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COMPREHENSIVE STUDY OF PHYTOPLANKTONIC COMMUNITY GROWING IN POLLUTED PONDS OF JAUNPUR CITY (U.P.)

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The study deals with 26 algal species occurring in polluted water bodies of Jaunpur city. The occurrence, abundance and their seasonal variation in relation to the input of nutrient and heavy metals in the habitats have been studied. Algal indicator species in relation to pollution monitoring program has been precisely emphasized. *Anabaena circinalis, Microcystis aeruginosa, Phormidium spp. and Euglena.* are the dominant species in the water site Ist and IInd (Polluted site). *Chlorella spp. Cosmarium quadrum, Spirogyra crassa, Cymbella affinis and Synedra ulna* are dominant species in water site IIIrd and IVth (less polluted site). Seasonal variation of the temperature, water depth, pH, dissolved oxygen, total dissolved solid, BOD, COD, Alkanity, Ammonia, Phosphate and Iron were in the range of 21 to 23^{0}C, 29 to 85 cm, 5.3 to 6.9 , 2.1 to 7.8 mg/l, 65 to 200mg/l, 12 to 76 mg/l, 40 to 220 mg/l, 10 to 28 mg/l 0.2 to 0.98 mg/l 0.05 to 0.23mg/l and 1.1 to 3.2 mg/l, respectively. Total Plankton density ranged between 20 to 1400/l of water. Studies on Phytoplankton generic diversity revealed the presence of Chlorophyceae (11 genera), Bacillariophyceae (6 genera), Myxophyceae (8 genera) and Euglenophyceae (1 genus).

Keywords: Algal indicator; Phytoplanktonic community.

Introduction

The growth and diversity of aquatic microflora in pond system is influenced by several physicochemical factors as well as biotic potential, tolerance and adaptive capacity of organism. The phytoplanktonic community of lake, rivers and ponds are reported[1-5]. Temperature, dissolved oxygen and low pH are favourable for the growth of blue green algae. But other supressive nutrients like nitrate and phosphate are insignificant.

Physico-chemical characters have much fluctuations and varied temperatures. Carbon dioxide, alkalinity and dissolved oxygen decreased significantly from July to December 2005 in pond systems. The less polluted water body of Shastri nagar with lower DO level, accounting for high and fuzy growth of phytoplankton. The conductivity, turbidity, total dissolved solids, BOD and COD all are substantially effective for the fuzy growth of algae. The BOD and COD level were found to be high at sewage affected sites and these are exceptionally high (75 & 218mg/l) in polluted water at T.D. College pond. But only BOD level was high in less polluted water at Shastrinagar low lying area (SLLA). An increase in BOD and COD is the natural consequence of sewage disposal in river Gomati[4,6].

Study Sites - Two water bodies with two locations each i.e.(i) Shastrinagar low lying area (site I, II) which contains comparatively less polluted water with sewage and (ii) T.D.College pond (site III, IV) which continuously receives the maximum chemical effluents from Chemistry laboratory were selected for the study. T.D.College pond is small in size (Area 0.16 sq. km, peak depth 4 m) on the road side of Varanasi and Allahabad (NH6) highway. Shastrinagar low lying area is large in size (Area 0.48 sq. km, peak depth 3 m). It is situated in the middle region of the city. The low lying area is surrounded by housing colonies. It is less polluted because of inputs of sewage and effluents of automobile work shops.

Material and Methods

Sampling was done fortnightly to evaluate various biotic and abiotic parameters, Water transparency was determined with the help of secchi disc, pH was measured in the field with century kit, chemical characteristics were determined[7]. Alkalinity, DO, free CO_2 content of water were analysed at the sampling time. The phytoplanktons were collected filtering 100 litre of water through a plankton net made up of bolting silk cloth (No 21). Water was sampled from four study sites twice in April and May 2005. The phosphate content was determined by stannous chloride method[7] and nitrates were determined by Phenol Disulphonic acid method. The quantitative and qualitative

Table 1. Physico-chemical characterstics (Mean Value) at different site in rural pond.

	April 2005 Sites				May 2005 Sites			
Parameters	I	II	III	IV	I	II	III	IV
Temperature	21.5	22.5	21.5	21	22.5	23.0	22.0	21.5
pH	6.2	6.1	6.8	6.9	6.1	5.3	6.8	6.7
Conductivity (μScm^{-1})	150	200	100	90	200	250	110	95
Turbidity (NTU)	85	95	29	36	100	110	28	26
Total dissolved solid	110	180	70	65	190	200	75	72
D O (mgl^{-1})	3.0	2.5	7.7	7.1	2.1	2.2	7.5	7.8
BOD (mgl^{-1})	65	75	16	12	70	76	15	10
COD (mgl^{-1})	210	218	56	40	214	220	62	55
Alkalnity (mgl^{-1})	12	14	26	28	10	12	24	22
Ammonia (mgl^{-1})	0.98	0.86	0.25	0.2	0.90	0.96	0.24	0.22
Phosphate (mgl^{-1})	0.15	0.19	0.07	0.05	0.21	0.23	0.08	0.06
Iron (mgl^{-1})	3.0	3.2	1.4	1.2	2.8	3.0	1.6	1.1

Table 2. Density of major groups of phytoplankton (Individuals L) and Shanon weiner index ($\overline{H}$) at various sampling sites in T.D. College pond and Shashtrinagar low lined area.

	April 2005 Sites				May 2005 Sites			
Parameters	I	II	III	IV	I	II	III	IV
Chlorophyceae	20	20	1400	1320	40	60	2000	1760
Cyanophyceae	840	1020	300	300	1010	1120	420	380
Bacillariophyceae	320	280	540	460	450	340	660	560
Euglenophyceae	160	160	20	20	180	300	280	240
Shanon. weiner index	3.3	3.1	4.2	4.3	3.4	3.3	4.3	4.3

estimation of the phytoplankton were done following the methods[8].The class wise identification and study of algae was done with the help of Presscott[9].

Result and Discussion

The water samples at site III and IV were blackish in colour while water at site I and II was only light greyish. The water temperature ranged from 21 to 23°C at various sites. The turbidity at site I and II was two fold higher than that of water at site III and IV. Water at site I and II was relatively more acidic than site III and IV with lowest alkalilnity (12&14mg/l). The acidity combined with very low dissolved oxygen content is perhaps responsible for quite low phytoplankton density at site III and IV despite highly accumulated organic matter. The dissolved oxygen is another limiting factor in aquatic ecosystem, drops rapidly in the water of T.D College pond and Shastrinagar low lying area. Low value of DO have been reported to be associated with high organic matter content[10-12] and sewage out falls[11-13]. The water at site III and IV, due to dilution effect shows low DO level, accounting the high phytoplankton density. Important parameters such as conductivity ,turbidity, total dissolved solids, BOD and COD all are substantially high at sewage affected site. Ammonia-N at site IIIrd and IVth was comparaple with that in other Indian rivers[14]. An increase in BOD and COD is a natural consequence of sewage disposal in rivers[6]. The iron concentration beyond 0.3 mg/l^{-1} is a matter of concern. Arivazhagan and Kamalaveni[15] have suggested that physical characterstics gradually increased and the temperature, dissolved carbon dioxide and alkanity gradually decreased. The chemical charaeterstics and the content of nutrients also increased in July to December. Shamim[16] has reported that Cyanophyceae were dominant in all the polluted habitats. Total nitrogen, phosphate, potassium and chloride contents play a vital role in their distributional pattern.

Chlorophyceae and Bacillariophyceae were dominant at less polluted water site while Cyanophyceae and Euglenophyceae dominated polluted site.Twenty six genera belonging to four different groups were recorded from the four sites (Table 3). Shanon-Weiner Diversity Indices for algae at different sites are presented (Table 2). The diversity (~3.1) was lower at sites I and II than that (~4.3) of less polluted water at site III and IV. Sewage

Table 3. Distribution of Phytoplankton at different sites, Jaunpur.

Chlorophyceae	Less Polluted site		Polluted site	
	1	**II**	**III**	**IV**
Hydrodicton spp.	+	-	+	+
Chlorella spp.	+	+	-	+
Closterium ehrenbergi	+	-	+	+
Cosmarium quadrum	+	-	-	+
Scenedesmus accuminatus	+	-	-	+
Spirigyra crassa	+	-	-	+
Ulothrix zonata	+	+	-	+
Zygnema spp.	+	-	-	+
Pandorina spp.	+	+	-	+
Pediastrum spp.	+	-	-	+
Actinastrum spp.	+	-	-	+
Cyanophyceae				
Anabaena circinalis	+	+	+	+
Microcystis aeruginosa	+	-	+	+
Oscillatoria limosa	+	+	+	+
Rivularia minutala	-	-	+	+
Spirulina major	+	+	+	+
Nostoc linkia	+	-	-	+
Phormidium spp.	+	-	-	-
Aerocystis	+	-	-	-
Bacillariophyceae				
Cymbella affinis	+	+	+	-
Gyrosigma spp.	+	-	+	-
Navicula amphibia	+	+	+	+
Nitzschia palea	+	+	+	+
Pinnularia spp.	+	-	+	-
Synedra ulna	-	+	-	+
Euglenophyceae				
Euglena	+	+	-	-

contamination causes the enhancement in generic diversity of phytoplankton. Deterioration in water quality at sites IIIrd and IVth is attributed to drains of chemical laboratory and automobile effluents. *Oscillatoria, Lyngbya, Microcystis* and *Spirulina* (Cyanotphyceae) abundently present, produce taste and odour in polluted water. While Chlorophyceae such as *Spirogyra, Zygnema, Ulothrix* and *Scendesmus* are dominant at the less polluted site[17]. Some algae like *Closterium chrenbergi, Pinularia species* and *Cymbella affinis* are common at all sites being rather insensitive to sewage pollution. Other two species of Bacillariophyceae and Euglenophyceae, *Nitzschia* and *Euglena* are dominant in the swage affected water. The dominance of *Oscillatoria* indicated pollution of biological origin[18-19]. *Oscillatoria* and *Spirulina* can serve as indicator species of sewage affected aquatic environment[20]. The correlation between organic pollution and blue green algae was first explained by Pearsall[21]. Prasad and Singh[20] have proved *Microcystis aeruginosa* to be best indicator of pollution. The particular species were dominant at site 2nd and 3rd recieving sewage water[22]. Different species of diatoms are indicators of pollution. The dominance of *Nitzschia* species at sewage affected sites can be used as an indicator of organic pollution in the pond.

References

1. Mishra U C 2000, Ecological investigation of river Gomati under the influence of municipal wastes of Jaunpur city. Ph.D. Thesis, V.B.S. Purvanchal University, Jaunpur.
2. Mishra K N and Mishra U C 2001, Biotics component of sewage entering into river Gomati at Jaunpur City (U.P.). P. 62 *In : Ab. Proc.* I B. S. 24th Annual session, Hyderabad.
3. Mishra U C and Mishra K N 2002, Species richness and Shanon Diversity Indices of diatomic comomunity in Gomati water influenced from Jaunpur city. P. 58 *Proc. In : Ab. Proc.* of 89th session of ISC. Lucknow.
4. Mishra K N and Mishra U C 2003, Limnological investigation of Gomati water under the influence of municipal wastes. P. 221-230. In : Environmental Pollution, problem and Management, Jaspal Prakashan, Patna (Bihar).
5. Mishra K N 2006, Impact of sugar industries effluents of species diversity and algal productivity at Shahganj (Jaunpur). P-103-108. In : *Human Pollution Natural Resources,* Jaspal Prakashan, Patna (Bihar).
6. Mishra S R 1996, Assessment of water pollution. APH Publishing Corporation, New Delhi P. 485.
7. APHA 1998, Standard methods for the examination of water and waste water. American Public Health Association, Washington. D.C. 20th (ed) New York, P.113.
8. Vollenwids RA 1969, A manual on methods for measuring planktonic composition in aquatic environment. In : IBP Hand Book No. 12. Blackwell Scientific Publication, UK pp 22.
9. Presscott GW 1951, The algae of western great lake area. Cranbook Institute of Science Bulletin No. 33.
10. Biun J L 1957, An ecological study of algae of the saline river michigan. *Hydrobiologia* **9** 361-408.
11. Saxena K L, Chkrabarty R N, Khan A Q, Chattopadhyaya S N and Harischandra 1966, Pollution studies on the river Ganges near Kanpur. *Indian J. Env. Health* **8** 270-286.
12. Bulusu K R, Arora H C and Aboo K M 1967, Certain observation of self purification of Khan river and its effect of Kshipra river. *Environmental Health* **8** 275-295.
13. Rai H 1974, Limnological studies on the river Yamuna at Delhi, India IInd. The dynamic of potamplankton population in the river Yamuna. *Archiv for Hydrobiologie* **73** 492-517.
14. Abbasi S A 1998, Water quality sampling and analysis. Discovery Publishing House, New Delhi. P. 212.
15. Arivazhagan P and Kamalaveni K 1997, Seasonal variation in physico-chemical parameters and plankton analysis of Kurichi Pond. *Env. Eco.* **15**(2) 272-274.
16. Ahmad Md. Shamim 1996, Ecological swrvey of some algae flora of polluted habitats of Darbhanga, *J. Env. Polln.* **3**(3&4) 147-151.
17. Jackson D F 1967, Management of waste water effluents in relation to algal problems, Proceeding ivth annual water quality symposium (algae and related problems) 37-71. N. Y. State Department of Health, Albany, New York.
18. Rai L C and Kumar H D 1976, Systematic and ecological studies on algae of some habitats polluted with fertilizer factory effluent near Sahupuri, Varanasi, India. *Nova Hedwigia* **27** 805-812.
19. Nandan S N and R J Patel 1985, Phytoplankton and physico chemical parameter used as indicator of eulrophication. *J. Plant and Nature* **2** 17-22.
20. Prasad B N and R Singh 1996, Algal indicators of water pollution. Bishen Singh, Mahendra Pal Singh, Dehradun.
21. Pearsal WH 1932, Phytoplankton in the English lakes II. *J. Ecology* **22** 241-262.
22. Cholnoky B J 1968, Die Okologie der Diatomeen in Binnergewasserm. Lehre. J. Crammer, stuttgart.