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Comparison of phytoplankton biomass in four water bodies of Dharwad, Karnataka State (India)

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Abstract. Hydrobiological studies of two ponds and two lakes of Dharwad (Karnataka State) for one year showed highest biomass in the nutrient rich Laxman Singh pond. Devaragudihal lake was comparatively poor in nutrients and showed lowest phytoplankton biomass. Both Kyarakoppa pond and Nuggikeri lake did not exhibit significant difference with respect to physical and chemical factors and also standing crop of phytoplankton.

Keywords. Phytoplankton biomass; ponds; lakes; hydrobiological studies.

1. Introduction

Ecological studies carried out in Karnataka for the last decade include physical and chemical measurements and phytoplankton estimations of freshwater habitats. Hosmani and Bharati (1980a, b) studied comparative phytoplankton ecology of four water bodies of Dharwad and algal indicators of organic pollution. Causative factors for certain algal blooms are given by Hosmani and Bharati (1975) and Somashekhar and Ramaswamy (1982).

The present paper is based on a one year (February 1976–January 1977) hydrobiological study of two ponds (Laxman Singh pond and Kyarakoppa pond) and two lakes (Nuggikeri lake and Devaragudihal lake) situated in Dharwad (15° 25′ N lat; 75° E long). The maximum and minimum temperature recorded are 38 and 12° C and the average rainfall is 380 mm. Laxman Singh pond is contaminated by sewage and was devoid of macrovegetation. As Devaragudihal lake continuously supplied water to the Hubli Railway Department; fishing, washing clothes and cattle-bathing were prohibited in this lake. Both Kyarakoppa pond and Nuggikeri lake were disturbed by cattle-bathing, washing of clothes and occasional duck hunters. These water bodies supported macrophytes including species of *Hydrilla, Vallisneria, Najas* and *Nymphaea.*

2. Material and Methods

Surface water samples from five sampling sites in each water body were collected once a month to study the chemical factors. Temperature and pH were measured in the field. Other factors (Oxygen, carbondioxide, carbonates, bicarbonate, major cations, chloride, nitrate, phosphate, silica, iron, oxidizable organic matter and free ammonia) were analysed in the laboratory, transferring the samples immediately, as prescribed by APHA (1965). Simultaneously, separate 500 ml samples were collected, from each water

body, for the estimation of phytoplankton chlorophyll a. Pigment extract was made with 90 % acetone and measured with Spectronic-20 at wavelengths of 630μ, 645μ and 663μ (Happey-Wood 1975).

Table 1. Average values of physical and chemical factors in ponds and lakes of Dharwad (February 1976–January 1977).

Factors	Laxman Singh pond (1)	Kyarakoppa pond (2)	Nuggikeri lake (3)	Devaragudihal lake (4)
Temperature water (°C)	24·4	22·8	22·3	25·0
pH	9·1	8·7	8·8	9·2
Dissolved oxygen (ppm)	9·7	12·6	7·5	14·6
Free carbondioxide (ppm)	50·9	41·5	29·9	3·7
Carbonates (ppm)	0·4	0·2	0·2	0·5
Bicarbonates (ppm)	11·4	6·7	9·1	2·8
Calcium (ppm)	39·0	21·5	19·1	14·1
Magnesium (ppm)	4·9	6·6	5·0	3·0
Sodium (ppm)	206·5	153·4	154·4	79·6
Potassium (ppm)	85·8	23·3	20·8	4·8
Chloride (ppm)	122·5	83·8	65·9	32·3
Nitrate (ppm)	4·0	0·8	1·3	0·2
Phosphate (ppm)	0·05	0·01	0·02	0·01
Silica (ppm)	10·5	6·1	5·4	6·2
Iron (ppm)	0·6	1·4	0·7	0·4
Oxidizable organic matter (ppm)	8·7	6·9	7·0	3·0
Free ammonia (ppm)	0·5	0·2	0·2	0·1

Calculated values of $t_{(1,2)} = 2{\cdot}210$; $t_{(1,3)} = 2{\cdot}551$, $t_{(1,4)} = 2{\cdot}272$, $t_{(2,3)} = 1{\cdot}86$, $t_{(2,4)} = 2{\cdot}176$, $t_{(3,4)} = 1{\cdot}946$.

Table 2. Phytoplankton biomass (mg/m^3) in ponds and lakes of Dharwad (February 1976–January 1977).

Months	Laxman Singh pond (1)	Kyarakoppa pond (2)	Nuggikeri lake (3)	Devaragudihal lake (4)
Feb 76	47·5	1·5	3·6	1·0
Mar 76	48·8	4·0	5·8	1·7
Apr 76	123·2	16·0	3·2	1·7
May 76	171·2	23·4	3·3	2·5
Jun 76	19·2	35·7	2·9	1·5
Jul 76	17·8	24·0	4·3	4·2
Aug 76	10·4	5·1	3·3	3·6
Sep 76	4·3	3·6	6·6	4·3
Oct 76	10·4	6·2	8·1	8·1
Nov 76	26·5	10·6	31·0	3·9
Dec 76	35·7	4·4	8·4	3·5
Jan 77	45·5	3·5	1·5	0·7
Average	46·8	11·5	6·8	3·1

Calculated values of $t_{(1,2)} = 2{\cdot}322$, $t_{(1,3)} = 3{\cdot}560$, $t_{(1,4)} = 2{\cdot}966$, $t = 1{\cdot}120$, $t_{(2,4)} = 2{\cdot}602$, $t_{(3,4)} = 1{\cdot}700$.

3. Results

The average values of various physical and chemical factors analysed are tabulated in table 1. Of the four water bodies Laxman Singh pond showed highest values for almost all the factors with significant differences from the other three water bodies ($p > 0{\cdot}005$). Such a relation between Kyarakoppa pond and Nuggikeri lake did not exhibit significant difference ($p < 0{\cdot}05$), but a significant difference existed between Kyarakoppa pond and Devaragudihal lake ($p > 0{\cdot}005$). Further, the two lakes had almost similar nutrient status.

Phytoplankton biomass, calculated from the estimation of chlorophyll a, is of an order of magnitude greater in Laxman Singh pond (46·8 mg/m^3) than the other three water bodies (table 2), the lowest being in Devaragudihal lake (3·1 mg/m^3). No significant difference in phytoplankton biomass prevailed in the two lakes ($p < 0{\cdot}005$). With regard to phytoplankton biomass, the physical and chemical factors of Kyarakoppa pond was significantly different from that of Devaragudihal lake ($p > 0{\cdot}005$) but with Nuggikeri lake the difference was not significant ($p < 0{\cdot}005$).

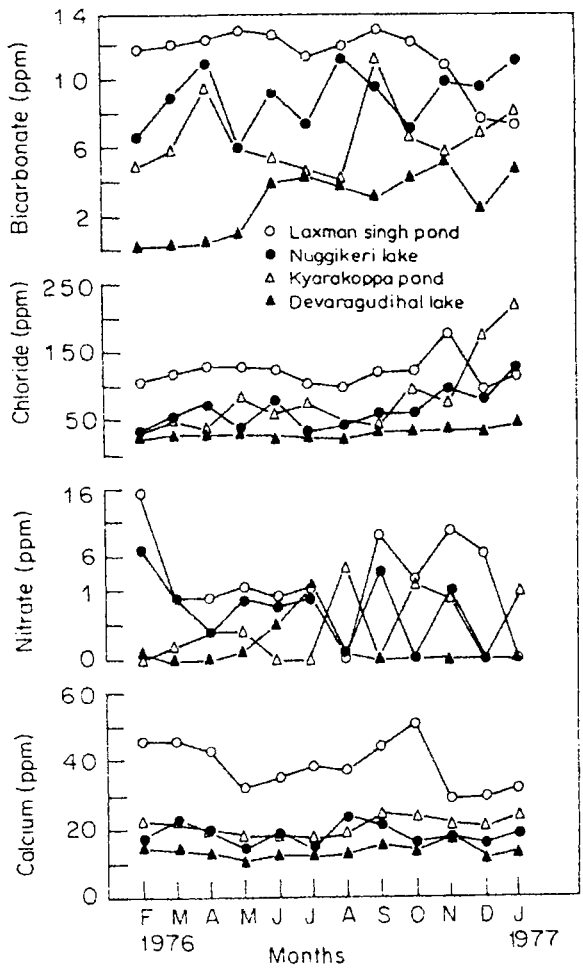
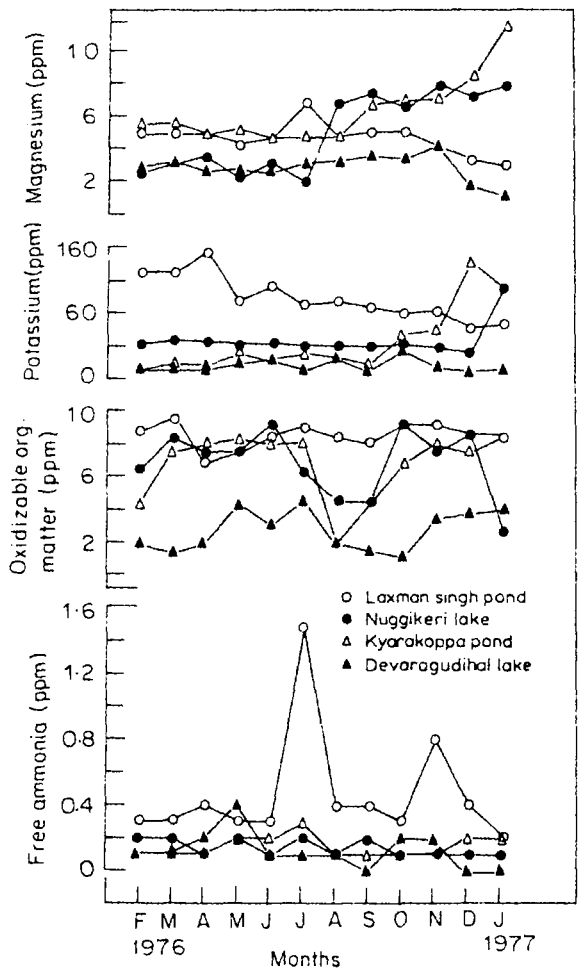


Figure 1.

4. Discussion

Sewage contamination was responsible for the higher nutritional status and phytoplankton biomass in Laxman Singh pond. Devaragudihal lake, undisturbed and uncontaminated, had the lowest nutrient values and also biomass. The relationship of the two lakes with Kyarakoppa pond was quite different. Though the two lakes had similar status with respect to physical and chemical factors and also biomass, Kyarakoppa pond showed significant difference with Devaragudihal lake but not with Nuggikeri lake. From table 1 it can be predicted that factors such as bicarbonate, calcium, magnesium, potassium, chloride, nitrate, dissolved organic matter and free ammonia were probably responsible for such a varied biomass of phytoplankton in these four water bodies. The monthly variations of these factors (figures 1 and 2) also indicate that Devaragudihal lake had the lowest values and Laxman Singh pond the highest values in almost all the months. Further, Kyarakoppa pond and Nuggikeri



Figures 1 and 2. Variations in chemical concentrations in ponds and lakes of Dharwad (February 1976–January 1977).

lake had almost similar values, lesser when compared to Laxman Singh pond and greater than Devaragudihal lake.

It can be concluded, therefore, that diversity in the physical and chemical factors was responsible for the difference in biomass in the four water bodies studied. Laxman Singh pond was richest in nutrients and hence had highest standing crop, whereas, Devaragudihal lake, because of its nutrient poor nature, had less growth of phytoplankton. With respect to both nutrient level and phytoplankton biomass, Nuggikeri lake had a status in between Kyarakoppa pond and Devaragudihal lake. Similar observations have been made by Happey-Wood (1975) for the lakes of North Wales. In general, the present study indicated that the two ponds had more growth of phytoplankton compared to the two lakes, an observation also made by Hosmani and Bharati (1980) for the Dharwad waters.

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