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Short Communication

Ecological studies on a desmid bloom

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Abstract

The ecology of a uni-algal bloom of *Cosmarium variolatum* Lund. var. *rotundatum* (Kreig.) Messik was studied in relation to certain physico-chemical and biochemical variables In evaluating the collective and individual influence of various chemical factors, a new approach has been followed by using multiple regression analysis. Simple correlation analysis between the physico-chemical parameters and algal number has also been made.

Key words: Ecology, bloom, oligotrophy, regression analysis.

1. Introduction

It is highly desirable to evaluate the trophic status of water bodies as fresh waters receive enormous quantities of wastes comprising a large number of nutrients in high concentrations which influence rapid multiplication and blooming of certain algae. The factors that influence the development, duration and decline of an algal bloom have been the subject of research investigations[1]. Prescott[2] reported that oligotrophic lakes are characterised by Chlorophycean flora with a conspicuous desmid element. Duthie[3] studied desmid populations in oligotrophic Welsh lakes to find out the status of desmids in the plankton. According to Brook[4] the greatest number of desmid species (i.e., 59%) occur frequently in oligotrophic lakes. Venkateswarlu[5] reported *Staurastrum tetracerum* from oligotrophic habitats. The present paper discusses the ecological characteristics of *Cosmarium variolatum* var. *rotundatum* and its significance in evaluating the trophic status of the habitat.

2. Material and methods

Surface water samples, altogether 11, were collected from a cement cistern (4m dia and 2m depth) once in three days during April-May 1987. The filtered samples were analysed for various physico-chemical variables by following standard procedures[6]. Certain biochemical constituents such as proteins and carbohydrates were also estimated[7,8]. The quantitative estimation of algae was done by using haemocytometer, and the data were statistically analysed by the methods of Snedecor and Cochran[9].

3. Results

The results of physico-chemical and biochemical factors are incorporated in Table I. The pH ranged from 8.7 to 9.3 showing highly alkaline nature of the medium. The average value of chlorides was 345.9 mg/l. Phosphates and nitrates were recorded in low concentrations and ranged from 0.0 to 0.2 and 0.4 to 0.7 mg/l, respectively. Dissolved oxygen (D.O.) was high with an average value of 7.4 mg/l. Organic matter was found in considerable quantities, fluctuating between 7.2 and 17.5 mg/l. Carbohydrates and proteins varied from 6.0 to 31.0 mg/l and 16.0 to 100 mg/l, respectively.

Multiple regression analysis has been done with phosphates, nitrates and D.O. as independent variables and algal number as dependent variable to find out their collective effect on the growth of *Cosmarium* and the overall regression was tested with the help of 'F' value. The overall regression is significant at 1% level of probability and the coefficient of determination (R^2) is 0.79. Phosphates, nitrates and D.O. explain the variation in algal number to the extent of 79.8%. When phosphates are eliminated in the step-down regression analysis there is no drop in R^2 value (0.79). This indicates that the effect of phosphates on algal number is negligible and both nitrates and D.O. are required to explain the variation in algal number to the maximum extent. Individually also, nitrates and D.O. have a significant positive influence on the growth of the alga (fig. 1, Table II).

4. Discussion

The main conclusion drawn from the various investigations carried out to explore the responses of desmids to the possible chemical conditions was that by far the greatest number of desmid species occur in acid waters[1] (pH 4–7). Recent researches, however, have shown that many species occur often in considerable abundance in alkaline waters[4,10,11]. In the present study, the pH ranged between 8.7 and 9.3, and it had a positive relation with desmid number and is significant statistically at 5% level of probability. The maximum algal number coincided with the highest value of pH.

Desmids are almost exclusively freshwater algae confined to natural waters with low salinities. However, high concentrations of chlorides were recorded in the present study. Nygaard[12] also reports the discovery of several *Cosmarium* species in a lake with high bicarbonate and chloride contents.

In the present investigation the highest algal number coincided with the highest calcium and pH values. The alga had a significant positive relation with calcium and negative relation with magnesium. The negative relation with magnesium might be due to its utilisation in chlorophyll synthesis. Since the average pH of the medium was around 9.0 the alga might have preferred CO_3 and HCO_3 as carbon source, thus releasing calcium into water[13]. This explains the positive relation between algal growth and calcium. Gough[11] also reports that the growth of *Cosmarium granatum* was better at both higher pH and calcium.

The nitrate concentrations were low, but were able to influence the growth of the desmid.

Table I

Physico-chemical, bio-chemical parameters and algal number in the habitat

(expressed in mg/l, except pH and temperature)

Sl no.	Temp (°C)	pH	CO_3	HCO_3	Cl	TH	Ca	Mg	PO_4	NO_3	D.O.	O.M.	Proteins	Carbo-hydrates	Algal number (no. of cells/l)
1.	33	9	96	323.3	325.4	280.8	30.2	49.92	0.2	0.53	12.2	9.13	16	9	9,76,000
2.	36	8.7	60	347.8	306.3	324.0	20.1	66.56	0.2	0.44	5.4	11.09	20	12	6,52,000
3.	35	9	96	311.1	344.6	324.0	21.6	65.60	0.05	0.44	7.4	9.92	20	15	7,10,000
4.	31	8.8	42	286.7	335.0	327.6	18.7	68.32	0.05	0.53	7.0	8.62	32	8	6,82,000
5.	34	9.1	102	286.7	336.6	334.8	27.3	64.81	0.03	0.62	9.2	17.58	44	16	9,10,000
6.	35	9.1	84	292.8	327.0	284.4	17.2	58.19	0.09	0.70	6.2	7.22	32	6	8,24,000
7.	37	9.3	84	298.9	344.6	286.8	40.3	43.79	0.1	0.62	10.0	8.75	24	7	10,84,000
8.	35	9.2	78	260.6	355.8	331.2	31.6	51.31	0.1	0.74	4.2	12.76	100	31	9,52,000
9.	35	9.2	96	262.3	354.2	270.0	14.4	56.93	in traces	0.53	8.6	11.48	36	8	9,68,000
10.	35	9.2	96	280.6	386.1	313.2	12.9	68.32	Nil	0.44	7.4	13.22	60	16	7,94,000
11.	35	9	102	262.3	389.3	313.2	18.7	64.88	Nil	0.44	4.0	12.15	40	13	4,52,000
Mean	34.5	9.0	85	292.1	345.9	308.18	23.0	60.78	0.079	0.54	7.41	11.08	38.54	12.81	8,18,545
S.D.	1.49	±0.1	±18	±25.9	±23.7	±22.14	±7.9	±7.57	±0.06	±0.1	±2.37	±2.73	±22.9	±6.72	±1,75,011

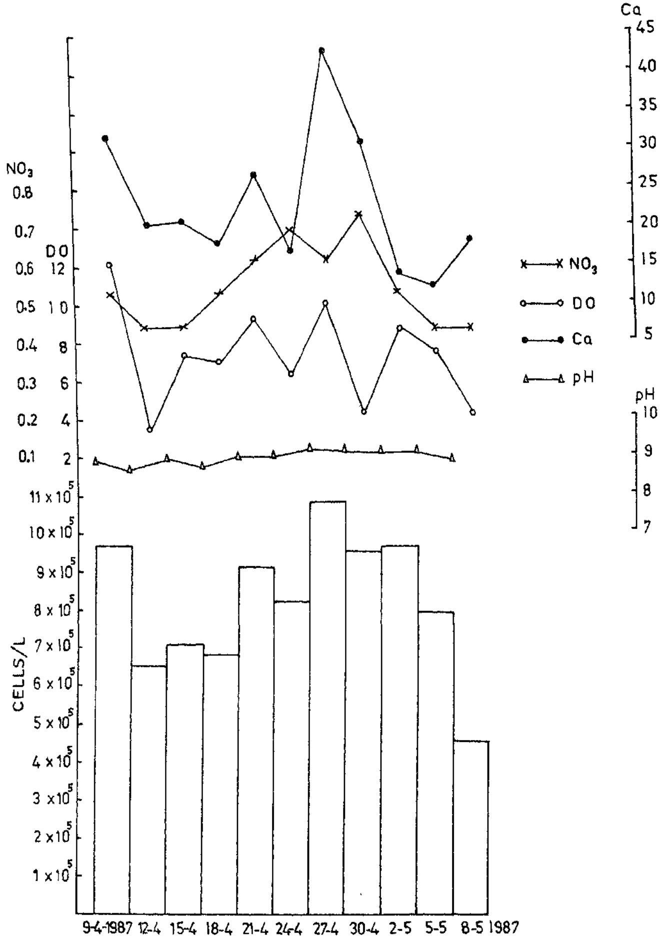

FIG. 1. Relationship between DO, NO_3, Ca and algae.

Table II
Correlation matrix of physico-chemical parameters and algal number

	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	Y
X_1	0.29	0.41	0.05	0.15	−0.03	0.06	−0.10	−0.01	0.04	−0.35	0.18	−0.01
X_2		0.59	0.58	0.50	0.31	−0.51	−0.40	−0.39	0.47	0.27	0.12	0.65*
X_3			−0.28	0.48	0.02	−0.22	0.29	−0.29	0.07	0.28	0.40	0.17
X_4				−0.75	0.16	−0.10	0.02	0.78	0.31	0.27	−0.31	−0.03
X_5					−0.24	0.19	0.04	−0.80	−0.21	−0.26	0.32	−0.23
X_6						−0.62	0.01	0.50	0.49	0.37	−0.02	0.58*
X_7							0.73	−0.34	0.40	0.61	0.40	−0.72**
X_8								−0.02	0.09	−0.50	0.51	−0.45
X_9									0.18	0.25	−0.22	0.25
X_{10}										0.01	−0.03	0.60*
X_{11}											−0.09	0.66*
X_{12}												−0.01

X_1 = Temperature; X_2 = pH; X_3 = Carbonates; X_4 = Bicarbonates; X_5 = Chlorides; X_6 = Calcium, X_7 = Magnesium; X_8 = Total hardness; X_9 = Phosphates; X_{10} = Nitrates; X_{11} = D.O.; X_{12} = Organic matter; Y = Algal number.

*Significant at 5% level; **Significant at 1% level.

The positive relation of nitrates and algal growth which is significant at 5% level of probability, might be due to its recycling. The decomposition of nitrogen is favoured as oxygen levels are increased.

Dissolved oxygen and algal numbers are directly related to each other. The variation in D.O. is due to variation in photosynthetic activity which in turn depends upon the algal number. The relatively high organic content in the water body can be attributed to the metabolic products liberated by the alga which is evident from the presence of high extracellular proteins and carbohydrates[5].

From the foregoing account it can be concluded that *Cosmarium variolatum* var. *rotundatum* prefers oligotrophic habitat as is evident by the presence of low-nutrient (NO_3 and PO_4) content in the medium. Further it can be termed as hard-water inhabiting species due to high water hardness.

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