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Study of Water Quality and Distribution of Phytoplankton in Hebbal Lake, Krishnarajanagara

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Abstract: ***Life on earth depends on fresh water. Phytoplanktons are free floating, photosynthetic, aquatic microorganisms, which moves from one place to another. Phytoplanktons which are present in Hebbal Lake, Krishnarajanagara, and Mysore were studied with respect to their species diversity and distribution. The phytoplankton community is mainly represented by algal representatives including both prokaryotes and eukaryotic genera. Studies on phytoplankton and water quality of Hebbal Lake, Krishnarajanagar, Mysore Karnataka were undertaken for 5months from May 2023 to September 2023. The quantitative analysis of phytoplankton was done by Lackey's drop method modified by saxena (1987).Diversity indices have been discussed by using PASTA Software Program. Physical and Chemical parameters were analysed using the standard methods of APHA (2025) and Trivedi and Gael (1984). Among the total 60 species recorded, 33species of Bacillariophyceae, 7species of Chlorophyceae, 8species of Cyanophyceae, 8 species of Desmidiaceae, 3species of Euglenophyceae are reported. Bacillariophyceae was the most dominant group followed by Chlorophyceae, Cyanophyceae, Desmidiaceae and Euglenophyceae. The result of physico-chemical and biological parameters along with statistical method and biodiversity indices indicated that the Hebbal Lake is threatened ecologically due to various anthropogenic activities which lead organic pollution and eutrophication status of the lake. Statistical program Bray – Curtis similarity index explained, the cluster of EC, Total hardness and Total alkalinity is highly correlated with the clusters of phytoplanktons. Shannon and Weiner index showed that the lake was heavily polluted in the month of May due to increased temperature.***

Keywords: Phytoplankton, Physico-chemical parameters, Bray-Curtis Similarity Index, Principal component analysis,

I. INTRODUCTION

Water is an essential component of the environment and it sustains life on the Earth. Water is also a raw material for photosynthesis and therefore is important for crop production. Obviously an optimum agriculture depends on water and soil quality. The 2/3rd mass of our body is water and 70% surface of the Earth is covered by water. It is nature's most Wonderful, abundant and most useful chemical gifted with physico- chemical properties with unique characteristics.[1]

Limnology is an interdisciplinary science which involves a great deal of detailed field as well as laboratory studies to understand the structural and functional aspects and problems associated with the fresh water environment from a holistic Point of view. Better quality of water is described by its physical, chemical and biological characteristics .[2] The physico- chemical methods are used to detect the effects of pollution on the water quality. Changes in water quality are reflecting in the biotic community structure. Water pollution occurs when water body is adversely affected due to the addition of undesirable materials to the water. The phytoplankton community is mainly represented by algal representatives including both prokaryotes and eukaryotic genera. Plankton populations are mostly represented by members of Cyanobacteria, Chlorophyta, Dinophyta, Euglenophyta, Haptophyta, Chrysophyta, Cryptophyta and Bacillariophyta.[3]

The planktonic studies are very useful tool for assessment of water quality and the productivity of any type of Water body and also contribute to understanding of water bodies.Algae are the main primary producers in all kinds of water bodies and they are involved in water pollution in a number of significant ways.[2]

Present study refers to the study of water quality of Hebbal Lake of Mysore which was assessed using both phytoplanktons and physico-chemical parameters. From May 2023 to September 2023.

A. Objectives

Investigations are undertaken in the selected Hebbal lake of Mysore district with the following objectives.

1) To study the relationship between physico-chemical parameters with phytoplankton population.
2) Evaluation of phytoplankton diversity of Hebbal Lake.

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II. MATERIALS AND METHODS

A. Topography of Hebbal Lake

Hebbal Lake is also called as Dodda Lake. It is located at 10° 02' 02" North longitudes 74° 43'36* East latitude at an altitude of 788 meters above the sea level. It is situated away from Mysore. Lake is located in Krishnarajanagara Taluk, which is 5 kms away from Krishnarajanagara town. The area was surrounded by 852.79 hectares. It's a small village and It comes under Hebbal panchayath, Krishnarajanagara.

Fig 1: Views of Hebbal Lake

B. Physico-Chemical Parameters

Surface water samples were collected every month in different spots of a lake for a period of five months from Hebbal Lake in Mysore district and 14 physico- chemical parameters have been analyzed by standard methods [4], [5].

Table 1: Physical water quality parameters along with methods and units

Parameter	Method	Units
pH	pH digital meter	-
Water temperature	Digital thermometer	°C
Electric conductivity	Conductivity meter	µS

Table 2: Chemical water quality parameters along with methods and units

Parameter	Method
Carbon di oxide (mg/L)	Titrimetric method (APHA, 2005)
Dissolved oxygen (mg/L)	Winkler's iodiometric method
Total hardness (mg/L)	EDTA titrimetric method (APHA, 2005)
Calcium (mg/L)	EDTA titrimetric method (APHA, 2005)
Magnesium (mg/L)	Calculation method (APHA, 2005)
Chloride (mg/L)	Argentometric method (APHA, 2005)
Total alkalinity (mg/L)	Titration method (APHA, 2005)
Bio-chemical oxygen demand (mg/L)	5- day BOD test (Trivedy and Goel, 1997)
Chemical oxygen demand (mg/L)	Potassium dichromate reflux method(APHA, 2005)
Total dissolved solids (mg/L)	Evaporation method (Trivedy and Goel, 1997)
Salinity (mg/L)	Titrimetric method (Trivedy and Goel, 1997)

C. Statistical analysis

To get a precise explanation on physico- chemical parameters and phytoplankton population various statistical analysis was performed. All data obtained were subjected to multivariate analysis. The statistical analysis was carried out by using following methods[1]

1) PCA by PASTA Software
2) Bray- Curtis Similarity index by PASTA Software
3) Biodiversity indices by PASTA Software

D. Phytoplankton analysis

Phytoplankton was collected by filtering 10 litres of water sample with the help of plankton net of mesh size 63 µm and 30cm diameter. The final volume of filtered sample was 50ml. The sample was transferred to 100ml sterile plastic bottle and labelled mentioning the time, date and place of sampling. The collected sample was preserved by using 2ml of 4% formaldehyde and 2 drops of lugol's iodine solution.

The preserved samples were taken to laboratory for further analysis.

Phytoplankton count was done by Lackey's Drop Method (1939) as mentioned in APHA (1985) and modified by Saxena (1987). In Lackey's drop method, the coverslip was placed over one drop of water sample in the slide, permanent slide is done by using DPX and whole coverslip were examined under Labomedtrinocular microscope (LX400) with image transferor (DCM 35 USB 2.0) and photographs was captured by the software minisee and species identification was done by using standard monographs like Sudipta Kumar Das and Siba Prasad Adhikary[13], research articles and research personnel. After that organisms were counted in each drop [1]. This procedure was repeated three times for each samples and number of organism was measured as organism per liter.

Formula used for the calculation of phytoplankton as units/L is

$$\text{Phytoplankton Unit/L} = = \frac{\mathbf{N \times C \times 1000}}{\mathbf{V}}$$

N = No. of phytoplankton counted in 0.1ml concentrate.
C = total volume of concentrate in ml.
V = total volume of water filtered through net

III. RESULT AND DISCUSSION

A. Physical-chemical parameters

The water was analysed for its physical and chemical properties and the results have been discussed and presented in the following sections [4],[5] and presented in Table 3 which shows the values obtained in all samples collected from May 2023 to September 2023.

1) *Temperature:* It is one of the critical physical parameter which controls most the biological activities in the aquatic environment. The water temperature of lake during study period ranges from 26°C to 29°C.
2) *Electrical conductivity:* Electric conductivity is a parameter used to ascertain the purity of water and is the measure of capability of water to transmit electric current. The Electric conductance ranges from 614µS to 670µS. A minimum value of 614µS was recorded in May and maximum of 670µS in July. It has been mentioned that increase in EC is due to dissolved salts content.
3) *pH:* pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. The pH value ranges from 7.2 to 7.8. The minimum value of 7.2 was recorded in July and maximum of 7.8 in August. It has been mentioned that the increase in pH value appears to be associated with increased use of alkaline detergents in residential areas & alkaline material from wastewater is from agricultural areas.
4) *Total Alkalinity:* Total alkalinity is the measure of capacity of water to neutralize a strong acid. The minimum value 350 mg/L was recorded in May and maximum value of 540 mg/L in September. The alkalinity in the waters is generally imparted by the salts of carbonates and bicarbonates, phosphates, nitrates, borates, silicates, etc, together with the hydroxyl ions in Free State. The high value of total alkalinity in the lake may be due to cattle bathing, Fishering and laundering of clothes.
5) *Salinity:* Salinity of the water is its capacity to neutralize a strong base to a fixed pH. It is caused by the presence of strong mineral acids, weak acids and hydrolysing salts of strong acids. Salinity low which ranges from 0mg/L to 15mg/L.

6) *Total Hardness:* The regular addition of large quantities of sewage and detergent into the lake from nearby residential localities is responsible for higher level of hardness. Hardness ranges from 182 mg/L as $CaCO_3$ to 260 mg/l as $CaCO_3$.The minimum of 182 mg/L as $CaCO_3$ was recorded in May and maximum of 260 mg/l as $CaCO_3$ in August. The hardness will be more where the concentration of calcium and magnesium is more.
7) *Calcium*: Hardness is caused by compounds of calcium and magnesium, and by a variety of other metals. Calcium ranges from 21 mg/L to 30 mg/L. The minimum of 21 mg/L was recorded in May and maximum of 30mg/L in September.
8) *Magnesium*: Hardness is caused by compounds of calcium and magnesium, and by a variety of other metals. Magnesium ranges from 32.6 mg/L to 62.3mg/L. The minimum of magnesium 32.6 mg/L was recorded in May and maximum of 62.3 mg/L in September.
9) *Chloride*: Chloride is not utilized directly or indirectly for aquatic plant growth and hence its existence in the aquatic system is regarded as pollution. Chloride ranges from 36.8 mg/L to 55.2mg/L in the lake. A Minimum of 36.80 mg/L was observed in July and maximum value of 55.2 mg/L in September. High chloride concentration in the lake water may be due to high rate of evaporation or due to organic waste of animal origin and also agricultural forming.
10) *Total Dissolved Solids:* Total dissolved solids represent the amount of soluble inorganic substance in water. Total dissolved solids observed in the lake ranges from 5 mg/L to 15 mg/L. Minimum value of 5 mg/L was recorded in June and maximum of 15 mg/L in September. The entry of sewage, urban runoff, industrial wastewater influence the increase in the concentration of Total dissolved solids.
11) *Free CO2:* Free Carbon-di-oxide (CO2) recorded in Hebbal lake ranges from 2.6 mg/L to 5 mg/L and it is found to be maximum in the month of August.
12) *Dissolved Oxygen:* Dissolved oxygen values ranges from 7.2 mg/L to 20 mg/L. The minimum value of 7.2 mg/L was recorded in May and maximum value 20 mg/L in July. The increase in DO is influenced by the moderate temperature. Lower DO indicates the pollution of the lake by algae is unwanted things in lake.
13) *Biochemical Oxygen Demand (BOD):* Biochemical oxygen demand (BOD) refers to the oxygen used by the micro-organisms in aerobic oxidation of organic matter, therefore with the increase in the amount of organic matter in the water BOD increases. BOD values ranges from 1.8mg/L to 6.67 mg/L. A minimum value of 1.8 mg/L was observed in September and maximum of 6.67 mg/L in August. Higher contents of organic load as well as high proliferation of microorganism are the causative factors for maximum BOD levels.
14) *Chemical Oxygen Demand (COD):* Chemical oxygen demand (COD) is commonly used to indirectly measure the amount of organic compounds in water. This makes COD as a useful indicator of organic pollution in surface water. COD values ranges from 52.8 mg/L to 90.2 mg/L. A minimum of 52.8 mg/L was observed in June and maximum of 90.2 mg/L in September. Higher value of COD pointing to deterioration of water quality was likely caused by the discharge of municipal waste water.

Table 3: Monthly variation in the Physico-chemical parameters from May 2023 to September 2023

Sl No	Parameter	May	June	July	August	September
1	Air temperature	29	26	27	28	27
2	pH	7.3	7.5	7.2	7.8	7.4
3	EC	614	625	670	655	645
4	TDS	7	5	10	8	15
5	Total alkalinity	350	375	415	425	540
6	Salinity	8	10	10	15	0
7	Free CO2	3.2	3.5	2.6	5	4.2
8	DO	7.2	8.6	20	13.6	5
9	BOD	4.3	2.5	3.9	6.67	1.8
10	COD	64.2	52.8	87.2	89.6	90.2
11	Total Hardness	182	190	220	260	240
12	Calcium	21	24.7	22.6	27.5	30
13	Magnesium	32.6	60.2	48	55.2	62.3
14	Chloride	46.7	49.7	36.8	51.4	55.2

All values are expressed in mg/L except pH, WT (°C) and EC (µS).

B. Analysis of Phytoplankton Population:

The phytoplankton community is a heterogeneous group of tiny plants adapted to float in the sea and fresh waters. The analysis of phytoplankton population was done in selected Hebbal lake in Krishnarajanagara. Phytoplankton population analysis was done by using standard methods and identification was done by consulting taxonomic guides and monographs [4],[5],[13].

In the present study total of 60 species of phytoplanktons were identified in the Hebbal lake Krishnarajanagara during the period from May -2023 to September -2023 which is represented in the fig 7 Bacillariophyceae was high (50%) followed by Chlorophyceae (17%) and Cyanophyceae (15%), Desmidiaceae (8%), Euglenophyceae (6%) .

Among all the phytoplankton, *Navicula tripunctata(9800 O/L)* was found in large number followed by *Ulnaria ulna* (9800 O/L), *Gomphonema dichotomum* (8400 O/L) .

Table 6:Phytoplanktons of Hebbal Lake from May 2023-September 2023

Name of Phytoplankton	May	June	July	August	September	O/L
Bacillariophyceae						
Pinnularia viridis	0	1400	2800	0	0	4200
Navicula striolata	2800	1400	2800	0	1400	8400
Gomphonema herbidense	1400	0	1400	2800	0	5600
Aulacoseira granulate	0	0	1400	0	0	1400
Amphora angusta	0	1400	2800	0	1400	5600
Navicula tripunctata	4200	0	1400	2800	1400	9800
Nitzschia sp.	1400	0	0	1400	0	2800
Gomphonema dichotomum	2800	1400	0	4200	0	8400
Cymbella tumida	1400	0	2800	2800	0	7000
Navicula sp.	0	0	1400	0	1400	2800
Nitzschia palea	2800	1400	0	1400	1400	7000
Pinnularia sp.	2800	0	0	1400	1400	5600
Grunowia tabellaria	0	0	2800	1400	0	4200
Fragilaria sp.	1400	0	2800	0	0	4200
Fragilaria tenera	2800	0	1400	2800	0	7000
Gomphonema gracile	1400	1400	0	1400	0	4200
Nitzschia acicularis	2800	0	1400	1400	1400	7000
Rhopalodia sp.	1400	0	2800	0	0	4200
Synedra ulna	2800	0	1400	1400	1400	7000
Ulnaria ulna	1400	4200	1400	2800	0	9800
Navicula sp.	0	1400	0	0	0	1400
Synedra sp.	0	0	1400	1400	0	2800
Nitzschia sp.	0	0	1400	0	0	1400
Nitzschia agnita	1400	1400	0	1400	0	4200
Synedra sp.	2400	0	0	1400	0	3800
Navicula atomus	1400	0	2800	0	1400	5600
Nitzschia holsatica	1400	2800	0	0	1400	5600
Epithemia gibba	1400	0	0	1400	1400	4200
Rhopalodia gibba	0	0	1400	0	0	1400
Gomphonema sp.	2800	0	1400	2800	1400	8400
Cymbella sp.	2800	1400	1400	0	1400	7000
Cymbella affinis	1400	0	1400	1400	0	4200
Ulnaria ungeriana	1400	0	0	1400	0	2800

Desmidiaceae						
Cosmarium contractum	1400	0	0	1400	0	2800
Closterium Navicula	0	1400	2800	1400	0	5600
Cosmarium sp.	0	0	0	1400	0	1400
Staurastrum tetracerum	0	0	1400	0	0	1400
Closterium sp.	1400	1400	0	0	1400	4200
Closterium libellula	0	0	1400	0	1400	2800
Closterium sp.	0	1400	1400	0	0	2800
Gonatozygon kinahanii	1400	0	2800	1400	0	5600
Cyanophyceae						
Anabaena inaequalis	0	1400	0	1400	0	2800
Oscillatoria major	0	0	1400	0	2800	4200
Komvophoron sp.	1400	0	2800	1400	0	5600
Arthrospira khannae	1400	0	1400	2800	1400	7000
Phormidium autumnale	1400	0	0	1400	0	2800
Oscillatoria brevis	0	0	1400	0	0	1400
Oscillatoria sp.	0	1400	0	1400	0	2800
Planktothrix isothrix	0	0	0	1400	0	1400
Chlorophyceae						
Scendesmus sp.	1400	0	0	0	1400	2800
Klebsormidium flaccidum	0	1400	1400	0	0	2800
Desmodesmus sp.	2800	0	1400	1400	0	5600
Oedogonium sp.	0	1400	0	1400	0	2800
Monoraphidium sp.	1400	0	1400	1400	0	4200
Characium acuminatum	0	1400	0	0	1400	2800
Monoraphidium fontinale	1400	0	0	1400	0	2800
Euglenophyceae						
Euglena splendens	0	1400	0	0	1400	2800
Trachelomonas armata	0	1400	0	0	0	1400
Euglena viridis	0	1400	0	1400	0	2800

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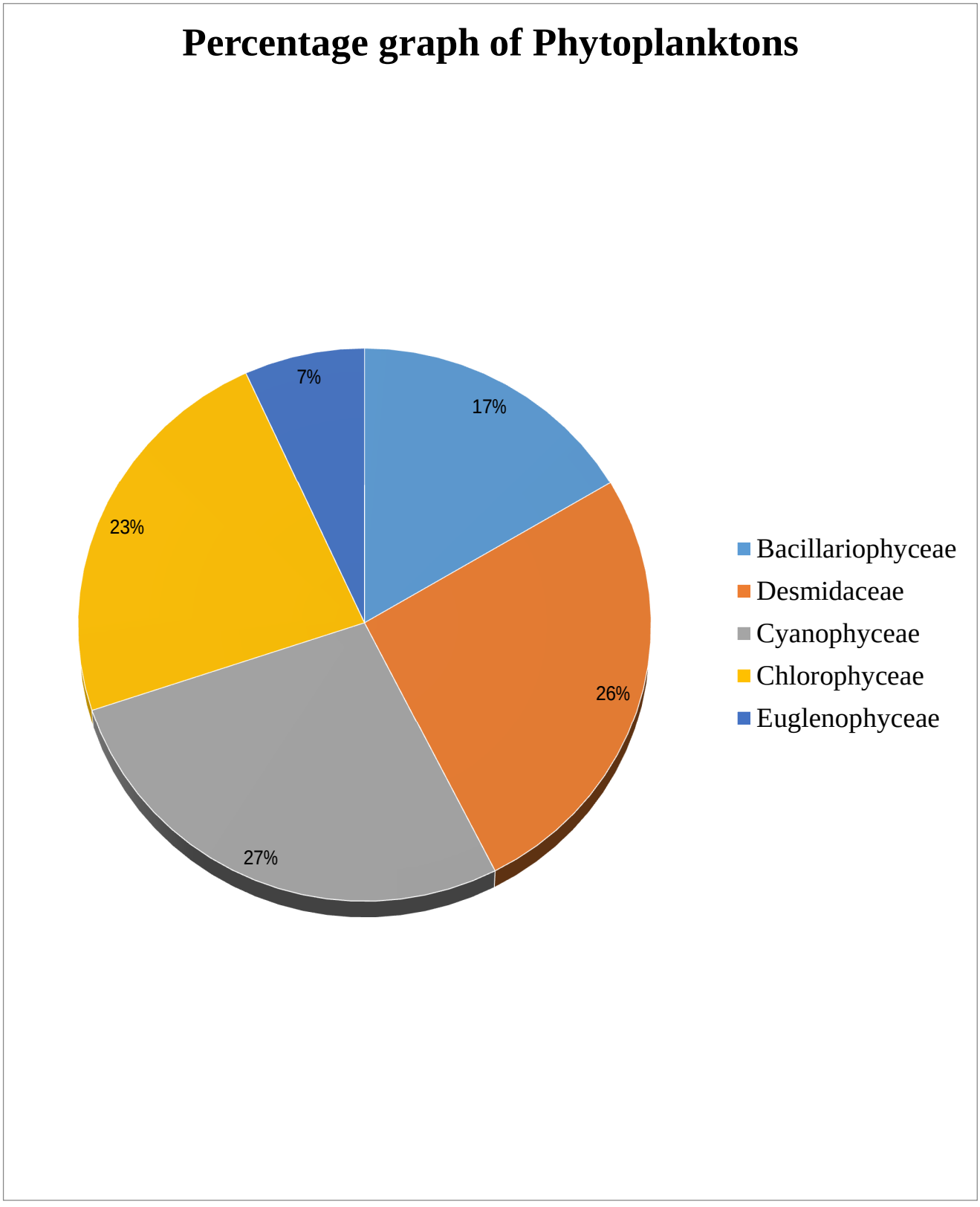

Graph 1: Percentage graph of phytoplankton of Hebbal Lake, Krishnarajanagara

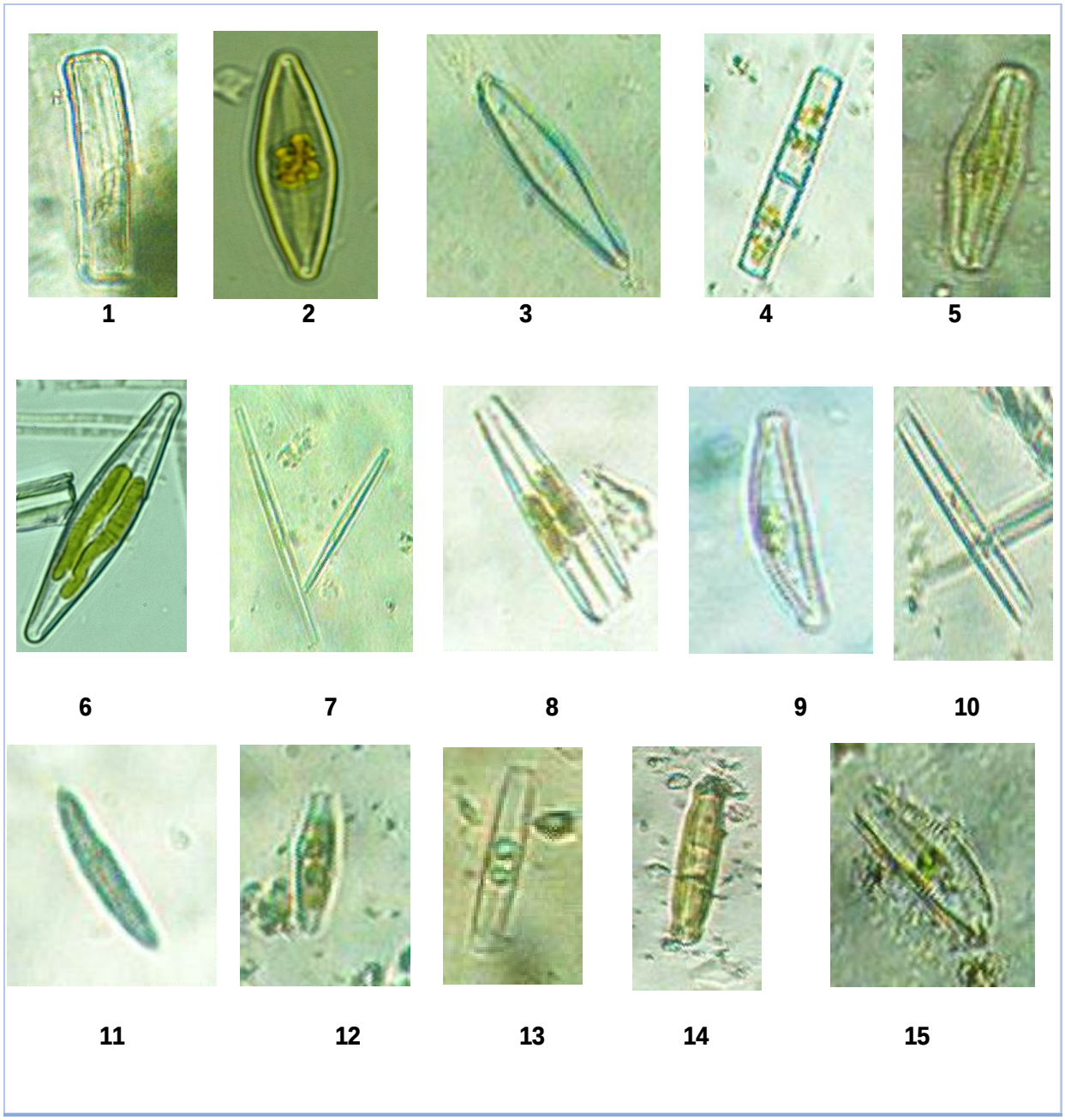

Plate1: 1)Pinnularia viridis 2)Navicula striolata 3)Gomphonema hebridense 4)Aulacoseira granulate 5)Amphora angusta 6)Navicula tripunctata 7)Nitzscia sp.8)Gomphonema dichotomum 9)Cymbella tumida 10)Fragilaria tenera 11)Closterium sp.,12)Gomphonema gracile 13)Nitzschia acicularis 14)Closterium libellula 15)Rhopalodia gibba

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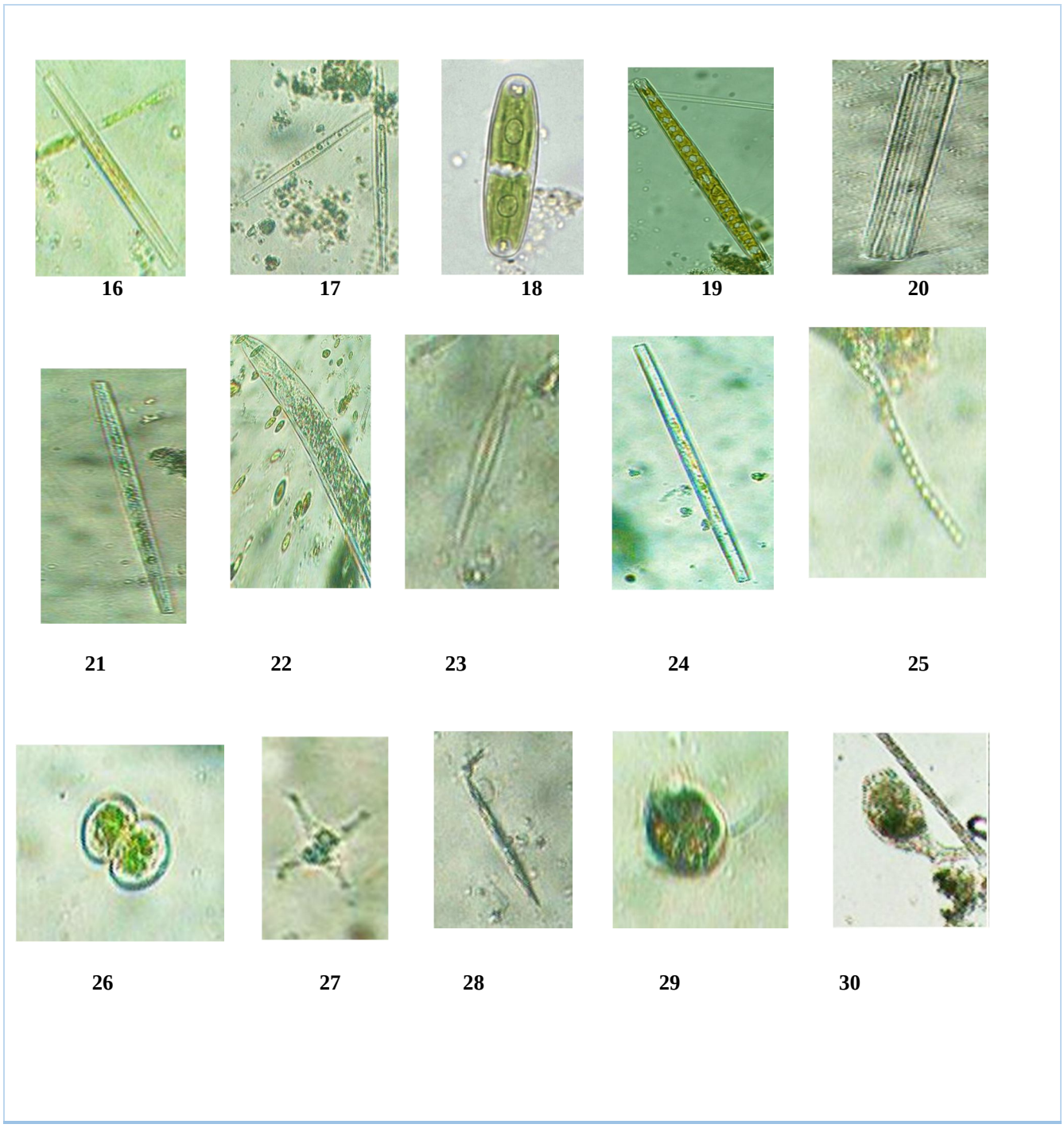

Plate 2: 16) Synedra ulna 17)Ulnaria ulna 18)Closterium navicula 19)Navicula sp.,20)Synedra sp.,21)Gonatozygon kinahanii 22)Nitzschia sp., 23)Nitzschia agnita 24)Synedra sp.25)Anabaena inaequalis 26)Cosmarium contractum 27)Staurastrum tetracerum28)Monoraphidium sp.,29)Trachelomonas armata 30)Characium acuminatum.

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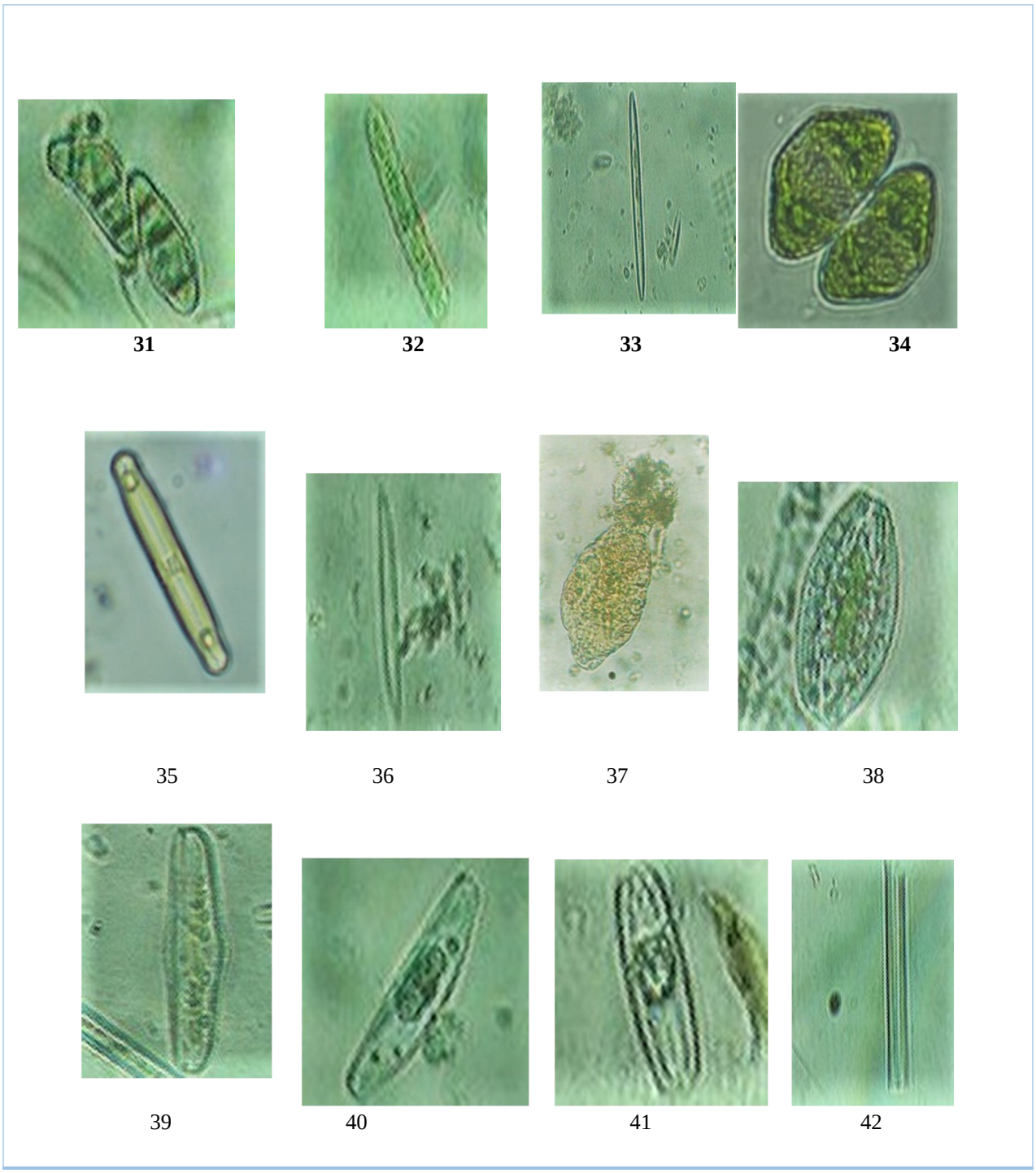

Plate 3: 31)Navicula sp.32)Oscillatoria major 33)Nitzschia holsatica 34)Cosmarium sp.,35)Epithemia gibba 36)Monoraphidium fontinale 37)Euglena splendens 38)Rhopalodia gibba39)Gomphonema sp., 40)Cymbella affinis 41)Cymbella sp.,42)Ulnaria ungeriana

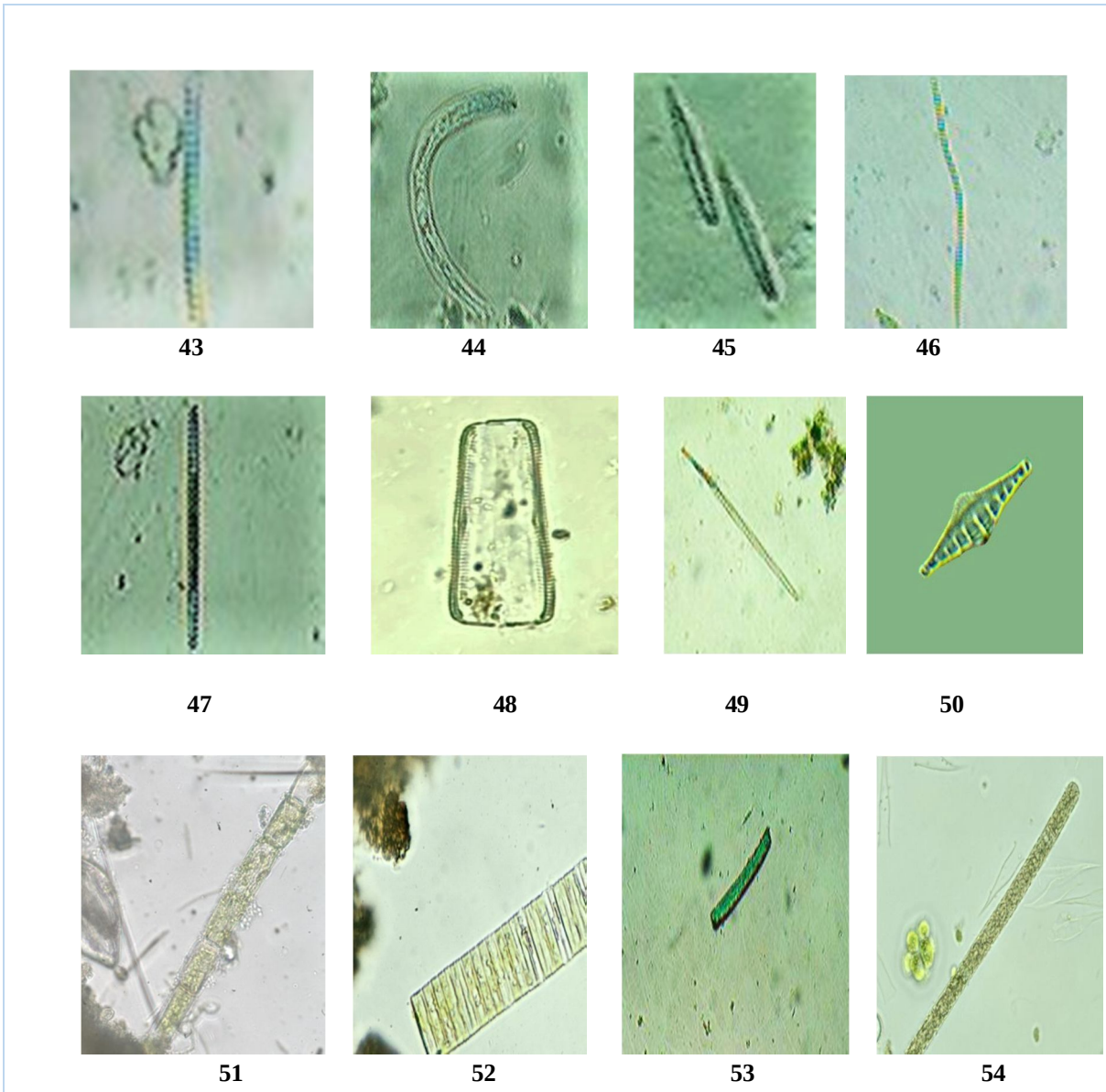

Plate 4: 43) Komvophoron sp., 44)Closterium sp.,45) Nitzschia palea 46)Arthrospira khannae 47)Phormidium autumnale 48)Pinnularia sp.,49)Oscillatoria brevis 50)Grunowia tabellaria 51)Oedogonium sp., 52)Fragilaria sp.,53)Oscillatoria sp.,54)Planktothrix isothrix.

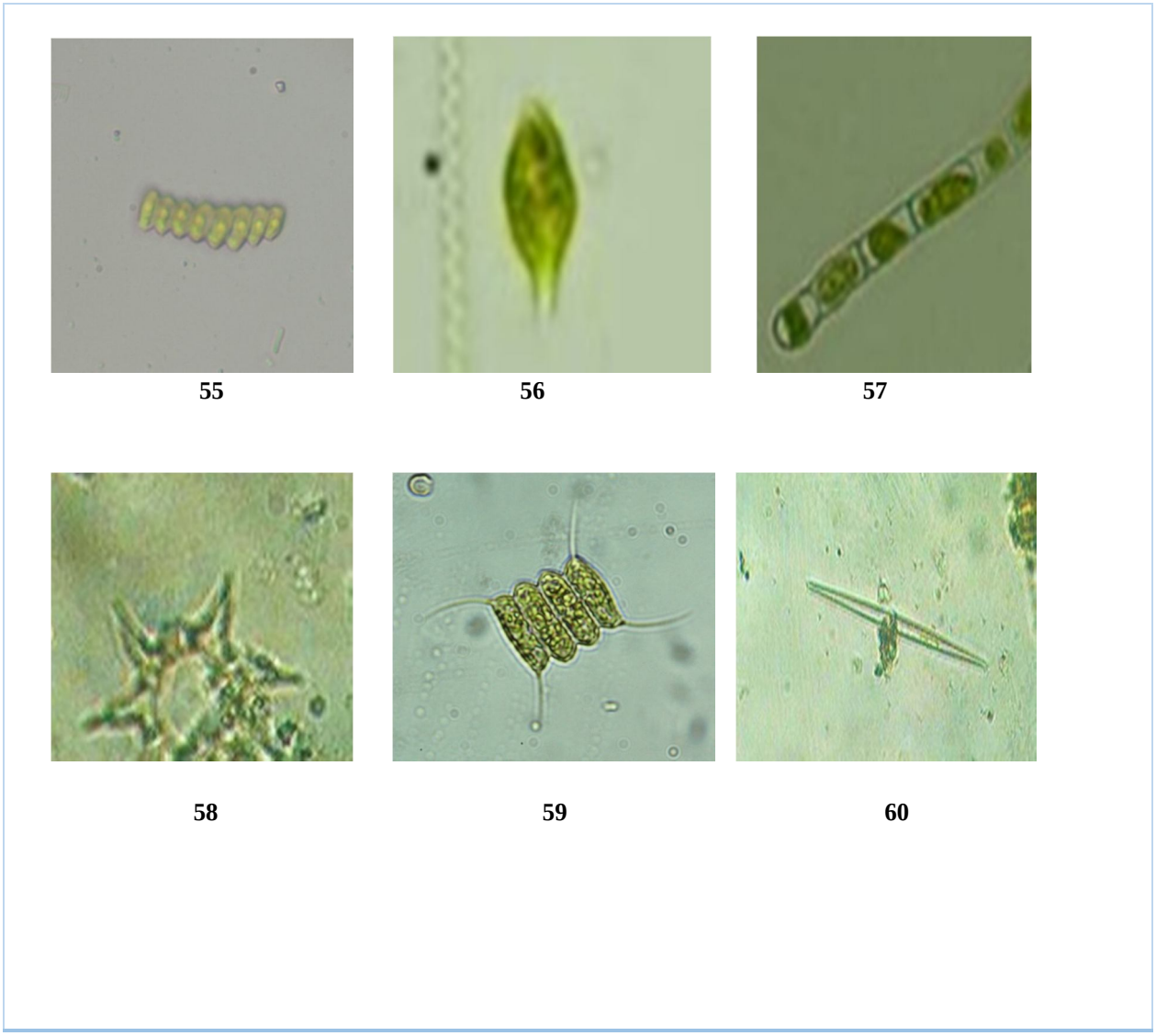

Plate 5: *55) Scenedesmus sp., 56) Euglena viridis, 57) Klebsormidium flaccidum, 58) Pediastrum simplex, 59) Desmodesmus sp., 60) Navicula atomus*

C. Bray - Curtis Similarity Index

The Bray- Curtis similarity index is the best tool in understanding the effect of abiotic and biotic component in the lake ecosystem. Based on the physico-chemical and plankton population hierarchical cluster analysis with Bray- Curtis distance measure was performed. The level of significance is taken to be 0.48 and above.

The outcome of Bray- Curtis cluster analysis for Hebbal lake, Krishnarajanagara during the period from May 2023 to September 2023 is represented in figure 2 for physicochemical and phytoplankton respectively. In the current study the highly correlated clusters were those of EC, Total hardness and Total alkalinity.

The biological parameters like Chlorophyceae, Cyanophyceae and Bacillariophyceae have became one cluster and Desmidiaceae, have became another cluster, these two clusters have showed high significance with the physico-chemical cluster of EC, Total hardness and Total alkalinity.

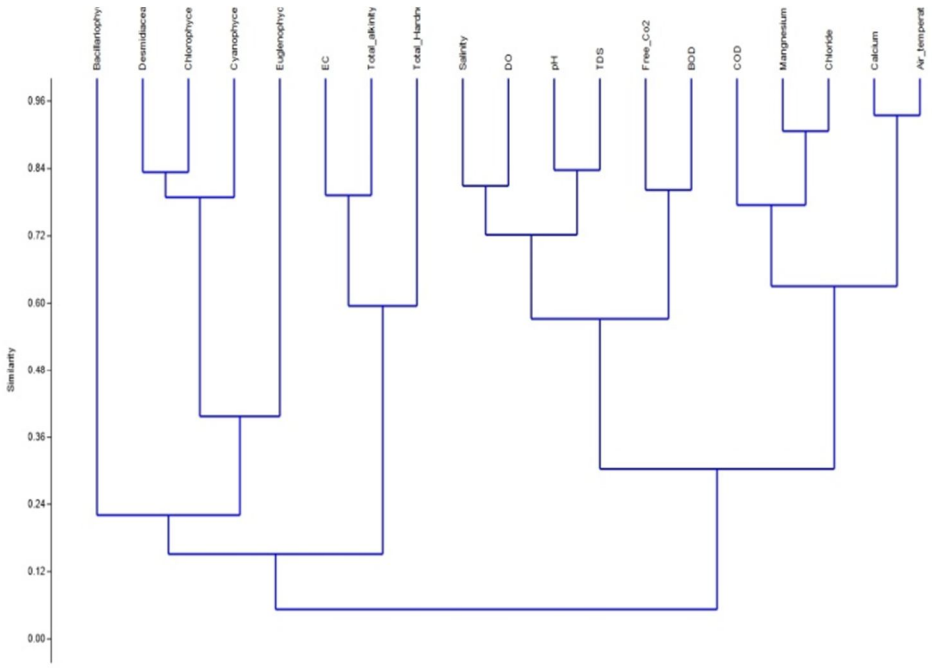

Fig 2: Bray-Curtis Similarity Index of Biological Parameters of Hebbal lake (May 2023 to September 2023)

D. Principal component Analysis

A statistical relationship between the composition of plankton and the physico-chemical environment variables in the surface water was done by Principal Components Analysis (PCA) in the Multivariate Statistical Package PASTA Software. In the current study Euglenophyceae , Chlorophyceae and Desmidaceae showed positive correlation with EC but showed the negative correlation with other physico-chemical parameters. The EC and other physico-chemical parameter showed the positive correlation with Bacillariophyceae. This was shown in the figure 3.

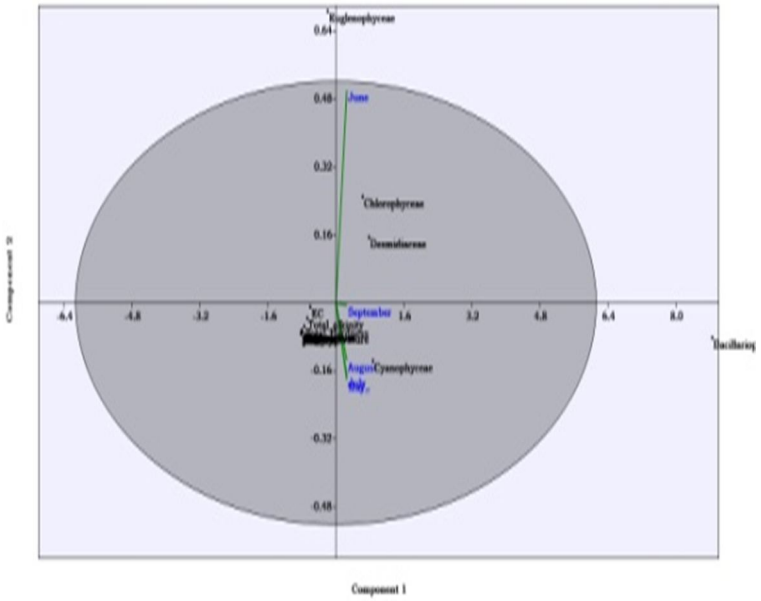

Fig 3: Principal Component Analysis of physico-chemical Parameters of Hebbal lake (May 2023 to September 2023).

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E. Biodiversity Indices

The diversity indices explain about the dominance, evenness and abundance of the species. Diversity indices like Simpson's, Shannon wiener, Pielou's evenness, Margalef's index, Fisher's alpha index and Berger-Parker index were discussed. To know the diversity of phytoplankton the data was subjected to PASTA software. The calculated diversity indices are shown in Table 5.

1) Simpson's Diversity Index

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. In essence it measures the probability that two individuals randomly selected from an area will belong to the same species. The formula for calculating D is presented as follows

$$D = \frac{\sum ni\ (ni - 1)}{N\ (N-1)}$$

Where ni= the total number of organisms of each individual species

N = the total number of organisms of all species

D ranges from 0 to 1. With this index, 0 represents infinite diversity and 1represents there is no diversity which indicates that, bigger the value lower the diversity 9. The index values ranged from 0.395 to 0.636. The minimum value recorded was 0.395 during May to a maximum value was 0.636 during June . It shows species are not evenly distributed throughout the study.

2) Shannon Weiner Index

This index helps in determining pollution status of the water body. According Willham and Dorris (1966) stated that values of the index >3 indicates clean water, values <3 indicates moderate pollution and values <1 is considered as heavily polluted. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species[15]. It is represented as follows:

$$(H') = \sum_{R} p_i\ 1np_i$$

Where p_i= proportion of the ith species and in natural logarithm. The values ranged from 0.797 to 1.29. The minimum value observed were 0.797 during May to a maximum value of 1.29 during June . It implies the lake moderately polluted throughout the study.

3) Pielou's Evenness Index

Pielou's Evenness Index (1975) measures the evenness of the species. The index is expressed as,

$J = H'$ log (S)

If H is the observed Shannon Weiner index, the maximum value this would take is log(S) where S is the total number of species in the habitat . The Pielou's values ranges from 0.554 to 0.726. The minimum value observed during May and maximum value of 0.726 during June . It shows that species were not evenly distributed throughout the year.

4) Margalef's Index

The Margalef's index is also similar to Menhinick index. It also measures richness of species in an ecosystem. It is calculated using the formula

$$D = \frac{S - 1}{Ln\ (N)}$$

It is calculated as the species number (S) minus 1 divided by the logarithm of the total number of individuals (N). In the present investigation, the values ranged from 0.270 to 0.388. The minimum value observed was 0.270 during May and maximum value of 0.388 during September . The maximum richness of the species was found in September and minimum richness was found in May.

5) Fisher's Alpha Index

The index is the alpha parameter. The index of diversity that assumes that the abundance of species follows the log series distribution. In the present investigation, the value ranges from 0.327 to 0.451. The minimum value observed was 0.327 during May to a maximum value of 0.451 during September . The maximum abundances of the species was found in september and minimum richness was found in May.

6) Berger - Parker Index

The Berger–Parker diversity index has been used typically to assess the dominance of species in a community. It is represented as follows:

$$D = \frac{N_{max}}{N}$$

Where N_{max} is the number of individuals in the most abundant species and N is the total number of individuals in the sample. In the present investigation, the Berger - Parker values ranges from 0.56 to 0.764. The minimum value observed was 0.56 during June to a maximum value of 0.76 4 during May . It shows species were not evenly distributed throughout the year.

Table 7: Biodiversity indices of Hebbal lake during May 2023 to September 2023

0	May	June	July	August	September
Taxa_S	4	5	4	5	5
Individuals	65400	35000	63000	61600	29400
Dominance_D	0.6042	0.3632	0.4854	0.4473	0.424
Simpson_1-D	0.3958	0.6368	0.5146	0.5527	0.576
Shannon_H	0.7971	1.29	0.9844	1.102	1.168
Evenness_e^H/S	0.5548	0.7266	0.6691	0.6021	0.6429
Brillouin	0.7968	1.289	0.9842	1.102	1.167
Menhinick	0.01564	0.02673	0.01594	0.02015	0.02916
Margalef	0.2706	0.3823	0.2715	0.3627	0.3888
Equitability_J	0.575	0.8016	0.7101	0.6848	0.7255
Fisher_alpha	0.3277	0.4434	0.3288	0.4203	0.451
Berger-Parker	0.7645	0.56	0.6667	0.6364	0.619
Chao-1	4	5	4	5	5

IV. CONCLUSION

The result of physico- chemical and biological parameters along with statistical method and biodiversity indices indicated that the lake in the present study is threatened ecologically due to various anthropogenic activities which lead organic pollution and eutrophication status of the lake. As wetlands are rich in life, reservoirs find utility for sewage disposal, maintenance of local ground water levels and as a refuge for local and migratory wildlife, therefore it's our responsibility to conserve the lakes in sustainable manner. Knowing the ecological status of the lake, will be helpful for carrying out restoring practices of the same.

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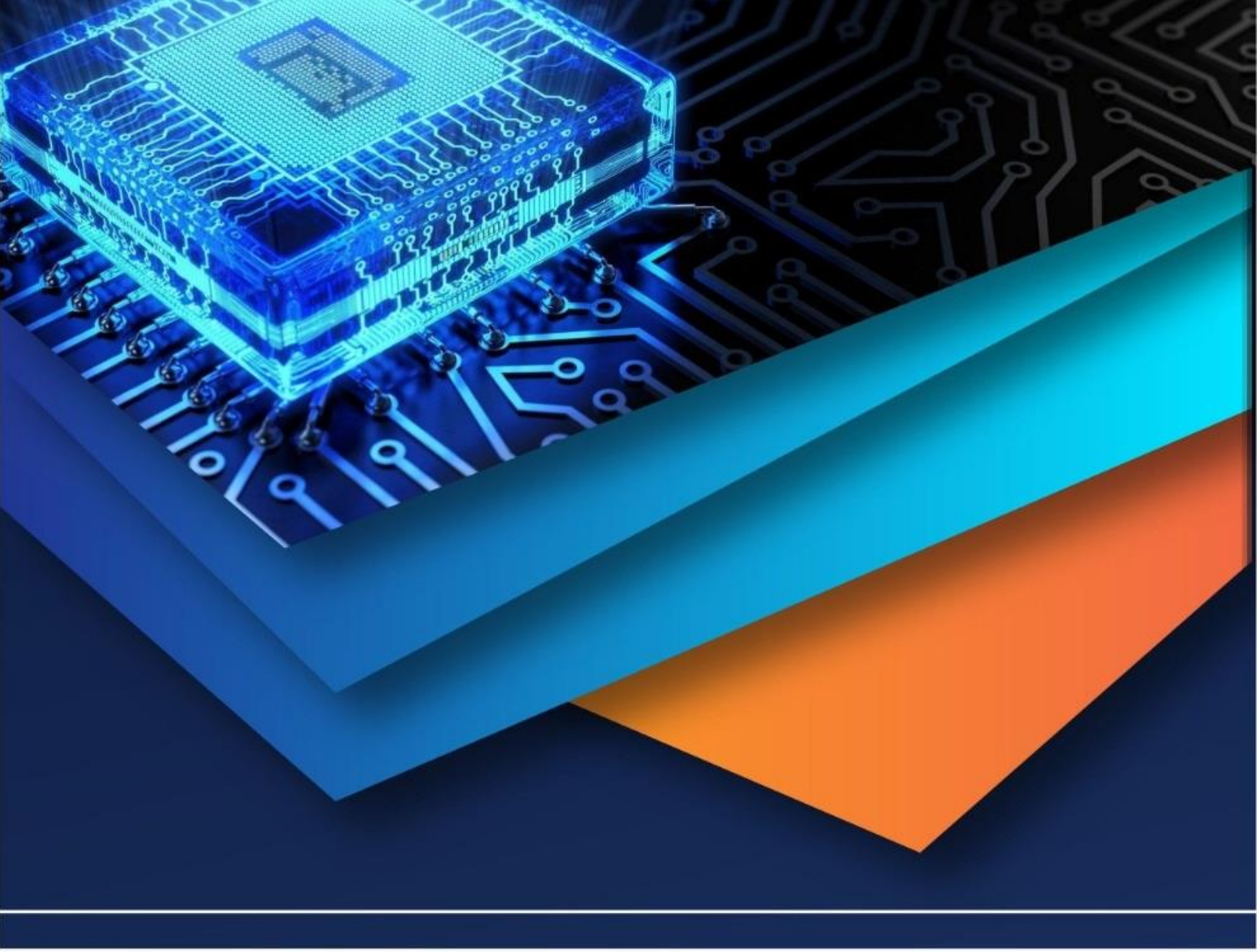

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