



Algal eco-diversity in the selected lakes of Koppal, Karnataka, South Western India

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Abstract

Algae act as indicators of environmental conditions due to their sensitivity changes in water quality and other factors. Therefore, three lakes were surveyed in Koppal District, North Karnataka; South-Western India for Algal diversity. The water samples of lakes were collected and examined. It was noted that, sodium (64.63), Tds (566.32) and pH (8.82) were found maximum in the water sample of Basapur Lake and Bicarbonate value (6.00), Total hardness (150) and chloride (5.6) were found to be more in Ginigera Lake. A total of 39 species belonging were identified and recorded, among them 16 species of Bacillariophyceae, 15 species of Chlorophyceae, 06 species of Cyanophyceae and 02 species of Euglenophyceae. Algal species namely *Cosmarium*, *Spirogyra* and *Closterium* belongs to Chlorophyceae were reported from all the lakes. The present research findings clearly indicate that, the physico-chemical parameters of water along with biological characteristics can provide clear idea of the trophic status of water bodies.

Keywords: Diversity, bacillariophyceae, algae, physico-chemical, lake

Introduction

Algae are a diverse group of primarily aquatic, single celled plant like organisms. Most of algae has characteristics in common with plants; they have cell wall, contain the green pigment chlorophyll and manufacture their own food through the process of photosynthesis. Algae are chief producer of oceanic water and contributing maximum of oxygen to atmosphere and are belongs to thallophytes of plant Kingdom. Algae were included under different groups such as plant Kingdom (the green and red algae), the bacteria (blue green algae), protozoa (single celled swimming group) and many members of the chrysochyta like diatoms.

Algae play a vital role in the Earth's ecosystem as primary producers providing food and oxygen for many other organisms. Algae act as indicators of environmental conditions due to their sensitivity changes in water quality and other factors. Here are a few ways in which algae can serve as environmental indicators. Some algae thrive in environments with high nutrient levels, particularly nitrogen and phosphorus algal blooms are produced in Lake due to accumulation of nitrogen and phosphorus. Presence of cyanobacteria or filamentous green algae will indicate nutrient pollution. Hence if we form cyanobacteria or filamentous green algae in lake water it indicates that lake is polluted with presence of high amount of nitrogen and phosphorus content which may be occurred due to runoff of agricultural water, waste water discharge. If we not found such algae and lake it indicates it is free from nutrient pollution.

These algae also act as bio indicators because their presence or absence can reflect specific environmental conditions. The diatoms morphologically features and sensitivity of water quality helps us to know the ecological health and water quality. Algae have specific tolerance of pH, temperature, dissolved oxygen levels and salinity based on the nature of water the different types of algae are present. Hence by visualizing or analyzing the type of algae present in water the quality of water can be determined.

In severe cases algae may provide shelter for the development of filamentous or pseudo-filamentous bacteria. A few algal groups can be toxic and should not be touched by people or animals. Many algal groups are part of the normal stream -micro floral and their presence is simply an indication that a stream ecosystem is functioning normally. The present work was undertaken to understand the diversity of algae in three different Lakes of Koppal talukas namely Ginigera Lake, Basapur Lake and Gavimatha Lake.

Materials and methods

Study area

Koppal District is a region of Kalyana Karnataka. It lies between north latitudes 15°09" and 16° 01" and east longitudes 75° 46" and 76° 48". Koppal district experiences a semi-arid type climate characterized by hot summer and low rainfall and located in Northern interior of Karnataka has an area of 8458 sq km. It is bounded by Raichur, Bagalkot, Gadag and Vijayanagar Districts. For the present study three lakes of Koppal talukas were selected namely Ginigera Lake, Basapur Lake and Gavimath Lake.

Ginigera Lake

Ginigera is 15Kms away from Koppal city. The total geographical area of village is 952.52 hectares. Ginigera has a total population of 8,449 peoples, which is both district & sub-district headquarter of Ginigera village. There are about 1,863 houses in Ginigera village. All major economic activities like agriculture, Industries, Animal Husbandry, etc. The lake provides habitat for fishes, crabs, frog, algal members, Shells, phytoplanktons etc. It is used for rain-water harvesting and storage purpose, agricultural purpose, domestic purpose, consumption of water by animals etc.

Spoorthi Sagara lake Basapur

Basapur is 8 kms away from Koppal city. The total geographical area of village is 1070.56 hectares. There are about 389 houses in Basapur village. Basapur has a total population of 2,095 peoples, which is both district & sub-district headquarter of Basapur. It is the best scenery place.

Lake area consisting of 2.73 Acres, Total 1500 Feet, Length 500 feet, Width 250 feet and 30 feet depth. The lake having more than 10,000 plants were planted. 15,000 fishes were living in the lake, with Swan, frog, algal members, Ducks, Tortoise, Crabs, phytoplanktons etc. It comes under forest department. It is used for rain-water Harvesting and storage purpose, agricultural purpose, and consumption of water by animals etc.

Gavimath Lake

Gavisiddeshwar math is also called Gavimath in Koppal city is one of the historical places. It consist a lake in the lower base of Gavimath. The lake is filled water and it serves as rain water harvesting reservoir of Gavimath. The lake is provides place to fishes, ducks, swans, tortoise, etc.

Collection of water sample

The water samples were collected in different bottles labeled as sample 1,2,3,4. Initially the pre-washed bottles were rinsed with the lake water. The closed bottle was dipped in the lake at the depth of 0.5 to 0.7m and then a bottle was opened inside and was closed again to bring it out at the surface. The samples were collected from the middle and corners of the lake. The algae samples were collected in plastic container with the help of dissecting forceps.

Sample handling and preservation

From the time of sample collection to the time of actual analysis, many physical, Chemical & Biological characteristics would change the quality of the water sample; therefore to minimize this change the sample were preserved soon after the collection. The collected samples were brought to the laboratory and relevant analysis was performed. For algal study, collected water sample along with filamentous algal material was preserved in 4% Formalin. The study was carried for a period of 3 Months (June – August 2023).

Analysis of samples

Analysis of the water samples collected from Lake was done in accordance with the standard procedures. The methods employed for analysis of various parameters are as follows.

Sl. No	Parameter	Method	Instrument used
1	pH	Electrometric	pH meter
2	Electrical conductivity	Electrometric	EC meter
3	Chlorine	Spectroscopy	Spectrophotometer
4	Sodium	Spectroscopy	Flame photometer
5	Bicarbonate	Spectroscopy	Spectrophotometer
6	TDS	Gravimetric analysis	TDS & EC meter
7	Hardness	Complexo -metric titration (EDTA)	Hardness test kit

Results and discussion

Algae are simple, aquatic, plant-like organisms that do not have true roots, stems and leaves. Many are single-celled so can only be seen using a microscope, while others grow in filaments or mats that are quite conspicuous. Algae have chlorophyll and can make their own food through the process of photosynthesis.

The water samples collected from selected lakes are subjected for physico-chemical properties of water. It was found that, all the selected water bodies have variations with respect to parameters analyzed during the study period. It

was noted that, sodium (64.63), Tds (566.32) and pH (8.82) were found maximum in the water sample of Basapur Lake compared to other two lakes of the present study. Further, it was observed that, Bicarbonate value (6.00), Total hardness (150) and chloride (5.6) were found to be more in Ginigera Lake compared to other two lakes (Table 1).

The main groups of algae found in fresh water were the green algae (Chlorophyta), diatoms (Bacillariophyceae), blue-green algae (Cyanobacteria) and Euglena (Euglenophyceaea). In Koppal district, very few researchers have been paid their attention on algal distribution. Among the selected lakes Ginigera and Basapur are the main source of water for domestic work. The Gavimath Lake is the main source of water for entire Gavimath campus. In order to study the algal distribution of selected water reservoirs of Koppal taluk, water sample and algal samples are collected. The said observation was undertaken from June-2023 to August-2023.

The algal forms were identified and described with the help of standard literature on algae as far as possible to the species level. The algal taxa encountered from the different lakes of Koppal taluk were belongs to 4 divisions consisting of 39 species. Over all 39 species were identified and recorded (Table 2), among them 16 species of Bacillariophyceae, 15 species of Chlorophyceae, 06 species of Cyanophyceae and 02 species of Euglenophyceae (Table 3). The members of Bacillariophyceae are dominant group of algae found in the lakes of Ginigera and Basapur lakes compared to Gavimath Lake.

The various genera with maximum number of species were *Cosmarium*, *Spirogyra* and *Closterium* belongs to Chlorophyceae were reported from all the lakes (Table 3). The algal members belong to class Bacillariophyceae mainly represented by the species of *Navicula*, *Gyrosigma*, *Pinnularia*, *Cymbella*, *Nitzschia*, *Synedra* and *Surirella* (Table 3). During investigation it was observed that, members of Bacillariophyceae were found more compared to other groups. The algal members of Cyanophyceae belong to various genera with maximum number of *Oscillatoria*, *Spirulina*, *Nostoc* and *Phormidium* etc., were reported (Table 3).

Table 1: Physico-chemical properties of water samples collected from selected lakes

Physico-chemical parameters	Ginigera lake	Basapur lake	Gavimath lake
pH	8.67	8.82	8.34
Electrical conductivity (EC)	1.98	1.28	0.73
Sodium (Na)	55.43	64.63	39.56
Bicarbonate (bi)	6.00	4.30	2.40
Chloride (Cl)	5.6	1.90	1.30
Total hardness	150	140	136
Tds	431.3	566.32	260.00

Table 2: Distribution of Algae in different lakes of Koppal

Algal species	Ginigera lake	Basapur lake	Gavimath lake
<i>Chaetomorpha spp</i>	+	+	-
<i>Closterium monoliferum</i>	+	+	-
<i>Closterium lunula</i>	-	-	+
<i>Closterium venus</i>	-	+	-
<i>Cosmarium</i>	+	-	+

<i>contractum</i>			
<i>Cosmarium formosulum</i>	+	+	-
<i>Cosmarium quadrifarium</i>	+	-	+
<i>Cosmarium quadrum</i>	+	+	+
<i>Cosmarium spp</i>	+	+	-
<i>Cosmerium pachydermum</i>	-	-	-
<i>Cyclotella spp</i>	-	+	-
<i>Cymbella spp</i>	-	+	-
<i>Euglena acuminatus</i>	+	+	-
<i>Euglena caudate</i>	+	+	+
<i>Gloeocapsa spp</i>	+	-	-
<i>Gomphonema acuminatum</i>	+	+	-
<i>Gyrosigma acuminatum</i>	-	+	-
<i>Gyrosigma chloroplast</i>	+	+	+
<i>Microcyst flos-aquae</i>	-	+	-
<i>Navicula frutule</i>	+	+	-
<i>Navicula spp</i>	+	-	+
<i>Netrium digitus</i>	+	-	-
<i>Navicula cuspidate</i>	+	+	-
<i>Navicula subminusula</i>	+	+	-
<i>Navicula subtilissima</i>	-	+	+
<i>Nitzschia gracilis</i>	+	+	-
<i>Nostoc spp</i>	+	-	-
<i>Odegonium spp</i>	+	+	+

Table 3: List of Algae belonging to in different divisions identified from different lakes of Koppal Taluk

Sl. No.	Algal Species	Division
1	<i>Gomphonema acuminatum</i>	Bacillariophyceae
2	<i>Synedra ulna</i>	Bacillariophyceae
3	<i>Terpsinoe spp</i>	Bacillariophyceae
4	<i>Cyclotella spp</i>	Bacillariophyceae
5	<i>Cymbella spp</i>	Bacillariophyceae
6	<i>Gyrosigma acuminatum</i>	Bacillariophyceae
7	<i>Gyrosigma chloroplast</i>	Bacillariophyceae
8	<i>Navicula frutule</i>	Bacillariophyceae
9	<i>Navicula spp</i>	Bacillariophyceae
10	<i>Netrium digitus</i>	Bacillariophyceae
11	<i>Navicula cuspidate</i>	Bacillariophyceae
12	<i>Navicula subminusula</i>	Bacillariophyceae
13	<i>Navicula subtilissima</i>	Bacillariophyceae
14	<i>Nitzschia gracilis</i>	Bacillariophyceae
15	<i>Pinnularia spp</i>	Bacillariophyceae
16	<i>Surirella spp</i>	Bacillariophyceae
17	<i>Staurastrum muticum</i>	Chlorophyceae
18	<i>Chaetomorpha spp</i>	Chlorophyceae
19	<i>Closterium monoliferum</i>	Chlorophyceae
20	<i>Closterium lunula</i>	Chlorophyceae
21	<i>Closterium venus</i>	Chlorophyceae
22	<i>Cosmarium contractum</i>	Chlorophyceae
23	<i>Cosmarium formosulum</i>	Chlorophyceae
24	<i>Cosmarium quadrifarium</i>	Chlorophyceae
25	<i>Cosmarium quadrum</i>	Chlorophyceae
26	<i>Cosmarium spp</i>	Chlorophyceae
27	<i>Cosmerium pachydermum</i>	Chlorophyceae
28	<i>Odegonium spp</i>	Chlorophyceae

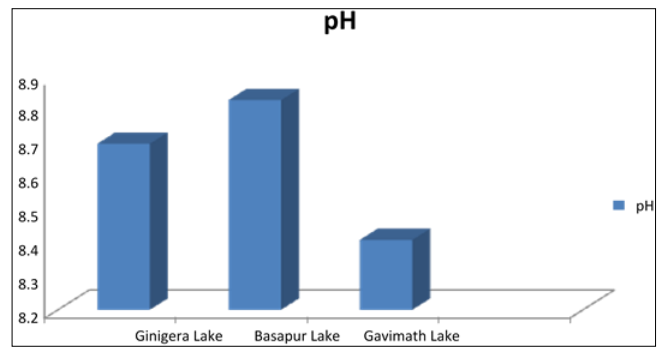


Fig 1: pH of water samples collected from three lakes of Koppal taluk

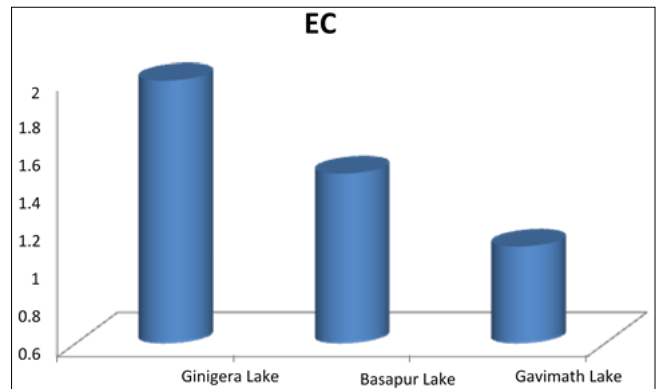


Fig 2: EC of water samples collected from three lakes of Koppal taluk

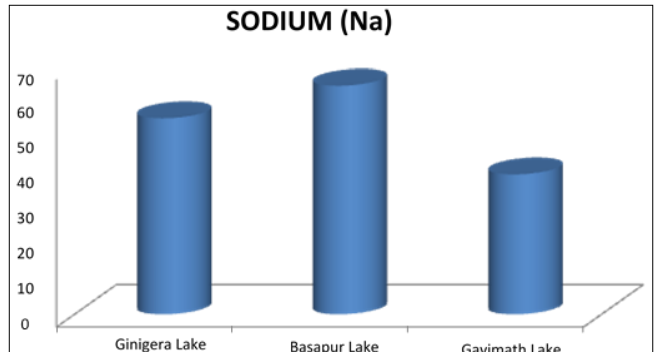


Fig 3: Sodium of water samples collected from three lakes of Koppal taluk

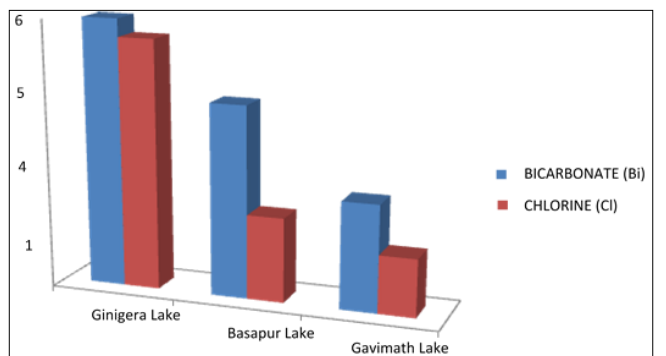


Fig 4: Chloride and Bicarbonate of water samples collected from three Lakes of Koppal taluk

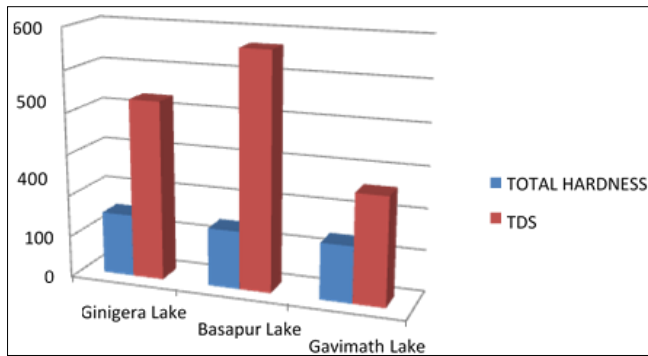


Fig 5: Total hardness and TDS of water samples collected from three lakes of Koppal

Discussion

The knowledge of physico-chemical parameters along with biological characteristics can provide clear idea of the trophic status of any water body. The present research findings are in support of the research, which have focused on variations in the algal species diversity based on the physico-chemical properties of water. It was observed by several researchers (Mehrotra & Jhingran, 1986, Shukla & Bais, 1990) have studied the nature of reservoir and lakes. Rajkumar *et al.*, (1994) studied the relationship between various species and environmental factors in water bodies of Chennai city.

The members of Bacillariophyceae were dominant followed by Chlorophyceae and Cyanophyceae. The similar kind of studies from freshwater habitats of Aurangabad district of Maharashtra was recorded by Ashtekar (1980). Here Chlorophyceae members were dominant followed by Cyanophyceae, Euglenophyceae, Chrysophyceae and Rodophyceae. Algal biodiversity of Sonvad and Devbhane dam in Dhule district of Maharashtra, it was observed that, total of 304 algal forms were reported, of which 97 belonged to Chlorophyceae, 90 belonged to Cyanophyceae, 87 belonged to Bacillariophyceae and 30 to Euglenophyceae. The similar studies were reported from Hartala lake, Jalgaon district Maharashtra (Mahajan, 2004, 2005). Kumawat and Jawale (2003 a & b) extensively studied phytoplanktons of some fish ponds at Anjale, in Jalgaon district and reported 65 taxa. It was observed that, during recent years a large number of publications related to limnological studies appeared, especially in the southern regions of Karnataka. The techniques from normal general descriptions were switched to modern statistical explanations and multivariate analysis were used. Basavarajappa *et al.*, (2011) [2] made an attempt to evaluate fresh water diatoms as indicators of water quality in some lakes of Mysore. All the lakes studied were alkaliphic, and nitrogen eutrophic tolerant species were present. The water quality ranged from alpha mesotrophic to polysaprobic. The study suggested that diatoms are an excellent source of ecological indicators. It was Verma (2008) observed phytoplankton of Narmada river of Maheshwar (M.P.) and recorded 48 species belonging to Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae. Several workers extensively worked on algal biodiversity of freshwater habitats; their results are agreed with present algal biodiversity study. (Hillaird 1959, Clearance 1960, Aykula 1978, Gophen 1994, Huszar 1996, Lausevik 1997, Rodrigues 1998, Iqbal *et al.*, 2006, Kamat 1962, Heddege 1983, Johnson, 2006,

Senthikumar and Sivkumar 2007, Vanjari *et al.*, 2007, Nandan *et al.*, 2007 and Jadhav *et al.*, 2007). The present experimental results are similar with to the findings of earlier researchers such as, Rao (1955) [24, 25] discussed the distribution of algae in a group of six small ponds of Hyderabad, Krishnamurthy (1954) [16] worked on the diatomic flora of south Indian lake; Gandhi (1955) [6] studied fresh water diatoms of Pratapgad, Rajasthan, Philipose (1960) [22] worked on fresh water phytoplankton of inland fisheries, Singh (1960) [26, 27] recorded the phytoplankton ecology of inland waters of Uttar Pradesh. It can be concluded from the present work that, Ginigera lake, Basapur lake and Gavimath lake inhabiting many number of algae belonging to diverse groups such as unicellular, filamentous unbranched and filamentous branched groups. All the algal members observed during the study have maximum beneficial impact on human health and welfare.

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