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LIMNOBIOTIC STUDY ON TROPHIC STATUS OF A POLLUTED FRSHWATER RESERVOIR OF COALFIELD AREA

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Abstract

Eutrophication, the self damaging impact of pollution to the water bodies, results into their premature death. The present communication embodies data on various physico-chemical and biological indices to assess the trophic status of the reservoir. The paper records the increasing trend of nutrient accumulation and phytoplankton production, nitrate nitrogn and phosphate phosphorus concertrations beyond critical level, chloride increasing and dissolved oxygen decreasing. The paper concludes that the reservoir is getting eutrophic fast.

Introduction

It is now well known that the polluted water bodies pose problems not only to mankind and otherl iving beings but also cause damage to themselves through eutrophication resulting into their premature slow death. Increasing soil erosion and introduction of high quantities of organic materials like sewage, industrial wastes etc. at the rate that cannot be assimilated, the rapid accumulation of such meterials gradually makes the water body eutrophic and bocomes destructive to the system (Odum 1971). The rate of eutrophication is very difficult to measure and no suitable single quantitative parameter of trophic level has so far been proposed (Kumar 1978). Continued temporal and spatial variation in nutrients, primary productivity, species diversity and other parameters, however, signifies the investigation of eutrophication.

Since the inception of the concept of eutrophication by Weber (1907), several indices based on limnobiotic parameters have been suggested (Strom, 1930; ohle, 1934; Olsen, 1950; Zafar, 1959; Spence, 1964; Sawyer, 1966; Rodhe, 1969; Wetzel, 1975) to assess the trophic status of water bodies. The review of literature reveals that there is no published account of trophic status of water bodies of Coalfield Area of Bihar. This paper presents, for the first time from the coal mine area, Some data on physico-Chemical and biological characteristics of water in order to evaluate the trophic status of a fresh water reservoir located at Govindpur in the district of Dhanbad.

Meterials and Methods

Physico-chemical analysis of water was done following the standard methods (A. P. H. A., 1960 and Trivedy and Goel, 1984). Plankton were sampled with a conical plankton net made up of bolting cloth (No .25) and were counted with the help of Sedgewick Rafter plankton counting cell. Monthly sampling was done for two years (1984 & 1985). The values of plankton count have been expressed as per ml original sample. (Welch, 1948).

Results

The data recorded on physico-chemical analysis of water has been summerised in Table 1. During both the year of investigation the minima of pH value, chloride, hardness, specific conductivity, calcium and magnesium was found in winter (January or December), and maxima in summer (May or June).

Table 1 : Physico-chemical characteristics of the surface water of the reservoir.

Sl. No.	Parameters	Year 1984			Year 1985			%Variation.
		Mix	Min	Avr	Mix	Min	Avr	
1.	Turbidity (%)	7 (Dec)	40 (Sep)	23. 5	6 (Jan)	42 (Aug)	24	2. 12
2.	pH	7. 6 (Dec)	8. 7 (Jun)	8. 15	7. 9 (Jan)	8. 9 (Jun)	8. 2	0. 61
3.	Diss. oxygen (mg/L)	7. 8 (Mar)	9. 6 (Jan)	8. 7	6. 6 (Jun)	7. 8 (Feb)	7. 2 (-)	17. 24
4.	Sp. Conductivity (m mhos)	0. 9 (Dec)	0. 42 (May)	0. 66	0. 14 (Jan)	0. 58 (Jun)	0. 36	45. 45
5.	Chloridle (mg/L)	50. 6 (Jan)	110. 32 (Apr)	80. 40	68. 86 (Dec)	134. 32 (Jun)	101. 59	26. 3
6.	Hardness (mg/L)	215. 7 (Jan)	415. 8 (Jun)	315. 75	241. 8 (Dec)	480. 8 (Jun)	361. 3	14. 42
7.	Calcium (mg/L)	5. 01 (Dec)	22. 30 (Jun)	13. 65	7. 02 (Dec)	27. 81 (Jun)	17. 41	27. 5
8.	Magnesium (mg/L)	5. 75 (Nov)	20. 10 (Jun)	12. 92	6. 86 (Dec)	24. 44 (Jun)	15. 65	21. 1
9.	Potassium (mg/L)	1. 3 (Aug)	7. 2 (Jun)	4. 25	1. 8 (Aug)	9. 2 (Jun)	5. 5	29. 4
10.	Sodium (mg/L)	3. 5 (Aug)	18. 2 (May)	10. 85	4. 5 (Aug)	20. 5 (May)	12. 5	15. 2
11.	Nitrate N (mg/L)	0. 8 (Jun)	0. 52 (Dec)	0. 76	0. 9 (Jun)	0. 92 (Jan)	0. 9	18. 4
12.	Phosphate P (mg/L)	0. 30	0. 52	0. 41	0. 42	0. 33	0. 62	51. 2

Turbidity, however, was recorded high during rainy season and low during early summer. Nitrate nitrogen was also recorded high in winter and low in summer while phosphorous followed the inverse relations with it. The low concentration of sodium and potassium was recorded during rainy season with their high values in summer. The data recorded revealed a marked increase in different parameters over the previous year reflecting a clear picture of accumulation of nutrients. The concentration of dissolved oxygen however decreased in the in the second year.

In the first year of study phytoplankton were represented by 36 species while in the following year there were only 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, the zooplankton showed an increase during the second year of the study, 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 crasspies*, *Hydrilla verticillata*, *Azola sp. Juncus sp.*

Discussion

The values recorded of physico-chemical parameters in the second year of the study, when compared with those of the first year, showed a marked increase indicating that the input of nutrients is more in the reservoir than its assimilating capacity, hence has resulted into the accumulation. As suggested by Odum (1971), Williums (1975) and Fonselius (1977) such accumulation of nutrients is the overfertilisation of water body i. e. eutrophication which gradually

Table 2 : Biological Characteristics of the reservoir.

Characteristics	1984	1985	%Variation
Total phytoplankton species	36	27	[-] 33. 33
Bacillariophyceae [Species / Density]	12 / 22403	9 / 35361	57. 84
Chlorophyceae	9 / 13381	6 / 15871	18. 60
Myxophyceae	6 / 12732	6 / 17205	35. 13
Euglenophyceae	4 / 11625	3 / 12338	6. 13
Dinophyceae	5 / 1805	3 / 2010	11. 35
Total phytoplankton density [ind / L / yr]	61946 X 10^3	82785 X 10^3	33. 64
Macrophyte Production [g / m^2 / yr]	540. 91	672. 72	24. 36
Total zooplankton species	18	22	22. 222
Crustacea	10 / 3437	12 / 4650	35. 29?
Rotifera	8 / 2540	10 / 3772	48. 5039
Total zooplankton [ind / L / yr]	6277 X 10^3	8422 X 10^3	34. 1723

becomes destructive to the system. Further, as pointed out by Fonselius (1977) in eutrophication the primary production increases initially and its effect is felt through the whole food chain, while the negative effects may be encountered later on. The present trend of observation is in conformity with the findings of Fonslius (1977) as the primary production has shown a marked increase over previous year confirming the reservoir to be in its early stage of eutrophication.

The dominance of phytoplankton particularly *Microcystis aeruginosa*, *Oscillatoria rubeseens* over other groups (Kumar 1978) increase in individual number of phytoplankton and decrease in species diversity (Cairns et al. 1972), growing concentration of nitrate-nitrogen and phosphate phosphorous and declining amount of dissolved oxygen (Brylinsky and Mann 1973) in a water body denotes its eutrophic condition. The result of the present study is in agreement with Cairns et al (1972), Brylinsko and Mann (1973) and Kumar (1978) pointing out the eutrophic status of the reservoir.

The high concentration of nitrate–nitrogen as recorded has alone been taken as eutrophication index (Strom 1930, Zafar 1959, Wetzel 1975). Ganpati (1960) pointed out that tropical waters, particularly unpolluted ones are deficient in nitrates and the concentration beyond 0,15 mg/L of nitrate-nitrogen is indicative of eutrophication (Sawyer 1966).

A typical seasonal cycle of nitrate–nitrogen i. e. with maxima in winter and minima in summer occurs in eutrophic waters, while the reverse is common with unpolluted bodies (Reynolds 1971, Holden and Cairns 1974, Wood and Gibson 194? Wilson et al, 1975). The present observations following the general trend is suggestive of eutrophic nature of reservoir. Sawyer (1966) suggested 0.03 mg/L of phosphate–phosphorous as critical level and higher concentration of it has been reported to be in eutrophic waters (Strom 1930, Zafar 1959, Wetzel 1975), which has been found in the present study.

High concentration of chloride has been observed during the study which is in conformity with the observations of Thresh et al. (1944) who pointed out that high chloride concentrationr are indicators of large amount of organic matter in the water which itself is suggestive of eutrophication. Further, Sharma et al. in 1978 has pointed out that chloride content also increase with the degree of eutrophication. The increase in chloride content by 26% over previous year thus suggests a high degree of eutrophication.

The physico–chemical and biological characteristics have been variously employed in classification of water bodies for level of their eutrophication. Table 3

Table 3 : Tropoio status of the reservoirs on the basis of different indices.

Index	Value	Trophic Status	Author index
Sp. Conductivity	0. 36	Eutrophic	Olsen (1930), Rawson (1960)
Calcium	17. 41	Eutrophic	Strom (1930), Ohle (1934).
Hardness	361. 30	Eutrophic	Spence (1940), Moyle (1945).
Monovalent Divalent	0. 60	Eutrophic	Zafar (1959).
Primary Production g / m^2 / yr	110 70	Eutrophic	Rodhe (1969).
Phosphate phosphorus	. 62	Eutrophic	Wetzel (1975).
Nitrate nitrogen	. 09	Eutrophic	Watzel (1975).
Chloride	Increasing	Eutrophic	Sharma et al (1978).

summerises the trophic status of the reservoir using the amount of various indices of different authors. With the background of the above discussion it is noted that the reservoir under investigation is eutrophic and the rate of eutrophication is increasing. Necersary steps shonld be taken to cheek the eutrophication rate iu this rerervoir.

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