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Phytoplankton Diversity in Relation to Physico-Chemical Factors in Some Selected Ponds at Patna (Bihar), India

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Abstract

Physico-chemical regulators of two ponds modulate phytoplankton diversity differentially. Pond I without getting sewage effluent shows significant correlation with HCO^-_3 (0.906), Ca (0.754), Cl (0.891), nitrate-nitrogen (0.913) and COD (0.850) at 0.001 level. It favors a maximum of 498 ind/liter in warmer months out of which 53% belong to Chlorophyceae. In Pond II a commonly by used pond correlation value of CI (0.869), nitrate-nitrogen (0.810) and COD (0.814) were significant favouring 43% population of Bacillariophyceae in warmer months. Total 36 genera were collected belonging to four classes of algae viz. Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae.

Key words : Phytoplanktons, Freshwater pond, Physico-chemical regulators.

Phytoplanktons are ecologically significant as they assimilate solar energy to metabolize inorganic materials. Many herbivores mostly zooplankton depends upon the phytoplankton for their energy requirement and in turn are preyed upon by other organism, thus passing the stored energy along to larger organisms which may be benthic macroinvertebrates or fish. Systematic enumeration of phytoplankton is of great biological significance to understand the limnobiotic dynamics of aquatic ecosystem. Das and Srivastava (1), Munawar (2), Singh and Ahamad (3), and Srivastava (4) have made valuable contributions to the phytoplankton diversity of lentic fresh water ecosystems in India inchucling Bihar. However literature pertaining to the comparative study of phytoplankton of pond water are rather scanty. The present work has been carried out in two ponds of Patna, Bihar. Pond I is commonly called Zoo Pond, situated at 25^{0}35′ 57.56′′ north latitude and 85^{0}6′ 0.27′′ east longitude having an area of 6 acres with an average depth of 3 meters. Pond II is popularly known as Old fish pond, located in the campus of Phulwari block. It is situated at 25^{0}34′ 4′′north latitude and 85^0 4′ 30′′ east longitude. It has an area of 5 acres with an average depth of 2.5 meters. The first pond is fully managed by the zoo authority and do not receive any sewage, while the second pond is a neglected pond and used by local people for various activities.

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Methods

Water samples were collected from May 2006 to June 2007 at monthly intervals. Physico-chemical parameters were analyzed following standard methods (5). The free CO_2 was determined by titrimetric method, DO by using Wrinkler's method, calcium and magnecium by EDTA titrimetric method. Hardness was estimated by EDTA titrimetric method, chloride by using argentometric method, phosphate by stannous chloride method, sulfate by barium chloride method and COD by using closed reflux method. The pH, water temperature and transparency were measured at site using portable kit number 335 (Systronics). Phytoplanktons were collected from four fixed sampling sites on monthly basis for the same duration with help of plankton net ; 50 liters of water was filtered from the subsurface at each site and the planktons were collected in tube attached at the tip of filteration net. The collected water with plankton was stored in bottles with Lugols solution with all requisite precautions and 1 ml. of preservative was used

Table 1. Monthly variation in the population of different classes of phytoplanktonic algae (ind/l) in Pond I during 2006-07.

Organism	Months											
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bacillariophyceae	72	32	52	56	60	86	94	112	78	110	132	166
Chlorophyceae	182	56	68	86	92	110	130	150	168	162	222	256
Cyanophyceae	18	6	8	12	10	16	14	22	20	40	52	58
Euglenophyceae	6	2		8	8	4	12	6	20	14	12	18
Total	278	96	128	162	170	216	250	290	286	326	418	498

per 100 ml of sample. Counting was done by Sedwick-Rafter cell method.

Calculation was made as

$$\text{No. of planktons/ml (N)} = \frac{(a \times 1000)\, C}{L}$$

Where, N = number of plankton per liter of water, a = Average number of plankton in 1 ml of sub-sample (concentrated). L = Volume of original water sample in 1 liter, C = ml of plankton concentrated. Statistical analysis was made to find out the correlation coefficient of phytoplankton diversity with physico-chemical factors.

Results and Discussion

Phytoplanktons are producers in aquatic systems and essential for maintaining the food chain leading to productivity. Monthly variations in plankton population, were recorded which may be due to climatological conditions, physico-chemical conditions or hydrological regime. Phytoplanktons make first trophic level in aquatic grazing food chain. The abundance, dominance and diversity of phytoplankton depend on several interrelated physico-chemical and biological factors. During investigation four groups of phytoplankton communities were recorded viz. Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae. Tables 1 and 2 indicate the monthwise population phytoplankton in Pond I and Pond II and these are represented in Figures 1 and 2. The abundance of phytoplankton showed well marked seasonal variations. Some genera of phytoplankton were recorded throughout the study period while some made sporadic appearance. In both Pond I and II, the maximum abundance was recorded during warmer months such as April and May while the minimum count was observed in monsoon months, mainly in July and August indicating the influence of physico-chemical modulates on presence and absence of phytoplanktons. In Pond I, maximum number 498 ind/liter was recorded in May 2007 and minimum 96 ind/liter in July 2006 (Fig. 3). While in Pond II, maximum number 362 ind/liter was also recorded in May 2007 and minimum 118 ind/liter in August 2006 (Fig, 3). Gupta and Sharma (6) observed maximum density in November and minimum during August and September. But Shrivastava (4). Sukumaran and Das (7) Suknad and Patil (8) reported that phytoplanktons were maximum in summer months supporting this study. Total 36 genera were collected in which three were common to both ponds. In Pond I, 23 genera of phytoplanktons were identified in which seven genera belonged to Bacillariophyceae, 10 genera of Chlorophyceae, four genera to Cyanophyceae and two genera of Euglenophyceae. In Pond II, a total of 16 genera were recovered in which six belonged to Bacillariophyceae, six genera of Chlorophyceae, three

Table 2. Monthly variation in the population of different classes of phytoplanktonic algae (ind/l) in Pond II during 2006-07.

Organism	Months											
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bacillariophyceae	80	46	50	58	62	72	98	98	98	100	128	148
Chlorophyceae	40	24	16	22	26	26	48	58	52	44	82	106
Cyanophyceae	70	50	38	50	38	40	44	58	64	74	78	80
Euglenophyceae	20	16	12			18	22	20	22	24	26	28
Total	210	136	116	130	126	156	212	234	236	242	314	362

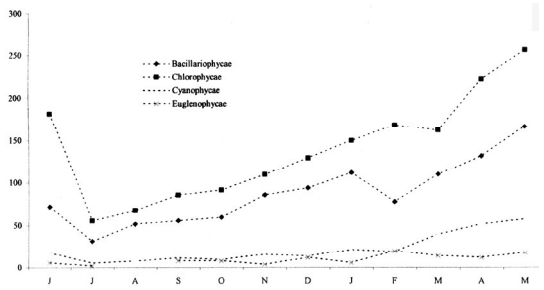

Figure 1. Monthly variation in the population of different classes of phytoplanktonic algae (ind/l) in Pond I.

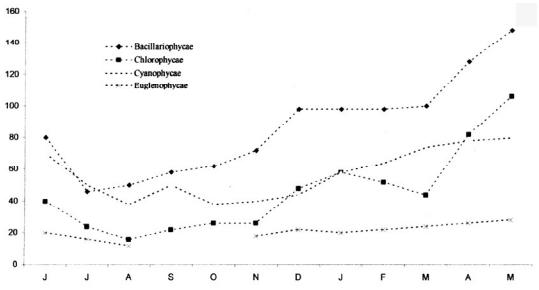

Figure 2. Monthly variation in the popullation of different clases of phytoplanktonic algae (ind/l) in Pond II.

genera to Cyanophyceae and one genus of Euglenophyceae. The groupwise quantitative analysis showed that in Pond 1 Chlorophyceae was the most abundant group with 53% contriubution in total count, similarly in Pond II, the population of Bacillariophyceae was dominant having 43% of total density. It shows the impact of physico-chemical regulators and their affinity with phytoplankton density. Suknand and Patil (8) reported 20 genera of phytoplankton in similar limnetic conditions and they also observed many genera which are common to these ponds viz. *Padiastrum* sp., *Scenedesmus* sp., *Quadricauda* sp., *Ankistrodesmus* sp., *Trachelomonas* sp., *Euglena* sp. and *Phacus* sp.

Table 3. Correlation coefficient (*r*) between phytoplanktons and physico-chemical parameters in Pond I and Pond II during 2006-07. **Shows significant at 0.001 level and (*) shows significant at 0.01 level. WT-Water temperature, TR-Transparency, pH-Hydrogen ion concentration, DO-Dissolved oxygen, HCO^{-}_{3}-Bicarbonate, TH-Total hardness, Ca^{++}-Calcium, Mg^{++} -Magnesium, Cl^{+} -Chloride, NO_3^{-N} -Nitrate-nitrogen, PO_4^{-P}-Phosphate-phosphorus, SO_4^{-S}-Sulfate-sulfur, BOD_5-Biological oxygen demand, COD-Chemical oxygen demand.

Parameters	Pond I	Pond II
W T	0.094	-0.038
T R	0.488	0.441
pH	0.282	0.190
DO	0.494	0.152
HCO_3^-	0.906**	0.607*
T H	0.462	0.543*
Ca	0.754**	0.929**
Mg	-0.017	-0.022
Cl	0.891**	0.869**
NO_3^{-N}	0.913**	0.810**
PO_4^{-P}	-0.631**	-0.659**
SO_4^{-S}	0.896**	0.854**
BOD_5	-0.594*	-0.579*
COD	0.850**	0.814**

The quantitative analysis shows that Cyanophyceae contributed only 9% in Pond I, while 27% in Pond II, similarly in Pond I, Euglenophyceae contributed only 4% but in Pond II, it accounts for 8% of total population density. The abundance of phytoplankton diversity of Cyanophyceae and Euglenophyceae in Pond II indicates their response to physico-chemical factors. The presence of pollution tolerant cyanophyceae members like *Oscillatoria tenuis, O. ulna, Nostoc* sp. and *Arthrospira* sp. in Pond II also indicate the pollution load in water body. Phytoplankton density of Pond I shows significant positive correlation with bicarbonate (0.906), calcium (0.754), chloride (0.891), nitrate-nitrogen (0.913) and COD (0.850) AT 0.001 level, but it shows inverse relation with phosphate (-0.631) at 0.001 level and BOD (-0.594) at 0.01 level. In Pond II the correlation values of chloride (0.869), nitrate-nitrogen (0.810) and COD (0.814) were found to be directly significant at 0.001

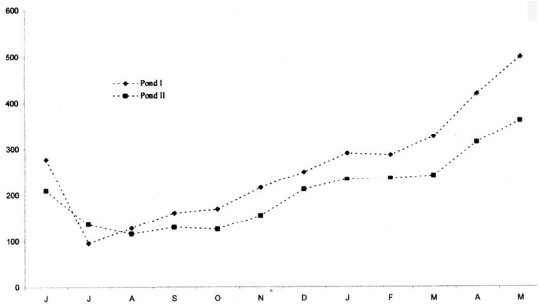

Figure 3. Monthly variation in the total phytoplankton diversity in Pond and Pond II during May 2006 to June 2007.

level (Table 3). This is in agreement with Patralekh and Patralekh (9) who also observed positive correlation with calcium and sulfate for green algae and diatom population at Ranitalab supporting this research work.

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