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Limno-Biotic Investigation Of A Tropical Freshwater Reservoir

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The paper includes data on physico-chemical and biological parameters reflecting the eutrophic conditions of the reservoir. The concentration of nutrients like phosphate, sulphate, nitrate and chlorides has been found increasing. The species number has decreased while the individual number has shown an increase over previous year. The primary productivity along with the production of hydrophytes has been recorded increased. The paper concludes that on the basis of various physico-chemical and biological indices the waterbody under investigation is eutrophic in nature.

Key words : Physico-chemical, Biological, Primary productivity, Reservoir.

Introduction

Several indices based on limno-biotic parameters have been suggested (Sawyer, 1966, Rodhe, 1969, Wetzel, 1975) to assess eutrophication level of waterbodies. The rate of eutrophication is very difficult to measure and no suitable single parameter has so far been proposed, but continued temporal and spatial variation in nutrients, primary productivity, species diversity and other parameters however, signifies investigation of eutrophication (Sinha, 1986).

The review of literature reveals that works pertaining to limno-biotic studies for assessing the eutrophication of Chhotnagpur plateau have not been done and hence the present communication attempts to present a picture of eutrophic conditions of Rajendra Sarobar, a freshwater reservoir in the heart of Dhanbad town.

Materials and Methods

The water samples had been collected manually by gently wading into water, in one litre polyethylene bottles. The pH, dissolved oxygen, free carbon dioxide and alkalinity were determined in the field. For other analysis the samples were preserved using suitable preservative (Trivedy and Goel 1984) and taken to laboratory and stored in refrigerator. The analysis was completed within 72 hours. In general, the methods recommended by APHA (1968), Golterman (1969) and Trivedy and Goel (1984) have been followed.

Plankton were sampled with a conical plankton net made up of bolting cloth (No.25) and were counted with the help of Sedgwick Rafter plankton counting cell. Monthly sampling was done for two Years (1984 and 1985).

Results

The data recorded after physico-chemical and biological analysis of samples have been presented in Figs. 1 (A-D) & Tables 1-2. Figs. 1 (A-D) show the seasonal variation in different parameters during first year of study while the Tables 1 & 2 reflects the comparative account of annual fluctuation in different parameters of second year in relation to the first year in terms of annual average and percentage.

pH during first year of study ranged from 7.2 to 8.6 in December and March respectively while in the second year the minima and Maxima of the same was 7.6 and 8.7 in December and June. The pH value increased 14.78% in second year over the first year.

Dissloved oxygen concentration varied from 0.6 mg/l to 4.2 mg/l in first year while 0.4 mg/l to 3.4 mg/l in the second year showing a decrease

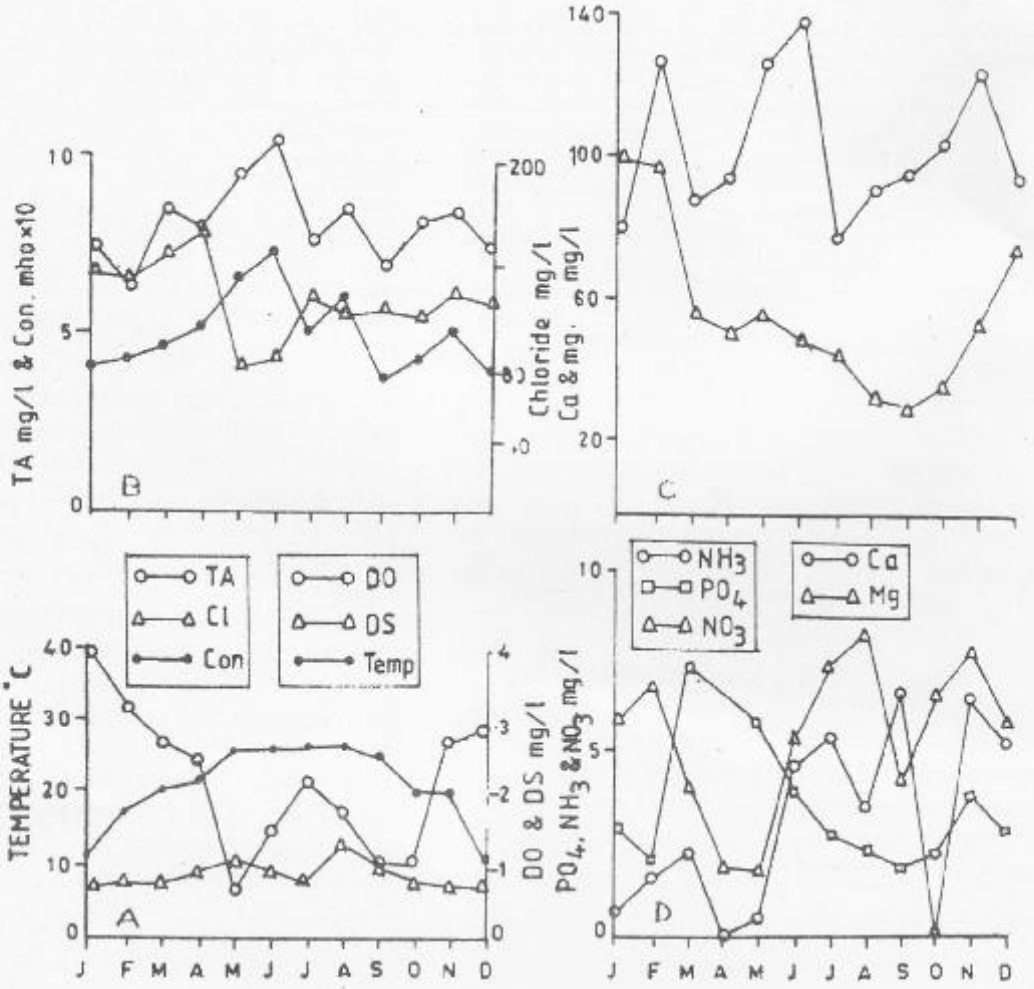

Fig.1(A-D) :Seasonal variation in physico-chemical parameters A. Temperature (Temp.), Dissolved oxygen (DO), Dissolved solids (DS); B. Total alkalinity (TA), Conductivity (CON.), Chloride; C. Calcium (Ca), Magnesium (Mg); D. PO_4^--p Ammonia (NH_3) and NO_3^--N.

Table 1 : Physico-chemical characteristics (minimum, maximum & average) of water body. (Values as mg/l)

	1984					1985				percentage increase	
	Min.		Max		Avg.	Min.		Max.	Avg		
pH	Dec	7.2	Mar	8.6	7.1	Dec	7.6	Jun	8.7	8.15	14.78
Dissolved oxygen	May	0.6	Jan	4.2	2.2	Mar	0.4	Jun	3.4	1.8	-22.22
Conductivity mho	Sep	0.38	Jun	0.75	o.51	Dec	0.42	May	0.9	0.66	29.41
Total alkalinity	Feb	60.2	May	90.5	80.5	Jan	50.9	Jun	100.3	90.2	80.23
Dissolved solids	Jan	65.5	May	293.0	131.55	Dec	58.6	May	328.8	142.6	8.39
Chloride	May	82.9	Apr	165.6	122.11	Jun	96 .5	May	180.3	135.8	11.21
Calcium	Jan	82.5	Jun	141.2	105.36	Dec	76.4	Apr	126.4	96.3	-9.40
Magnesium	Sep	32.5	Jan	101.5	59.58	Nov	20.10	Jun	98.2	60.5	1.54
Nitrate Nitrogen	May	1.8	Nov	8.1	5.79	Jun	1.9	Dec	9.2	6.20	7.08
Phosphate Phosphorus	Sep	1.9	Mar	7.9	3.85	Dec	1.9	Mar	8.6	4.10	6.49
Free CO_2	Mar	0.8	Jul	16.8	7.72	Apr	1.4	Aug	18.4	9.3	20.46

Table 2 : Biological characteristics of the reservoir with percentage of annual increase.

Chracter	1984	1985	% increase
Total Phytoplankton species	36	27	-33.33
Bacillariophyceae (sp./ind.)	12/22403	9/35361	57.84
Chlorophyceae "	9/13381	6/15871	18.60
Myxophyceae "	6/12732	6/17205	35.13
Euglenophyceae "	4/11525	3/12338	06.13
Dinophyceae "	5/1805	3/2010	11.35
Total phytoplankton density (ind/1/Yr.)	$61946x10^3$	$82785x10^3$	33.60
Macrophyte production ($g/m^2/Yr.$)	540.91	672.72	24.36
Total zooplankton species	18	22	22.22
Crustacea (sp./ind.)	10/3437	12/4650	35.29
Rotifera "	8/2540	10/3772	48.50
Total zooplankton density (ind/1/Yr.)	$6277x10^3$	$8422x10^3$	34.17

of 22.22% in the later in comparison to first year.

The annual mean for the first year of conductivity was 0.51 mho while the same for the second year was 0.66 mho which is 29.41% higher.

An increase of 8.2% in the second year was recorded in total alkalinity concentration over first year in which its annual average was 80.5 mg/l with minima and maxima 60.2 mg/l and 90.5 mg/l respectively.

With highest concentration in May (293.0 mg/l) and lowest in January (65.5 mg/l) in first year of dissolved solids increased 8.39% more in second year in which maximum and minimum

values were recorded in May and December as 328 mg/l and 58.6 mg/l respectively.

The chloride content, however, was found very high, the annual average of first year being 122.11 mg/l and the same in the second year 135.8 mg/l which is an increase of 11.21 % over previous year. The maximum value of chloride content in first year was recorded in April while the same in the second year was in May. The minimum values were found in May and June in first and second year respectively.

Calcium and magnesium concentrations were high in summer and low in winter in second year. Calcium content decreased in second year by 9.4% while magnesium increased by merely 1.5%.

In both the years nitrate nitrogen was more in winter season and less during summer season. The annual average of nitrate nitrogen was 5.79 mg/l in first in first year and 6.2 mg/l in second year, It showed increase by 7.08% while its annual averages were 3.85 mg/l and 4.10 mg/l for the first and second years respectively.

Free carbon dioxide increased by 20.46% in second year. The biological analysis of the samples revealed that in the first year of study the phytoplankton were represented by 36 species while in the following year the species number decreased to 27, however, individual richness was considerably increased (33.64%) (Table-2). The zooplankton were less than phytoplankton, in both quality and quantity and were represented by two groups Crustacea and Rotifera. In contrast to phytoplankton, zooplankton showed an increase during the second year of studies both in species richness (22.22%) and individual richness (34.17%) (Table-2).The net hydrophyte production showed an increase of 24.36% over previous year. The hydrophytes were mainly represented by *Eichhornia crassipes, Hydrilla verticillata, Azolla sp., Juncus sp.*

Discussion

In the present investigation the values recorded of physico-chemical parameters in the second year of the study, when compared with those of the first year show a marked increase (Table -1) indicating increased availability of nutrients more than the assimilating capacity of the reservoir and hence accumulation has been started. As suggested by Odum (1971) such accumulation of the nutrients is the over fertilization i.e. eutrophication which gradually becomes destructive to the system.

The prsence of algal bloom (Sharma *et al.*,1978) dominance of Bacillariophycean phytoplankton, increase in individual number of phytoplankton and decrease in species number and diversity (cairns *et al.*, 1972), growing concentrations of nitrate-nitrogen and phosphate-phosphorus and declining amount of dissolved oxygen (Brylinsky and Mann, 1973) in a water body denote its eutrophic condition. The results of the present study (Tables 1& 2) are in agreement with the findings of; Cairns *et al.* (1972); Brylinsky and Mann (1973); and Sharma *et al.* (1978) pointing out the eutrophic condition of the reservoir.

The increasing pH values may be attributed to algal blooms because Hutchinson (1929) and Roy (1955) have shown that the higher pH is associated with the phytoplankton maxima. The decrease in dissolved oxygen values may be correlated to high decomposition rates of organic matter. The decreased level of oxygen are considered as reliable parameters of the magnitude of eutrophication (Edmondson, 1966). The electrical conductivity which ranged from 0.51 mho/cm (average value) in first year to 0.60 mho /cm (average value) in the second year clearly denotes the eutrophic conditions of this waterbody. The high concentration of nitrate nitrogen as recorded has been taken as eutrophication index (Wetzel, 1975). Ganapati (1960) pointed out that tropical waters particularly unpolluted ones are deficient in nitrates and a concentration beyond 0.15 mg/l of nitrate nitrogen is indicative of eutrophication (Sawyer,1966).

Sawyer (1966) suggested 0.03 mg/l of phos-

phate phosphorus as critical level and higher concentrations of it have been reported to be in eutrophic waters (Wetzel, 1975), which has been observed during the present study.Rodhe (1966) reported that among the various determinants accelerating eutrophication, phosphate-phosphorus has been found to be the prime and initiating factor, whereas a simultaneous increase of sulphate catalyzes the speed of eutrophication.

The high concentration of chloride has been observed during the study which is in confirmity with the observations of Thresh *et al.* (1944) who pointed out that high chloride concentrations are indicators of large amount of organic matter which itself is suggestive of eutrophication. Further Sharma *et al.* (1978) have reported that chloride content also increase with the degree of eutrophication.

With the background of above discussion it is noted that the reservoir under investigation is highly polluted and eutrophic in nature and is adversely affecting itself which ultimately will lead to its premature death if immediate preventive measures are not taken up.

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