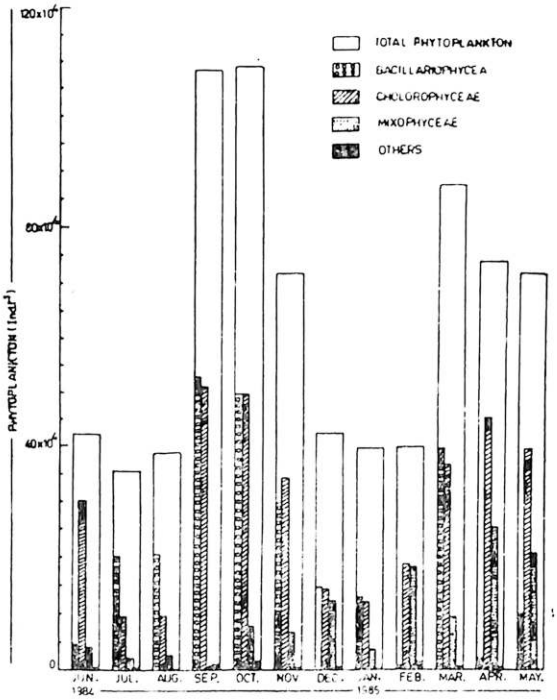

Fig. 2. Average phytoplankton population (Ind. l^{-1}) from June, 1984 to May, 1985 in Rewalsar lake.

population was highest (88×10^4 Ind. l^{-1}) in March and lowest (72×10^4 Ind. l^{-1}) in May (Fig. 2).

Statistically, chlorophyll-a showed significant and positive relationship with Myxophytes ($r=0.63$, $p<0.05$) Chlorophyll-b was found highly significant and positively related to total phytoplankton ($r=0.73$, $p<0.01$). Chlorophyll-c showed highly significant and positive relationships with Bacillariophytes

(r=0 94, p<0.01) and total phytoplankton (4=0 83, p<0.01). Highly significant and positive relationship of total chlorophyll with total phytoplankton (r=0 91, p<0.01) has been recorded (Table I).

Table 1. Correlation coefficient (r) between different Chlorophyll and Phytoplankton of Rewalsar lake from June, 1984 to May, 1985.

Phytoplankton	Chlorophylls			
	C_a	C_b	C_c	Total (a+b+c)
Bacillariophytes	-0.34	0.27	0.94**	0.51
Chlorophytes	-0.05	0.32	0.30	0.24
Myxophytes	0.63*	0.16	-0.45	0.13
Others	0 25	0.13	0.43	0.47
Total Phytoplankton	0.20	0.73**	0.83**	0.91**

C_a = Chlorophyll-a C_b = Chlorophyll-b C_c = Chlorophyll-c

* = p<0 05 ** = p<0.01

DISCUSSION

During rainy season, chlorophyll-a showed decrease from June to September due to low density of blue-green algae. Chlorophyll-b decreased from June to August and abruptly increased in September.This was probably due to low density of Chlorophytes in July/August and high in September. Chlorophyll-c showed an increase from June to September corresponding to the density of Bacillariophytes. During winter season, in the month of December and January low values of different chlorophylls may be ascribed to the low phytoplankton population at low temperature. The lowest concentration of chlorophyll-c in February corresponded to the diatoms population. During summer season, chlorophyll-a decreased from March to May owing to decline in blue-green algae (Fig. 2).

Different chlorophylls showed trimodal peaks. First peak of chlorophyll-a in March may be due to highest concentration of total phosphate-phosphorus (Chauhan, 1987). The peaks of chlorophyll-b and c can be ascribed to the more presence of phytoplankton population of their respective groups. The average total chlorophyll also showed trimodal peaks. The first peak (225.0 $\mu g\,l^{-1}$) was

recorded in October, second (213 0 μgl^{-1}) in September followed by the third peak (193.0 μgl^{-1}) in March. The higher average values of net photosynthesis (171.0 mg Cm^{-2} hr^{-1}) in September (147.0 mg Cm^{-2} hr^{-1}) in October and (144.0 mg Cm^{-2} hr^{-1}) in March with more phytoplankton population have been attributed to these peaks (Chauhan, 1987).

Statistically, chlorophyll-a showed significant and positive relationship with Myxophytes and chlorophyll-b with total phytoplankton. Chlorophyll-c revealed highly significant and positive relationships with Bacillariophytes and total phytoplankton. Total chlorophyll also showed highly significant and positive relationship with total phytoplankton population. Thus, it can be said that chlorophyll is an index of phytoplankton population and vice-versa to the certain extent in an aquatic ecosystems.

ACKNOWLEDGEMENTS

This work was financed by the Department of Environment, Govt. of India. Thanks are due to Miss Lalita for her help in calculations.

REFERENCES

APHA, 1976. Standard methods for the examination of water and waste water. 14th Edition, American Public Health Association, Broadway, New York.

BHATNAGAR, G. P. & PURUSHOTHAMAN, A. 1978. Chlorophyll Ratios in Vellary Estuary, South India. *Nat. Acad. Sci Letters* **1** : 195-197.

CHAUHAN, R. 1987. Hydrobiological studies of Renuka and Rewalsar lakes of Himachal Pradesh with special emphasis on productivity. Ph. D. Thesis, Himachal Pradesh University, Shimla (India)

PURUSHOTHAMAN, A. & BHATNAGAR, G. P. 1976. Primary production studies in Porto Novo waters, South India. *Arch. Hydrobiol.* **77** : 37-50.

SHARMA, P. C. & PANT, M. C. 1979. Certain physico-chemical features, chlorophyll concentration and phytoplankton population in a high altitude lake. *Trop. Ecol.* **20** : 101-113.

THOMSON, G. B & HO, J. 1981. Some effects of sewage discharge upon phytoplankton in Hong-Kong. *Marine Poll. Bull.* **12** : 168-173.