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Enumeration of Phytoplankton in Bhadra River, Karnataka

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Article History

Abstract

The present study was carried out on the varieties of phytoplankton/algae in the Bhadra river of Bhadravathi taluk, Karnataka for a period of six months (January to June 2017). A total of 67 species of phytoplankton belonging to 05 classes were recorded viz., Bacillariophyceae, Chlorophyceae, Cyanophyceae, Zygnematophyceae, Euglenophyceae and they are represented throughout the study period. Bacillariophyceae having 29 species followed by Chlorophyceae with 13 species, Zygnematophyceae by 07 species and Cyanophyceae with 06 species respectively. During the present study, the dominant genera recorded *are Navicula, Synedra, Cosmarium, Spirogyra, Cymbella, Pinnularia, and Trachelomonas.* Boyd diversity index values indicates the order of pollution and its values ranged from 1.45 to 2.05. Although the river is used for fisheries, irrigation and other recreational activities and it need regular monitoring.

Keywords: Phytoplankton, Bhadra river, Moderately polluted, Bhadravathi taluk.

Introduction

Aquatic environment is the most assorted biological system on the planet. The primary life started in the water and the main living being were additionally water where, water was the essential outer as well as inward mechanism for creature. The absolute water is partitioned into lentic and lotic water bodies. Running water, in which the entire body of water moves in a specific direction, is represented by the word "lotic," which comes from the Latin word *lavo*, which means "to wash." It incorporates spring, stream, or waterway saw as a biological unit of the biotic local area and the physiochemical climate. Lotic biological system is portrayed by the cooperation between streaming water with a longitudinal gradiation in temperature, natural and inorganic materials, energy and the life forms inside a stream hall.

The effluent from the pulp and paper mill and iron and steel factories are the main source of pollution in Bhadra river. As the dilution of the paper effluents increased in the water, a dark soft became perceptible at the bottom. Blanketed by colonies of whitish, fluffy fungus like higher bacteria and tubifer worms. A good amount of pulp fibres and silt were also caught in these colonies which gradually built up a loose anaerobic substratum. Roughly this part of the river may be designated as the paper wastes polluted area. Through somewhat complicated by the addition of wood distillation wastes part of the way below railway bridge.

Phytoplankton derived from the Greek word plant and tiny fish (made to meander or float. Phytoplankton are tiny creatures that live in watery conditions, both salt and fresh water. The majority of phytoplankton are single-celled plants, while some phytoplankton are bacteria or Protista. Among the normal sorts are cyanobacteria, silica encased diatoms, noise lashes, green growth and chalk covered coccolithophores. Phytoplankton are the autotropic components of the plankton community. However, when present in high enough numbers some varieties may be noticeable as coloured patches on the water surface due to the presence of chlorophyll with in their cells and accessory pigments (such as phycobili proteins or xanthophyllous) some species. About 1% of the global biomass is due to phytoplankton.

Phytoplankton's are the photosynthetic portions of plankton life. Plankton is the tiny, drifting organism that lives in aquatic ecosystem. Phytoplankton's are vital to aquatic ecosystem. They are producers (autotrophs) that form the foundation of most aquatic food webs. As photosynthetic organisms, they are able to convert solar energy into chemical energy and store it as sugars, consumers can either eat autotrophs directly, or eat other consumers. Phytoplankton are eaten by other small organisms such as zooplanktons.
The main objective of the present study is to know the fresh water phytoplankton in Bhadra river of Karnataka.

Materials and Methods

Study area
The Bhadra river begins at Gangamoola close to Kudremukha, Western Ghats range and streams east across the southern piece of Deccan level, joined by its feeders the somavahini close to Hebbe, Thadabehalla and Odirayanahalla. It moves through the towns of Kudremukh, Kalasa, Horanadu, Haluvalli, Balehonnur, Balehole and Narasimharajapura. The Versifier dam is worked across the stream at BRP Bhadravathi, Karnataka, which frames the Bhadra supply (186 ft.). From here the stream proceeds with its excursion through the city of Bhadravathi, Karnataka. The Bhadra river meets the Tunga river at Koodli, close to Shivamogga. The joined river proceeds with east as the Tungabhadra. a significant Krishna tributary that empties into the Bay of Bengal.

Collection of water samples
Water samples are collected from the different sources of Bhadra River. These samples contain filamentous algae. I have collected water samples from 4 different sites of Bhadra river, they are; Paper town, New bridge, Lower hutta and Dhadamghatta. These water samples are collected in 250ml transparent bottle.

Preparation of Lugol's Iodine Solution
Lugol's iodine is prepared from 10g neutral potassium iodide, 20ml distilled water, 5g iodine crystals, 50ml of distilled water, 5g of sodium acetate. 10g of neutral potassium iodide is added to 20ml of distilled water to this mixture, 5g of iodine crystals are added. 50ml of distilled water and 5g of sodium acetate are added to prepare Lugol's iodine solution.

Addition of Lugol's Iodine Solution to Collect Water Samples
25ml of Lugol's iodine solution is added to each 250ml samples and mix well. Leave this mixture to settle for 24hrs. After 24hrs precipitate/pellet is settled down the supernatant liquid is removed from the samples and precipitate/pellet is used for the microscopic estimation to identify different types of filamentous algae.

Microscopic estimation of Filamentous Algae
One or two drops of sample is taken in clean slide from the collected samples one drop of Lugol's stain is added and covered with cover slip, excess stain is removed out by using blotting paper. The prepared slide is observed in electron microscope under 40X to identify the different types of filamentous algae. Course and fine adjustments are adjusted to desired manner to focus the object clearly. Focused algae photos are captured in camera to identify the type.

Bottling Method
Sampling by water samples is the recommended method to obtain a correct picture of quantitative composition of the phytoplankton. A water bottle sample contains all but the rarest organism in the water mass sampled and includes the whole size spectrum from the largest entities like diatoms colonies to the smallest single cells. These are ideal for quantitative phytoplankton collection as required quantities of water can be collected from the desired depth. Bottle sample methods is the simplest method as generally used for the collection of water sample from any desired depth of shallow systems like near the water.

Collecting Bottle direct water sample in the Sites
For most purposes, the procedure for bottle-direct water sample collection is used specifically for insitive water sample collection taken directly in the sites. This method does specifically require bottles or sample container but it is not appropriate for bottle or samples container that contains preservative. If the preservative is added after collection, this procedure may be used when collecting analysis that requires preservative.

RESULTS & DISCUSSION

The main result of the study is to learn more about the phytoplankton diversity in 04 sampling sites of Bhadra river water of Bhadravathi taluk and understand better their role in the possible transmission of river water. Results are appended in Figure 1 and Tables 1 to 4.

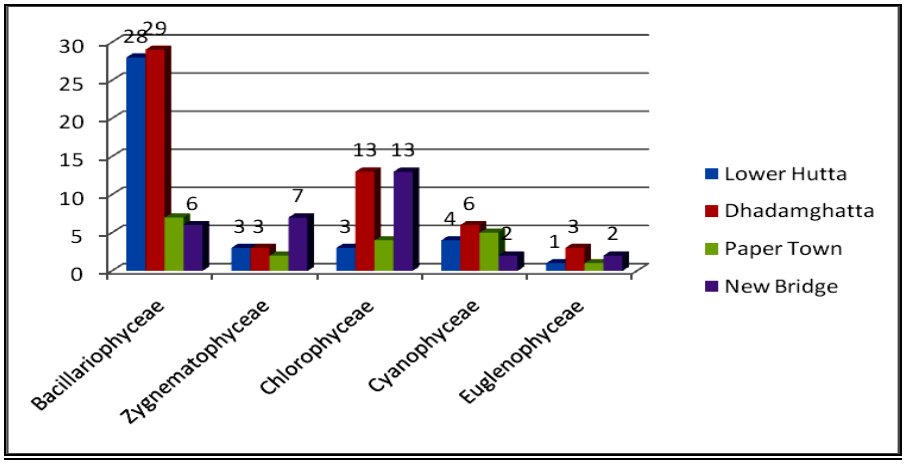


Figure 1: Total number of phytoplankton in each class of Bhadra river

Among phytoplankton a total of 67 species belonging to 05 classes were recorded viz., Bacillariophyceae, Chlorophyceae, Cyanophyceae, Zygnematophyceae, Euglenophyceae and they are represented throughout the study. Bacillariophyceae dominated with 29 species followed by Chlorophyceae with 13 species, Zygnematophyceae by 07 species and Cyanophyceae with 06 species respectively. During this study, dominant genera found are *Navicula*, *Synedra*, *Cosmarium*, *Spirogyra*, *Cymbella*, *Pinnularia*, and *Trachelomonas.*

In the context of the importance of phytoplanktons in the river water and realized multifunctional role of phytoplanktons in river water in the sources of Bhadra river, the study is implemented during 2017-2018 with major purpose of sustainable development of the phytoplankton through improved agriculture.

Initially the study aims to cover the sources of Bhadra river such as Paper town bridge, New Bridge, Lower hutta. In all aspects of this study there are 3 stages collection of water sample and identification of species in laboratory.

The study result is to Achieving a better understanding of types of phytoplanktons present in river water of Bhadravathi taluk. This result shows different types of phytoplankton present in the river water with quantified evaluation of phytoplankton. Thus, this report is concluded that it found majority of species in Lower hutta site than Paper Town and New Bridge and it also concluded that majority of species that belongs to class Bacillariophyceae and some species in class chlorophyceae, cyanophyceae and few species in the class euglenophyceae in the river water of Bhadravathi taluk based on the study.

Bacillariophyceae

This class is represented by approximately 200 genera and 600 species. Members are commonly known as Diatoms and are commonly found in fresh water, in air or on soil. Thallus is unicellular, uninucleate diploid and show radial or bilateral symmetry cell wall is silicified. It shows characteristics secondary structures. Members of this class are called as golden brown algae because of their characteristics pigments which include carotenoids, fucoxanthin, diatomin (diatoxanthin, diadinoxanthin), beside chlorophyll-a and chlorophyll-b.

The stored food products are in the form of oil, volutin chrysolaminarin. Cell shows gliding movement. Reproduction by cell division and auxospore. Motile stages possess a single, anteriorpantonematic flagellum.

Zygnematophyceae

Zygnematophyceae or conjugatophyceae is a class of green algae in the division charophyta. It contains the order zygnematales. The chloroplast may be discoid, cup-shaped, and spiral or ribbon shaped. The inner cell wall is made up of cellulose and the outer layer is pectose.

The zygnematophyceae are the sister clade of the Mesotaenium, together forming the sister clade of the land plants. The body plan of zygnematophyceae is simple, and appear to have gone through a secondary loss of morphological complexity.
They contain genes involved in protection from desiccation that appear to have been derived by horizontal gene transfer from bacteria; the genes are found in plants, zygnematophyceae, bacteria but no other organisms.

Chlorophyceae
The Chlorophyceae are one of the classes of green algae, distinguished mainly on the basis of ultra-structural morphology. For example the chlorophycean DO clade, are defined by the CW clade, have flagella that are displaced in anticlockwise direction e.g.:- *Chlamydomonada* .
They are usually green due to the dominance of pigments chlorophyll a chlorophyll b. Most of the members have one or more storage bodies called pyrenoids contain protein besides starch. Green algae usually have of cellulose and outer layer of pectose.

Cyanophyceae
Blue green algae or cyanophyceae are algal like bacteria with photosynthetic capabilities. The toxic component is micocystin, which gives the water a moldy, musty, grassy, or septic-tank odour. Blue – green algal overgrowths on surface waters are treated with a registered copper sulphate by weight per 2.1 million litres water (Government of Saskatchewan 2008).

Euglenophyceae
Euglenoids or Euglenophyceae are excavate eukaryotes of the phylum commonly found in freshwater, especially when it is rich in organic materials with a few marine and endosymbiotic members, many euglenoids feed by phagocytosis or strictly by diffusion. A monophyletic group consisting of the mixotropic *Rapaza viridis* (1species) and the two groups Eutreptiales (24 species) and Euglenales (938 species) have chloroplast and produce their own food through photosynthesis. They vary from rigid to flexible and gives the cell often giving it distinctive striation.

Discussion

Bhatt and Negi Usha (1985) have studied the physico- chemical characters and phytoplankton population in a subtropical pond. Hosmani Shankar (2010) recorded the phytoplankton diversity in lakes of Mysore district Karnataka, India. Kensa Mary (2011) studied the inter–relationship between physico-chemical parameters and phytoplankton diversity of two perennial ponds of Kulasekharam area, Kanyakumari district, Tamilnadu, However, Prasad Umesh et al., (2001). have worked on the phytoplankton population in water bodies of local mines area with special reference to pollution indication,
Sayeshwara et. al., (2011) studied the physico-chemical parameters and planktonic composition of Hosahalli pond for a period of twelve months. They recorded a total of 60 species belonging to 43 genera of phytoplankton of which chlorophycean and diatoms were found to be dominant among 04 classes. Rashmi and Somashekar Malammanavar (2013) have carried out on the diversity of phytoplankton of Lakkinakoppa pond in Shivamogga district, Karnataka for a period of six months. 54 species were identified by them belonging to the 04 classes viz., Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae.

Boyd's Diversity Index
The Boyd diversity index values indicates the order of pollution of a water body. If the values are >4 indicates less pollution and unpolluted water, values of 3 –2 indicate moderate pollution and values <1 indicate that water is highly polluted (Sudeep and Hosmani, 2006). The calculated value of diversity index is shown in Table 4. As per the diversity index of Boyd, the Bhadra river is protected from major disturbances is always moderately polluted to polluted (Table 5).

Conclusion

In this study it could be concluded that there is a more pollution occurs in Dhadamghatta than paper town, New bridge. all the three site shows increased diatoms. The diatoms indicate water nutrients levels; these nutrients excess are one of the greatest threats to water quality in the united states stream. here some sites consist cyanobacteria, it plays a major indicator of eutrophication caused by run-off of agricultural fertilizers,

sewage and other form of pollution. High nutrients can cause increased productivity in algae, resulting in blooms that cause low dissolved oxygen and fish mortality. This is due to the impact of liquid water from a paper mill and VISL limited on the benthic diatoms in flowing water. The water before the confluence of effluents was well oxygenated with an alkaline pH, organic matter, ammonia and nutrients were recorded at low concentration.

Table1: Distribution of phytoplankton in different sites of Bhadra river.

Sl. No.	SPECIES	CLASS	SITES
1	*Cosmarium reniform* *Cosmerium nitidilum* *Cosmerium sp.* *Genicularia sp.* *Spirogyra aequinoctials* *Spirogyra sp.* *Staurastum sp.*	Zygnematophyceae	New Bridge Lower hutta Paper Town Dhadamghatta
2	*Achanthes sp.* *Achanthes sp.* *Amphora sp.* *Cyclotella sp.* *Cylindrotheca sp.* *Cymbella affinis* *Cymbella sp.* *Cymbella sp.* *Cymbella tumida* *Diatomella sp.* *Diplonies sp.* *Flagilaria sp.* *Frustulia sp.* *Gomphoneima parvulum* *Gomphonema sp.* *Gomphonema sp.* *Gyrosigma exilis* *Gyrosigma nodiferum* *Gyrosigma sp.* *Melosira sp.* *Meridion sp.* *Navicula gregaria* *Navicula inconspicua* *Navicula palea* *Navicula schoenfeldii* *Navicula schoenfeldii* *Navicula veneta* *Navicula.capitatoradiata* *Nitzchia sp.* *Nitzschia gracillus* *Pinnularia subcapitata* *Stauroneis sp.* *Synedra sp.* *Synedra ulna*	Bacillariophyceae	New Bridge Paper Town Dhadamghatta
3	*Ankistrodesmus falcatus* *Characium sp.* *Coelastrum sphareicum* *Cylindroscystis sp.* *Gonatizygon sp.* *Microspora pachyderma* *Pediastrum tetras*	Chlorophyceae	Paper Town New Bridge Dhadamghatta

	Pediastrun duplex *Scedesmus quadricauda* *Scendesmus sp.* *Scenedesmus oblicus* *Sirogonium sp.* *Ulothrix sp.*		
4	*Anabena sp.* *Nostoc sp.* *Oscillatoria foreauii* *Oscillatoria sp.* *Phormidium sp.* *Spirulina* platensis	Cyanophyceae	Paper Town Dhadamghatta
5	*Euglena sp.* *Trachelomonas sp.* *Phacus sp.*	Euglenophyceae	Paper Town Dhadamghatta

Table 2: Distribution of phytoplankton's in Lower hutta.

Sl. No	SPECIES	CLASS
1	*Achanthes sp.* *Amphora sp.* *Cyclotella sp.* *Cylindrotheca sp.* *Cymbella affinis* *Cymbella sp.* *Diatomella sp.* *Diplonies sp.* *Frustulia sp.* *Gomphoneima parvulum* *Gomphonema sp.* *Gyrosigma exilis* *Gyrosigma sp.* *Gyrosigma nodiferum* *Melosira sp.* *Navicula gregaria* *Navicula inconspicua* *Navicula schoenfeldii* *Navicula veneta* *Navicula capitataradiata* *Navicula schoenfeldii* *Nitzchia sp.* *Nitzschia gracillus* *Pinnaluria subcapitata* *Stauroneis sp.*	Bacillariophyceae
2	*Cosmarium nitidikum* *Staurastrum sp.* *Cosmarium reniform*	Zygnematophyceae
3	*Pediastrum tetras* *Scendesmus sp.* *Microspora pachderma*	Chlorophyceae
4	*Spirulina sp.* *Oscillatoria sp.* *Oscillatoria foreauii* *Anabena sp.*	Cyanophyceae
5	*Trachelomonas sp.*	Euglenophyceae

Table 3: Showing distribution of phytoplankton's in paper town.

Sl. No	SPECIES	CLASS
1	*Amphora sp.* *Gonthonema sp.* *Nithschia sp.* *Nabicula sp.* *Achnanthes sp.* *Fragilaria sp.* *Cymbella sp.*	Bacillariophyceae
2	*Cosmorium sp.* *Spirogyra sp.*	Zygnematophyceae
3	*Gonatoygon sp.* *Coelastrum sp.* *Ankistrodesmus falcatus* *Scendesms sp.*	Chlorophyceae
4	*Euglena sp.*	Euglenophyceae

Table 4: Distribution of phytoplankton in New Bridge.

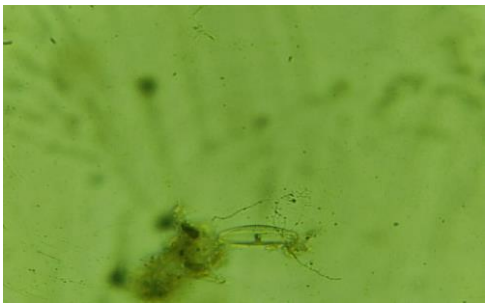
Sl. No.	*SPECIES*	*CLASS*
1	*Genicularia sp.* *Cosmarium reniform* *Cosmerium sp.* *Cosmerium nitidilum* *Spirogyra sp.* *Spirogyra aequinoctials* *Staurastum sp.*	Zygnematophyceae
2	*Navicula sp.* *Gyrosigma sp.* *Cymbella sp.* *Pinnularia sp.* *Nitzchia sp.* *Synedra ulna*	Bacillariophyceae
3	*Sirogonium sp.* *Microspora pachyderma* *Scendesmus sp.* *Pediastrum tetras* *Scenedesmus oblicus* *Gonatizygon sp.* *Ankistrodesmus falcatus* *Scedesmus quadricauda* *Ulothrix sp.* *Pediastrun duplex* *Characium sp.* *Coelastrum sphareicum* *Cylindroscystis sp.*	Chlorophyceae
4	*Oscillatoria sp.* *Anabena sp.*	Cyanophyceae
5	*Euglena sp.* *Trachelomonas sp.*	Euglenophyceae

Table 5: Boyd's Diversity index

Months	Ln N	Boyd's index value	Pollution status
January	14.24	2.05	Moderately polluted
February	16.38	1.45	Moderately polluted
March	14.42	1.90	Moderately polluted
April	13.98	1.60	Moderately polluted
May	14.28	1.92	Moderately polluted
June	14.39	1.69	Moderately polluted

>4= Clean water 3-2= moderately polluted <1 = heavily polluted.

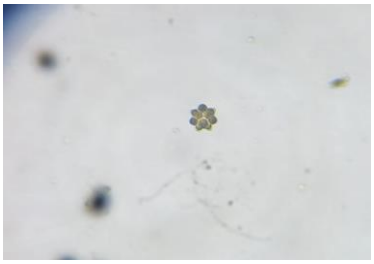
Plate 1: Microphotographs of Phytoplankton



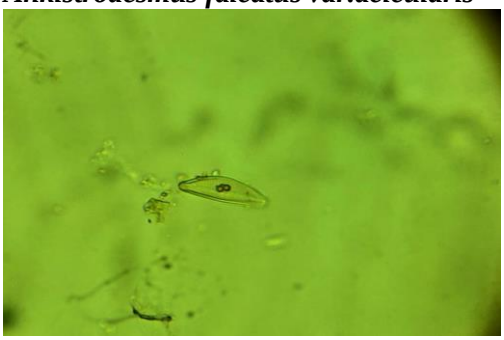
Achnanthes sp.

Amphora sp.

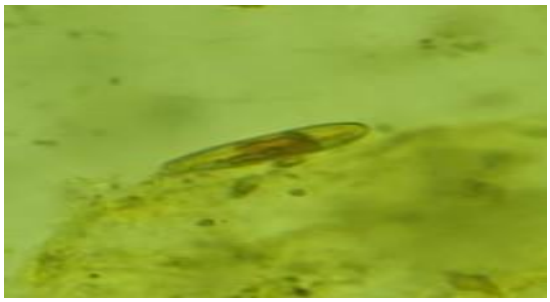
Ankistrodesmus falcatus var.acicularis



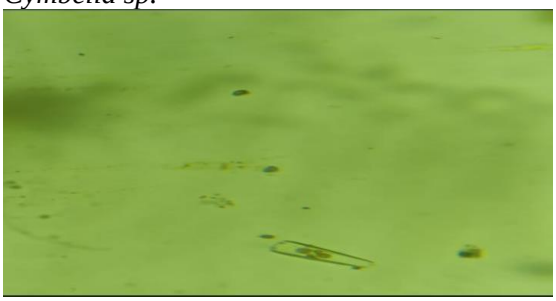
Coelastrum sphaericum



Cymbella sp.



Euglena sp.

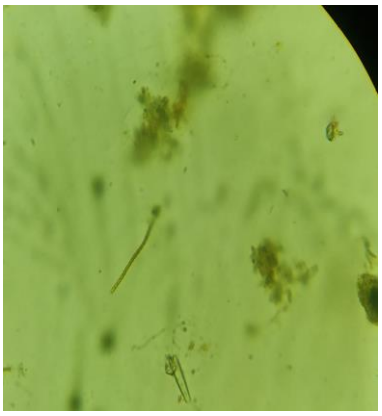


Gomphonema sp

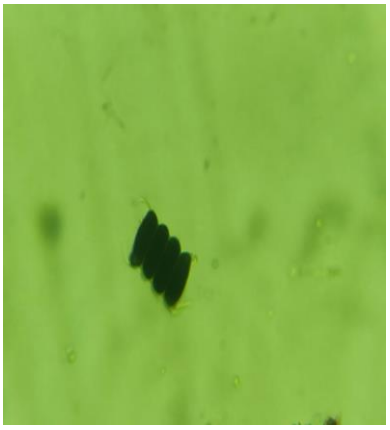
Gonatozygon

Navicula capitatoradiata

Nitschia sp.

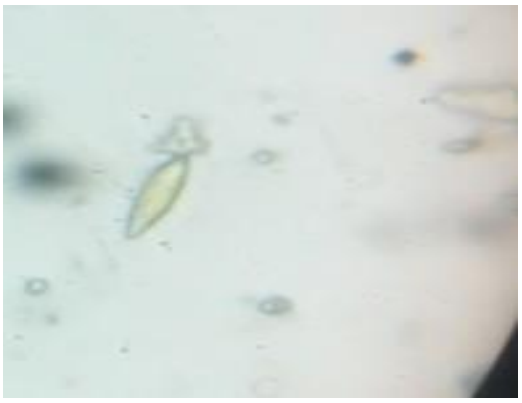


Oscillatoria foreauii



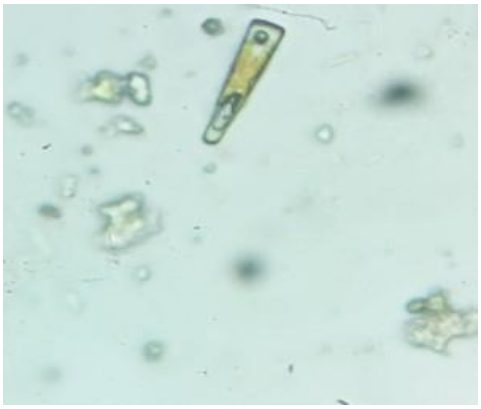
Scenedesmus quadricauda

Spirogyra aequinoctials

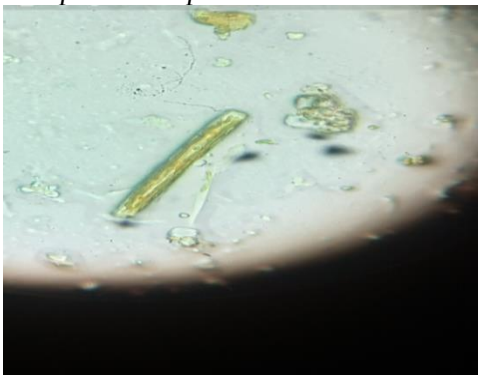


Frustulia sp

Gomphonema sp.

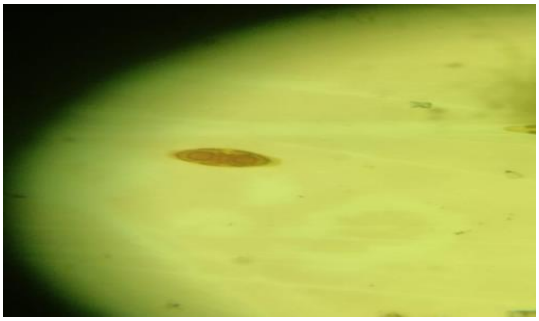


Meridion sp.



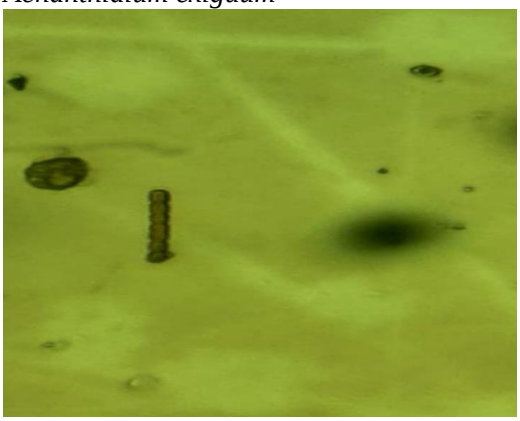
Pinnularaia cell division

Stauroneis sp.



Achanthidium exiguum

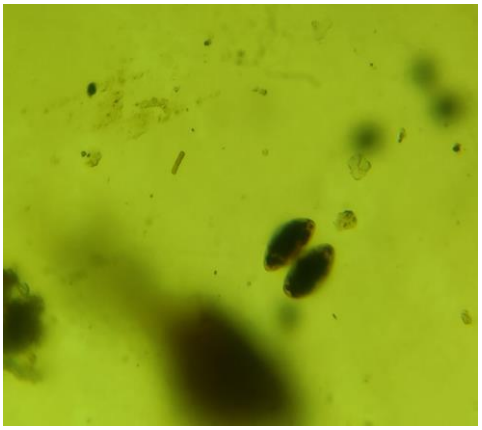
Stauroneis sp.



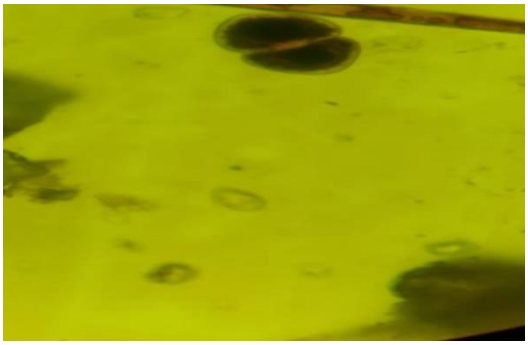
Anabena sp.

Characium sp.

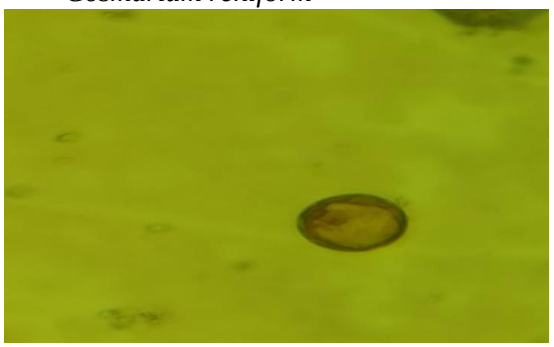
Cosmarium nitidilum



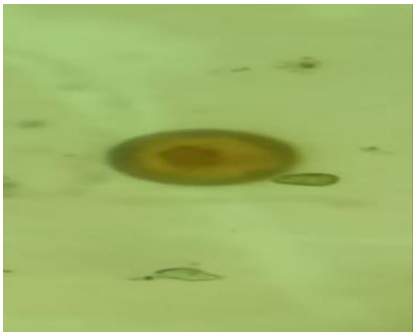
Cosmarium reniform



Cosmarium sp.

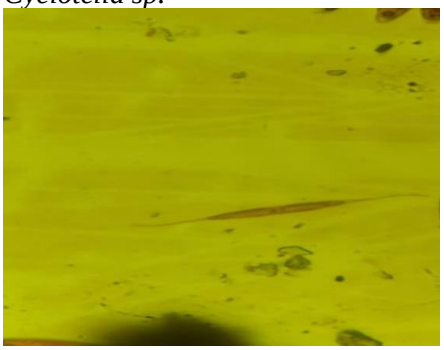


Cyclotella sp.

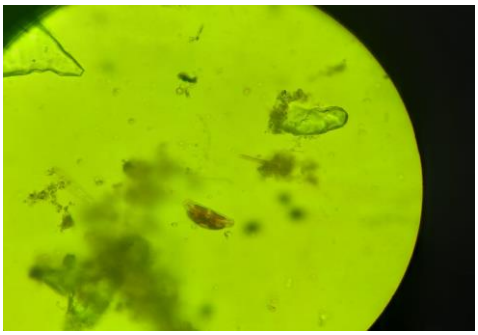


Cyclotella sp.

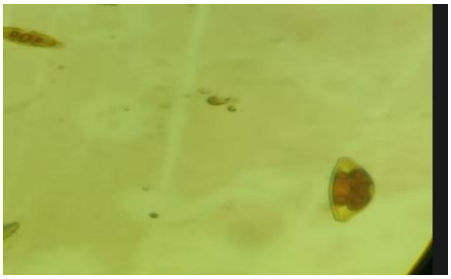
Cylindrocystis sp.



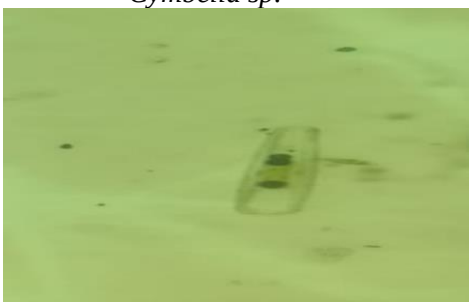
Cylindrotheca sp.



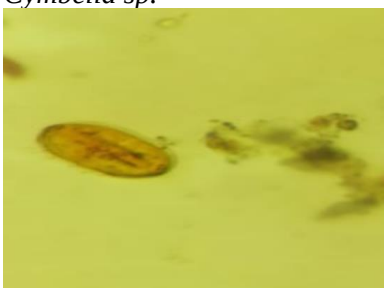
Cymbella sp.



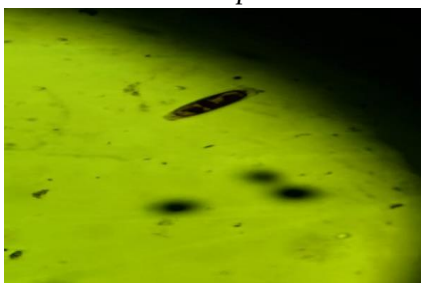
Cymbella sp.



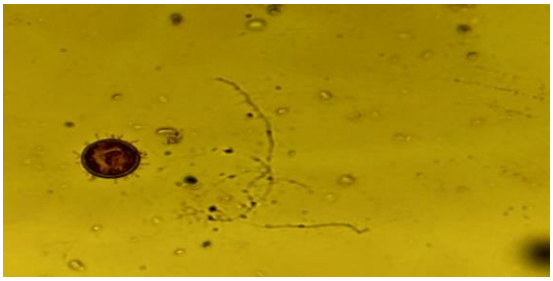
Diatomella sp.



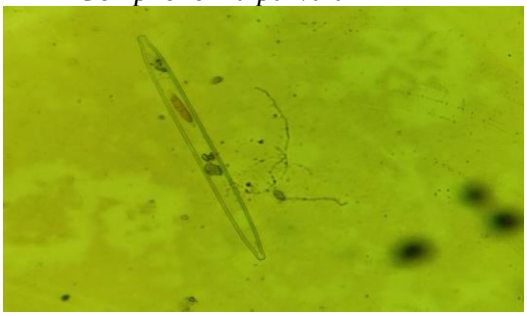
Diplonis sp.



Gomphoneima parvulum

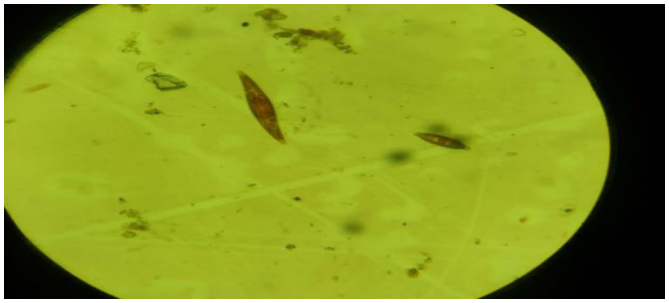


Trachelomonas sp.

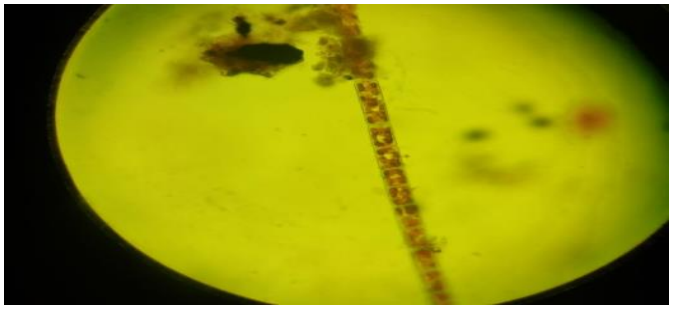


Synedra sp.

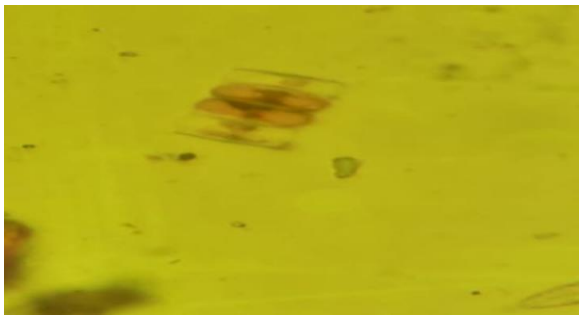
Gomphonema. Sp



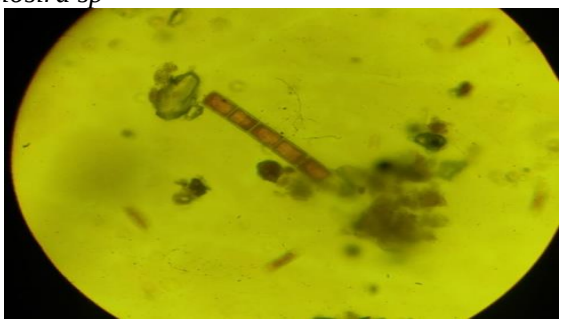
Gyrosigma exilis



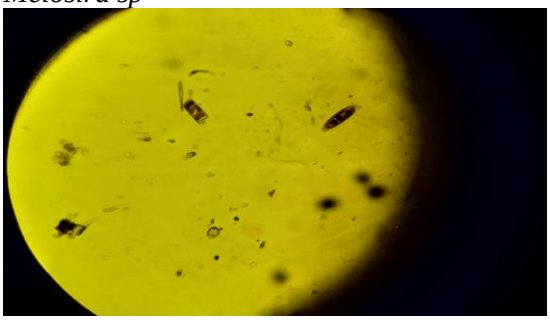
Melosira sp



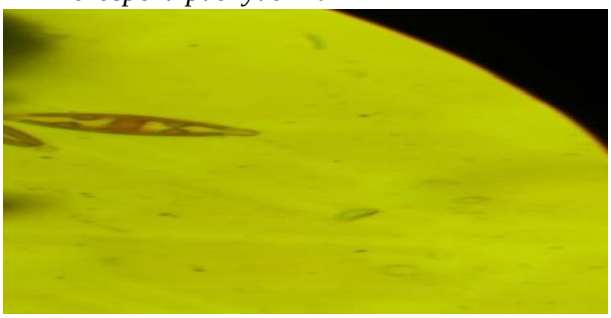
Melosira sp



Microspora pachyderma

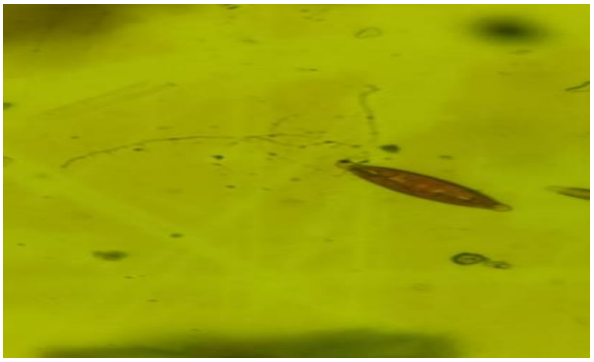


Navicula inconspicua

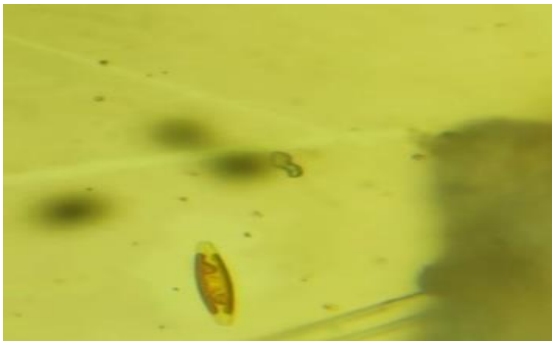


Navicula veneta

Navicula gregaria

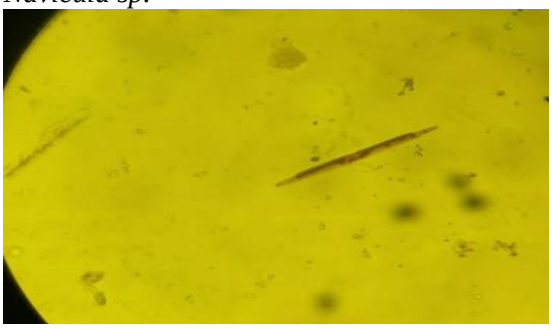


Navicula sp.



Navicula sp.

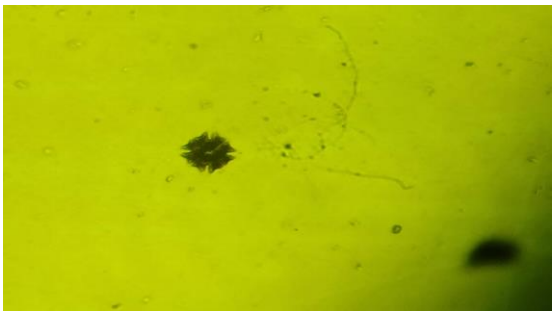
Navicula palea



Nitzschia gracilis

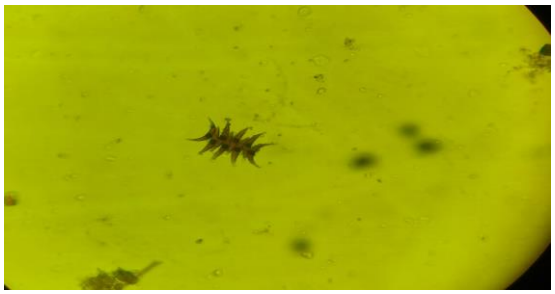
Nitzschia sigmoidea

Oscillatoria sp.



Pediastrum tetras

Pinnularia subcapitata



Scendesmus sp.

Spirulina sp.

Staurastrum sp.

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