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A Seasonal Study Phytoplankton diversity and pollution indicators of Bathi pond near Davangere City, Karnataka (India)

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Abstract

A study was carried out in Bathi pond near Davangere city Karnataka (India) on phytoplankton diversity, density and distribution in different seasons and their correlations with physico-chemical properties of water. A total of 67 phytoplankton species belonging to Chlorococcales, Blue-greens, Desmids, Diatoms and Euglenoids were represented. Relative abundance of phytoplankton showed maximum of Blue-greens (45.61%) followed by Chlorococcales (40.11), Diatoms (13.97), Desmids (0.17%) and Euglenoids (0.13%). The highest density of phytoplankton was recorded during summer season. Chlorococcales varied with peak density (14,134 org/l) during summer and lowest during rainy season (10,333 org/l), Blue-greens recorded 16,361 org/l in summer and least during winter (14,289 org/l). Diatoms were found maximum (5,600 org/l) during summer and minimum with (3,739 org/l) during rainy season, Desmids varied from 76 org/l during summer and lowest during rainy season with 48 org/l and Euglenoids were recorded 57org/l during summer and least during winter with 41 org/l. Our study revealed that the growth of phytoplankton is governed by BOD, Chloride, COD, Conductivity, Potassium and Sodium. During course of study air temperature was found positively correlated with Euglenoids, BOD with Diatoms. Chloride with Desmids and Diatoms. COD showed positive correlation with Blue-green algae, Chlorococcales and Euglenoids while Potassium and sodium were found positively correlated with Desmids. Pollution tolerant species like *Scenedesmus quadricauda*, *Coelastrum* sp., *Tetraedon muticum*, *Closterium* sp., *Euglena* sp., *Phacus* sp., *Trachelomonas* sp., *and Microcystis* sp. were recorded.

Keywords: *Bathi pond*, *Blue-greens*, *Chlorococcales*, *Desmids Euglenoids*, *phytoplankton*

Introduction

Environmental pollution is a modern day devil affecting all ecosystems including aquatic ecosystems. Therefore the conservation of freshwater environment and its monitoring is highly essential (Mohapatra and Rengarajan, 1995). Phytoplankton plays an important role in the biosynthesis of organic matter (primary production) in aquatic systems, which directly or indirectly serve all the living organisms of a water body as food (Anjana and Kanhere, 1998). The planktonic study is a very useful tool for the assessment of water quality in any type of water body and also contributes to understanding of the basic nature and general economy of the lake (Pawar *et al*., 2006). Unplanned urbanization rapid industrialization and indiscriminate use of artificial chemicals in agriculture are causing heavy and varied pollution in aquatic environments leading deterioration of quality and depletion of aquatic biota (Yeole and Patil, 2005). Due to certain reasons some planktonic population flair-up to dominate water body and ultimately

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blooms form. Unlike other algae all the common bloom forming blue-green algae contain gas vacuoles which can impart positive buoyancy to the algae under certain conditions. Some species of blue-green algae aggregate and make a colony floating over the surface forming the bloom. Water bloom besides imparting color to the water also gives a disagreeable smell and taste to it. Phytoplankton species distribution shows wide spatio-temporal variations due to the differential effect of hydrographical factors on individual species and they serve as good indicators of water quality pollution (Gouda and Panigraphy, 1996). Phytoplankton of pond ecosystems were studied by Hosmani and Bharati (1980), Bhatt and Negi (1985), Saha and Chaudhary (1985), Kant and Raina (1985), Kumar and Dutta (1991), Verma and Mohanty (1995) and several studies on phytoplankton diversity was made in India and abroad on the ponds, lakes and reservoirs (Tiwari and Chauhan, 2006; Tas and Gonulol, 2007; Senthikumar and Sivakumar, 2008). In this paper an attempt has been made to study the seasonal changes and correlation of phytoplankton diversity in relation with physico-chemical parameters in Bathi pond.

Materials and Method

The study was conducted in Bathi pond near Davangere city during Sep. 2003 to Aug. 2005. The pond is situated 3 kms away from Davangere on the way to Harihar. It lies between 14^0 28' N latitude and 75^0 52' E longitude. Water spread area of this water body is 73 Hectares. Rain water is the main source of water and Bhadra right bank channel is the other source. Water is mainly used for irrigation 0.70 sq. kms which is covered by paddy, sugarcane and groundnut crops.

To evaluate the water characteristics a series of physico-chemical and biological tests were performed during two years period of Sept 2003 to Aug 2005. Water samples were collected in Bathi pond and mixed as per the standard methods of Khanna and Bhutiani (2004). Sampling at each station consists of taking one litre of sample for biological analysis and two litres in polyvinyl carbuoys for physico-chemical analysis.

temperature, pH and DO tests were performed in the field. Alkalinity, chloride, turbidity and hardness were determined. Phosphate, nitrate, nitrite, sulphate and silica were determined using UV-Visible Spectrophotometer. Standard prescribed methods were followed for the physico-chemical analysis of the water sample APHA, (1998) and Khanna and Bhutiani (2004).

For qualitative and quantitative analyses of phytoplankton one liter of composite water samples at surface level were collected at interval of 30 days for 2 years during the period September 2003 to August 2005. One liter of sample was fixed with 20 ml of 1% Lugol's Iodine solution and kept for 24 hours for sedimentation. 100 ml of sample is subjected to centrifugation at 1500 rpm for 20 minutes and used for further investigation. Identification of plankton up to species level was done by referring standard manuals (Philipose, 1967; Fritch, 1945). Quantitative estimation of phytoplankton was done by using Sedgwick Rafter Counting cell. The Pearson correlation coefficient was used to examine the relationships among the different environmental variables including phytoplankton density. Correlation coefficient(r) was calculated to detect the relationship between the various parameters of the water bodies under study.

Results and Discussion

Pearsons correlation matrix of different physico-chemical variables and Phytoplankton taxa recorded are given in Table 1 and 2 while Fig 1 and 2 showed **s**easonal changes of phytoplankton density and distribution of phytoplankton in percentage (%) in Bathi pond respectively.Total of 66 phytoplankton species were recorded in Bathi pond among which 21 species belong to Chlorococcales, Bluegreen algae, 12 species Diatoms, 15 species, Euglenoids, 9 species and Desmids, 10 species. The major phytoplankton in terms of frequency and abundance were *Crucigenia crucifera*, *Pediastrum duplex*, *Melosira sp*. Seasonal variations in phytoplankton diversity was recorded, although the highest number of species was recorded during summer season.

Table 1. Correlation coefficient calculated among the physico-chemical parameters with the density of the phytoplankton in Bathi pond, Karnataka (India)

Parameters	Blue-green algae	Chlorococcales	Desmids	Diatoms	Euglenoids
Air temp	0.494	0.378	0.350	0.324	**0.509**
BOD	0.131	0.353	0.445	**0.524**	0.466
Calcium	0.134	0.330	0.299	0.411	0.118
Chloride	0.069	0.072	**0.510**	**0.584**	0.418
COD	**0.567**	**0.536**	**0.710**	0.263	**0.737**
Conductivity	-0.274	0.168	0.143	0.091	0.101
DO	-0.040	0.225	0.181	0.376	0.222
Carbon dioxide	-0.137	-0.044	-0.235	-0.269	-0.117
Magnesium	-0.365	0.132	-0.012	0.112	-0.106
Nitrate	0.116	0.117	0.361	0.315	0.330
Nitrite	-0.465	-0.331	-0.159	0.091	-0.320
pH	0.132	-0.018	-0.160	-0.196	0.010
Phosphate	0.333	0.474	0.383	0.144	0.238
Potassium	0.178	0.337	**0.576**	0.418	0.441
Silica	-0.202	-0.244	-0.042	-0.151	0.219
Sodium	0.020	0.346	**0.514**	0.334	0.236
Sulphate	0.422	0.035	0.075	0.162	0.236
Total alkalinity	-0.159	-0.099	0.192	0.328	0.010
TDS	-0.248	-0.050	0.150	0.129	0.111
Total hardness	-0.200	0.238	0.112	0.251	0.042
Turbidity	0.115	0.084	0.463	0.438	0.483
Water temp	0.450	0.191	0.281	0.248	0.334

Values in the bold letters indicate the significant values

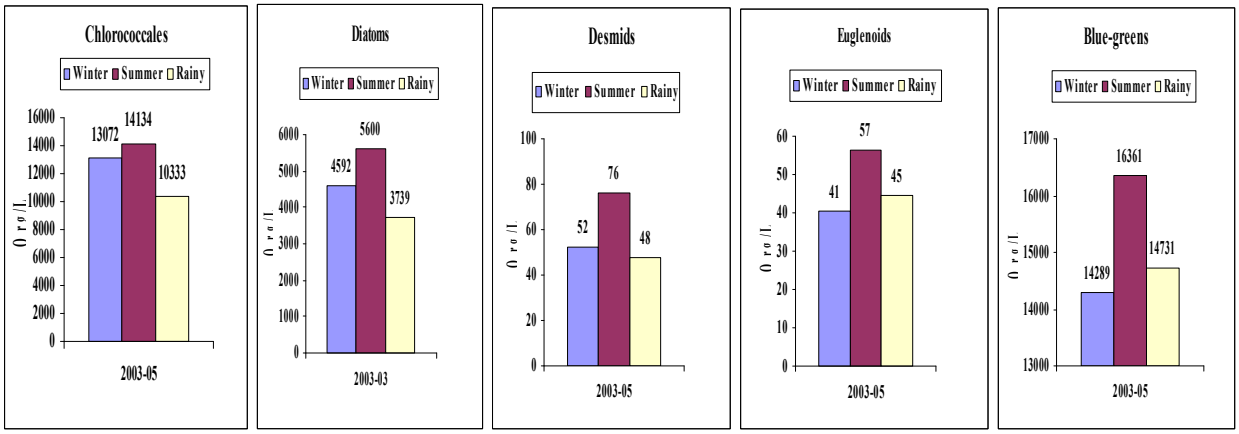
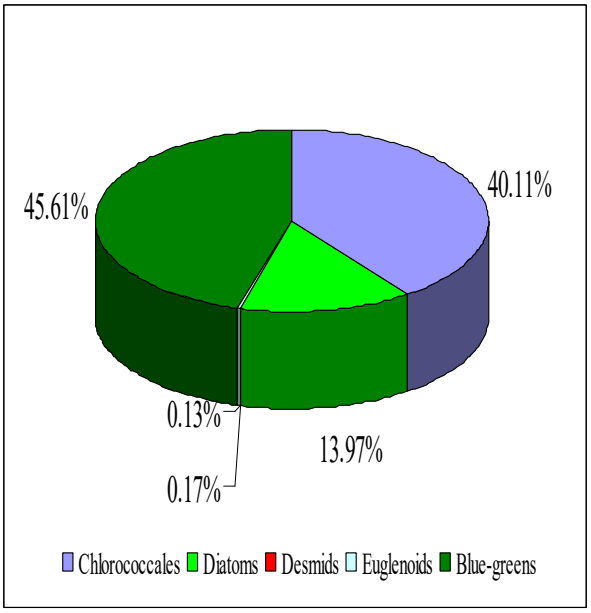


Fig.1 Seasonal changes of phytoplankton density of Bathi pond

Table. 2: Phytoplankton taxa record

	Chlorococcales		
1	*Actinastrum* sp.	*35*	*Surirella capronii*
2	*Ankistrodesmus falcatus*	*36*	*Synedra ulna*
3	*Arthrodesmus* sp.		**Desmids**
4	*Chlorella vulgaris*	*37*	*Cosmarium retusiformi*
5	*Coelastrum* sp.	*38*	*Cosmarium subtumidum*
6	*Crucigenia crucifera*	*39*	*Cosmarium depressum*
7	*Crucigenia retangularis*	*40*	*Cosmarium lundelli*
8	*Kirchneriella lunaris*	*41*	*Cosmarium capitulum*
9	*Pediastrum simplex*	*42*	*Closterium lunula*
10	*Pediastrum duplex*	*43*	*Closteriopsis* sp.
11	*Pediastrum duplex* var. *tetradon*	*44*	*Micrasterias* sp.
12	*Pediastrum tetras*	*45*	*Staurastrum wilde*
13	*Scenedesmus bijugatus*	*46*	*Staurastrum* sp
14	*Scenedesmus quadricauda*		**Euglenoids**
15	*Scenedesmus dimorphous*	*47*	*Euglena acus*
16	*Scenedesmus armatus*	*48*	*Euglena gracile*
17	*Scenedesmus acuminatus*	*49*	*Euglena accutissima*
18	*Scenedesmus abundance*	*50*	*Euglena* sp.
19	*Selenastrum gracile*	*51*	*Phacus orbicularis*
20	*Tetradaedron gracile*	*52*	*Phacus longicauda*
21	*Tetradaedron muticum*	*53*	*Phacus meson*
	Diatoms	*54*	*Strombomonas gibberosa*
22	*Anomoeonies sphaeophora*	*55*	*Trachelomonas robasta*
23	*Closterium* sp.		**Bluegreens**
24	*Cyclotella stelligera*	*56*	*Anacystis* sp.
25	*Gyrosigma gracilis*	*57*	*Anabaena aphnizomenoides*
26	*Gyrosigma spencerii*	*58*	*Aphanocapsa* sp
27	*Gyrosigma attenuata*	*59*	*Chroococcus turgidus*
28	*Gyrosigma elongata*	*60*	*Gloecapsa* sp.
29	*Melosira granulata*	*61*	*Merismopedia glauca*
30	*Navicula pupula*	*62*	*Microcystis aeruginosa*
31	*Navicula cuspidate*	*63*	*Microcystis viridis*
32	*Navicula pigmea*	*64*	*Nostoc microscopium*
33	*Navicula radiosa*	*65*	*Oscillatoria tennuis*
34	*Pinnularia microstauron*	*66*	*Spirulina major*

Fig.2 Distribution of phytoplankton percentage in Bathi lake, Karnataka (India)



The class Chorococcales was represented by highest number of species followed by Diatoms, Blue-greens, Desmids and Euglenoids. In Bathi pond Chlorococcales represents 40.11% of the total phytoplankton population being the second dominated group among the other groups of phytoplankton.This lake supported 10 genera and 18 species of class chlorococcales which *Crucigenia crucifera*, *Pediastrum duplex*, *Scenedesmus dimorphous*, *Kirchneriella* appeared in all the months during the investigation and *Pediastrum tetras* Var. *tetraodon*, *Selenastrum westlii* appeared as rare forms. The genus *Scenedesmus* was represented by seven species, *Pediastrum* by four species, *Crucigenia* and *Tetradron* by two species and other forms like *Actinastrum*, *Ankistrodesmus*, *Chlorella*, *Selenastrum* and *Kirchneriella* were represented by single species.

Diatoms in Bathi pond is represented by 9 genera and 15 species constituting 13.97% of total phytoplankton population. If the diversity of diatoms are considered a genus *Navicula* and *Gyrosigma* represented by four species, *Pinnularia* and the forms like *Anamoenieis*, *Cyclotella*,

Gomphonema, *Melosira*, *Surirella* and *Synedra* were represented by single species.

The occurrence of Desmids in Bathi pond recorded 5 genera and 10 species constituting of 0.17 % of total phytoplankton population. The diversity of desmids is considered a genus *Cosmarium* represented by 5 species, *Staurastrum* with two species and other genera like *Micrasterias*, *Closterium* and *Closteriopsis* were represented by single species.

Bathi pond favoured more number of Euglenoids with 4 genera and 9 species of Euglenoids comprising 0.13 % of the total phytoplankton. Species diversity of Euglenoids showed *Euglena* represented by four species followed by *Phacus* three species and other genera like *Trachelomonas* and *Strombomonas* represented by single species.

Bathi pond supported 10 genera and 11 species of blue-greens constituting 45.61% of the total plankton population. With regard to their diversity the genus *Microcystis*, *Aphanocapsa* and *Oscillatoria* were represented by two species, *Arthrodesmus*, *Anacystis*, *Anabaena*, *Nostoc*, *Spirulina*, *Chroococcus* and *Merismopedia* were represented by single species.

Some of the pollution tolerant species (Palmer, 1969) identified during the present study are *Scenedesmus quadricauda*, *Coelastrum* sp, *Tetradron muticum*, *Navicula* sp, *Synedra* sp, *Cyclotellasp*, *Pinnularia* sp, *Closterium* sp, *Cosmarium* sp, *Staurastrum* sp, *Euglena* sp, *Phacus* sp*, Trachelomonas* sp, *Oscillatoria* sp, *Microcystis aeruginosa, Anabaena* sp*., Microcystis aeruginosa* were recorded from the pond indicates the civic pollution.

Among physico-chemical parameters air temperature was most significantally positively correlated with Euglenoids. BOD was most significantally positively correlated with diatoms. Chloride was most significantally positively correlated with Desmids and Diatoms. COD was most significantally positively correlated with Blue-green algae, Chlorococcales, Desmids and Euglenoids. Potassium and sodium were positively correlated with Desmids. In this calcium, conductivity, DO, carbon dioxide, magnesium, nitrate, nitrite, pH, phosphate, silica, sulphate, total alkalinity, TDS, total hardness, turbidity and water temperature is not showing any correlations and COD has shown maximum correlations. Calcium, chloride, conductivity, DO, magnesium, nitrate, nitrite, pH, phosphate, silica, sodium, TDS, total hardness, turbidity and water temperature has not shown any correlations.

Bhatt *et al*., (1999) showed that nitrites and total dissolved solids are negatively correlated with Chlorococcales. Similar observations have also been made in our studies. Tripati and Pandey (1990) are of the opinion that high temperature favours the abundance of Chloroccocales. Our findings are of conformity with the above said researchers.

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