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A Preliminary Study on Phytoplankton in Fresh Water-Lake of Gogi, Yadgir District, Karnataka

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ABSTRACT: The present study was conducted in a semi arid region of Karnataka. The study discusses the phytoplankton diversity of the Gogi lake ecosystem. A standard methodology was followed in conducting to complete this study and samples were collected at different points from the lake ecosystem located at the core area of the proposed uranium mining site. Through a field survey, twenty one species of phytoplankton were recorded coming under four classes *viz.*, Bacillariophyceae(8), Chlorophyceae(7),Cyanophyceae (5) Charophyceae (1) and twelve families and Fragilariaceae (4), Bacillariaceae (3), Zygnemataceae(3), Desmidiaceae (2), Oscillatoriaceae (2), Melosiraceae (1), Cladophoraceae (1), Scenedesmaceae (1), Microcystaceae (1), Nostocaceae (1), Phormidiaceae (1), Characeae (1). The data were collected over two seasons- March to May and September to November -2012. A total of 21 species were recorded from the study region of which 10 species were recorded during March to May, while 02 species from September to November, nine species were recorded.

KEYWORDS: Phytoplanktons, Species diversity, Semi arid region, Karnataka, India.

I. INTRODUCTION

Studies on the seasonality of Indian fresh water plankton were initiated by Sewell in 1934 [1]. The aquatic diversity is highly sensitive and is influenced by various factors. However, the organisms in the aquatic ecosystems are indicators of changes that occur due to various anthropogenic activities, for example, pollution, climate change etc. Phytoplanktons are unicellular and free floating organisms belonging to the Algae group. Phytoplanktons are the easiest food source for most of the aquatic beings like zooplanktons, fishes and thus are the basic food producers in any aquatic ecosystem [2]. Generally fresh water ecosystems are two types: (a) lotic; and (b) lentic; lotic water ecosystem includes streams, canals, waterfalls and rivers, lentic water ecosystem includes ponds, reservoirs, lakes, pools and agricultural fields like that of paddy. Fresh water ecosystems are differentiated into various types of planktons (free floating), benthoms (attached to sediments) and epiphytic algae attached to hydrophytes, stones, mud, sand, reservoir rocks and lakes [3, 4]. Various studies have been carried out in the Indian context related various aspects of phytoplankton such as seasonal distribution [5, 6], diversity of fresh water algae [1, 7, 8, 9, 10, 11, 12, 13, 14, 15], seasonal variations and physical-chemical aspects [6, 16, 17, 18] and algal blooms [19].

Most of the work on phytoplankton is being carried out in with respect to lotic ecosystems. Many works such as described above are also available with regard to lentic ecosystems. However, lentic ecosystems of semi arid regions which are dominated by human habitations require more attention regarding the study of plankton. Therefore, the current study on diversity and documentation of phytoplankton was carried out across water bodies located in a semi-arid region of India. Arid and semi arid regions are important regions on the planet earth as they cover more than 60% of the earth's surface besides being home to more than 2 billion people [20]. The semi arid regions provide habitats for

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a large number of plant and animal species across terrestrial and water ecosystems. In India, 37% of the country's total area comes under arid and semi-arid regions spread over 11 states [21]. The current study relates to the lakes located adjacent to a human habitation in Gogi village of Yadgir district, Karnataka. Since a few studies are available on the phytoplankton diversity of the study region, the present study aimed at studying the documentation of phytoplankton across fresh water lakes of the study area.

II. MATERIALS AND METHODS

A random sampling method was used for the collection of samples from the selected site over two different seasons- March- May and September – November 2012. The samples were collected using a phytoplankton mesh net consisting of a cylindrical tube with stoppers at each end and a closing device (Photo plate 1); water samples were collected up to 6 ltr at each station through a mesh net (Photo plate 2). Through collection of whole water samples from the site, all size classes of phytoplankton can be collected. Different size and categories of phytoplankton were separated subsequently by filtering these whole water samples through an appropriate size mesh. A 100 ml final water sample was collected from the mesh for further study. Samples were also collected from the surroundings of the lake where Algae grows; the algal sample growth is abundant and visible on the surface of the rocks [24].

Lugol's solution and Formalin methods followed in the preservation of phytoplankton samples. **Lugol's solution**: After collection of phytoplankton samples, preservation is done using Lugol's solution. Add 0.3 ml Lugol's solution to a 100 ml sample and store in a dark place. For long time preservation of Lugol's solution, add 0.7 ml per 100 ml of sample and buffrered formaldehyde, add 2.5% final concentration after 1 hour [25]. **Formalin:** After collection of the sample, 4% of formalin (20g sodium borate, Na2B2O4, + 1 L 37% formaldehyde) are added to 50 ml sample immediately [14]. The samples were identified in Phycology lab at the Madras University, Gundy campus. Glycerine was used for mounting the material. The centric organism was photographed using a LABOMED microscope with attached SANYO ccd camera [3].

Photo plate 1: Phytoplankton mesh net

Photo plate 2: Collection of Phytoplankton from Gogi Lake

III. STUDY AREA

The present study area is situated at Gogi, Shahapur taluk of Yadgir district. The district is bound on the west by Bijapur district, on the north by Gulbarga district of Karnataka, on the east by Maheboobnagar district of Telangana and on the south by Raichur district of Karnataka (Figure 1). The average co-ordinates of the study area are 16° 72' 58''N latitude and 76° 74'19''E longitude with an elevation of 1609 ft above the sea level. The district falls under the Krishna river basin with her tributary Bheema. Climatically the study area exhibits a high temperature pattern with a low rainfall and humidity [22] and due to high temperatures; the loss of surface water is very high. The lakes in the study region almost dry up, in summer but get filled up during monsoon. This is also one of the major causes for the loss of aquatic biodiversity in the Lake Ecosystem, while appearance-disappearance of the species is subject to seasonal changes [23]. A phytoplankton investigation of the lake ecosystem was mainly carried over two different seasons (March to May and September to November). The lake is a shelter for many bird species and other aquatic biodiversity with many aquatic plant species recorded such as *Ipomia auatica, Ipomia carnia, Typha angustifolia, Cyprus spp.,*

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Hydrilla, Pistia, Eichornia etc. Day-to-day activities such as washing clothes, cleaning vehicles and animals, dumping solid waste and other human regular activities including answering nature calls are commonly observed in the lake ecosystem.

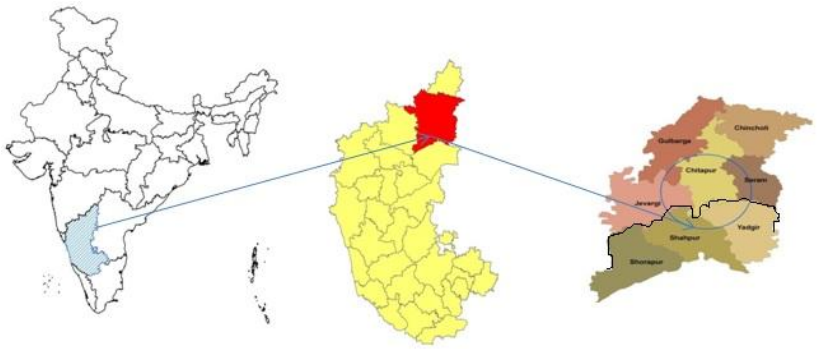

Figure 1: Location of the study area

IV. RESULTS AND DISCUSSION

A Phytoplankton inventory was carried out in Gogi Lake mianly over two different seasons, March to May and September to November during the year 2012. A total of 21 species were recorded belonging to 4 different classes, namely Bacillariophyceae, Chlorophyceae, Cyanophyceae, Charophyceae are given in Figure 2. Out of 21 species maximum number of species belong to Fragilariaceae (4) followed by Zygnemataceae and Bacillariaceae (3 each), Oscillatoriaceae Desmidiaceae (2 each). However, for seven families viz., Melosiraceae, Cladophoraceae, Scenedesmaceae, Microcystaceae, Nostocaceae, Phormidiaceae and Characeae 1 species each was recorded from the studied fresh water ecosystem (Figure 3).

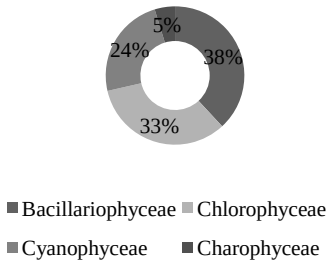

Figure 2: Distribution percentage of studied species in study area

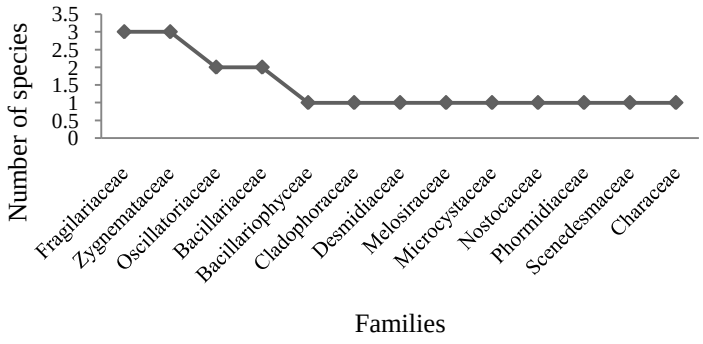

Figure 3: Number of species according to various families of phytoplankton

Most of the species belong to class Bacillariophyceae (8) followed by Chlorophyceae (7), Cyanophyceae (5) and Charophyceae (1). Under Bacillariophyceae eight (8) species were recorded namely *Hantschia amphioxys, Synedra ulna, Fragilaria fonticola, Melosira granulate, Nitzschia closterium, Nitzschia paradoxa, Synedra ulna Var. amphirhynchus, Synedra ulna Var. oxyrynchus.* Out of these three species (*Hantschia amphioxys, Fragilaria fonticola, Synedra ulna Var. amphirhynchus*) were recorded over both the seasons; *Nitzschia paradoxa* was recorded post monsoon, While *Melosira granulate, Synedra ulna, Nitzschia closterium* and *Synedra ulna* Var. *oxyrynchus* were recorded during pre monsoon. The species namely *Cladophora glomerata, Staurastrum gracile, Zygnema Khanne, Spirogyra hyalina, Coelastrum microporum, Spirogyra condensata* and *Cosmarium innae* belong to class Chlorophyceae. Under Chlorophyceae, 3 species (*Cladophora glomerata, Staurastrum gracile, Spirogyra condensata*)

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were observed during pre monsoon season and one species (*Cosmarium innae*) was found after the monsoon season and three (3) species (*Zygnema Khanne, Spirogyra hyaline, Coelastrum microporum*) were *recorded over* both the time periods (March-May and September-November). Under class Cyanophyceae, 5 species namely *Lyngbya majuscule, Gleocapsa punctata, Nostoc piscinale, Oscillatoria tenuis* and *Phormidium corium* were recorded during the study period. All species were found to be available before monsoon, however, after monsoon, only two species, *Gleocapsa punctata* and *Phormidium corium*, were recorded. Under class Charophyceae, one species (*Chara sp.* spread throughout tha Lake) was recorded during the study period. The presence of species during season and at various sample collection points are presented in Table 1 and 2.

Table 1: Inventory of Phytoplankton in Gogi Lake

1	**Scientific Name**	**Family**	**Class**	**Season-1 March-May 2012**							**Season-2 Sep-Nov 2012**						
				S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 1	S 2	S 3	S 4	S 5	S 6	S 7
1	*Hantschia amphioxys* (Ehr.) Grun.	Bacillariaceae	Bacillariophyceae	+		+			+		+			+	+	+	
2	*Synedra ulna* (Nitsch) Her	Fragilariaceae	Bacillariophyceae	+		+	+		+								
3	*Fragilaria fonticola* var. chandolensis	Fragilariaceae	Bacillariophyceae	+	+			+		+		+			+		
4	*Melosira granulata* (Kutz.) Ralfs	Melosiraceae	Bacillariophyceae				+			+							
5	*Nitzschia closterium* (Ehr.)	Bacillariaceae	Bacillariophyceae		+	+											
6	*Nitzschia paradoxa* (J.F.Gmelin) Grunow	Bacillariaceae	Bacillariophyceae										+				+
7	*Synedra ulna* (Nitz.) Ehr. Var. amphirhynchus (Ehr.) Grun.	Fragilariaceae	Bacillariophyceae	+				+		+		+		+			
8	*Synedra ulna* (Nitz.) Ehr. Var. oxyrynchus (Kutz.) Van Heurck	Fragilariaceae	Bacillariophyceae		+		+		+								
9	*Cladophora glomerata* (Linnaeus) Kützing	Cladophoraceae	Chlorophyceae		+			+									
10	*Staurastrum gracile* forma Iyengar et Vimala bai	Desmidiaceae	Chlorophyceae	+	+		+		+								
1	*Zygnema*	Zygnematac	Chlorophycea				+		+		+			+		+	

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1	*Khanne* Skuja	eae	e														
12	*Spirogyra hyalina* Cleve	Zygnematac eae	Chlorophycea e	+		+		+			+	+	+		+	+	
13	*Coelastrum microporum* Naegeli	Scenedesma ceae	Chlorophycea e		+		+	+		+		+		+			+
14	*Spirogyra condensata* (Vaucher)Kuet zing	Zygnematac eae	Chlorophycea e		+	+			+								
15	*Cosmarium innae*	Desmidiacea e	Chlorophycea e											+		+	
16	*Lyngbya majuscula* (Dillwyn) Harvey	Oscillatoriac eae	Cyanophycea e	+			+		+								
17	*Gleocapsa punctata* Nägeli	Microcystac eae	Cyanophycea e		+	+		+				+	+	+	+	+	+
18	*Nostoc piscinale* Kutzing ex Born. Et Flah.	Nostocaceae	Cyanophycea e	+	+				+								
19	*Oscillatoria tenuis* Ag. Ex Gomont	Oscillatoriac eae	Cyanophycea e		+	+			+								
20	*Phormidium corium* var. captatum Gardner	Phormidiace ae	Cyanophycea e	+			+	+			+		+	+	+	+	
21	*Chara*	Characeae	Charophycea e	+	+		+		+		+	+			+	+	

**Note: S=Sample collection points

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Table 2: Inventory of Phytoplankton in Gogi Lake

S.No	Scientific Name	Family	Class	Season-1 Mar-May	Season-2 Sep-Nov
1	*Hantschia amphioxys* (Ehr.) Grun.	Bacillariaceae	Bacillariophyceae	+	+
2	*Synedra ulna* (Nitsch) Her	Fragilariaceae	Bacillariophyceae	+	-
3	*Fragilaria fonticola* var. chandolensis	Fragilariaceae	Bacillariophyceae	+	+
4	*Melosira granulata* (Kutz.) Ralfs	Melosiraceae	Bacillariophyceae	+	-
5	*Nitzschia closterium*(Ehr.) Wm. Smith	Bacillariaceae	Bacillariophyceae	+	-
6	*Nitzschia paradoxa* (J.F.Gmelin) Grunow	Bacillariaceae	Bacillariophyceae	-	+
7	*Synedra ulna* (Nitz.) Ehr. Var. amphirhynchus (Ehr.) Grun.	Fragilariaceae	Bacillariophyceae	+	+
8	*Synedra ulna* (Nitz.) Ehr. Var. oxyrynchus (Kutz.) Van Heurck	Fragilariaceae	Bacillariophyceae	+	-
9	*Cladophora glomerata* (Linnaeus) Kützing	Cladophoraceae	Chlorophyceae	+	-
10	*Staurastrum gracile forma* Iyengar et Vimala bai	Desmidiaceae	Chlorophyceae	+	-
11	*Zygnema Khanne* Skuja	Zygnemataceae	Chlorophyceae	+	+
12	*Spirogyra hyalina* Cleve	Zygnemataceae	Chlorophyceae	+	+
13	*Coelastrum microporum* Naegeli	Scenedesmaceae	Chlorophyceae	+	+
14	*Spirogyra condensata* (Vaucher)Kuetzing	Zygnemataceae	Chlorophyceae	+	-
15	*Cosmarium innae*	Desmidiaceae	Chlorophyceae	-	+
16	*Lyngbya majuscula* (Dillwyn) Harvey	Oscillatoriaceae	Cyanophyceae	+	-
17	*Gleocapsa punctata* Nägeli	Microcystaceae	Cyanophyceae	+	+
18	*Nostoc piscinale* Kutzing ex Born. Et Flah.	Nostocaceae	Cyanophyceae	+	-
19	*Oscillatoria tenuis* Ag. Ex Gomont	Oscillatoriaceae	Cyanophyceae	+	-
20	*Phormidium corium* var. captatum Gardner	Phormidiaceae	Cyanophyceae	+	+
21	*Chara* sp.	Characeae	Charophyceae	+	+

The temperatures vary throughout the study area from 42^0c during summer to 26^0c during winter. The water temperatures also play an important role in controlling the occurrence and abundance of phytoplankton [7] Phytoplankton play a key role in the aquatic ecosystem and have a great ecological importance as primary producers and their work as biological indicators of the aquatic ecosystem because of their quick response of pollution. An estimation of phytoplankton composition and diversity depicts the health state of water ecosystems. We recorded a few species during the post monsoon from the study region. The excessive flooding is the main causative factor for the presence of a low population of phytoplanktons during monsoon followed by the immediate post monsoon season. During the winter season, when water becomes clear and substances in water settle down, the number of phytoplankton shows an increasing trend. Similar observations were made by Kanagasabapathi and Rajan [1]. There are several studies that discuss the effects of environmental, physico-chemical factors on phytoplankton [6, 7, 17]; an osmotic stress also causes a decline in phytoplankton diversity in the lake ecosystem [26]. However the effects of various factors on the seasonal appearance and disappearance of phytoplankton differ significantly across the Lake ecosystem [19]. In the study region, water decline starts from December onwards in view of less rainfall and high temperatures. Figure 4 describes the number of species recorded during pre-monsoon and post-monsoon periods in the study area. Our results indicate that for the pre-monsoon period 8 species were found under class Bacillariophyceae, 6 species under Chlorophyceae and for Cyanophyceae and Charophyceae 5 and 1 species recorded respectively.

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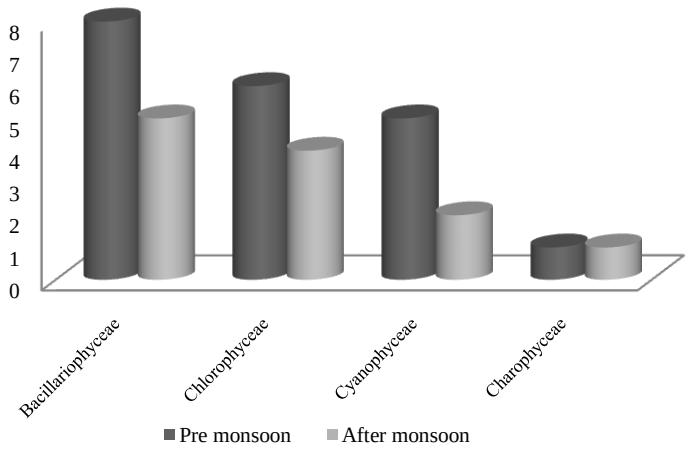

Figure 4: Seasonal variations in Gogi Lake during study period

Fresh water ecosystems are more associated with human culture and in the rural landscape of India; these are an integral part of social development as services from water bodies are used in sustaining the livelihoods. Phytoplanktons have numerous environmental functions and are important not only to aquatic ecosystems, but also the social system. The Gogi lake ecosystem is influenced by biotic factors like grazing, human effects (fishing), physical (light condition), chemical effects (nutrient concentration) and hydrological effects (loss of water) [9]. The Lake is located adjacent to the village with the villagers using it for multiple purposes like bathing, washing clothes, cleaning animals and vehicles, dumping solid waste, numerous religious rituals and other human daily activities. This activates affect the growth and distribution of phytoplankton diversity in the Lake ecosystem. The major cause behind the lake pollution is the villager's mismanagement and lack of awareness. Therefore, there is a need for the prevention of washing clothes, bathing of cattle, dumping of agricultural waste and solid waste, cleaning vehicles and avoiding the use of chemical fertilizers and other human activities so as to maintain the purity of this lake [17].

V. CONCLUSION

Wetland ecosystems are the primary shelter for aquatic biodiversity including aquatic flora, fauna and other microorganisms. Phytoplankton is one of the important components of aquatic ecosystems. Fresh water lakes play an important role in the social ecology of the region in which they are located. The lakes located in the human dominating areas are facing a threat due to various factors including anthropogenic activities, for example, bathing, washing clothes, cleaning animals and vehicles, dumping solid waste etc. Such activities, in turn, lead to the loss of aquatic biodiversity, especially plankton diversity. The present study area falls under a semiarid region; generally semiarid regions are highly vulnerable to climatic factors such as high temperatures and less rainfall. Due to less rainfall and high temperatures as well as increased anthropogenic activities in the study area, the water bodies are in jeopardy. Over the last five decades, a few water bodies have slowly vanished from the study region (Data not provided). In the study region, we conducted extensive field survey; of the total number of species documented 21 belong to different families. The increase and decrease species diversity during summer and monsoon seasons may be due seasonal changes as well as water movement. However, there are some studies that indicate that, the species diversity is high across other lake ecosystems. But in the study region, due to water scarcity, the species diversity is low. However, the main factor for the loss of aquatic biodiversity is anthropogenic pressure. Therefore, for a better management of the water ecosystem, people should be educated regarding the importance of water bodies and their uses. The aim of conducting this study was documenting the existing diversity of phytoplankton of the Gogi lake ecosystem in a semiarid region. Therefore, it can be considered a baseline data source for researchers conducting further research in semiarid regions.

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